Journal of Optimization in Industrial Engineering
Vol. 16, Issue 2, Summer & Autumn 2023, 87-97
DOI: 10.22094/JOIE.2023.1986337.2068

Research Article

How Does The Coffee Supply Chain Work in Indonesia?

Anton Mulyono Azis [a] , Maya Irjayanti [a,*]

[a] *School of Economics and Business, Telkom Universit,y, Indonesia*

Received 17 May 2023; Revised 05 July 2023; Accepted 12 July 2023

Abstract

Indonesia is the fourth largest coffee-producing country in the world. Coffee beans produced in Indonesia are to meet not only domestic consumption but also global demand. This study focuses on investigating to what extent the performance of the coffee supply chain in Indonesia has been optimum and what factors contributing to the performance of coffee supply chain in Indonesia based on previous literature findings. This research used mixed methods of qualitative and quantitative approach and applied a comparative study from relevant literature in the global context to determine the supply chain performance weights in one area of sampling. The performance of coffee supply chain was measured in West Java area as one of coffee producers in Indonesia. The supply chain performance weight was identified using the Supply Chain Operation Reference (SCOR) approach based on various supply chain performance attributes. The results showed that the score of supply chain performance for all attributes in West Java was 71 which equaled to "average" level. This research contributes to designing a coffee supply chain model and identifies factors that require specific attention, particularly those that significantly impact supply chain performance.

Keywords: Performance; Coffee; Supply Chain Model; Operation Reference

1. Introduction

Literature has identified the challenges in coffee supply chain, particularly related to its traceability, visibility, transparency, and security (Thiruchelvam, 2018). These issues are also associated with many causal factors, including inaccurate manual processing of coffee beans, technology adoption in the operation, and challenges in geographic, economic, and social contexts, and intermediaries in the coffee supply chain (Azis et al., 2022; Ibrahim and Zailani, 2010; Shanker, 2022; Grabs and Ponte, 2019; Torga and Spers, 2020). Recent studies have reported that despite being the fourth largest coffee-producing country in the world (after Brazil, Vietnam, and Colombia), Indonesia is still facing similar challenges in the coffee supply chain (Azis et al., 2022; Ibrahim and Zailani, 2010; Berampu et al., 2019; Noviantari, 2015). This research aims to investigate the recent conditions of coffee supply chain in Indonesia and the possible challenges that potentially threatens coffee business in the country.

As the number seven coffee drinker in the world, Indonesia has many opportunities to make coffee as one of the primary commodities to contribute to the country's income. Originally, Arabica coffee beans were brought by the Dutch during the colonialization in 1646 to be planted in the West Java region, then in 1900, Robusta coffee beans were imported to Indonesia because they were considered to have better quality and resistance to grow in Indonesia's typical geographical area. Thus far, coffee has been planted in many parts of the country, including Sumatra, Bali, Sulawesi, and Timor Island.

The largest coffee-producing areas are spread in several islands of Indonesia (Hermawan, 2022), from Sumatra to Java, Sulawesi, little Sundas, and Papua. While coffee beans grown in Indonesia are generally Robusta, Arabica, and Liberica, each region has a unique taste, so the same type of coffee beans may produce different notes. The most famous coffee beans come from distinctive areas like Mandailing (Sumatra Island), Gayo (Aceh), Kintamani (Bali Island), Toraja (Sulawesi Island), Flores (Nusa Tenggara Island), Java, and Wamena (Papua Island). In Java Island, the largest coffee plantation is situated in West Java Province. Also, Indonesia is the origin of one of the most famous and expensive coffee in the world, namely Luwak coffee from Bali. While most Luwak coffee is made of Arabica coffee beans, it has unique taste because it is made in a rare and bizarre process. The coffee beans are collected from the droppings of luwak (a civet or weasel), so they have undergone a fermentation process in the luwak's digestion. Table 1 presents coffee the types of coffee produced in Indonesia.

* Corresponding author Email address: mayairjayanti@telkomuniversity.ac.id

Table 1
Coffee Bean Produced in different islands of Indonesia

	Sumatera	**Java**	**Sulawesi**	**Bali**	**Papua**
Coffee Bean Type	· Arabica · Robusta · Liberica	· Arabica · Robusta	· Arabica · Robusta · Minahasa Koya	· Arabica · Robusta	Arabica

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Unfortunately, the increasing coffee production in Indonesia in a span of decades is not translated to significant growth of coffee exports from the country. One of the contributing factors is that most coffee producers in Indonesia are small-scale business with limited production capacity but imposed with high cost to cover coffee export. Based on data obtained from the Association of Indonesian Coffee Exporters, the average volume of Indonesian coffee exports in 2015 was around 350 thousand tons per year, consisting of 85% Robusta coffee and 15% Arabica coffee (Aeki-Aice, 2015). Indonesia exports coffee to over 50 country destinations that include the top ones, namely the USA, Japan, Italy, Germany, and the UK (Aeki-Aice, 2015). Before 2022, Indonesia managed to rank the third largest coffee producer in the world, but it has dropped now to the fourth ranking with an annual production of 11,950,000 coffee bean bags, equivalent to 717,000,000 kilograms (Aeni, 2022). Ten largest coffee-producing countries in the world are summarized in Table 2.

Table 2
Ten Largest Coffee-Producing Countries

	Coffee-Producing Country	Coffee Production (in Coffee Bag)	Coffee Production (in Kg)
1	Brazil	63,400,000	3,804,000,000
2	Vietnam	29,000,000	1,740,000,000
3	Columbia	14,300,000	858,000,000
4	Indonesia	11,950,000	717,000,000
5	Ethiopia	7,370,000	442,200,000
6	Honduras	6,100,000	366,000,000
7	Uganda	6.100,000	366,000,000
8	Mexico	4,000,000	240,000,000
9	Peru	2,800,000	168,000,000
10	Guatemala	3,750,000	225,000,000

*Production per year (11).

Some of these coffee producers are of small and medium scale businesses facing multiple obstacles to sustain their business. However, because small and medium enterprises are the backbone of Indonesian economy in various business sectors (Irjayanti and Azis, 2012; Irjayanti, 2016; Irjayanti and Azis, 2021), the Indonesian government has helped many coffee producers to market their products overseas through different measures, including the Trade Expo Indonesia exhibition.

This study aims to investigate the coffee supply chain in Indonesia in order to produce the latest coffee supply chain model applied in Indonesia, and to investigate to what extent the performance of the coffee supply chain in Indonesia has been optimal. The coffee supply chain model is expected to identify various potential blocked chains that cause problems in the availability of coffee for both domestic and international markets.

2. Literature Review

The implementation of a proper supply chain management will result in a sense of benefits to all entities involved in the coffee supply chain and impact the advantages in various aspects to increase competitiveness. Also, supply chain performance will determine the good or bad of a supply chain management applied to the business. Therefore, it is crucial to measure the supply chain performance for evaluation and improvement purposes, particularly on every dimension involved, from retrieving the raw materials to manufacturing process and delivering the products to the consumer ends. Research findings on the competitiveness of Indonesian coffee products have been published by many local Indonesian researchers since decades ago (Azis et al., 2022).

2.1. Coffee supply chain in global context

The world's coffee industry has the established standards to ensure the quality and sustainability of the coffee supply chain. The common standards include ISO 9001 about the quality management for coffee production (Illy and Viani, 2005). Also, The Fairtrade Standards and The Rainforest Alliance is a certification system that sets standards to ensure the welfare of coffee farmers and workers, protect human rights and environmental conservation, and promote good agricultural practices and sustainability. The UTZ Standard is a certification that promotes sustainable agriculture with a focus on coffee, cocoa, and tea (Meemken and Qaim, 2018), while The Specialty Coffee Association (SCA) Standard is a global organization that sets standards for specialty coffee

that measure the parameters of coffee bean processing, grinding, beverage preparation, and barista expertise (Pereira, 2019). Lastly, The Global Coffee Platform (GCP) standards focus on the sustainability of the coffee supply chain (Martin, 2019).

The efforts in optimizing the supply chain are designed to ensure the proper flow and well management of goods, information, and money. Thus, all parties must have accurate information that moves fast and precisely among the networks or links to ensure the movement of goods has conformed to the plan and the results will impact the satisfaction of related stakeholders. In this case, the role of information technology becomes significant in the coffee supply chain (Azis et al., 2022; Yadav and Barve, 2018; Gopal and Thakkar, 2016; Maskey et al., 2020; Irjayanti and Azis, 2017) because effective communication and coordination of each party involved in the supply chain will allow a seamless flow from each channel of the chain with limited congestion, excess, or shortage of goods.

Previous studies have investigated the coffee supply chain and reported the coffee business process from coffee plantations to the involvement of technology (Thiruchelvam, 2018; Shanker, 2022; Grabs and Ponte, 2019; Ho et al., 2018; Agrawal et al., 2016). Despite the importance of supply chain in coffee industry, there is scarce research in Indonesia that addresses the key success factors of the coffee supply chain in the country. There are potential risks in the future of coffee supply chain, especially the challenges from supply chain management including a fragmented production process, climate change, and market instability (Thiruchelvam, 2018). Currently, the transformation of digital-based information systems has not been widely used by the coffee industry (Li et al., 2017), whereas the information systems in supply chain management can increase transparency and traceability (Li et al., 2017). Information related to the coffee supply chain requires multi-level data (Shanker, 2022). The first level is identifying supply chain stakeholders to the source, the next level is enabling suppliers to communicate and share information with customers, and lastly analyzing various facilities to for their business processes (Shanker, 2022).

According to the findings of various literature, it is essential to identify the success factors in the supply chain for coffee commodity in order to reach global competitiveness for the industry (Torga and Spers, 2020; Mangla et al., 2016; Macdonald, 2007; Sudjarmoko, 2013; Wang, 2020; Grimm, 2014). These success factors include the importance of trust between supply chains (farmers, coffee bean collectors) and selling agents in domestic/international markets until the coffee products reach the hands of the final buyers (Shanker, 2022; Grimm, 2014). Furthermore, mutual relations with suppliers are dubbed to play a significant role in maintaining coffee supply, whereas lack of communication is a common reason for supplier's failure to fulfil coffee demand (Yadav and Barve, 2018; Grimm, 2014). Several studies mentions location as one of the keys to success in the supply chain (Ramaa et al., 2012; Miller et al., 2016; Govindan, 2016), and poor transportation facilities are one of the causes of blocked chains in the coffee business (Maskey, 2020; Takayama, 2020) which indirectly causes issues in logistics (Maskey, 2020; Mangla et al., 2016; Gandhi et al., 2016) and inventory (Kumar et al., 2017; Pundir et al., 2019), two crucial factors in the supply chain.

Another key factor that potentially affects coffee performance is environment, including the procedures for planting and maintaining coffee plants which are still problematic (Raut et al., 2017; Agarwal et al., 2020; Meilin et al., 2019). Coffee beans need to be treated carefully since they were planted, and the farmer should be equipped with knowledge on how to pick the coffee bean properly. Also, government intervention through regulation is also considered to play a role in the coffee business process as also found in various literature related to supply chain regulation (Mangla et al., 2016; Gandhi et al., 2016; Luthra et al., 2016).

2.2. Coffee Supply Chain Performance in Indonesia

Based on studies more than a decade ago, the coffee supply chain in Indonesia is situated in a complex network that involves relationships between roasters, traders, processors, farmers, and lack of information about products, stakeholders, and costs (Ibrahim and Zailani, 2010). Enterprise in Indonesia at almost all levels (micro, small, and medium) shares common problems regarding the performance of coffee producers in Indonesia, namely proper internal business management of small businesses, lack evidence of quality management, and no standardized procedure or process (Irjayanti and Azis, 2021; Tejaningrum et al., 2016; Azis et al., 2019). Most businesses run with outdated technology, which reflects their financial barrier (Irjayanti and Azis, 2017), and some businesses implement little to no transfer and documentation of knowledge related to business processes (Irjayanti and Mulyono, 2013). Coffee research in Indonesia is mostly published in national-scale publication, and only scarcely discussing the performance of the coffee supply chain in the latest international publications (Ibrahim and Zailani, 2010; Berampu et al., 2019).

The coffee supply chain in Indonesia started from coffee farmers who brought all their coffee beans to the cooperatives in the local areas that played dual functions as coffee collectors which provided coffee processing facilities into green beans and distributors which marketed the green beans. The cooperative coffee business itself started from a coffee farming business carried out by members of the cooperatives and members of the coffee farmer group. Therefore, these cooperatives have been greatly facilitating coffee farmers in Indonesia by collecting the coffee beans from farmers and helping them earn income quickly since most coffee farmers lack of direct access to markets. Despite numerous coffee farmers in Indonesia, not all domestic

demands have been met, especially for coffee shop businesses across Indonesia.

Coffee agribusiness activities in general start with coffee processing from red cherry to green beans by applying the Standard Operational Procedure or conforming with the UTZ Certified (Prihandono and Relig, 2019). While some coffee farmers support the sustainability goal of coffee farming by not using inorganic fertilizer in coffee cultivation except for the initial planting (Rahmah et al., 2022), most farmers in many areas are not equipped with proper knowledge about plantation management.

Based on our findings of the latest research on coffee supply chains in Indonesia, the problem parameters were generally divided into three subsystems: production and processing, logistics and distribution, and selling and marketing (Azis et al., 2022).

In the production and processing subsystem, the problems faced by coffee supply chain as reported in the literature include unstable production continuity, scarcity of good quality coffee seeds, poor knowledge on production, narrower area of coffee plantations, insufficient plantation cleanliness, inadequate picking of red coffee beans, harvest-reliant scheduling, under-optimum role of farmer advisors, limited family workforce, limited manpower at the start of planting and harvesting, diseases and pests, limited working capital support, manual processing, low production mastery, and low maintenance of the utilized tools (Azis et al., 2022; Grabs and Ponte, 2019; Meilin et al., 2019).

In the second subsystem, logistics and distribution, some problems identified from the various literature findings collected are the long distribution channels, disintegrated distribution networks, high logistics costs, multi-party controls of distribution channels, wide operating areas, inadequate transportation facilities, long distance from production to customer, inadequate road infrastructure for transportation, inadequate warehousing, low mastery of post-harvest technology, limited supply of good coffee beans, suboptimal delivery tracking, poor reverse logistics processes, poor inventory management, and poor material handling (Thiruchelvam et al., 2018; Azis et al., 2022; Shanker et al., 2022; Thiruchelvam et al., 2019).

At last, sales and marketing subsystem also poses some barriers, including the unbalanced coffee beans pricing, non-standard labeling of coffee products, farmers' low bargaining power, direct sales to collectors with a tie system, uncertain global demand, fluctuating coffee bean prices with a downward tendency, and multi-party controls of the coffee bean market. In some areas, we found poor marketing information technology, unattractive packaging, low utilization of online marketing media, price game of coffee big players, difficulty of demand forecasting, limited market information, low promotion support, and lack of utilization in packaging technology (Azis et al., 2022; Grabs and Ponte, 2019; Torga and Spers, 2020; Macdonald, 2007; Grimm et al., 2014; Thiruchelvam et al., 2018).

3. Methodology

This study was inductive research with both quantitative and qualitative research approaches. Supply chain performance was identified by utilizing the Supply Chain Operations Reference to identify various dimensions and attributes of the supply chain and calculate the performance weight collected from the data. The supply chain dimension was found from the data collection and supported by literature on coffee in Indonesia in the last ten years.

Identifying the supply chain performance using the Supply Chain Operation Reference method involved several standard metrics. First, we identified which metrics were relevant to the purpose of the study. Then, we gathered the necessary data to calculate the identified metrics. After all relevant data were obtained, each metric was calculated using a formula to show its value. Interviews were conducted with participants (the farmers, the owner of coffee businesses, and the employees in the factory) using a criteria form to fill and to record the value of each metric identified. The successful rate of the metric would be calculated into the total criteria to revealed the performance metrics relevant to the supply chain called attributes. Performance attributes identified in this study were supply chain reliability, supply chain responsiveness, supply chain flexibility (agility), and supply chain asset management. Before measuring each of the performance attributes, the researchers needed to obtain the activity data and the current conditions of the supply chain from sources based on five core processes, Plan, Source, Make, Deliver, and Return. Plan consists of planning, ordering, inventory and purchasing of goods. Source is related to the source from which the goods will be obtained, including suppliers. Make is when the company processes raw materials into semi-finished products or finished products. Deliver is the process of distributing goods to consumers. Return is the return of goods (if any) from the consumer to the company, or the return of defective raw materials to the supplier, or the return of goods between departments within the company. Primary data were obtained by semi-structured interviews and surveys, while secondary data were obtained from research data published in fields relevant to this research.

The samples for quantitative data were collected from representative parties in the coffee supply chain from several distributors and coffee plantations in several areas near Bandung city because this area is the largest coffee producer in West Java. The level of performance in the attributes in the supply chain operations reference was measured based on the number of achievements confirmed in the interview. In general, the number of samples or participants in qualitative research depends on data saturation. Interview results usually achieve data saturation on an average of 10 to 12 participants (Saunders et al., 2016).

4. Results and Findings

One of the largest coffee producers in Indonesia is based in West Java. According to the data from West Java Province, the highest coffee production is obtained from Bandung district, accounting for 7,680,000 kilograms against a total of 12,329,000 kilograms coffee production in West Java Region (Opendatajabar, 2021). Arabica coffee of West Java is considered as a high-value and high-quality coffee known as the Java Preanger Arabica Coffee, grown and produced by farmers in the Priangan highlands at an altitude no less than 1,000 meters above sea level. Java Preanger Arabica Coffee is one of the specialty coffees that has been registered with a geographical index with a target overseas market. Usually, cooperatives sell their coffee in the form of green beans to agents who have permits to export. To meet the recognized quality standards, coffee producers need a special certification called the UTZ certification which is an added value for coffee beans to prove the guarantee of the physical quality of the product and the sustainability of the coffee business being implemented (Trienekens, 2011). Currently, Arabica coffee from West Java is exported to various countries, including Morocco, South Korea, Australia, and Germany (Putra and Ferry, 2015)

The model of the coffee supply chain in Indonesia (see Figure 1) has a similar pattern, starting from farmers who hand over the coffee beans they pick to coffee collectors for further processing with specific standard procedures. Unfortunately, most farmers deliver coffee cherries instead of green coffee beans which potentially increases the added value of the coffee beans to the collectors. It frequently happens because coffee farmers lack knowledge and facilities to process the coffee themselves. Also, most coffee farmers have a small plantation area, thus producing low capacity of coffee production in Indonesia. The coffee collectors are usually cooperatives or agents located near the coffee plantations. They are equipped with proper facilities to process coffee beans for distribution. The processed coffee is distributed to the retailers or another agent, then sold to the final sellers or buyers. For international markets, the processed coffee is sent to agents who have a special license to export. At this stage, Indonesian coffee has reached the international market.

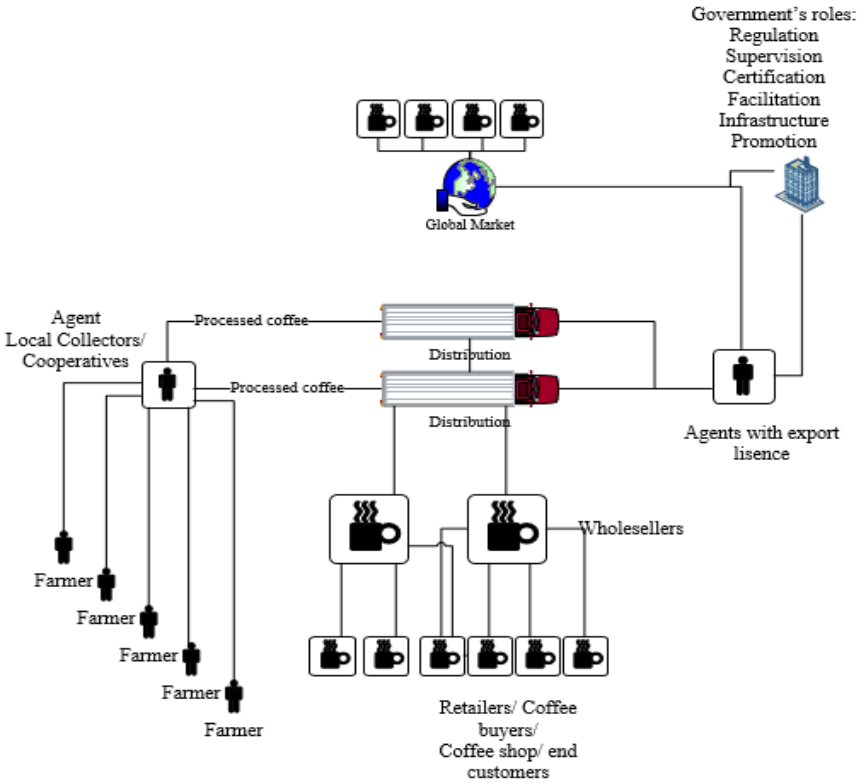


Fig. 1. Supply chain coffee model in indonesia

While the supply chain illustrated in Figure 1 may seem unproblematic, there are various problems identified in the field. From the results of interviews with different parties, we found that the end consumers generally prefer ground coffee to coffee beans. Most farmers/farmer groups, as coffee producers, can manage their own channel but prefer to sell through the wholesaler chain. It is because the farmers are actually reluctant to pay for the shipping costs to get their coffee beans to the local collectors. Meanwhile, they can directly access the end consumers who are willing to buy the unroasted coffee beans. In Indonesia, all parties have the right to determine the area of coffee sales or market segmentation, but there remain trade requirements that buyers must comply. The cooperation between parties in the supply chain is based on the prevailing market price. Although some farmer groups have established an

agreement on the standard coffee quality and selling price for collectors or other buyers, there remain many retailers, wholesalers, and distribution channels involved in the coffee supply chain starting from the coffee collectors. Most coffee farmers choose the fastest way to earn money, so they accept the sale price imposed by the collector, consequently, they earn a relatively small income.

Based on the data from the research participants, this study obtained the weighted value of the supply chain performance in the samples collected from coffee farmers/producers in the West Java area. The items in the survey instrument consist of metrics derived from supply chain performance attributes that measured Reliability, Responsiveness, Agility, and Asset Management. For each attribute, measurement metrics were designed to refer to the data accessed during the study to identify the performance scores. The weighting process was carried out in two stages to produce the total supply chain performance score presented in Table 3.

Table 3
Supply Chain Performance Score

Attribute	Metric	Total Performance Score
Reliability	Order Fulfilment: Delivery fulfilment: · Number of Order · The accuracy of the Item · Quantity Documentation of delivery and shipping	26
Responsiveness	Order Fulfillment cycle: Cycle time of sources Cycle time of delivery	11
Agility	Supply Chain Flexibility: "Source" and "Make"	10
	Supply Chain Adaptability	9
Asset Management	· Cash cycle time · Account payable (in an average of days) · Inventory of supplies · Account receivable (in an average of days)	15
Total		71

According to Table 3, the final score of the performance of the coffee supply chain in this study is 71, meaning that the supply chain performance of Java Preanger Coffee in West Java is at the "average" level. It indicates that the Indonesian coffee business, particularly in this study, needs improvements in several areas. Factors that potentially cause the "average" performance were investigated through further analysis based on data collected specifically in the attributes of supply chain performance.

Based on the weighting results measured by the Order Fulfillment metric consisting of the Cycle time of sources and Cycle time of delivery, the lowest score is at the Responsiveness attribute. Based on the participants' responses, the performance of supply chain asset management is relatively lower than the other attributes. This fact confirmed the findings from the interview that supply chain performance were affected by multiple factors, including the farmers, the collectors/factories, the distribution process, and the agents. In some cases, farmer did not harvest their coffee beans in timely manner, whereas premature picking will reduce the quality of the coffee beans. A contributing factor from the collectors/factories' side was the engine failures which put the supply chain on hold. From the distributors side, the lengthy distribution system contributed to the cycle time of the supply chain. In the sales context, we found that many retailers did not utilize digital platform facilities like social media or e-commerce, so the coffee products could not directly reach the end consumers. Every contributing factor to the delay of coffee supply chain at Java Preanger Coffee in West Java would ultimately cause potential lost revenue in the future.

Based on the interviews with participants, the coffee supply chain management channels identified in this study were coordinating activities for product procurement, inventory, and product delivery to customers. The coffee farmers in our interviews described several conditions related to the challenges in coffee supply chain as follow:

1. Coffee farmers often faced difficulties in accessing good markets and buyers. They found it difficult to sell their crops at a fair price, especially if they did not have access to effective distribution channels or extensive networks.
2. The underdeveloped transport infrastructure in some coffee plantation areas led to complicated distribution of coffee products from farmers to the market. Damaged roads, lack of adequate transportation, and long distance between production areas and markets had caused delays in delivery and increase in logistics costs.
3. Some coffee farmers faced challenges in increasing production capacity and maintaining consistent coffee quality due to limited resources, lack of access to modern technologies, and lack of knowledge of good agricultural practices.
4. Coffee farmers faced difficulties in accessing the latest information on market trends, the latest farming techniques, and the effective supply chain

management practices. They had limited access to essential training, education, and resources that become additional potential barriers to improving supply chain performance.

5. Volatile coffee price in the global market and sudden price changes impacted all parties in coffee business and destabilized their economy.

Based on the results of the investigation, the better the implementation of effectiveness in the supply chain, the greater the impact on increasing the competitiveness of coffee products. Coffee producers must be encouraged to utilize new technology to increase production because consumers would feel satisfied if the product they use or buy is a quality one. In addition, government policies have a significant effect on increasing the competitiveness of coffee products. In other words, the right government policies and support would foster a positive relationship to competitiveness because the better the implementation of government policies in the supply chain, the greater the effect on increasing the competitiveness of coffee products where this finding also confirms the literature that investigated the significant influence of regulation on business competition (Mangla et al., 2016; Gandhi et al., 2016; Luthra et al., 2016). Also, service excellent was also mentioned as the key to maintaining loyal customers since it significantly impacted the increase of customers' purchasing power. Increasing the purchasing power can be done through the ease of obtaining products, the ease of transaction processes, and good communication with consumers.

According to the data, the current issues faced by the farmers and other parties in coffee business involved various aspects, some of them were subjected to the quantitative analysis using SCOR approach to measure the performance in supply chain metrics. Figure 2 illustrates the issues mentioned by the participants.

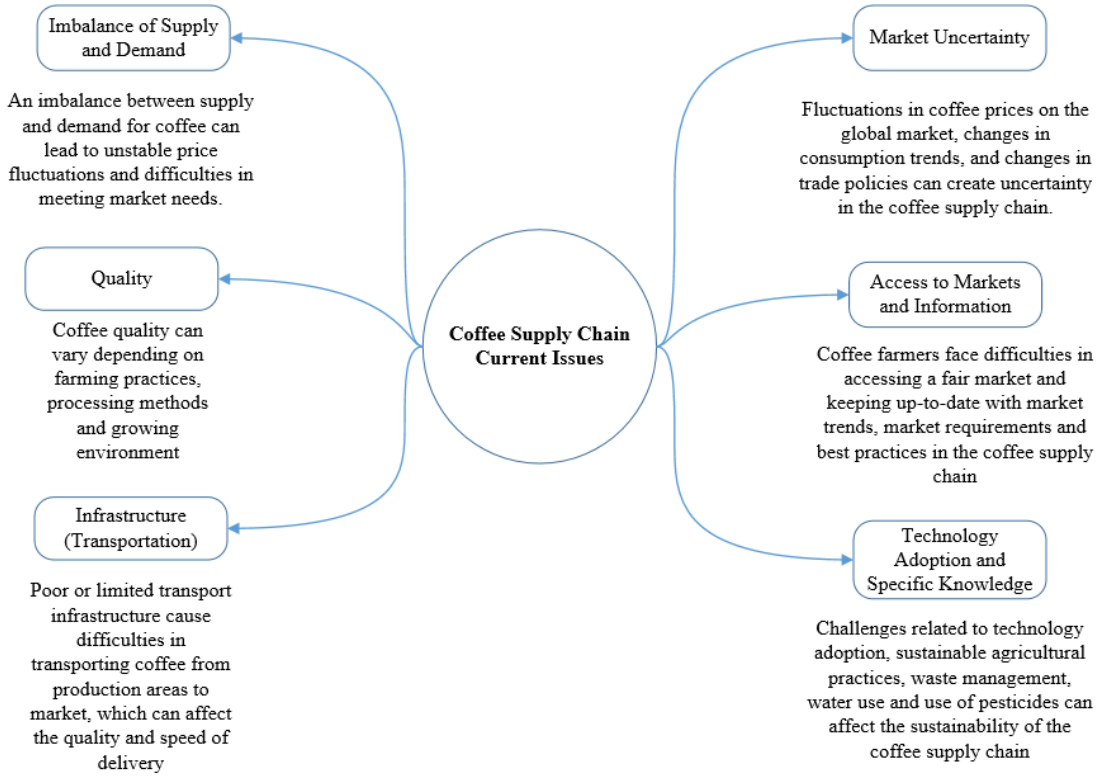


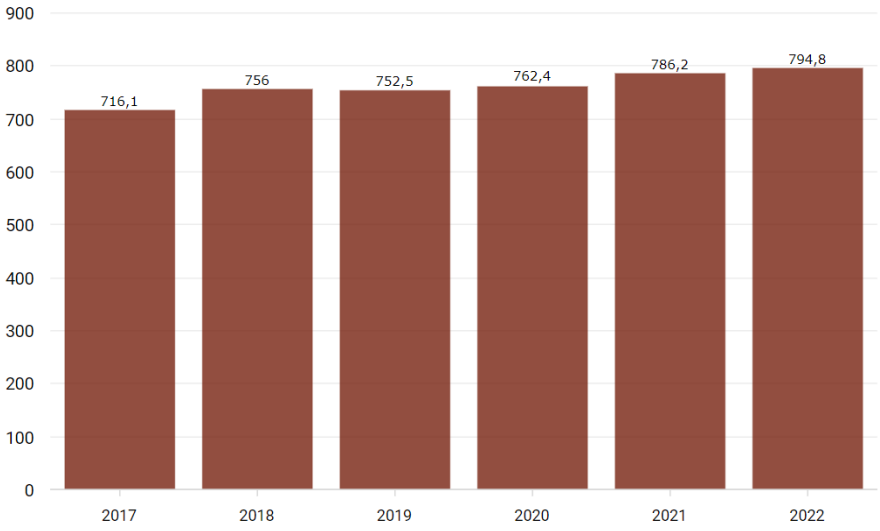
Fig. 2. The Current Issues of Coffee SC in Indonesia

The potential constraints identified in the production process at the coffee factory were (1) delays in raw materials due to various constraints outside of the factory, (2) non-standardized handling of raw materials, (3) lack of machine maintenance that caused breakdowns of the machines, (4) the accumulated work-in-progress at a particular process level, (5) relatively large number of inadequate machines being utilized, (6) lack of planning in machine capacity, (7) non-standardized factory layout, (8) low-skilled or underqualified workers, (9) poorly managed work environment.

The average income received by coffee farmers was relatively low. The potential approach to increase revenue can be conducted in two ways: increase productivity or increase the output quality by developing organic Arabica

coffee. The global demand for organic coffee has recently increased due to the escalating demand for commodities that use eco-friendly technologies and are free from pesticide residues. In the near future, organic product demand will be difficult to fulfil in the international market because many coffee businesses have not offered such products. Hence, it provides another opportunity for the coffee industry.

In the past six year, there has been little to no significant growth in coffee production in Indonesia, which accounted only 1.1% on average for annual production. It is potentially caused by the challenges faced by the coffee farmers in the operational coffee plantation and coffee processing.



*in thousands of tons production

Fig. 3. Indonesian Coffee Production 2017-2022 (Databoks, 2023)

Another obstacle identified in this study was the limited capacity that coffee farmers could provide. As mentioned in the previous section, most farmers did not have a large plantation area, in fact, they did not own most of the land. Also, not all coffee farmers joined the local cooperatives as a member, so the amount of coffee supply in cooperatives were not always predictable. Further, despite being essential, the UTZ certificate was not owned by all coffee farming businesses in Indonesia; hence, another barrier to prove the quality of the process and the sustainability of the coffee business. These issues have confirmed the findings from relevant research (Prihandono and Relig, 2019; Rahmah et al., 2022) that the quality standards in coffee businesses are crucial to gain the client's trust. Another problematic situation currently faced by Indonesian coffee farmers was the unaddressed pests and plant diseases that became the major cause of decreasing production as found in coffee plantation areas in Jambi Province, Sumatra Island (Meilin et al., 2019).

A comparative study was conducted on the coffee supply chain in Indonesia and other countries, focusing on several main aspects like supply chain structure, coffee variety, quality, and infrastructure. In Indonesia, the coffee supply chain generally consists of coffee farmers, processing companies (in some cases separated from the farmers), distribution agents, and retailers (Noviantari et al., 2015; Ginanjar et al., 2020; Fadillah et al., 2019). This supply chain model applies to various production scales, from small farmers to large companies. Meanwhile, countries such as Brazil, Colombia and Vietnam apply a more centralized structure of coffee supply chain (Fadillah et al., 2019; Nguyen and Sarker, 2018; Nab and Maslin, 2020; Ramirez-Gomez et al., 2022), meaning that farmers usually sell their crops to cooperatives or large processing companies, and then export coffee products in bulk.

For coffee varieties and quality, Indonesia is famous for its superior coffee varieties, such as Mandailing, Toraja, or Robusta Arabica Coffee. The quality of Indonesian coffee varies depending on factors, such as geographic location, processing methods, and farming practices. In other countries, different qualities of coffee depend on growing conditions and processing methods (Nguyen and Sarker, 2018), for example, Brazil is famous for its Brazilian Arabica Coffee, Colombia with Colombian Arabica Coffee, and Vietnam with Robusta Coffee (Torga and Spers, 2020; Nguyen and Sarker, 2018; Ramirez-Gomez et al., 2022). There is a standard of quality that is acknowledged by coffee certification. In Indonesia, sustainable farming practices and coffee certification, such as Rainforest Alliance certification or organic certification, have become increasingly important. However, the remains low certification penetration among coffee farmers. Other countries (Brazil, Colombia and Ethiopia) have adopted sustainable farming practices and certified

coffee with higher penetration rates compared to those in Indonesia (Fadillah et al., 2019; Ramirez-Gomez et al., 2022).

Another issue in the coffee supply chain in Indonesia is the poor transportation infrastructure near coffee-producing areas which is primarily located in rural areas. It affects the accessibility and efficiency of the coffee supply chain. Other countries like Brazil and Vietnam have better infrastructure in terms of transportation and logistics to support coffee supply chains.

5. Conclusion

Based on the analysis data, the weighting results of the supply chain performance of four performance attributes and six core metrics of the supply chain process (Plan, Source, Make, Deliver, and Return) was at the score of 7. It means that the performance of Indonesian coffee supply chain, especially Java Preanger Coffee in West Java area was at the "Average" level, so it is imperative to have improvements in various supply chain metrics. However, being the fourth largest coffee-producing country in the world, Indonesia can overcome potential obstacles with the assistance of relevant parties, especially the government to maintain the attractiveness of Indonesian coffee at the global market.

Conclusively, the potential barriers to supply chain performance include (1) the limited production capacity, (2) the prevalence of small-scale coffee businesses, (3) relatively low income of coffee that prevents them from upgrading their planting methods and equipment for better production, (4) the use of conventional equipment for coffee production, (5) lack of UTZ standardized coffee processing, (6) limited communication chains between supply chains, (7) scarcity of agents with the licenses to export.

This study has some limitations, including the samples for qualitative and qualitative research that may not sufficiently represent the entire population of the coffee industry in Indonesia, but concentrating in one large plantation in West Java. Further research is needed to investigate supply chain performance in other areas in Indonesia that have coffee with the potential of export quality products.

Acknowledgement

The authors would like to thank the Ministry of Education, Culture, Research, and Technology of the Republic of Indonesia as a sponsor for this research.

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