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Enhancing the supply chain performance of Kayumas specialty coffee based on the SCOR-ANP approach

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ABSTRACT

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Keyword

Analytic Network Process;
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Introduction: Performance evaluation is essential in defining supply chain strategies because the firm can find out how the business processes in the supply chain are running and formulate strategic policies. Kayumas coffee is one of Indonesia's specialty coffee with a unique aroma and flavor originating from Kayumas Village, Situbondo District, East Java. Kayumas coffee supply chain needs to be evaluated because of the lack of competitiveness with other specialty coffees. Strategies are needed to improve supply chain performance, improve product quality, and reduce costs. This study aims to configure the supply chain of Kayumas specialty coffee structure, evaluate its performance, and determine performance improvement strategies. **Methods:** This study uses descriptive analysis to configure the supply chain structure and flow. Analysis of supply chain performance based on Supply Chain Operation Reference (SCOR) model then weighted with Analytic Network Process (ANP). Performance improvement strategies were formulated by a discussion with experts and then weighted with ANP. **Results:** The research results show that the Kayumas specialty coffee supply chain comprises farmers, farmer groups, distributors or resellers, and consumers. There are 6 performance indicators (metrics) to measure performance: perfect order fulfillment, order fulfillment cycle time, flexibility, total supply chain management cost, cost of goods sold, and cash-to-cash cycle time. Performance measurement shows that Kayumas specialty coffee supply chain performance is in the inferior category. **Conclusion:** The strategy needed to improve supply chain performance by reducing cost is a partnership between supply chain members to reach a price agreement.

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INTRODUCTION

Indonesia is a country that produces coffee and boasts the largest variety of specialty coffee in the world (AEKI, 2023). Some of Indonesia's most well-known specialty coffees include Gayo, Toraja, Javanese, and Mandheling. Specialty coffee is a premium coffee with a unique aroma and flavor that originates from a specific region and can be easily traced from the garden to the consumer's hand (Puslitkoka, 2023). The attributes that differentiate specialty coffee from regular coffee include flavor, aroma, cupping score, physical appearance, size/grade, origin, certification, farm origin, and brand (SCA, 2021). Kayumas coffee is a type of specialty coffee from Java, specifically from Kayumas Village, Arjasa Subdistrict, Situbondo Regency, East Java. Kayumas coffee is characterized by its fruity and floral flavors, with a slight aroma of chocolate. It has less than 3% defects and is certified organic according to SNI 6729:2016. Organic Farming System and SNI 01-2907:2008: Coffee Beans. It is included in the Geographical Indication (GI) Java-ljen Raung Arabica Coffee, which describes the origin of coffee that is native to Indonesia and originates from the cultivation areas of Mount Ijen and Raung.

Agribusiness supply chains face significant challenges, including a lack of industrialization, inadequate management, information inaccuracies, and inefficient supply chains (Kamble *et al.*, 2020). Despite having diverse types of specialty coffee, Indonesian coffee products are less competitive than those of other countries. The quality of Indonesian coffee is affected by several factors, such as low productivity and high production costs. Indonesian coffee is primarily grown on smallholder plantations, resulting in traditional cultivation and processing methods. This can impact the quality of the coffee products (Yunita, 2021). Therefore, effective and efficient management is needed to achieve good business performance. The supply chain can improve company performance by managing aspects of quality, suitability, sensitivity to change, and cost efficiency (Avelar-Sosa *et al.*, 2019). Supply chain performance is a set of measures used to measure the efficiency and effectiveness of processes and relationships in the supply chain,

which includes different functions and companies so that the supply chain can operate. Performance measurement is very important in the formulation of a supply chain strategy. Performance measurement provides information about parts of the supply chain that need improvement, helps identify problems, and provides a reference for focusing performance improvement efforts (Cohen & Roussel, 2005). The Supply Chain Operation Reference (SCOR) model approach can be used to measure supply chain performance. The SCOR model was developed to describe the business activities involved in fulfilling customer demand. It is organized into six main management processes: Plan, Source, Make, Deliver, Return, and Enable (APICS, 2017). The SCOR model offers guidance for measuring overall supply chain performance in various dimensions, including reliability, responsiveness, agility, cost, and asset management efficiency. According to Aramyian *et al.* (2006), the SCOR model's performance measurement results include both internal and external supply chain performance.

Improving supply chain performance involves formulating strategies that align with the supply chain's conditions. The strategy must aim for the long-term goal of producing affordable, high-quality, timely, and diverse products. To achieve these goals, the supply chain must operate efficiently (Pujawan & Mahendrawathi, 2017). This study aims to identify the configuration of the supply chain, evaluate its performance, and determine strategies to improve the performance of the Kayumas coffee supply chain.

METHODS

The study conducted a descriptive analysis of the supply chain conditions and performance measurement. The descriptive analysis determined the structure and flow of the supply chain. The internal supply chain section at the Sejahtera Farmers Group, a producer and processor of Kayumas coffee, underwent a supply chain performance measurement analysis. The study employed purposive sampling as the sampling method. Respondents were selected based on specific criteria related to the research topic. They were parties involved in the supply chain, including farmer groups, distributors, consumers, and experts who know the Kayumas coffee supply chain, such as related agencies, coffee practitioners in Situbondo, and academics. Data was collected through interviews, questionnaires, and a literature review of relevant documents. The study utilized both qualitative and quantitative data. The qualitative data consisted of information on the supply chain structure and activities, while the quantitative data included harvest, production, and sales data.

Descriptive analysis was conducted by interviewing stakeholders regarding the supply chain structure, goods/materials flow, money/financial flow, and information flow which were then compiled in a scheme. Performance measurement was carried out based on level-1 performance metrics in the SCOR model version 11.0. Performance indicators are compiled based on the performance attributes of Reliability, Responsiveness, Agility, Cost, and Asset Management which are explained as follows:

1. Perfect order fulfillment (POF) is the percentage of orders delivered on time, in the right amount ordered, and in perfect condition.
2. Order fulfillment cycle time (OFCT) is the time to fulfill one customer order from when the company receives the order until the order reaches the customer (days).
3. Flexibility is the time needed to fulfill customer orders when there is a change in the quantity of goods ordered, calculated from the time the company receives a change in the order until the order reaches the customer (days).
4. Total supply chain management cost (TSCMC) is the percentage of total supply chain operating costs to overall supply chain revenue.
5. Cost of goods sold (COGS) is the percentage of the total cost to produce products to total supply chain revenue.
6. Cash-to-cash cycle time (CTCCT) is the time it takes for a company to receive payment from consumers and pay suppliers (days).

Furthermore, each performance indicator's weight value is calculated using the Analysis Network Process (ANP) method. The first ANP analysis stage determines the decision-making model consisting of goal clusters, criteria clusters, sub-criteria clusters, and alternative clusters. The criteria cluster contains elements of the core process (Plan, Source, Make, Deliver, and Return), the sub-criteria cluster is an element of performance attributes (Reliability, Responsiveness, Agility, Cost, and Asset Management), and the alternative cluster contains elements of performance indicators. Then, the calculation of pairwise comparisons of elements in the cluster against elements in other clusters (outer-dependence), as well as comparisons between elements in the same cluster (inner-dependence). The importance value of the elements with values of 1, 3, 5, 7, and 9 is called the Saaty Interest Rate— furthermore, a synthesis to determine the weight of each performance indicator.

The overall performance value is calculated by summing the performance index value of each performance indicator. The performance index is calculated by multiplying the actual value of the performance measurement results and the weight value of the performance measurement. The results of the performance index calculation are then compared with the supply chain performance standards (benchmarking). The standard value of supply chain

performance consists of: Excellent (95% - 100%), Good (90% - 94%), Medium (80% - 89%), Inferior (70% - 79%), Very inferior (60% - 69%), and Poor (below 60%) according to Monczka *et al.* (2008).

The benchmark value is determined by internal benchmarking, namely by measuring the average value of the process performance. However, if the company does not have enough data, then benchmarking is done by external benchmarking based on various references (Apriyani *et al.*, 2018). The performance measurement results are the basis for formulating alternative strategies to improve supply chain performance. Alternative supply chain strategies are still unstructured formulations, so to determine the priority of alternative strategies based on the Kayumas coffee supply chain conditions using ANP analysis. The ANP analysis model is based on the core process and weakness factors (product quality, cost, and management).

RESULT AND DISCUSSION

Supply chain configuration

The Kayumas coffee supply chain comprises farmers, farmer groups, distributors/resellers, and consumers. Coffee cultivation is carried out with an organic cultivation system certified by the National Accreditation Committee (KAN) in 2018 as presented in Figure 1. The resulting product is coffee cherries, then sold to farmer groups. The farmer group acts as a processing unit for coffee cultivated by farmers. Post-harvest coffee processing is traditionally carried out with full-washed, natural, and anaerobic processes. The product produced from the process in the farmer group is coffee beans (green beans). The coffee beans are stored in the farmer group's warehouse and distributed to distributors. Distributors consist of repacking distributors (resellers) and roastery. Repacking distributors buy coffee beans in bulk, then repackage them into smaller packages and sell them. Roastery further processes coffee beans into roasted or ground coffee, then sold to consumers. Apart from distributors, the sale of coffee beans is also done directly by farmer groups to consumers. Figure 1 presents the Kayumas coffee supply chain structure. Farmers are the ones who cultivate coffee.

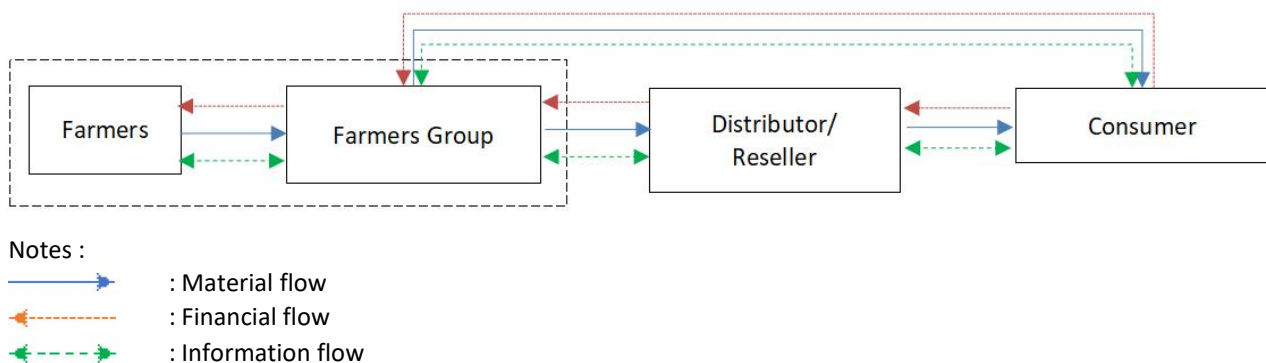


Figure 1. Kayumas coffee supply chain configuration

The flow of materials in the Kayumas coffee supply chain occurs from upstream to downstream starting with producers, that is farmers who grow arabica coffee then to farmers group to distributors or resellers and ultimately reaching the final consumer. At the farmers' level, the processes that occur are cultivation, land and plant maintenance, and harvest. The coffee is harvested by farmers in the form of coffee fruits often called coffee cherry or coffee berry. Farmers' group acts as processing units for coffee fruit that harvested by the farmers. The final products produced by farmers groups are green beans, roasted beans, and ground beans. The processes that occur in farmer groups are raw material procurement, post-harvest processing, roasting, grinding, packaging, and shipping. The distributors consist of retail, reseller, and roastery. The retail generally sells the final product which is ground coffee with the farmer's group label. The reseller, on the other hand, purchases the coffee bean in bulk and then repackages it to their brand. Also, the roastery then purchases green beans from farmers' groups and then roasts the beans in their facility to sell to the customer.

The flow of finance in the Kayumas coffee supply chain starts downstream and moves upstream, beginning with consumers, then distributors, followed by farmer groups, and finally farmers. The flow of finance in the Kayumas coffee supply chain starts downstream and moves upstream, beginning with consumers, then distributors, followed by farmer groups, and finally farmers. The flow of finance in the Kayumas coffee supply chain starts downstream and moves upstream, beginning with consumers, then distributors, followed by farmer groups, and finally farmers. Transactions are conducted in cash or through transfers. Payment to farmers by the farmer groups is made upon delivery of the harvest to the farmer group, with full payment based on the number of coffee logs deposited. Payment from distributors or customers either in full or in part at the time of ordering, depending on the agreement between the farmer group and the consumer. For distributors, payment uses a down payment and settlement system. The down payment is 30% of the total price of the order, and repayment is made when the order is ready to be shipped.

The price set to distributors is a discounted price, which is 15%-20% cheaper than the price set to consumers. For purchases by end consumers, payment is made in full according to the order before the goods are delivered by the farmer group. The farmer group provides a discount in the form of free shipping.

The information flows in two directions: upstream to downstream and downstream to upstream, depending on the type of information conveyed. The information contained in the Kayumas coffee supply chain includes order information, price information, delivery information, and coffee consumption trends among consumers.

Kayumas coffee supply chain performance

The performance of Kayumas coffee supply chain is measured based on the attributes of reliability, responsiveness, agility, cost, and asset management. Table 1 contains the result of the performance evaluation of the Kayumas coffee supply chain. The result shows the actual value of each of the performance indicators; weighted value indicators to determine how much influence they have on the overall supply chain performance by using ANP analysis; and the overall performance index obtained by multiplying the actual performance value by the weighted value of indicators.

Table 1. Results of the performance evaluation of Kayumas coffee supply chain

Attributes	Indicators	Actual value (%)	Weighted value	Performance index (%)
Reliability	Perfect order fulfillment	96.43	0.24	22.68
Responsiveness	Order fulfillment cycle time	77.08	0.20	15.86
Agility	Flexibility	77.08	0.21	16.54
Cost	Total supply chain management cost	81.25	0.14	11.13
	Cost of goods sold	41.99	0.10	4.41
Asset management	Cash-to-cash cycle time	100.00	0.09	9.81
Overall performance value				80.42
Category				Medium

Source: Primary data, processed (2023)

Table 1 shows the following performance results: The perfect order fulfillment (POF) indicator has an actual value of 96.43% with a performance index of 22.68%. The order fulfillment cycle time (OFCT) indicator has an actual value of 77.08% with a performance index of 15.86%. The Flexibility indicator has a performance index of 77.08%, with an actual value of 16.54%. The Total supply chain management cost (TSCMC) indicator has a performance index of 11.13%, with an actual value of 81.25%. The Cost of goods sold (COGS) metric has an actual value of 41.99%, with a performance index of 4.41%. The Cash-to-cash cycle time metric has an actual value of 100%, with a performance index of 9.81%.

The overall performance value is calculated by adding all of the performance index values, resulting in a total of 80.42%. The results of the performance index calculation are then compared with the supply chain performance standards (benchmarking). The category of supply chain performance is comprised of the following elements: Excellent if the performance value is between 95% - 100%.; Good, if the performance value is between 90% - 94%.; Medium, if the performance value is between 80% - 89%.; Inferior, if the performance value is between 70% - 79%.; Very inferior performance, if the performance value is between 60% - 69%.; and Poor performance, if the performance value is below 60%. The benchmark value is determined through internal benchmarking, which involves measuring the average value of the process performance. Given that the overall performance value falls within the range of 80% to 90%, it can be concluded that the performance of the Kayumas coffee supply chain management falls within the Medium category.

Perfect Order Fulfillment (POF) is a performance indicator that measures a company's ability to fulfill orders accurately. The perfect order criteria include delivering orders on time, with the correct quantity, in perfect condition, and without shipping damage. According to Diaz *et al.* (2022), companies must meet the criteria of time, quantity, quality, and documentation to achieve good delivery performance. The company has fulfilled consumer demand well, including meeting these criteria.

The average cycle time to fulfill customer orders, known as the Order Fulfillment Cycle Time (OFCT), is also mentioned. The calculation of order fulfillment time begins with determining the cycle time to locate products in the warehouse referred to as the 'source cycle time', followed by the process of packaging the goods known as the 'make cycle time', and finally the time it takes for the product to be ready for shipment until it is received by the consumer referred to as the 'deliver cycle time'. The average delivery time after an order is received is 5 days. According to Kinding *et al.* (2019), supply chain performance improves with shorter OFCT durations. Consumers expect faster delivery times, typically within 1-2 days (D. H. Nguyen *et al.*, 2019).

Supply chain flexibility refers to the time required for companies to fulfill order changes. This is calculated by measuring the time it takes for the company to respond to changes in orders, locate the goods in the warehouse, and

pack them. The company carries out production once a year, and the products stored are rice, coffee beans, or green beans that are ready to be sold. The company stores finished products to quickly fulfill consumer orders in response to changes. High agility value is achieved through flexibility, and internal and external integration, which positively influences supply chain performance (Ramos *et al.*, 2023).

The Total Supply Chain Management Cost (TSCMC) is an indicator of the efficient use of costs for supply chain operations. It includes crop maintenance costs, production operational costs, and shipping costs. The TSCMC metric does not calculate production costs in the Kayumas coffee supply chain, as they will be calculated in the COGS metric. The production operational cost, which includes routine labor costs and routine operational costs, has the highest portion in the TSCMC indicator. The cost of goods sold (COGS) is an indicator of the costs used to make a product. The COGS calculation consists of the cost of purchasing raw materials, labor costs, and indirect costs. The cost of purchasing raw materials is the aspect that most affects the value of COGS. While the use of costs in the supply chain is deemed satisfactory, improvements are needed in resource aspects, such as labor and raw materials. According to Nguyen *et al.* (2021) research, the Cost attribute's low value suggests that the supply chain is not operating efficiently. According to Schliephake *et al.* (2009), efficient utilization of material resources can be achieved through strong integration among stakeholders in the supply chain.

The cash-to-cash cycle time (CTCCT) is the duration required for investments used for raw material purchases to return to the company. CTCCT demonstrates the efficiency of asset utilization in supply chain activities. To calculate CTCCT, determine the range of payments from consumers and the range of payments to suppliers. In the Kayumas coffee supply chain, a direct payment system is used, either in cash or through transfer. Payment for raw materials is given to farmers upon delivery of cherry coffee to the farmer group. Payment from consumers is received upon placing an order, and delivery is made only after full payment is received. This payment system ensures that the company has no debts to suppliers or receivables from consumers, which keeps the value of CTCCT low.

The overall performance evaluation results indicate that the Kayumas coffee supply chain is in a Medium category, with a total performance value of 80.42%. The dimensions of responsiveness and agility require improvement in terms of prioritization of supply chain performance and performance, indicating that the company still cannot meet the satisfaction of consumers who want the ordered goods to arrive quickly. The study's results align with Asamoah *et al.* (2021) finding, which suggests that companies with adaptable transportation, distribution, and warehousing systems are more successful in attracting, satisfying, and retaining consumers in response to environmental changes.

Strategies in enhancing Kayumas coffee supply chain performance

The performance improvement strategies were formulated based on the results of performance measurements and interviews with Kayumas Coffee's business actors. Five alternative strategies were formulated to improve supply chain performance based on the results of supply chain performance measurement and discussions with experts. These strategies include (1) periodic management evaluation and improvement, (2) partnerships with supply chain members to reach price agreements, (3) implementation of good agricultural practice (GAP) in cultivation, good handling practice (GHP) in harvesting, and good manufacturing practice (GMP) in processing, (4) increasing the use of technology, and (5) improving the quality of human resources with counseling related to GAP, GHP, and GMP. Strategy priorities were determined by weighing alternative strategies based on expert opinion using the ANP method.

According to the ANP analysis, the recommended strategy for improving the performance of the Kayumas coffee supply chain is to establish a partnership with supply chain members to reach a price agreement. Currently, the supply chain operates on a trust-based transaction system without a formal binding contract. The procurement and delivery process heavily relies on suppliers, specifically farmers and freight forwarders. Farmers have a significant impact on the quantity and quality of raw materials, while delivery services greatly affect delivery time. Collaboration between suppliers, such as farmers, and delivery services is crucial to ensure the smooth operation of the supply chain. Therefore, it is important to establish effective collaboration between these two parties (Karmaker *et al.*, 2021). To achieve a sustainable supply chain, collaboration with suppliers, distributors, investors, and certification agencies is necessary, as suggested by Proença *et al.* (2022).

CONCLUSION

The Kayumas coffee supply chain, encompassing farmers, farmer groups, distributors/resellers, and consumers, currently exhibits a "Medium" level of performance with a score of 80.42%. While aspects like perfect order fulfillment and cash-to-cash cycle time demonstrate strength, the supply chain faces challenges concerning responsiveness and agility. This suggests that the current system struggles to satisfy consumer demands for rapid order fulfillment and adapt effectively to changing market dynamics. To enhance the overall performance of the Kayumas coffee supply chain, a multi-faceted approach is necessary. The study strongly recommends forging partnerships with supply chain members to reach price agreements. This strategy aims to establish greater stability

and transparency in transactions, mitigating the reliance on informal agreements with suppliers like farmers and freight forwarders.

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