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Chain performance for coffee agro-industry supply in Kalibaru, Indonesia

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ABSTRACT: The performance of the total value chain is a sustainability study. Therefore, it is necessary to control performance to ensure the competitiveness of the coffee agro-industry in Kalibaru; the actual conditions produced have yet to show the achievement of minimum standards. This research identified process performance activities in each dimension by farmers, traders, and the coffee industry. Data was collected by cluster random sampling involving nine farmers, three traders, two industries, and three experts; in contrast, the data collection technique was carried out in 3 stages: desk study, focus group discussions, and in-depth interviews. The method used is the Supply Chain Operations Reference (SCOR), and the aggregation method determines the dimension values for each metric. The results showed that the measurement of the total farmer value chain with the dimensions of reliability (63.62%), agility (62.66%), and asset management (63.91%) was in the medium category for traders who were included in the medium category, namely power responsiveness (66.94%), agility (65.00%), cost (64.10%) and for industry only the cost dimension (62.16%) is included in the medium category, while the other dimensions are in the value category above 70.00%.
Keywords: value chain; total performance; agroindustry coffee.

Desempenho da cadeia de fornecimento para a agroindústria de café em Kalibaru, Indonésia

RESUMO: O desempenho de toda a cadeia de valor é um estudo de sustentabilidade, portanto, é necessário controlar o desempenho para a competitividade da agroindústria cafeeira em Kalibaru, as reais condições produzidas ainda não demonstraram o alcance dos padrões mínimos. Esta pesquisa identificou atividades de desempenho de processos em cada dimensão por parte de agricultores, comerciantes e da indústria cafeeira. Os dados foram coletados por amostragem aleatória por conglomerados envolvendo nove agricultores, três comerciantes, duas indústrias e três especialistas. Em contrapartida, a técnica de recolha de dados foi realizada em 3 fases: estudo documental, discussões em grupos focais e entrevistas em profundidade. O método utilizado é o Supply Chain Operations Reference (SCOR), e o método de agregação determina os valores das dimensões para cada métrica. Os resultados mostraram que a medição da cadeia de valor total do agricultor com as dimensões de confiabilidade (63,62%), agilidade (62,66%) e gestão de ativos (63,91%) estavam na categoria média para os comerciantes incluídos na categoria média, nomeadamente energia capacidade de resposta (66,94%), agilidade (65,00%), custo (64,10%) e para a indústria apenas a dimensão custo (62,16%) está incluída na média da categoria, enquanto as demais dimensões estão na categoria de valor acima de 70,00%.
Palavras-chave: cadeia de valor; desempenho total; agronegócio cafeeiro.

1. INTRODUCTION

The processing of the smallholder coffee industry is a top priority to increase the economic growth of the planters and the surrounding community. The lack of awareness and knowledge of plantation owners regarding the sustainability management system shows that the minimum quality standard has yet to be achieved, and the quantity is low. Implementation in each processing unit is a special obstacle that needs to be studied to get the expected production.

Research on value chain systems in coffee agro-industry aims to answer the main problems by detecting key factors in total, starting from the stages: red cherry processing, green bean processing, roasted bean processing, final processing, so that each processing requires primary detection and secondary detection as a direction balanced management of the coffee industry, from several initial findings from interviews and field observations, there are several potential factors that must be considered, namely: (1) red cherry processing, not implementing a good maintenance system, including: cherry picking, post-harvest pruning, fertilization, pest and disease control, adequate shading system and use of uniform seeds (clones); (2) green bean processing requires derivative techniques and formulas as an effort to develop product variations; (3) roasted bean processing requires knowledge of roasting techniques as a standard reference for further processing as desired; (4) powder processing, it is necessary to determine the grinding level according to the characteristics contained in the product; (5) brewing techniques, it is necessary to determine good brewing procedures and techniques to produce a distinctive taste.

Continuous efforts have been made in various ways and methods to obtain production standards and product quality. Still, an appropriate agro-industry value chain system has yet to be developed, especially in an integrated actor and institutional environment with local or national stakeholders.

So a new management system scheme and design are needed, which not only builds synergies between stakeholders but also must provide productive direction for the coffee agenda in the future; one of the things that needs to be considered is to restrain the flow of the raw material supply chain (red cherry) on a large scale to build production activities in areas close to raw materials, the basic assumption is that this concept can be applied if it gets support from farmers, Gapoktan, government, support from related parties and support for market access.

Various problems faced by smallholder coffee plantations include: (1) there is no coffee industry processing system as a pioneer company in the region or areas close to raw materials, (2) structured innovation is needed as an effort to develop natural raw materials, develop derivative raw materials to the development of final raw materials, (3) the agro-industry value chain system is still weak and has not worked as expected, (4) optimization of upstream-downstream coffee processing has not been managed professionally.

People's plantations in Banyuwangi Regency are areas where perennials grow, one of which is coffee plants, starting from the Kalibaru, Glenmore, Songgon, Pasangrahan, Glagah, Wongsorejo, Kalipura to Licin areas; this area is dominated by robusta coffee plants so that smallholder plantations in this area it is important to manage and find solutions by answering existing problems, as well as designing agroindustry systems and predictive adaptive analysis, which are integrated between regions (bean belt coffee connection) as a direction for sustainable coffee development in the future (robusta coffee foresight), to a balanced supply chain and a directed value chain to support to maintain the performance of main activities and supporting activities in a system so that it is more targeted and effective.

The view above is that managing the flow of products, information, and money is carried out in an integrated approach involving all parties from upstream to downstream (PUJAWAN; MAHENDRAVADI, 2010). Meanwhile, agro-industrial activities aim to build integration of all aspects of production with environmental factors, from purchasing raw materials to the processing of the final product, including delivery to the consumer (Srivastava2007) and the activities of the material supply chain flow network to manufacturers and ending to consumers (STADTLER et al., 2015). Companies will continue to innovate using materials, labor, and energy to reduce resource use in production (KITZMANN; ASMUS, 2006).

The emergence of sustainability issues aims to draw attention to the fact that the concept of sustainable value chains is very productive for the development of agroindustry to produce higher quality and environmentally friendly products and will be of great concern in the subject of sustainability research (PAGELL; SHEVCHENKO, 2014). Focus on environmental improvement will directly benefit economic and social life. At the same time, steps for sustainable development lead to a triple bottom line balance, namely profit, people, and planet (Porter; Kramer, 2006) and total green productivity is one a very precise concept and analysis technique for application (SUHARJITO; MARIMIN, 2015).

1.1. Backgrounds

The purpose of the Total Chain Measurement is to measure performance while controlling the supply chain in each agro-industry line to determine the effectiveness and efficiency of the unitary process in production activity units from raw materials to processed added value, from raw materials to finished goods, the storage process, the provision of goods, and the process of sending goods to consumers.

The coffee agro-industry in Kalibaru-Banyuwangi is a coffee company whose raw materials are supplied by farmers in Kalibaru. The current condition of the coffee agro-industry in Kalibaru-Banyuwangi has yet to carry out a comprehensive measurement system. The measurements used are only functional matrix measurements and only contain output aspects in the production section with several performance indicators such as material efficiency, machine, and equipment efficiency; this is still considered weak because it does not cover all issues, so a method is needed that can describe and analyze the company's performance as a whole, so a more complete, systematic and integrated total chain measures framework is required.

In this study, the Supply Chain Operation Reference (SCOR) method was used to complement measurements that are still weak and incomplete in measuring SCOR, this model can produce good relationships in general, tactically, and strategically and can identify, evaluate, and monitor chain performance supply. The basic difference in this SCOR model is the vacancy to define the relationship between process performance and each dimension affecting the specified request's scope. The SCOR model method is expected to determine the performance value of each activity unit so that priority indicators that require improvement can be identified, as well as provide suggestions for improvement to build better company performance and in by expected targets.

1.2. System of total chain measures

In the early 1920s, a traditional measurement system focused only on indicators, namely performance measurement, which should have a long-term orientation compared to the short-term. Financial measures show the impact of company policies and procedures on the company's short-term financial position. This is one of the areas in which traditional performance measurement systems can be improved. Along with changes in the business environment, performance measurement has developed to focus on non-financial measurements.

Non-financial measurement systems have more flexibility in current conditions, are sustainable, and are more consistent with goals and strategy development. Non-financial factors are more long-term oriented and contribute significantly to company performance; for example, indicators are related to product quality that can increase sales and customer satisfaction in the long term (MASKELL, 2009). With the development of the industry in the 21st century, SCM has become the main focus of every organization, even in some recent studies, which show that supply chain management is practical in improving the performance of world-class companies.

By development of supply chain performance measurement systems (Chibba, 2007), there are four types of SCM performance measurement, namely: (1) functional measures, measurement separately from each function in the supply chain, such as measurement of delivery only or production only; (2) internal integrated measures, performance measurement of all functions in the supply chain in one company; (3) One side Integrated Measures, define performance within boundaries between organizations or between companies and measure performance between companies in the perspective of suppliers or customers; (4) total chain measures, complete supply chain performance measurement that includes inter-company, including the relationship from suppliers to consumers. So, several studies still highlight the importance of practices adapted to actual field conditions (ZENG , 2011).

The main reason for conducting a supply chain management study is that many obstacles remain in its implementation (ABDULNABI et al., 2022). This is in line with the basic concept of a system, which always has differences in implementation, depending on the level of readiness of the relevant institutions and the level of needs of each actor and stakeholder in each region (HADI et al., 2022).

2. MATERIALS AND METHODS

Performance analysis in the Robusta coffee agro-industry is an alternative performance measurement that can be used for sustainability development. These methods are mutually interactive and mutually supportive in reaching complex decisions. The following is the research method and systematics in Figure 1. The technique used is Supply Chain Operations Reference (SCOR) to determine the position of the total yield on each dimension and the performance of the supply value chain for each activity; the calculation is performed using the aggregation method to determine the dimension value in each metric.

2.1. The model of supply chain operation reference

Development of a supply chain performance measurement framework known as the model (SCOR) developed in 2002 by the Supply Chain Council (SCC) to describe managerial processes which are then associated with all elements involved in fulfilling customer requests; there are five main supply chain management processes defined In this model, namely: plan, source, make, deliver, and return. SCOR was developed and supported by an independent non-profit organization called the Supply Chain Council (PITTIGLIO, 1996). The SCOR method is a method that provides basic guidelines for obtaining further information, starting from the detection of each business process to performance metrics so that more detailed performance measures can be obtained, several advantages of using SCOR are: (1) knowing the relationship between objectives general and specific objectives in strategic areas, (2) able to identify, evaluate, and measure performance in tactical areas, (3) able to define and control the relationship between bases on each metric and between business processes (4) able to describe the minimum size at each level.

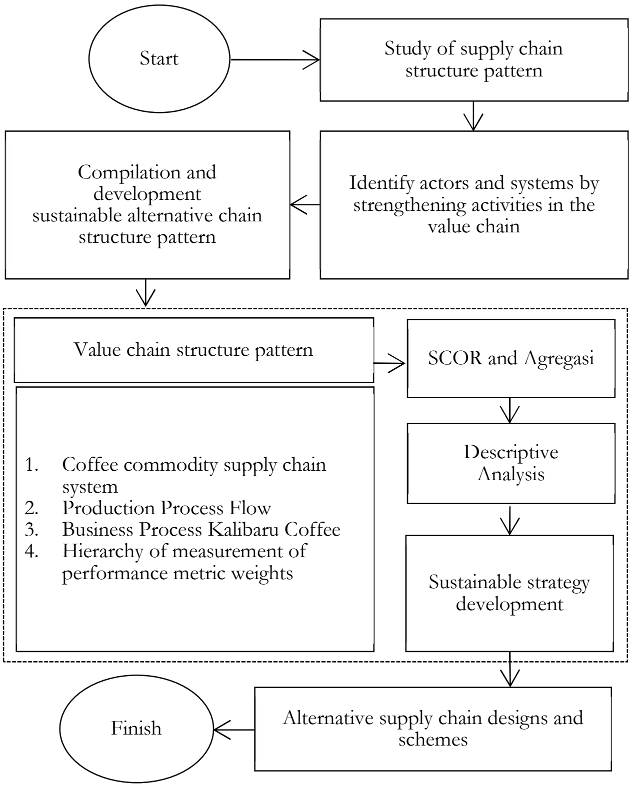

Figure 1. Research methods and systematics.
Figura 1. Métodos e sistemática de pesquisa.

2.2. Identify supply chain and performance metrics

The first step is to identify specifications on SCOR performance using an interrelated metric process element model. Then, each processing element in the model will identify the relationship between practices and technology that supports each other or with other company facilities, as shown in Table 1.

2.3. Supply chain performance measurement

World companies have carried out various ways of measuring performance. One of them is the measurement method carried out by a supermarket. First, they determine the performance objectives needed in these measurements, such as quality, speed, reliability, flexibility, etc. The objective is given a score and weight. The normalization of these performance indicators defines the level of performance fulfillment. For a definite supply chain strategy, the following relationship applies:

$$P = \sum_{j=i}^{n} s_{ij}\ w_{ij} \qquad (01)$$

where: P_i = total Supply Chain performance variance i; n = number of performance objectives; S_{ij} = Supply Chain score to i in the j performance objective; W_{ij} = weight of performance objectives.

Table 1. Performance attributes and metrics.
Tabela 1. Atributos e métricas de desempenho.

Performance metrics	Performance attributes				
	External			Internal	
	Reliability	Responsiveness	Agility	Cost	Asset
Order Fulfillment	√				
Delivery performance	√				
Compliance with quality standards	√				
Order Fulfillment Cycle		√			
Order fulfillment lead time		√			
Supply Chain Flexibility			√		
SCM Fee				√	
Cash-to-Cash Cycle					√
Inventory days of supply					√

The normalization process is carried out using the Snorm dr De Boer normalization formula, namely:

$$\text{Snorm} = \frac{\text{Si} - \text{S}}{(\text{Max S} - \text{Min S})} \text{x } 100 \qquad (02)$$

Descriptions: Si = Actual indicator that has been achieved; Smin = The value of the worst performance achievement of the performance indicators; Smax = The value of achieving the best performance from the performance indicators.

In this measurement, each indicator weight is converted into a certain value interval, namely 0 to 100. Zero (0) means the worst, and one hundred (100) represents the best. Thus, the parameters of each indicator are the same, after which a result can be obtained that can be analyzed, as in Table 2.

3. Data Collection

The data collection technique was carried out in 3 stages, namely examining all variables and attributes related to the total performance of the robusta coffee agroindustry value chain (desk study). Group discussions were carried out, which were attended by farmers, coffee activists, coffee plantation employees, and coffee experts (focus group discussion), and direct interviews with respondents who understand the problems of upstream and downstream coffee by assessing the key instruments that have been determined (in-depth interviews), as for the flow model of data collection techniques in Figure 2.

Table 2. Performance monitoring and classification system.
Tabela 2. Sistema de monitoramento e classificação de desempenho.

Monitoring System	Performance Classification
90-100	Very Fine/Extraordinary
80-90	Fine/Very Good
70-80	Premium/Good
60-70	Average
50-60	Usual Good Quality/Marginal
< 50	Commercial/off grade/Poor

Source: Hetzel (2021) and Hadi (2023).

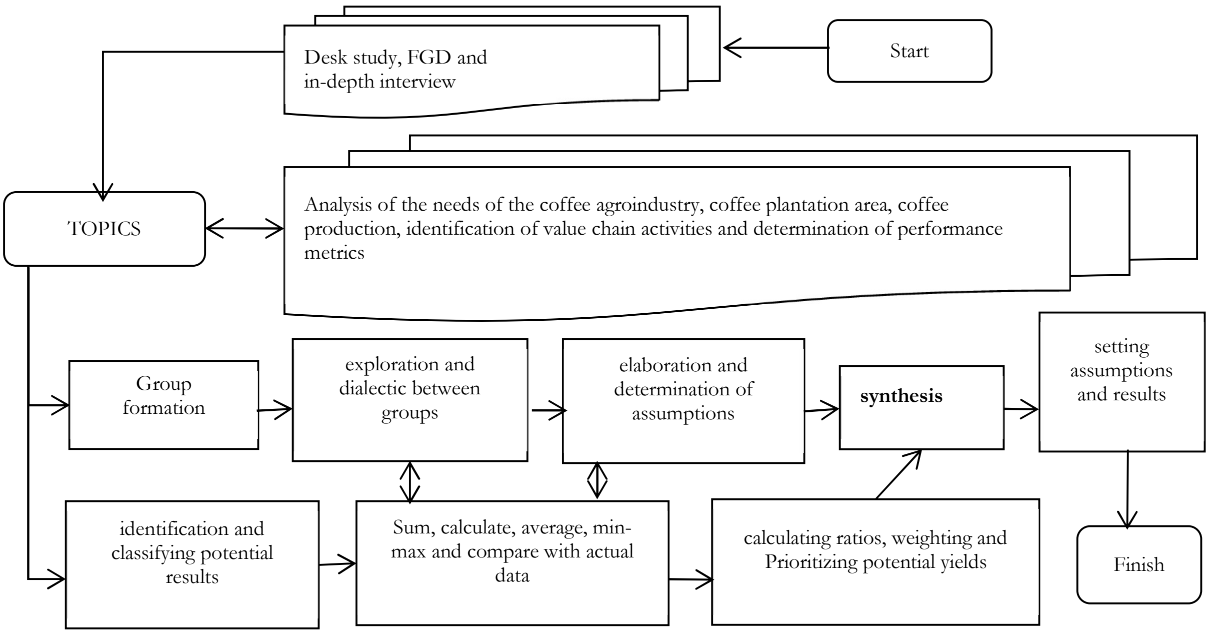

Figure 2. Flow model of data collection.
Figura 2. Modelo de fluxo de coleta de dados.

3.1. Variety of supply chain structure patterns

The following is a pattern of supply chain structure resulting from the 2011-2019 paper, which is used as a basis for developing a new supply chain structure pattern in an area by taking into account the existing objective and existing conditions of various supply chain structures patterns as follows: Pattern 1: Farmers, collectors, intermediaries, wholesalers, green bean processors, powder processors, supermarkets and traders, exporters (KUSTIARI, 2011). Pattern 2: Coffee farmers, coffee collectors, coffee fruit traders, small and large traders, agroindustry, exporters, and consumers (KHAIRUNNISA; NOVIANTARI et al., 2015). Pattern 3: Coffee farmers, village collectors, sub-district collectors, ground coffee producers (UMKM), and exporters (KHAIRUNNISA; NOVIANTARI et al., 2015). Pattern 4: Farmers, traders, agro-industry, exporters, and consumers (HARYADI et al., 2016). Pattern 5: Farmer, coffee cafe, wholesaler, and consumer (REN, 2018). Pattern 6: Coffee farmers, collectors, coffee cherry traders, wholesalers, agroindustry, and exporters (PUTRA et al., 2019). Pattern 7: Independent farmers, partner farmers, traders, processors, IKM, and consumers (SHOFFIYATI, 2019).

3.2. Data tabulation and total supply chain performance metrics

Data collection was obtained from field observations and the BPS 2020 Banyuwangi portal, and then tabulation was carried out to facilitate calculations and synthesis in further tests; the following is data on land area, production, actors, and total value chain processes in agro-industry in Kalibaru, in Table 3.

Table 4 shows the initial data used as a basis for research development. Calculations are then carried out using additional data from direct field observation. The following is a performance metric based on stakeholders' activities. It is based on the dimensions of the stages, including reliability, responsiveness, agility, cost, and asset management.

This process also contains tabulations with unit sizes, targets, and codes to facilitate the calculation of the total performance measurement of each actor involved, namely farmers, traders, and industry. Farmers are plantation owners and managers who act as stakeholders in the upstream area, use their knowledge and personal costs, and are not associated with any company. Business activities include land preparation, seeding, planting, fertilizing, pruning, and other maintenance up to harvesting, as in Table 5.

Table 6 measures traders' total supply chain performance. Traders buy coffee beans (green beans) from farmers and then sell them to coffee producers. The stages of traders' activities include buying coffee beans (green beans), processing or processing follow-up, packing and shipping.

Then, in Table 7, there is a metric of total performance in the industry, while the activities are buying coffee beans (green beans) from traders, reprocessing them to make ground coffee and selling them to consumers. The activities are buying coffee beans (green beans), processing or further processing, packaging, and distribution on the market.

Table 3. Plantation and coffee production of Banyuwangi.
Tabela 3. Plantação e produção de café em Banyuwangi.

Coffee plantations and production areas in Banyuwangi				Number of respondens			
No	Sub District	Area (ha)	Production (tons)	Capacity (ton year^{-1}) Big	Small	Traders	Planters
1	Pesanggaran	242	259				
2	Glenmore	248	267		1		
3	Kalibaru	3,847	4,124	1	4	34	106
4	Songgon	331	344		3		
5	Glagah	138	148	1			
6	Licin	387	415	1	1		
7	Giri	63	68				
8	Kalipuro	4,397	4,717	1	1		
9	Wongsorejo	68	73				

Source: Department of agriculture and food Banyuwangi 2022.

Table 4. Location, area, and coffee production of Kalibaru.
Tabela 4. Localização, área e produção de café de Kalibaru.

Robusta coffee plantation area in Klibaru				
No	Kalibaru District	Coffee Plantation Area (ha)	Number of Traders	Number of Planters
1	Ledok Sari	123.58	2	5
2	Watu Lempit	232.46	2	8
3	Panjurejo	336.67	2	10
4	Tretes	328.90	2	11
5	Gunung Sari	245.54	2	9
6	Kampung Tengah	394.83	3	12
7	Mulyo Sari	281.26	2	8
8	Kampung Rukun	186.78*	2	4
9	Glen Nevis	353.55*	2	8
10	Glen Falloch	128.11*	1	4
11	Amali	77.32	1	2
12	Kalibaru Utara	428.78	6	9
13	Kalibaru Selatan	729.96	7	16

Source: Hadi (2007).

Table 5. Metrics to measure the performance of planters.
Tabela 5. Métricas para medir o desempenho das fazendas.

No	Business Process	Performance Metric	Code	Unit	Target
Reliability					
1	Harvest	Coffee Bean Production per Harvest Cycle	SCP1-1	Ton/Ha	Max
2		Harvest Cycle Period (Picking)	SCP1-2	Month (1-4)	Min
3		Planting Age	SCP1-3	Year (40 th)	Min
4		Plant Care	SCP1-4	Year	Max
5		Good Amount of Coffee	SCP1-5	Kg (RC, B, G)	Max
6		Number of cycles of harvesting Raw/leftover coffee	SCP1-6	Kg	Min
7	Delivery	Availability of transportation facilities	SCP1-7	Yes or no	Max
8		Transport capacity	SCP1-8	Ton	Max
9	Confirm Weight	Weighing process	SCP1-9	Boolean (1/0)	Max
Responsivity					
10	Processing	Spindle supply waiting period	SCP2-1	Day	Min
11		The process of sorting the good seeds, spindles	SCP2-2	Ton (1 - 3)	Max
12		Wet HS Production	SCP2-3	Day	Min
13		Dried HS Production	SCP2-4	Day	Min
14	Plant maintenance	Prune Off Harvest	SCP2-5	Day	Max
15		Fertilization Cycle	SCP2-6	Day	Max
16	Delivery	Green Beans	SCP2-7	Ton	Min
Agility					
17	Facility	Work equipment	SCP3-1	Yes or no	Max
18		Number of Equipment Suppliers	SCP3-2	Pcs	Max
19		Number of Fertilizer Suppliers	SCP3-3	Sak	Max
Cost					
20	Land Preparation	Rejuvenation/replanting	SCP4-1	Rp	Min
21		Shade plant cost	SCP4-2	Rp	Min
22	Maintenance	Direct labor costs	SCP4-3	Rp	Max
23		Indirect labor costs	SCP4-4	Rp	Min
24	Delivery	Coffee Bean Shipping Cost	SCP4-5	Rp	Min
Asset Management					
25	Payment	Payment system	SCP5-1	Noncash	Max
26		Payment Period	SCP5-2	Day	Min

Table 6. Metrics to measure the performance of traders.
Tabela 6. Métricas para medir o desempenho dos traders.

No	Business Process	Performance Metric	Code	Unit	Target
Reliability					
1	Purchase GB	GB Request Fulfillment	SCT1-1	Linguistic (1-5)	Max
2		GB price information	SCT1-2	Rp/Kg	Min
3		GB price from the farmer	SCT1-3	Rp/Kg	Max
4		GB retrieval time	SCT1-4	Linguistic (1-5)	Max
5	GB Delivery	Delivery period	SCT1-5	Day	Min
6		Number of GB shipments to manufacturers	SCT1-6	Ton	Max
7		Number and capacity of transportation facilities	SCT1-7	Unit	Max
8		on time in delivery GB	SCT1-8	%	Min
9	Receipt of payment	GB selling price to the producer	SCT1-9	Rp/Kg	Max
Responsiveness					
10	GB Delivery	Frequency of sending GB to manufacturers	SCT2-1	Day	Max
11		GB delivery duration	SCT2-2	Hour	Min
Agility					
12	Delivery	Fulfillment of additional requests	SCT3-1	Yes or No	Max
13		Number of alternative suppliers	SCT3-2	Yes or No	Max
Cost					
14	Delivery	Retribution fee	SCT4-1	Rp	Min
15		Shipping costs	SCT4-2	Rp	Min
16	Maintenance	Return fee	SCT4-3	Rp	Min
17		Storage fee	SCT4-4	Rp	Min
Asset Management					
18	Receipt of payment	Payment contract system	SCT5-1	Contract and Non	Max
19		Payment period	SCT5-2	Day	Min

Table 7. Metrics to measure the performance of the industry.
Tabela 7. Métricas para medir o desempenho da indústria.

No	Business Process	Performance Metric	Code	Unit	Target
Reliability					
1	GB sorting	Size sorting	SCI1-1	Grade: L, M, S	Max
2	GB Processing	production volume GB	SCI1-2	%	Max
3		GB production capacity	SCI1-3	%	Max
4	Powder Processing	Powder Production Volume	SCI1-4	%	Max
5		Powder production capacity	SCI1-5	%	Max
Responsiveness					
6	GB Receipt	Raw material receiving cycle	SCI2-1	Day	Max
7	GB processing	GB processing time	SCI2-2	Day	Min
8		Production cycle per day	SCI2-3	Kg	Max
9		Working hours per day	SCI2-4	Hour	Min
10		Engine check and recheck cycle	SCI2-5	Hour	Min
11	Powder Processing	Powder processing time	SCI2-6	Hour	Min
12		Production cycle per day	SCI2-7	Kg	Max
13		Working hours per day	SCI2-8	Hour	Min
14		Engine check and recheck cycle	SCI2-9	Hour	Min
Agility					
15	Receive Raw Material	Safety Stock	SCI3-1	Ton	Max
16	GB Processing	Overtime	SCI3-2	Day	Min
Cost					
17	processing	Storage fee	SCI4-1	Rp	Min
18		WIP Fee	SCI4-2	Rp	Min
19	GB Processing	direct and indirect labor costs	SCI4-3	Rp	Min
20		Electricity cost	SCI4-4	Rp	Min
21		Energy	SCI4-5	Rp	Min
22	Maintenance	Powder storage fee	SCI4-6	Rp	Min
Asset Management					
23	Payment	Payment contract system	SCI5-1	Contract / Non	Max
24		Payment system	SCI5-2	Cash/Non-Cash	Max
25		Payment Period	SCI5-3	Day	Min

4. RESULTS

4.1 Situation analysis of supply chain structure and pattern

Based on the data analysis above, the Kalibaru area is the second largest coffee producer after Kalipuro in Banyuwangi, with a plantation area of ± 3,847 ha and an average production of ± 4,124 tons per year, meaning that it has great potential to be developed, by making improvements to each process unit, including having to be connected with various networks and actors, so that the sustainability of coffee in Kalibaru in the future will receive better attention. Based on an analysis of the situation of supply chain patterns in various regions of

Indonesia, the Kalibaru region urgently needs ongoing efforts to support increased coffee production by directing supply chain balance, maintaining the performance of main activities and supporting activities within the existing system. So far, efforts are still being made to find a scheme for implementing the supply chain structure pattern to increase production, quality, and continuity of coffee in Kalibaru, with an emphasis on the smallholder plantation sector and after conducting a situation analysis and literature study on the pattern of supply chain structure that has been implemented in several regions. The resulting supply chain pattern for the proposed Kalibaru area is shown in Figure 3.

4.2. Supply chain performance attribute metrics

Making attribute metrics on the performance of the robusta coffee supply chain aims to determine the level of importance in each metric that affects the performance of the dimensions and indicators for each actor. Calculations are then carried out to determine each performance matrix's SCOR value and the weight value of each performance in Figure 4.

The following are the results of measuring the performance of the total supply chain for farmers, traders, and the robusta coffee industry in Kalibaru. From the observations and data obtained, the minimum and maximum values for each activity are generated. Then, from the actual value with the target data to be achieved, the normal value, improvement rate, and weight factor are generated. Tables 8, 9, and 10 show the resulting score and performance value.
The results of measuring supply chain performance starting from farmers, traders, and industry with business processes carried out to perform activities in each dimension show that improvements must be made to the lowest score presented in Table 11.

The following are the results of measuring the performance of the total supply chain for farmers, traders, and the robusta coffee industry in Kalibaru. From the observations and data obtained, the minimum and maximum values for each activity are generated. Then, from the actual value with the target data to be achieved, the normal value, improvement rate, and weight factor are generated. Tables 8, 9, and 10 show the resulting score and performance value.

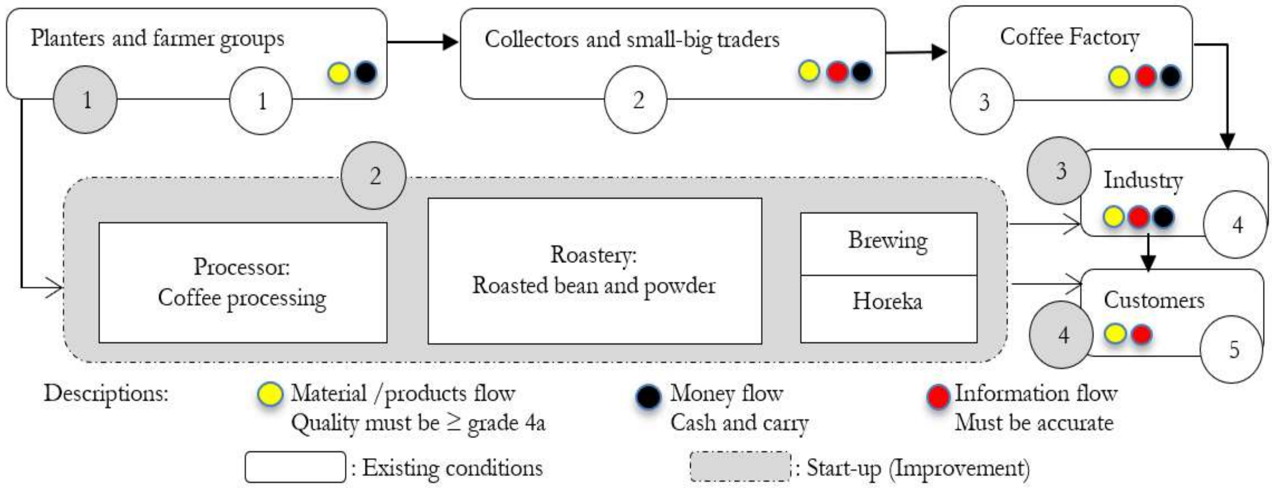

Figure 3. Robusta coffee supply chain configuration in Kalibaru.
Figura 3. Configuração da cadeia de suprimentos de café Robusta em Kalibaru.

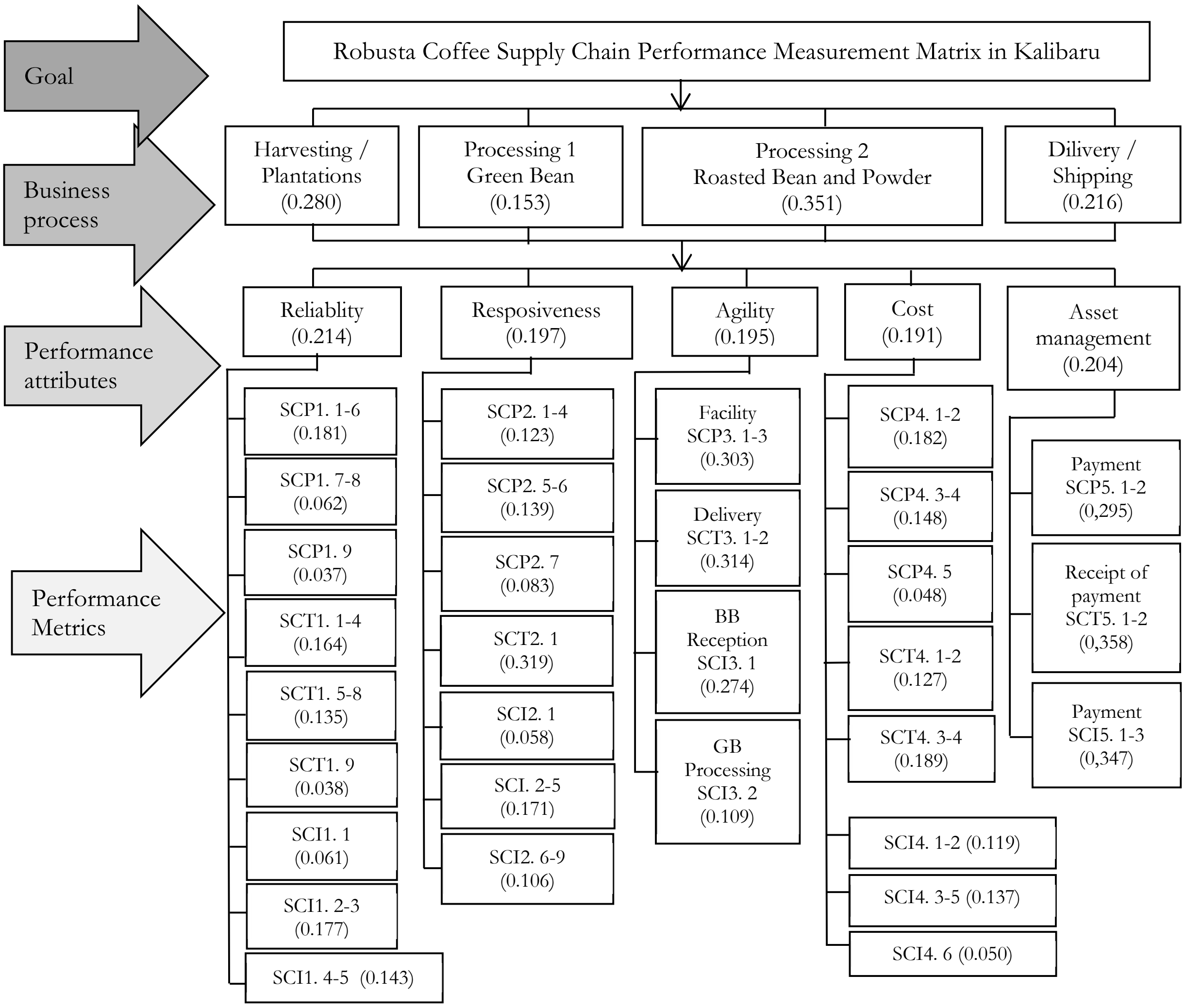

Figure 4. Metrics for measuring the supply chain performance of the coffee agroindustry in Kalibaru.
Figura 4. Métricas para medir o desempenho da cadeia de suprimentos da agroindústria do café em Kalibaru.

Table 8. Measurement results of total supply chain performance on Kalibaru Robusta coffee planter.
Tabela 8. Resultados da medição do desempenho total da cadeia de suprimentos na plantadora de café Kalibaru Robusta.

No	Code	Min Value	Max Value	Actual Value	Target	Normal Value	Improvement rate	Weight Factor	Weight %	SC OR	Performance Value
Reliability											
1	SCP1-1	2	11	5	16	0.333	3.200	1.067	12.75%	31	3.98%
2	SCP1-2	12	18	13	12	0.167	0.923	0.154	1.84%	92	1.70%
3	SCP1-3	35	40	50	40	3.000	0.800	2.400	28.69%	80	22.95%
4	SCP1-4	1	2	3	1	2.000	0.333	0.667	7.97%	33	2.66%
5	SCP1-5	5.71	8.62	7.16	13.00	0.502	1.815	0.908	10.85%	55	5.98%
6	SCP1-6	200	550	400	300	0.571	0.750	0.429	5.12%	75	3.84%
7	SCP1-7	0	1	1	1	0.600	1.667	1.000	11.95%	60	7.17%
8	SCP1-8	2	8	6	7	0.583	1.273	0.742	8.87%	79	6.97%
9	SCP1-9	0	1	1	1	0.700	1.429	1.000	11.95%	70	8.37%
Responsivity											
10	SCP2-1	1	3	3	1	1.000	0.333	0.333	8.13%	33	2.71%
11	SCP2-2	1	3	2	3	0.500	1.500	0.750	18.28%	67	12.19%
12	SCP2-3	15	30	22	16	0.467	0.727	0.339	8.27%	73	6.02%
13	SCP2-4	12	28	18	13	0.375	0.722	0.271	6.60%	72	4.77%
14	SCP2-5	1	2	2	2	0.500	1.333	0.667	16.25%	75	12.19%
15	SCP2-6	1	2	2	2	0.700	1.176	0.823	20.08%	85	17.06%
16	SCP2-7	2	9	7	9	0.714	1.285	0.918	22.39%	78	17.41%
Agility											
17	SCP3-1	0	1	1	1	0.600	1.667	1.000	41.77%	60	25.06%
18	SCP3-2	1	4	2	4	0.400	1.818	0.727	30.38%	55	16.71%
19	SCP3-3	20	40	30	40	0.500	1.333	0.667	27.85%	75	20.89%
Cost											
20	SCP4-1	3	5	4	3	0.500	0.750	0.375	14.68%	75	11.01%
21	SCP4-2	13	16	16	13	1.000	0.813	0.813	31.81%	81	25.85%
22	SCP4-3	4	6	5	4	0.500	0.800	0.400	15.66%	80	12.53%
23	SCP4-4	2	3	3	2	1.000	0.667	0.667	26.10%	67	17.40%
24	SCP4-5	2	4	3	3	0.250	1.200	0.300	11.75%	83	9.79%
Asset Management											
25	SCP5-1	0	1	1	1	0.700	1.429	1.000	69.57%	70	48.70%
26	SCP5-2	7	15	14	7	0.875	0.500	0.436	30.43%	50	15.22%

Table 9. Measurement results of total supply chain performance at Kalibaru Robusta coffee traders.
Tabela 9. Resultados da medição do desempenho total da cadeia de suprimentos em comerciantes de café Robusta em Kalibaru.

No	Code	Min Value	Max Value	Actual Value	Target	Normal Value	Improvement rate	Weight Factor	Weight %	SC OR	Performance Value
Reliability											
1	SCT1-1	2	5	3	5	0.400	1.562	0.625	13.64%	64	8.73%
2	SCT1-2	21.00	26.00	25.00	21.00	0.800	0.840	0.672	14.67%	84	12.32%
3	SCT1-3	18.00	24.00	22.00	19.00	0.667	0.865	0.577	12.57%	86	10.86%
4	SCT1-4	1	5	2	3	0.250	1.500	0.375	8.19%	67	5.46%
5	SCT1-5	1	3	2	1	0.500	0.500	0.250	5.46%	50	2.73%
6	SCT1-6	5	9	7	9	0.500	1.286	0.643	14.03%	78	10.92%
7	SCT1-7	6	8	7	8	0.500	1.143	0.571	12.47%	88	10.92%
8	SCT1-8	65	100	75	95	0.286	1.267	0.362	7.90%	79	6.24%
9	SCT1-9	45	120	75	95	0.400	1.267	0.507	11.06%	79	8.73%
Responsiveness											
10	SCT2-1	7	21	12	7	0.357	0.583	0.208	48.39%	58	28.23%
11	SCT2-2	1	4	2	2	0.167	1.333	0.222	51.61%	75	38.71%
Agility											
12	SCT3-1	0	1	1	1	0.600	1.67	1.00	50.00%	60	30.00%
13	SCT3-2	0	1	1	1	0.700	1.43	1.00	50.00%	70	35.00%
Cost											
14	SCT4-1	5.00	12.00	8.00	5.00	0.429	0.625	0.267	17.65%	63	11.03%
15	SCT4-2	200	400	300	200	0.500	0.667	0.333	21.96%	67	14.64%
16	SCT4-3	100	200	200	100	1.000	0.500	0.500	32.94%	50	16.47%
17	SCT4-4	300	600	400	500	0.333	1.250	0.417	27.45%	80	21.96%
Asset Management											
18	SCT5-1	0	1	1	1	0.800	1.250	1.000	76.92%	80	61.54%
19	SCT5-2	7	14	10	7	0.429	0.700	0.300	23.08%	70	16.15%

Table 10. Measurement results of total supply chain performance in the Kalibaru Robusta coffee industry.
Tabela 10. Resultados da medição do desempenho total da cadeia de suprimentos na indústria de café Robusta Kalibaru.

No	Code	Min Value	Max Value	Actual Value	Target	Normal Value	Improvement rate	Weight Factor	Weight %	SC OR	Performance Value
Reliability											
1	SCI1-1	1	5	3	4	0.500	1.333	0.667	18.62%	75	13.97%
2	SCI1-2	50	95	85	95	0.778	1.118	0.869	24.28%	89	21.73%
3	SCI1-3	80	95	90	95	0.667	1.056	0.704	19.66%	95	18.62%
4	SCI1-4	65	95	85	100	0.667	1.176	0.784	21.91%	85	18.62%
5	SCI1-5	85	95	90	100	0.500	1.111	0.556	15.52%	90	13.97%
Responsiveness											
6	SCI2-1	2	12	8	12	0.600	1.500	0.900	18.31%	67	12.21%
7	SCI2-2	7	28	14	10	0.333	0.714	0.238	4.84%	71	3.46%
8	SCI2-3	100	1000	700	1000	0.667	1.429	0.952	19.38%	70	13.57%
9	SCI2-4	3	8	6	5	0.600	0.833	0.500	10.17%	83	8.48%
10	SCI2-5	1	2	1.5	2	0.500	1.333	0.667	13.57%	75	10.17%
11	SCI2-6	10	18	14	10	0.500	0.714	0.357	7.27%	71	5.19%
12	SCI2-7	40	80	50	60	0.250	1.200	0.300	6.10%	83	5.09%
13	SCI2-8	2	8	4	6	0.333	1.500	0.500	10.17%	67	6.78%
14	SCI2-9	1	2	2	1	1.000	0.500	0.500	10.17%	50	5.09%
Agility											
15	SCI3-1	1	7	6	7	0.833	1.167	0.972	66.04%	86	56.60%
16	SCI3-2	1	4	2	3	0.333	1.500	0.500	33.96%	67	22.64%
Cost											
17	SCI4-1	3	5	4	3	0.500	0.750	0.375	17.11%	75	12.83%
18	SCI4-2	1	2	2	1	1.000	0.500	0.500	22.81%	50	11.41%
19	SCI4-3	2	5	4	3	0.667	0.750	0.500	22.81%	75	17.11%
20	SCI4-4	1	3	2	1	0.500	0.500	0.250	11.41%	50	5.70%
21	SCI4-5	1	2	2	1	0.500	0.467	0.233	10.65%	47	4.97%
22	SCI4-6	2	4	3	2	0.500	0.667	0.333	15.21%	67	10.14%
Asset Management											
23	SCI5-1	0	1	1	1	0.850	1.176	1.000	38.00%	85	32.30%
24	SCI5-2	0	1	1	1	0.900	1.111	1.000	38.00%	90	34.20%
25	SCI5-3	7	14	19	7	1.714	0.368	0.632	24.00%	37	8.84%

From the table above, it can be concluded that farmers with limited knowledge and transportation difficulties will feel safer and easier selling their crops to collectors who come directly to the coffee farmer's plantations. Supply chain mechanisms like this place farmers in a weak position because middlemen (collectors) will take a large margin (MARIMIN; MAGHFIROH, 2010). So, a more in-depth study is needed regarding the upstream mitigation of the coffee commodity in Kalibaru.

There are several weaknesses and deficiencies in each actor in several dimensions and business process indicators, so in developing an agricultural and agro-industry supply chain design, at least one must pay attention to the five factors that characterize agricultural or plantation products, namely perishability, varying quality, seasonality, kanba, and sensitive to climate change, in industrial supply chains, in-bound, in-process, and out-bound need to be designed carefully based on the right approach and decisions from various aspects and related criteria, agro-industry Webinar series (MARIMIN, 2020).

Marketing of ground coffee agro-industry products through the main marketing channels, namely direct production to consumers and farmers, is expected to process some of their output into a powder so that farmers get additional income from their coffee (HARIYATI, 2014). There is a need for regulatory support related to the regulation of product quantity and quality, regulation of distribution provisions, price regulation, as well as the implementation of strict price control regulations and the prohibition of excessive profit-taking (price control and anti-benefiting act), as well as controlling the supply of strategic commodities (Supply control act), and demand matching system, (MARIMIN, 2017).

5. DISCUSSION

With the increase in knowledge and the easier flow of distribution and current technology, it is necessary to develop new strategic units to manage coffee products from upstream to downstream, hoping to build the independence of farmers and surrounding communities to be more productive and competitive. A decision-making stage is needed in each framework to produce a better value chain by rearranging the performance to be achieved and then rearranging drivers or performance metric indicators that are clearer and measurable to suit the capabilities of existing human resources. Then, adequate infrastructure, organizational development, and good access between institutions are required. The success of the value chain in each supply chain does not only depend on partial efficiency and flexibility but rather on the compromise between each stakeholder who is trying to find the best balance between actors. as well as a more in-depth analysis of transaction costs and financing mechanisms at the farmer level; if the above is considered, it can be ascertained that the chain cycle in the coffee agroindustry will increase.

Table 11. Low-performance score metric for an actor.
Tabela 11. Métrica de pontuação de baixo desempenho para ator.

Actor	Low-Performance score metric for actor		Low-Performance Index	Strategies and solutions
	Code	Description		
Planter	SCP1-1	Loaf coffee production per harvest cycle	0.138	The garden's provisions and schedule of activities must be followed for fertilization, pruning, maintenance of the shade system, and replanting according to recommended clones.
	SCP1-4	Plant care		Soil tillage involves loosening the soil, detecting soil pH, and educating about good plant care.
	SCP1-5	a good amount of ground coffee		Good picking training, time management for picking and supervising activities in the garden
	SCP2-1	Waiting period for spindle supply	0.113	Adequate preparation and provision of transportation, especially in remote and steep terrain
	SCP2-3	Wet HS production		Make a list of production planning and procurement of better facilities by creating a production center.
	SCP2-4	Dry HS production		Make a list of production planning and procurement of oven machines to help the drying process.
	SCP3-2	Number of equipment suppliers	0.229	Supply and maintenance of equipment
	SCP4-3	Direct labor costs	0.168	Evaluation and control of employee productivity performance, as well as providing financial training to the workforce
	SCP4-5	Log copy shipping fee.		Carrying capacity and mileage adjustments
	SCP5-2	Payment period	0.351	Commitment and coordination between business units and implementing punishment for late payments and payments using the cash and carry method.
Trader	SCT1-4	GB pick-up time	0.066	Accuracy of information between units and synchronization of schedules in distribution
	SCT1-5	Delivery period		Improve coordination and consistency in delivery execution.
	SCT1-8	GB delivery time		Implementation of time management between units
	SCT2-2	GB delivery duration	0.259	Estimated time and distance traveled when picking up goods and optimizing transportation availability.
	SCT3-2	Number of alternative suppliers	0.251	Expanding information on supply and establishing good partnerships with suppliers
	SCT4-1	Retribution fee	0.124	Inter-institutional regulatory support
	SCT4-2	Shipping costs		Commitments and agreements between business units
	SCT5-2	Payment Period	0.300	Commitment and coordination between business units, as well as the implementation of punishment for delays and payments using the cash and carry method
Industry	SCI1-1	Size sorting	0.207	Improved technical skills in product processing and control management
	SCI1-3	GB production capacity		Evaluate the implementation of SOPs regularly
	SCI1-5	Powder production capacity		Human resource evaluation and control management improvement
	SCI2-2	GB processing time	0.093	Procurement of appropriate technology and improvement of workforce skills
	SCI2-6	Powder processing time		Development and procurement of more adequate technology/machinery
	SCI2-7	Production cycle per day		Optimization of the workforce to carry out follow-up activities to reduce unproductive activities
	SCI2-9	Machine check and recheck cycle		Maintenance and care of the machine with the provisions
	SCI3-1	Stock Security	0.472	Rescheduling of stock security and storage and warehousing management
	SCI4-1	GB storage cost	0.123	Scheduling and redesign of item layout
	SCI4-2	WIP Fee		Improved scheduling and production on time
	SCI4-4	Electricity cost		Efficiency and effective use of electricity
	SCI4-5	Energy		Improved coordination in energy use
	SCI4-6	Powder storage fee		Marketing network improvement and expansion
	SCI5-3	Payment Period	0.105	Commitment and coordination between business units, as well as the implementation of punishment for delays and payments using the cash and carry method

5.1. Research limitations

Based on the situational analysis and the proposed supply chain structure pattern results, only three supply chain actors were measured for total performance: planters, traders, and industry. After a desk study, 26 performance metrics were assigned to farmers, to traders 19 metrics, and for industry 25 metrics. Nine farmers were involved: three traders, two industries, and three experts. This research was only conducted in one sub-district consisting of 6 villages with a total area of 3,847.74 ha of coffee plantations, with details of 1,943.24 ha for PTPN XII, 558.98 ha for PBS and 1,158.74 ha for people's plantations.

5.2. Recommendations

From the results of this research, special treatment is needed for small farmers, especially from local governments, local coffee activists, universities and national coffee associations, to carry out productive collaboration by carrying out strategic planning, namely building processing systems close to raw materials, building connectivity for farmers and suppliers. Markets, procurement of machines, downstream digital technology, handling supply chain risk management, training to improve supply chain actors, and socialization of coffee processing to achieve better quality and quantity results.

The strategy for sustainable coffee development at the farmer level is intensification and rejuvenation/replanting. This requires funding support, farmer training, cluster-based policies for coffee-based areas, and strengthening farmer institutions. It also requires innovation in regional coffee brands at premium and fine Robusta levels, increasing domestic consumption of Robusta coffee, creating a good business climate, and developing coffee-based cooperation in bean belt areas (bean belt coffee connections).

6. CONCLUSIONS

This research resulted in a new supply chain structure pattern, which originally consisted of smallholders, large and small collectors, factories, industries, and consumers, to the proposed supply chain structure pattern presented in Figure 3: smallholders, start-up business units, and consumers. Total value chain performance is measured on three supply chain actors: planters, traders, and industry.

From the results of the calculation of the performance value for farmers on the reliability dimension (36.62%), it is in the low average category; this is caused by three performance metrics that still need to be improved is the production of coffee logs per harvest cycle, plant maintenance and the number of good coffee logs, for the agility dimension (62.66%) due to the limited number of equipment, the amount of fertilizer supply and for the asset management dimension (63.91%) is included due to by excessively long payout periods.

While the performance value for traders that should be the focus of improvement is on the responsiveness dimension (66.94%), namely the low duration of green bean delivery, on the agility dimension (65.00%), additional alternative suppliers are needed, and for the cost dimension (64.10%) still the cost of refund and delivery. Industry players need improvement on the cost dimension (62.16%) spread across six performance metrics: green bean storage, WIP, electricity, energy, and powder storage.

Overall, the measurement of the total supply chain value of the robusta coffee agro-industry in the Kalibaru sub-district has not yet reached the standard value of good performance, so improvements are needed in the upstream and downstream management systems, which are related to the amount of coffee log production, plant maintenance, soil processing mechanisms, processing at the wet process and dry process as well as the completeness of equipment.

At the trader level, improving the mechanism for the timely collection and delivery of green beans, the payment period, and the determination of supply alternatives is necessary. Meanwhile, at the industrial level, improvements in the quality and quantity of coffee beans, the duration of green bean and powder processing, the use and maintenance of machine cycles, storage costs, and stock security and payment periods are needed.

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