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PERFORMANCE MEASUREMENT AND RISK MITIGATION OF PINEAPPLE SUPPLY CHAIN IN CENTRAL KALIMANTAN PROVINCE

PENGUKURAN KINERJA DAN MITIGASI RISIKO RANTAI PASOK KOMODITAS NANAS DI PROVINSI KALIMANTAN TENGAH

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ABSTRAK

Petani nanas dan usaha agroindustri di Kapuas dan Pulang Pisau menghadapi beberapa risiko. Salah satu risiko yang signifikan adalah kurangnya kejelasan mengenai struktur dan kinerja rantai pasok yang ada, yang mengakibatkan ketidakefisienan operasional. Penelitian ini bertujuan untuk mengidentifikasi dan mengukur kinerja rantai pasok agroindustri nanas, menganalisis risiko yang berpotensi pada rantai pasok agroindustri nanas, serta menganalisis aksi mitigasi risiko agroindustri nanas yang ada di Kabupaten Kapuas dan Kabupaten Pulang Pisau Kalimantan Tengah. Metode yang digunakan untuk menganalisis kinerja rantai pasok menggunakan metode SCOR-AHP (Supply Chain Operations Reference-Analytic Hierarchy Process) sedangkan analisis risiko menggunakan metode HOR (House of Risk). Hasil penelitian ini Kinerja rantai pasok yang memiliki nilai paling tinggi yakni pada aktor distributor dengan total nilai kinerja 72,89 tergolong pada kategori good. Sedangkan kinerja rantai pasok terendah pada aktor petani dengan nilai 42,55 dan tergolong pada kategori marginal. Risiko tertinggi bagi petani adalah harga jual nanas terlalu rendah, bagi pengepul tingkat fluktuasi harga, dan bagi IKM (Industri Kecil Menengah) nanas Perencanaan dan penjadwalan produksi kurang tepat. Prioritas tindakan mitigasi risiko petani adalah mengoptimalkan penerapan SOP (Standard Operating Procedure) budidaya nanas dan pascapanen yang baik dan benar, sementara pengepul membuat standarisasi dan kesepakatan dengan petani mengenai kualitas nanas, sedangkan industri berfokus merencanakan, mengoptimalisasi, mengawasi, dan mengevaluasi proses produksi secara berkala, dan distributor meningkatkan jangkauan pemasaran produk.

Kata kunci : HOR, kinerja rantai pasok, nanas, risiko, SCOR-AHP

ABSTRACT

Pineapple farmers and agro-processing businesses in Kapuas and Pulang Pisau face several risk. One significant risk is the lack of clarity regarding existing supply chain structures and performance, resulting in operational inefficiencies. This study aimed to identify and measure the performance of the pineapple agroindustry supply chain, analyze potential risks within the supply chain, and evaluate risk mitigation actions in the pineapple agroindustry located in Kapuas Regency and Pulang Pisau Regency, Central Kalimantan. The method used to analyze supply chain performance was the SCOR-AHP (Supply Chain Operations Reference-Analytic Hierarchy Process) method, while risk analysis was conducted using the HOR (House of Risk) method. The results showed that the highest supply chain performance score was attributed to the distributor, with a total score of 72.89, categorized as "good." Conversely, the lowest performance was seen among farmers, with a score of 42.55, classified as "marginal." The highest risk for farmers was the low selling price of pineapples, for collectors was price fluctuations, and for pineapple SMEs was inaccurate production planning and scheduling. The prioritized risk mitigation actions for farmers included optimizing the implementation of proper SOPs (Standard Operating Procedure) for pineapple cultivation and post-harvest processes, for collectors was the establishment of standards and agreements with farmers regarding pineapple quality, while the industry focuses on planning, optimizing, monitoring, and periodically evaluating the production process. Additionally, distributors should enhance the marketing reach of the products.

Keywords: HOR, performance of supply chain, pineapple, risks, SCOR-AHP

INTRODUCTION

Pineapple (*Ananas comosus* L. Merr.) is a prominent horticultural commodity with significant potential to contribute to foreign exchange earnings and improve farmers' income. Its cultivation is widespread, particularly in equatorial regions, ranging from lowlands to mountainous areas, where the crop grows optimally (Mariati, 2023). While pineapples are predominantly consumed fresh as table fruit, they can also be processed into various products such as juice, dodol, chips, and jam.

**Coressponding Author*

Central Kalimantan boasts a variety of agricultural products, with pineapple emerging as a leading horticultural commodity. The province's major production centers are Kapuas Regency, with an average output of 6,707.3 tons per year from 2019 to 2023, and Pulang Pisau Regency, with an average annual production of 3,233.3 tons over the same period (BPS, 2023). These high production levels present a substantial opportunity to develop a pineapple-based agroindustry. Furthermore, the geographical proximity of these two regencies facilitates seamless raw material procurement within the supply chain, minimizing distribution time and inventory costs.

Despite these advantages, pineapple farmers and agro-processing businesses in Kapuas and Pulang Pisau face several risk. One significant risk is the lack of clarity regarding existing supply chain structures and performance, resulting in operational inefficiencies. According to research by Saputra and Wijaya (2020), the pineapple supply chain in Indonesia remains weak due to a lack of coordination among actors and inadequate infrastructure. A study by Nugroho *et al.* (2021) indicates that the pineapple supply chain in rural areas is often hindered by limited market access. Additionally, risks affecting various actors within the supply chain have not been adequately identified, limiting efforts to implement effective mitigation strategies. The absence of well-developed agro-processing industries means that surplus pineapples during peak harvests cannot be absorbed effectively, resulting in price drops that adversely impact farmers' incomes.

The limited market reach of locally grown pineapples further exacerbates these challenges, as their distribution remains confined to local markets. Astoko (2019) highlighted that domestic pineapple marketing frequently encounters issues, particularly price declines during peak harvest seasons. Given these risks, it is imperative to evaluate the performance of the pineapple supply chain and implement risk mitigation strategies to ensure optimal resource utilization and value addition. These efforts align with the government's agenda of promoting agricultural downstream development, emphasizing value creation and green economic principles. The ultimate goal is to foster sustainable economic growth at local and regional levels by leveraging indigenous resources. The need to ensure the sustainability of the supply chain makes performance measurement a crucial undertaking. According to Marimin (2018), the continuity of a supply chain depends significantly on its performance. Thus, optimizing supply chain performance is essential for improving future operations (Asrol, 2017).

In addition to performance, risk management plays a pivotal role in maintaining supply chain sustainability. Risks that adversely affect operational performance necessitate thorough identification to ensure the resilience of the supply chain. Disruptions in core business processes can destabilize the entire supply chain network (Setyadi, 2016). Therefore, an integrated risk management framework encompassing risk identification, assessment, mitigation, monitoring, and evaluation is indispensable (Ulfah, 2017). A systematic approach to managing risks enables the collection of relevant data and insights, which inform the formulation of targeted mitigation strategies (Safriana, 2019).

This study aims to identify and measure the performance of the pineapple agroindustry supply chain, assess potential risks, and develop mitigation strategies for the supply chain in Kapuas and Pulang Pisau Regencies, Central Kalimantan. The SCOR (Supply Chain Operations Reference) model will be employed for performance measurement, a crucial component of effective supply chain management. Meanwhile, the identification and mitigation of risks will utilize the House of Risk (HOR) method (Pujawan, 2009), which focuses on proactive risk management by addressing the root causes of risks. Implementing risk management through the HOR method can enhance the operational efficiency of the pineapple agroindustry by mitigating potential risks (Magdalena, 2019). In a dynamic supply chain environment, adopting risk management practices is essential to prevent disruptions and minimize future losses (Chopra, 2016).

RESEARCH AND METHODS

Framework

The performance measurement of the pineapple supply chain in Central Kalimantan will provide comprehensive insights into the performance of all actors involved across the entire supply chain. This information serves as a foundation for improving the performance of each actor, thereby enhancing the overall efficiency of the supply chain. In addition, the identification and mitigation of risks associated with each actor play a critical role. Mapping risks by their severity-high, medium, or low-helps establish a priority order for addressing them. This enables the development of alternative mitigation strategies to reduce risk levels effectively. The conceptual framework of this study is presented in Figure 1.

Data Collection Techniques

This study utilizes both primary and secondary data. Primary data were collected through field observations, interviews, and discussions using structured questionnaires targeting farmers, collectors, small and medium-sized enterprises (SMEs) involved in pineapple processing, academics, and relevant government agencies. The collected data include respondent profiles, general information on pineapple farming activities, the condition of the supply chain at each level, the overall relationships among supply chain actors, and expert opinions from Lecturers or academics and government authorities.

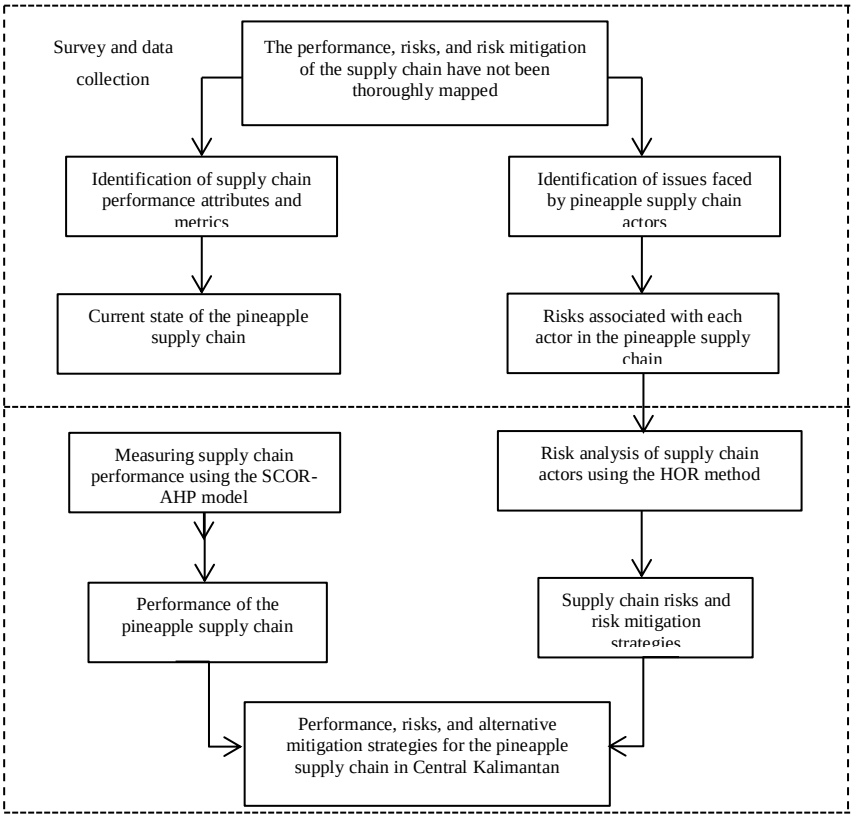

Figure 1. Framework

Table 1. External respondents

Respondents	Number (People)
Lecturers/Academics	2
Department of Agriculture, Kapuas Regency	1
Department of Trade, Industry, Cooperatives, and SMEs, Kapuas Regency	1
Department of Agriculture, Pulang Pisau Regency	1
Department of Industry, Trade, Cooperatives, and SMEs, Pulang Pisau Regency	1
Department of Food Crops, Horticulture, and Animal Husbandry, Central Kalimantan Province	1
Department of Cooperatives and SMEs, Central Kalimantan Province	1
Regional Development Planning Agency (Bappeda), Kapuas Regency	1
Regional Research and Development Planning Agency (Bappedalitbang), Pulang Pisau Regency	1
Regional Research and Development Planning Agency (Bappedalitbang), Central Kalimantan Province	1
Total	**11**

Secondary data were obtained through descriptive analysis of literature reviews, previous research findings, and scientific journals

Sampling Techniques

The respondents for this study consist of experts selected based on specific criteria. Purposive sampling was employed to select farmers, SMEs, collectors, and distributors operating within Kapuas and Pulang Pisau Regencies. Meanwhile, snowball sampling was applied to identify external respondents, including academics and officials from relevant government agencies. The selected respondents are presented in Table 1.

Research Location and Period

This study was conducted in the pineapple production centers and pineapple-processing SMEs located in Kapuas and Pulang Pisau Regencies, Central Kalimantan Province, from June 2024 to October 2024.

Analysis Method

The data analysis in this study employs the Supply Chain Operations Reference (SCOR-AHP) Model, following these steps: mapping business processes based on the SCOR model, aligning the SCOR model with supply chain objectives, defining supply chain performance attributes and key performance indicators (KPIs), validating supply chain performance assessments, assigning weights to performance attributes and KPIs and calculating the overall supply chain performance. The steps of analysis using the Analytic Hierarchy Process (AHP) method include establishing a hierarchy of criteria, constructing a pairwise comparison matrix, calculating criterion weights, conducting a consistency test, and performing evaluation and refinement. Risk analysis and risk mitigation are performed using the House of Risk (HOR) Method with the following steps: identifying risk events, identifying risk agents, constructing a risk priority index, developing a Pareto diagram, identifying relevant mitigation actions, calculating the total effectiveness of mitigation actions and ranking the total effectiveness of mitigation strategies.

RESULTS AND DISCUSSIONS

Supply Chain Analysis

The structure of a supply chain network encompasses not only processing plants but also transporters, wholesalers, retailers, and end consumers (Chopra and Meindl, 2013). The pineapple supply chain operates through integration and coordination among its members to meet consumer demands. Generally, pineapple-processing SMEs source their raw materials from suppliers or collectors. Before reaching the processors, the raw materials undergo agricultural management activities, including land preparation and crop maintenance.

Once acquired, the raw materials are processed into various products by SMEs, tailored to meet consumer demand. These pineapple-based products are then distributed to consumers through several channels, including direct sales by the industry or through distributors. The general structure of the pineapple supply chain is illustrated in Figure 2.

Chain Members and Commodity Flow

Supply chain management encompasses all stages from the initiation of manufacturing to the conclusion of sales, involving various levels within the supply chain. Given the complexity of these levels, effective coordination is crucial for delivering efficient services that enhance consumer satisfaction (Pathak *et al.*, 2019). The supply chain structure for pineapple commodities is composed of multiple components. It begins with the sourcing of raw materials specifically, pineapples from various suppliers or farmers-followed by the processing activities conducted by small and medium-sized enterprises (SMEs) to transform these raw materials into pineapple products. Product marketing is carried out by distributors, ultimately reaching consumers, who are the end users in the supply chain flow for pineapple commodities. The flow of pineapples within the pineapple commodity supply chain can be illustrated through several structural models, which include:

1. Farmers – Consumers
2. Farmers - Collectors – Consumers
3. Farmers - Collectors - Pineapple SMEs - Distributors – Consumers
4. Farmers - Small Collectors - Large Collectors - Pineapple SMEs – Consumers
5. Farmers - Small Collectors - Large Collectors - Pineapple SMEs - Distributors – Consumers

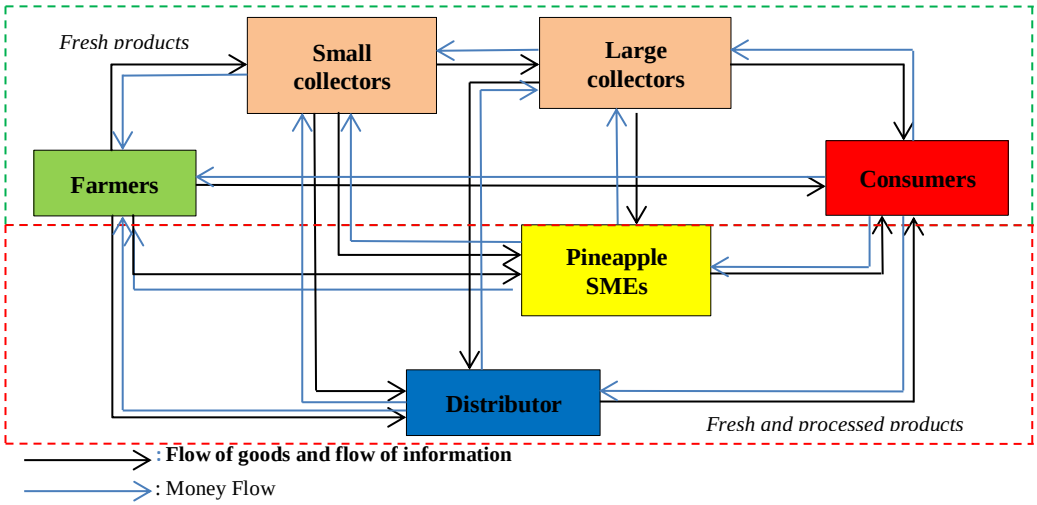

Figure 2. Structure of Pineapple Supply Chain

The shortest supply chain structure is represented in the first model, where farmers occasionally sell pineapples directly to consumers, albeit in limited quantities. Conversely, the longest supply chain structure is found in the fifth model, where the product flow extends from the initial actor, the farmer, to the final actor, the consumer.

Supply Chain Performance

The analysis of supply chain performance is crucial for facilitating informed decision-making in supply chain management. This control is implemented based on the supply chain strategy adopted, with the objective of ensuring that established targets are achieved (Hadiguna, 2016). Supply chain performance is instrumental in evaluating the effectiveness of supply chain members in executing their business activities (Elrod *et al.*, 2013; Asrol *et al.*, 2017). It is defined as a measure of overall performance that relies on the effectiveness of each activity within the supply chain structure (Chopra and Meindl, 2001). Through the assessment of supply chain performance, members can determine the value of their performance and develop strategies for improvement (Asrol *et al.*, 2017). The identification of problems and objectives focuses on measuring the performance of the pineapple supply chain. The supply chain mapping employs the SCOR (Supply Chain Operations Reference) model, which consists of five main processes. The Plan phase involves planning for demand, inventory, and resources. The Source phase covers the procurement of raw materials or products. The Make phase refers to the transformation of raw materials into finished products. The Deliver phase ensures the distribution of products to customers, while the Return phase manages returned or defective products. The final step in this process is identifying key performance indicators (KPIs) for each phase, including cost, cycle time, and quality. The Supply Chain Operations Reference (SCOR) model serves as a framework for measuring the overall performance of a supply chain (Paul, 2014). Hierarchy and Weighting Results of Pineapple Supply Chain Performance Metrics is illustrated in Figure 3.

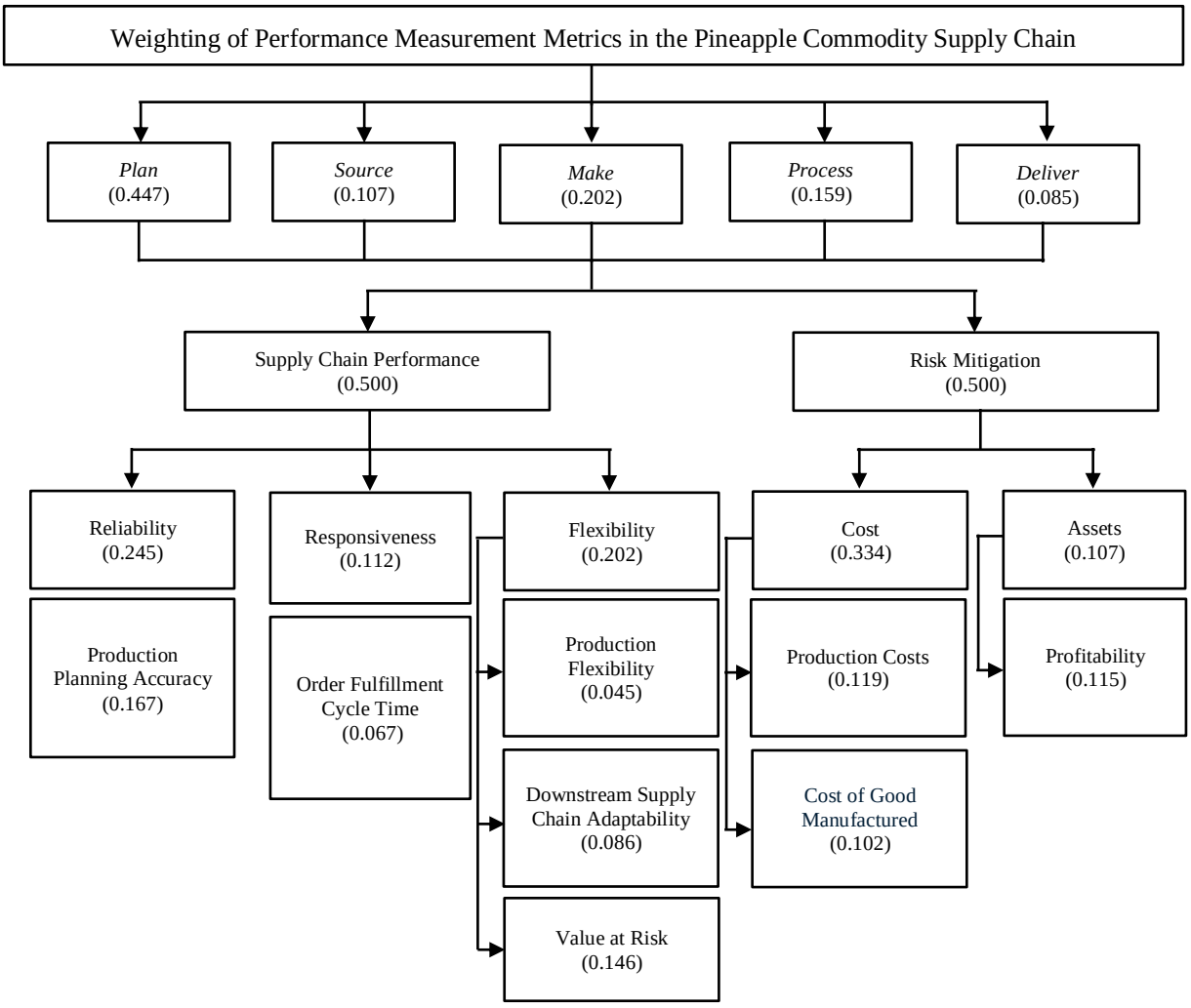

Figure 3. Hierarchy and weighting results of pineapple supply chain performance metrics

The Analytical Hierarchy Process (AHP) results reveal the prioritization at each level of supply chain management. At Level 1, the Plan dimension holds the highest weight of 0.447, indicating that planning is the most critical aspect of the supply chain. Following this, the Make dimension ranks second with a weight of 0.202, while Process is third with a weight of 0.159. The Source (0.107) and Deliver (0.085) dimensions are assigned lower priorities, emphasizing the importance of ensuring upstream processes before product delivery.

At level 2, two primary objectives are equally weighted: Supply Chain Performance (0.500) and Risk Mitigation (0.500). This balance reflects the dual focus on enhancing overall supply chain efficiency and managing risks to ensure sustainability and operational stability. At level 3, the performance dimensions are ranked based on their importance. Cost holds the highest priority with a weight of 0.334, underscoring the critical role of cost efficiency in supply chain performance. Reliability ranks second with a weight of 0.245, highlighting the importance of consistency in meeting customer demands. Flexibility is the third priority, with a weight of 0.202, reflecting the need for adaptability in responding to changes or disruptions. Meanwhile, Responsiveness (0.112) and Asset Utilization (0.107) are assigned lower weights, indicating that while they are relevant, their impact on strategic decision-making is less pronounced.

At level 4, as a performance metric, the accuracy of production planning carries the highest weight at 0.167, while production flexibility has the lowest weight at 0.045. The accuracy of production planning is associated with the occurrence of risks within the pineapple agro-industrial supply chain. This consideration is critical for the performance of the pineapple agro-industrial supply chain, as the accuracy of production planning can significantly influence overall business activities. When measuring performance, the resulting performance values are subsequently categorized into five distinct categories according to their performance standards. The performance standards are presented in Table 2.

Table 2. Performance standards

Performance Value (%)	Category
<40	Poor
40-50	Marginal
50-70	Average
70-90	Good
>90	Excellent

Source: Sumiati (2012)

The performance measurement results are conducted for each member of the supply chain. The performance value is derived from the product of the weight and the score. The performance values obtained from each metric are then summed to yield the overall performance value for each supply chain member. Subsequently, the total performance values are categorized according to the performance standards established by Sumiati (2012). The performance measurement results can be found in Table 3.

Based on Table 3, the supply chain performance with the highest score is attributed to the distributor actor, with a total performance value of 72.89, classified as "good." In contrast, the lowest supply chain performance is observed in the farmer actor, with a score of 42.55, categorized as "marginal." The performance values for the collector and pineapple SMEs are 64.4 and 65.13, respectively, placing them in the "average" category. Several issues contribute to the low performance score at the farmer level, including a high level of adaptation difficulty and significant value at risk, which result in lower scores.

Table 3. Performance of pineapple supply chain actors

Code	Performance Metrics Level 4	Performance Value of Farmers (%)	Performance Value of Collectors (%)	Performance Value of Pineapple SMEs (%)	Performance Value of Distributors (%)
R7	Production Planning Accuracy	8.45	12.42	7.68	5.75
R8	Raw Material Fulfillment Rate	3.34	6.76	15.9	10.42
E2	Order Fulfillment Cycle Time	2.01	5.81	8.23	8.78
E5	Production Scheduling Cycle	9.12	4.23	7.91	5.5
F2	Production Flexibility	7.32	9.67	2.23	8.72
F4	Downstream Supply Chain Adaptability	1.78	3.67	4.73	8.97
B4	Value at Risk	2.67	5.62	3.78	9.46
B1	Production Costs	1.32	4.87	6.75	5.74
A1	Cost of Good Manufactured	2.47	5.28	4.51	3.77
A3	Profitability	4.07	6.07	3.41	5.78
Total		**42,55**	**64.40**	**65.13**	**72.89**
Category		**Marginal**	**Average**	**Average**	**Good**

It is undeniable that farmers bear the greatest risk burden among the various actors due to their limited bargaining power with other stakeholders. Additionally, farmers have the longest production cycle compared to other actors, leading to elevated risk levels. Ineffective and inefficient performance among stakeholders can result in inadequate supply chain management integration (Ramos *et al.*, 2018). The performance measurement results are not only intended to assess achievement levels but also to facilitate performance improvement by analyzing the reasons behind low scores (Hadiguna, 2016). When measured performance yields low values, it is advisable to pursue development or enhancement strategies (Andharini, 2012).

Risk Analysis of the Pineapple Supply Chain

In determining risk priorities, the Aggregate Risk Potency (ARP) for each risk agent is calculated, followed by ranking based on ARP values from highest to lowest. The ARP value indicates the risk priorities that need to be mitigated. There are eleven priority risks identified for farmers, six for collectors, nine for pineapple SMEs, and six for distributors as shown in Table 4. The highest risk for farmers is the low selling price of pineapples, for collectors it is the price fluctuation, and for pineapple SMEs, it is the inaccuracy in production planning and scheduling. Subsequently, each risk agent receives corresponding risk mitigation actions.

In terms of the quantity of risks, farmers face the greatest risks due to the lengthy process required to produce pineapples. The second largest risk is associated with pineapple SMEs, which require specific skills and effective management to produce products that meet consumer expectations. Supply chain risk management should be established as a standard procedure within operational processes. By doing so, potential risks can be effectively mitigated (Neupane, 2017). With proper risk management, stakeholders can gain a better understanding of risk sources, manage unforeseen costs, and implement more effective risk mitigation processes (Singh and Wahid, 2014)

Table 4. Priority risks for each actor in the pineapple supply chain

Rank	Farmers	Collectors	Pineapple SMEs	Distributors
1	The selling prices for pineapples are significantly low	Price fluctuations in the pineapple market	Inadequate production planning and scheduling	Limited geographical range for product delivery
2	Margins of profit are notably low	Elevated transportation costs	Insufficient market outreach	Occurrences of packaging damage during transit
3	Cultivation and harvesting are still conducted manually	Incidences of damaged pineapples during transit	Competitive pressures from alternative products	Inaccuracies in order placement and shipping logistics
4	Reliance on rudimentary machinery and equipment	Deficiencies in quantity planning	Persistence of manual processes in production	Disruption in order continuity
5	Suboptimal post-harvest handling practices	Basic grading equipment still in use	Workforce characterized by slow response times	Incomplete storage facilities
6	Low quality of produced pineapples	Limited duration for pineapple storage	Labor force inadequately adhering to job descriptions	Insufficient delivery infrastructure
7	Limited access to capital loan resources		Ineffective communication with suppliers	
8	Inadequate education and extension services related to optimal pineapple cultivation and processing		Errors in input management	
9	Insufficient support and subsidies for production facilities to enhance farmer welfare		Mistakes in the production process	
10	Limited availability of subsidized fertilizers			
11	High costs associated with fertilizer and pesticide procurement			

Risk Mitigation in the Pineapple Supply Chain

The Effectiveness to Difficulty Ratio (ETD) is calculated to prioritize risk mitigation actions. Ranking is conducted based on ETD values from highest to lowest to identify the most urgent risk mitigation actions that need to be implemented. Farmers have seven prioritized risk mitigation actions, collectors have five, pineapple SMEs have six, and distributors have four actions, as illustrated in Table 5. The top priority risk mitigation action for farmers is to optimize the implementation of standard operating procedures (SOP) for proper cultivation and post-harvest practices. Collectors focus on standardizing and reaching agreements with farmers regarding pineapple quality, while SMEs concentrate on planning, optimizing, supervising, and periodically evaluating the production process. Distributors aim to enhance the marketing reach of their products.

Table 5. Risk mitigation actions for each actor in the pineapple supply chain

Rank	Farmers	ETD	Collectors	ETD	Pineapple SMEs	ETD	Distributors	ETD
1	Optimize the implementation of standard operating procedures (SOPs) for proper pineapple cultivation and post-harvest handling	6576	Establish quality standards and agreements with farmers regarding pineapple quality	4380	Plan, optimize, monitor, and periodically evaluate the production process	4670	Enhance the marketing reach of products	3405
2	Communicate aspirations regarding pineapple pricing policies to the government	5021	Manage stability in the supply of pineapples	3890	Develop and implement effective SOPs for production	3081	Implement accurate SOPs for order planning and shipping	2607
3	Foster partnerships with government and private sectors	3670	Develop precise planning for the procurement and sale of pineapples	3200	Implement cost-reduction strategies in production	2104	Strengthen cooperation with trade partners	1478
4	Provide education and training for farmers	2089	Create SOPs for pineapple storage to maintain quality	2435	Supervise labor to ensure compliance with job descriptions	1304	Improve storage and delivery facilities	1265
5	Monitor and supervise the application of SOPs in pineapple cultivation and post-harvest handling	1789	Develop SOPs for the procurement and delivery of pineapples	1872	Provide training and enhance employee skills	989		
6	Advocate for government support for capital investment in pineapple cultivation	1501			Enhance market reach through marketing and promotion	703		
7	Invest in machinery and equipment for pineapple cultivation	980						

The analysis and mitigation of supply chain risks can be employed to minimize losses occurring at each activity within the structure of the pineapple agro-industrial supply chain. Overall, there are still numerous risks present in the pineapple commodity supply chain, with more than five priority risks identified for each supply chain member. However, despite the risk assessments conducted, the identified risks and the proposed mitigation actions must be implemented and managed according to the measurement outcomes. If the implementation and management of risks and their mitigation are not conducted appropriately, the supply chain structure cannot operate effectively and efficiently. Risk mitigation is undertaken as a means to address risks and reduce losses (Septiani *et al.*, 2016), as well as to prevent the recurrence of similar risks (Ismail *et al.*, 2018). This process also serves as an evaluation for stakeholders in formulating strategies and assisting the government in policy development (Pamungkassari *et al.*, 2018). In determining risk mitigation strategies, it is essential to consider the nature of the risks, their sources, and the resources allocated for their reduction (Mavi *et al.*, 2016). Risk mitigation does not always equate to reducing or eliminating risks, as there are situations where certain levels of risk may be deemed acceptable. In such cases, risk management involves assessing risk acceptance, evaluating potential risk reduction or enhancement, selecting appropriate methods, and determining the feasibility of and choosing the most optimal strategies for risk reduction (Kozlov and Tamer, 2018).

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

The supply chain performance is highest for the distributor actor, with a total performance value of 72.89, categorizing it as good. In contrast, the lowest supply chain performance is attributed to farmers, with a value of 42.55, placing them in the marginal category. The highest risk for farmers is associated with low selling prices for pineapples, while collectors face risks related to price fluctuations, and pineapple SMEs encounter issues with inaccurate production planning and scheduling. The priority risk mitigation action for farmers is to optimize the implementation of proper cultivation and post-harvest standard operating procedures (SOPs), whereas collectors should standardize and establish agreements with farmers regarding pineapple quality. Additionally, SMEs should focus on planning, optimizing, supervising, and regularly evaluating the production process, while distributors should enhance the marketing reach of their products.

Recommendations

Further research is recommended regarding the institutional aspects of the pineapple commodity supply chain structure, value addition, and discussions on risk mitigation and balancing among stakeholders involved in the pineapple supply chain in Central Kalimantan.

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