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RISK MANAGEMENT MODEL FOR RAW MATERIAL PROCUREMENT AND PRODUCTION PLANNING IN THE COFFEE AGROINDUSTRY: A CASE STUDY IN KALIBARU, BANYUWANGI

MODEL MANAJEMEN RISIKO PERENCANAAN PENGADAAN BAHAN BAKU DAN PERENCANAAN PRODUKSI AGROINDUSTRI KOPI : STUDI KASUS DI KALIBARU BANYUWANGI

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ABSTRAK

Agroindustri kopi menghadapi risiko yang signifikan akibat proses bisnis yang kompleks dan keterlibatan berbagai pemangku kepentingan. Risiko tersebut, terutama dalam pengadaan bahan baku dan perencanaan produksi, dapat mengancam keberlanjutan bisnis, termasuk kualitas dan kuantitas bahan baku yang tidak konsisten, fluktuasi harga, keterbatasan sumber daya, serta ketidakefisienan dalam pengambilan keputusan. Penelitian ini menganalisis proses bisnis, mengidentifikasi risiko, serta mengembangkan model mitigasi risiko untuk agroindustri kopi di Kalibaru, Banyuwangi. Analisis proses bisnis dilakukan dengan metode deskriptif yang berfokus pada mekanisme dan penggerak rantai pasok, serta dilengkapi dengan metrik manajemen rantai pasok. Manajemen risiko menggunakan kerangka kerja House of Risk (HOR) Fase 1 dan 2. Hasil penelitian menunjukkan model proses bisnis yang lebih efisien dan terintegrasi, serta mengidentifikasi 20 kejadian risiko dan 20 sumber risiko dalam pengadaan serta perencanaan produksi. Sebanyak 11 sumber risiko prioritas diidentifikasi dalam pengadaan dan 10 dalam produksi, yang menjadi dasar strategi mitigasi yang ditargetkan. Tindakan mitigasi utama mencakup pelatihan petani dalam Good Agricultural Practices (GAP), kerja sama dengan lembaga penelitian untuk pengadaan, serta penerapan pemeliharaan preventif pada peralatan pengolahan dalam produksi. Strategi ini bertujuan untuk meningkatkan pengelolaan sumber daya dan daya saing industri.

Kata kunci: agroindustri kopi, mitigasi risiko, proses bisnis, perencanaan pengadaan, perencanaan produksi

ABSTRACT

The coffee agroindustry encounters significant risks due to its intricate business processes and the involvement of multiple stakeholders. These risks, particularly in raw material procurement and production planning, threaten business sustainability and include inconsistent raw material quality and quantity, fluctuating prices, limited resources, and inefficiencies in decision-making. This study analysed business processes, identifies risks, and develops a risk mitigation model for the coffee agroindustry in Kalibaru, Banyuwangi. Business process analysis employed descriptive methods focusing on supply chain mechanisms and drivers, complemented by supply chain management metrics. Risk management utilized the House of Risk (HOR) Phase 1 and 2 framework. Results revealed a refined business process model emphasizing efficiency and integration, alongside 20 risk events and 20 risk sources in both procurement, and production planning. Eleven priority risk sources were identified for procurement, and ten for production, forming the basis for targeted mitigation strategies. Key mitigation actions include training farmers in Good Agricultural Practices (GAP), partnering with research institutions for procurement and implementing preventive maintenance of processing equipment for production. These strategies enhance resource management and industry competitiveness.

Keywords: business process, coffee agroindustry, risk mitigation, procurement planning, production planning

INTRODUCTION

Indonesia ranks as the world's fourth-largest coffee producer, yet much of its output remains unprocessed, exported as raw beans (Directorate General of Estate Crops, 2019). The government's down streaming initiative seeks to add value, bolster economic resilience, and reduce reliance on volatile commodity markets. Downstream processing of coffee can enhance the competitiveness of the industry and reduce the risk of price fluctuations (Limaseto, 2022).

The coffee agroindustry in Kalibaru, Banyuwangi, is an example of an industry with abundant raw material potential, supported by plentiful raw materials and a continually growing domestic and global market (ICO, 2021). However, its complex supply chain spanning procurement, production, and distribution exposes it to significant risks, such as unreliable raw material supply, price

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volatility, and operational inefficiencies (Nguyen and Sarker, 2018). Effective business process management and risk mitigation are critical to ensuring sustainability and competitiveness. In large-scale industries, business process analysis is typically conducted and presented in greater detail, as these organisations are required to adapt to sustainable business models that are responsive to contemporary developments (Jaya, 2014). Consequently, the formulation and design of BPMN for micro, small, and medium enterprises is highly necessary, enabling the proposal of improvements and the optimisation of both efficiency and quality (Sulthan *et al.*, 2021).

In addition to the development of business process modelling, the sustainability and success of industries in competitive markets are also significantly influenced by risk factors (Fadhil, 2018). Poorly managed risks can disrupt the continuity of core business processes (Wahyudin *et al.*, 2016), making the implementation of a risk management system essential to maintain operational stability. Efforts to minimise risks within the supply chain are particularly crucial, as these directly affect the overall efficiency of business processes (*Asrol et al.*, 2021). Risk management should be conducted in a measured and systematic manner to address vulnerabilities (Zsidisin, 2019).

Previous research in the Kalibaru Coffee Agroindustry has indicated that value chain performance remains suboptimal due to persistent risks encountered in procurement and production planning. These ongoing challenges hinder the effectiveness and continuity of the supply chain, highlighting the need for targeted improvements (Hadi, 2023). This research aims to analyze these processes, assess associated risks, and propose a mitigation model using the House of Risk (HOR) framework, offering actionable insights for the Kalibaru coffee agroindustry and beyond.

RESEARCH AND METHODS

Research Framework

This study focused on the Kalibaru coffee agroindustry, analyzing raw material procurement and production planning. The methodology comprised two stages: (1) business process analysis using descriptive methods based on supply chain mechanisms (Vorst, 2006) and management metrics (Chopra *et al.*, 2016), and (2) risk management analysis via the HOR Phase 1 and 2 approach (Pujawan and Geraldin, 2009). HOR integrates Failure Mode and Effect Analysis (FMEA) and House of Quality (HOQ) principles to prioritize risks and mitigation actions. The Research Framework is presented in Figure 1.

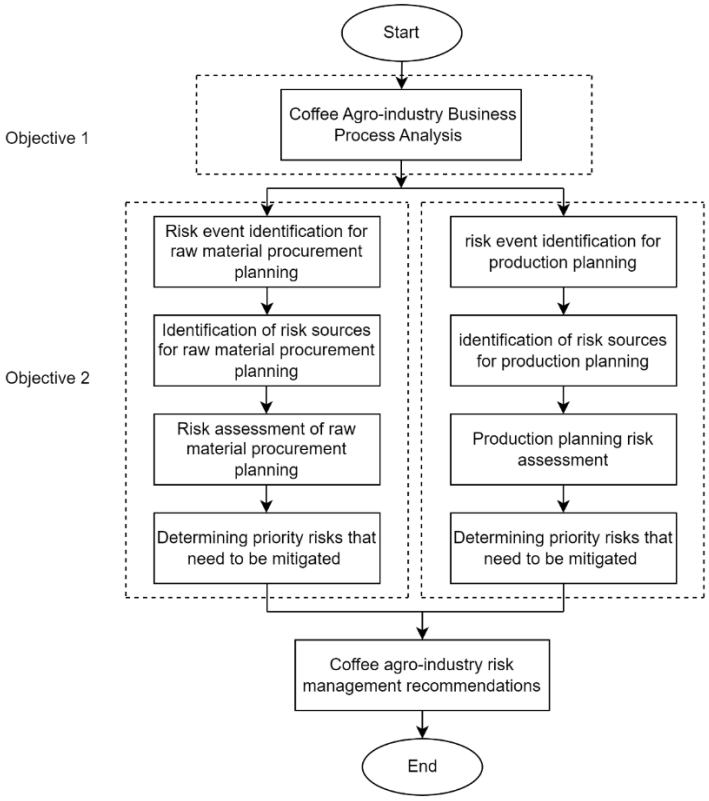


Figure 1. Research Framework

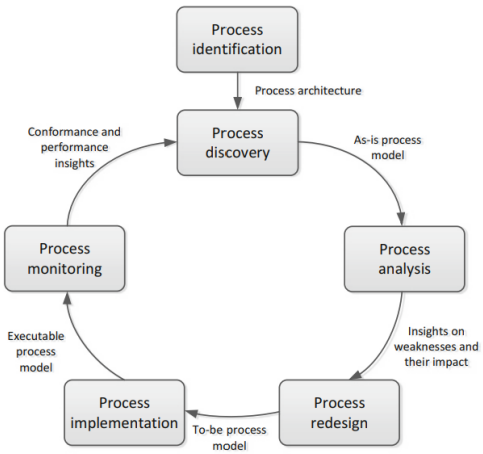
Data Collection Procedure

Primary data were gathered from March to August 2023 through field observations, interviews with industry stakeholders (e.g., KUB Srikandi, KSU Ketakasi, Oceanno Coffee), and discussions with experts from the Indonesian Coffee and Cocoa Research Institute. Secondary data were sourced from peer-reviewed literature and industry reports.

Analysis Techniques

Business Process Modelling

Business processes were mapped using Business Process Modeling Notation (BPMN) to identify inefficiencies and propose improvements (Valacich and George, 2021). The BPM lifecycle is presented in Figure 2.



Source : (Valacich dan George, 2021)

Figure 2. The BPM lifecycle

Risk Management Analysis

The steps in risk management include risk identification, risk assessment, mitigation, monitoring, and evaluation, all of which are essential for addressing vulnerability to risks (Zsidisin, 2019). In this study, risk events were identified through interviews and brainstorming sessions with coffee industry practitioners and farmers. The results of risk identification and assessment relating to raw material procurement and production planning activities were subsequently validated by experts. The respondents involved in this research comprised two industry practitioners with a minimum of ten years' experience in the coffee business, two academics (university) holding doctoral qualifications, and one researcher from the Indonesian Coffee and Cocoa Research Centre.

House of Risk Phase 1

Identified risk events, assessed severity (1–5 scale), identified risk sources, evaluated occurrence likelihood (1–5 scale), and calculated Aggregate Risk Potential (ARP) using :

$$ARP_j = O_j \sum_i S_i R_{ij} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Where:

ARP_j : Set of potential risks from the source/cause of risk (risk agent)

O_j : Occurrence level of risk from the source/cause of risk

S_i : Severity level of risk

R_{ij} : Correlation (relationship) between risk and risk source (0, 1, 3, 9)

House of Risk Phase 2

Prioritized mitigation actions based on :

- Total Effectiveness

$$TE_k = \sum_j ARP_j E_{jk} \quad \forall k \ldots\ldots\ldots (2)$$

Where:

TEk : Total effectiveness

Ejk : Effectiveness value

k : 1,2,3,4,...m

- Effectiveness-to-Difficulty ratio

$$ETD_k = {}^{TE_k}/_{D_k} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3)$$

with D_k assessed on a 1–5 Likert scale.

RESULT AND DISCUSSIONS

Business Process Analysis

The Kalibaru coffee agroindustry involves farmers (suppliers), KUB Srikandi (processor), and coffee MSMEs (partners). BPMN modeling produced an improved process design, enhancing efficiency and integration across procurement and production activities (Figure 3). This aligns with prior findings emphasizing process optimization for competitiveness (Sulthan *et al.*, 2021).

Based on the identification results, the actors involved in the planning of raw material procurement and production in the Kalibaru Coffee Agroindustry have been determined. The BPMN diagram in Figure 3 depicts the proposed new business process for the Kalibaru coffee industry, which has been designed by taking into account resource capabilities in raw material procurement and production planning, with the expectation of improving the overall effectiveness and efficiency of the business processes.

Risk Management Analysis

Raw Material Procurement Planning

Risk Identification: Twenty risk events were identified (e.g., limited raw material availability, supplier inconsistency) with severity scores (Table 1). Twenty risk sources were linked to these events (e.g., small farmer landholdings, poor harvest practices), assessed for occurrence (Table 2 and Table 3).

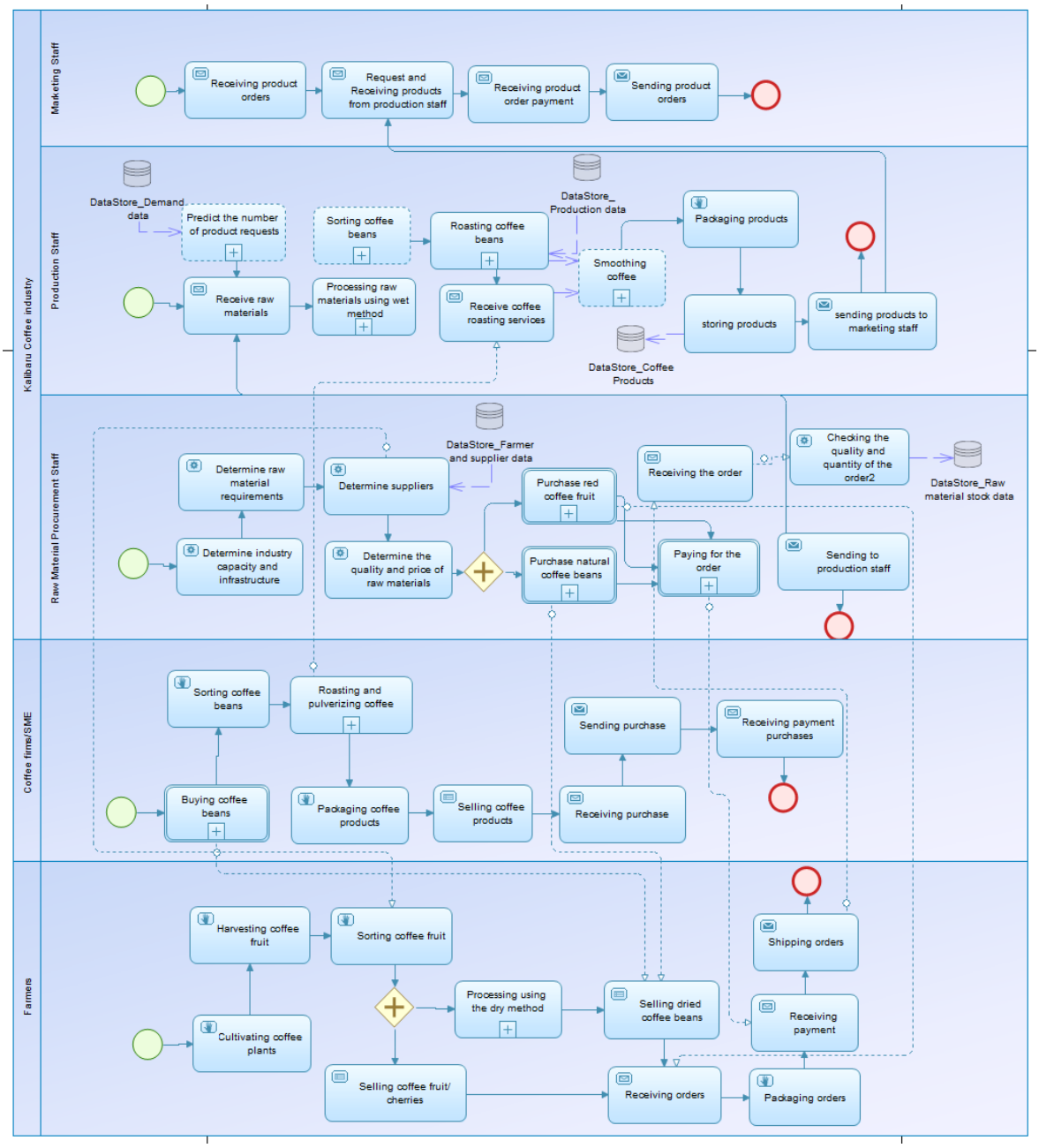


Figure 3. Proposed business process model for kalibaru coffee agroindustry

Risk Assessment: ARP values prioritized 11 risk sources (e.g., limited coffee varieties, ARP = 784) responsible for 80% of cumulative risk (Figure 4). These reflect field conditions, such as small-scale farming and climatic variability. Mitigation Strategies: HOR Phase 2 identified 11 actions, with top priorities including farmer training in GAP (ETD = 5234) and partnerships with research institutes (Table 4). These address quality and supply stability.

Based on the analysis and evaluation of the priority risk mitigation actions within the coffee raw material supply chain, several strategic implications have emerged that can serve as guidelines for policy formulation and practical interventions. These implications include improving raw material quality, strengthening land management systems, and enhancing land productivity in a sustainable manner. Improving raw material quality can be achieved through the implementation of training programmes and technical assistance for farmers, particularly in applying Good Agricultural Practices (GAP). The adoption of GAP not only contributes to better harvest quality but also increases cultivation efficiency and reduces negative environmental impacts. Moreover, such assistance programmes play a vital role in building farmers' capacities in a participatory and sustainable way.

Table 1. Raw material procurement planning risk events

Business Process	Risk Event	Code	Severity
Identify industrial capacity and infrastructure.	Inadequate industrial capacity for extensive processing	KR1	3
	Inadequate industrial facilities and infrastructure (lacking and damaged)	KR2	4
Identify and determine raw material requirements.	Limited availability of raw materials at suppliers	KR3	5
	Difficulty in finding raw materials that meet industry standards	KR4	5
	Significant raw material procurement costs	KR5	3
Determine suppliers	Suppliers are inconsistent with the quality and quantity agreed upon at the beginning of the collaboration.	KR6	4
	Suppliers cannot work together on an ongoing basis	KR7	4
	A small amount of raw materials	KR8	4
	Farmers/suppliers do not accept the return of raw materials	KR9	3
	Do not have reserves of farmers/suppliers to fulfill raw material needs	KR10	3
Determine the price and quality of raw materials.	Price and quality do not follow the initial contract agreement	KR11	4
	Farmers ask for a down payment of 50-70%	KR12	4
Purchase agreement and cooperation	Farmers sell raw materials to other parties without prior confirmation	KR13	4
Delivery and receipt of raw materials	Delays in receiving raw materials due to accidents in the mode of transportation	KR14	3
	Raw materials contain stones, coffee tree trunks, and other impurities.	KR15	4
	The quantity of raw materials does not match the scales (less)	KR16	3
	Costs and services for shipping raw materials are expensive/high	KR17	3
Payment	Payment system for raw materials in the form of cash	KR18	3
	Payment for raw materials is made in stages (installments)	KR19	3
Raw material inventory management	Raw material inventory exceeds production capacity and needs	KR20	2

Table 2. Sources of risk in raw material procurement

Risk Agents	Risk Code	Occurrence (Oj)
The industry does not have sufficient processing land, significant capital, and infrastructure facilities.	SR 1	2
Facilities and infrastructure used previously and not properly maintained	SR 2	2
Farmers' cultivated coffee plantations are few and of limited varieties	SR 3	4
Farmers do not harvest and process correctly, and suppliers do not monitor coffee quality properly.	SR 4	4
The distance between the coffee farm and the processing site is very far, and the geographical location of the farm is high (around 600-1200 meters above sea level)	SR 5	4
Harvest yields (coffee quality) do not align with predicted crop productivity.	SR 6	3

Risk Agents	Risk Code	Occurrence (Oj)
Evaluation factors of quality, quantity, and price of previous coffee and cooperation agreements are not committed.	SR 7	3
Farmers' land ownership is small, and the majority of smallholder coffee (mountain slopes)	SR 8	3
Raw materials (loose coffee) cannot stay overnight/be left for more than 24 hours.	SR 9	4
Most farmers have already cooperated with collectors/traders before the harvest period arrives.	SR 10	4
Weather and climate factors make coffee quality and yields uncertain	SR 11	3
Many wholesalers/traders and even industries make early transactions with farmers.	SR 12	4
Delay in payment by buyers (traders/intermediaries/industry) and free market	SR 13	4
Steep land slope and rugged road terrain	SR 14	1
Performance patterns and harvest volume income of gelding coffee pickers are measured by the fullness of harvest containers (sacks) and daily working hours.	SR 15	4
Fresh coffee fruits differ from the number of coffee fruits in the sack after delivery, resulting in weight loss.	SR 16	1
The geographical location of the farm is complex and very far from transportation modes, risking accidents.	SR 17	2
Farmers do not have ATMs, do not want to struggle with financial issues, and want to get cash immediately.	SR 18	3
Limited capital and at the request of suppliers	SR 19	4
Coffee harvest and low raw material selling price	SR 20	1

Table 3. Classification of risk sources based on ARP value

Ranking	Code	Risk Agent	ARP	Cumm	Cumm %	Classification
1	SR3	Farmer-cultivated coffee plantations are few and of limited varieties	784	772	15.72%	A
2	SR4	Farmers do not harvest and process correctly, and suppliers do not monitor coffee quality properly	660	1432	29.16%	
3	SR15	The pattern of picking performance and income is measured by the fullness of harvest containers (sacks) and the daily working hours of coffee pickers	404	1836	37.39%	
4	SR11	Weather and climate factors make coffee quality and yield uncertain	303	2139	43.56%	
5	SR6	Harvest yields (coffee quality) do not match predicted crop productivity	297	2436	49.60%	
6	SR8	The majority of farmers have limited farmland, and the majority of smallholder coffee (mountain slopes)	294	2730	55.59%	B
7	SR13	Delays in payment by buyers (traders/intermediaries/industry) and the market is free-ranging	276	3006	61.21%	
8	SR5	The distance between the coffee farm and the processing plant is far, and the geographical location of the farm is high (around 600-1200 meters above sea level)	228	3234	65.85%	

Ranking	Code	Risk Agent	ARP	Cumm	Cumm %	Classification
9	SR12	Many wholesalers/traders and even the industry make early transactions with farmers	220	3454	70.33%	
10	SR10	The majority of farmers have already cooperated with collectors/traders before the harvest period arrives	220	3674	74.81%	
11	SR19	Limited capital and at the request of suppliers/farmers	208	3882	79.05%	
12	SR7	Evaluation factors of quality, quantity, and price of previous coffee and non-committal cooperation agreement	183	4065	82.77%	
13	SR9	Raw materials (loose coffee) cannot be left overnight for more than 24 hours	168	4233	86.19%	
14	SR18	Farmers do not have ATMs, do not want to struggle with financial issues, and want to get cash immediately	156	4389	89.37%	
15	SR2	Facilities and infrastructure used previously and not well maintained	118	4507	91.77%	
16	SR17	The geographical location of farms is complex and very far from transportation modes, risk of accidents	114	4621	94.09%	C
17	SR1	The industry does not have processing land, significant capital, and sufficient facilities and infrastructure	112	4733	96.38%	
18	SR20	Coffee harvest and low selling price of raw materials	79	4812	97.98%	
19	SR14	Steep land slope and rough road terrain	57	4869	99.14%	
20	SR16	Fresh coffee fruit is different from the amount of coffee fruit in the sack after delivery, resulting in weight loss	42	4911	100.00%	

Table 4. Classification of raw material procurement risk mitigation priority scale

Rankings	Kode	Tek	Dk	ETD	Cumulative Value	Mitigation Action
1	SMR 3	10467	2	5234	5234	Farmers need to receive training and knowledge on coffee picking techniques, processing, quality control, and how to weigh coffee accurately.
2	SMR 2	7683	3	2561	7795	Farmers can apply GAP in the process of harvesting and processing coffee plants.
3	SMR 5	4601	3	1534	9328	Ensure clarity of purchase contracts and cooperation between suppliers and the industry, especially regarding long-term cooperation quality, price, and sustainability.
4	SMR 8	4019	3	1340	1340	Establish a coffee processing center in a strategic area close to the location of farmers' coffee plantations and the use of

						efficient and economical means of transportation.
5	SMR 7	3804	4	951	2291	Building solid relationships with suppliers and business partners
6	SMR 9	3765	4	941	3232	Building solid and harmonious partnerships with suppliers
7	SMR6	3633	3	1211	1211	Increasing land productivity by practicing sustainable farming systems such as agroforestry systems and applying proper GAPs
8	SMR10	3468	3	1156	2367	He is joining organizations or institutions that support coffee farmers in identifying new opportunities and diversifying crop and product distribution channels.
9	SMR4	2955	3	985	3352	Diversify farmers' resources by planting different coffee varieties resistant to weather and climate change.
10	SMR11	2148	3	716	716	Ensure that cooperation contracts between farmers and buyers stipulate payment terms, including payment schedules, amounts, and payment mechanisms.
11	SMR1	2091	3	697	1413	Farmers can diversify coffee plant varieties, implement Good Agricultural Practices (GAP) in cultivation, and collaborate with plantation research institutions (Puslitkoka).

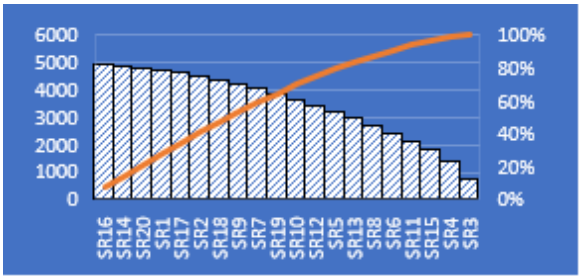


Figure 4. Pareto diagram of procurement risk sources

Furthermore, land management and productivity can be enhanced through partnerships with research and development institutions in the plantation sector, such as the Indonesian Coffee and Cocoa Research Centre (Puslitkoka). This collaboration facilitates the transfer of knowledge and technology, including the use of superior varieties, precision fertilisation techniques, and ecological pest and disease control. Thus, a scientific and data-driven approach forms the foundation for improving cultivation practices at the field level.

Diversifying sources of raw material supply from various regions is also an important strategy for risk mitigation, particularly to reduce dependence on a single production area vulnerable to climate disturbances, natural disasters, or harvest fluctuations. This strategy not only strengthens supply chain resilience but also provides flexibility in meeting market demand with diverse coffee characteristics. Finally, accurate planning of raw material procurement in terms of volume, quality, and timing is a crucial step in proactively managing risks. Such planning should be based on production cycle analysis, regional harvest calendars, and market demand estimations. This approach enables improved operational efficiency without compromising quality or supply continuity.

Production Planning

Risk Identification: Twenty risk events (e.g., machine breakdowns, fluctuating demand) with severity scores (Table 5) were identified. Twenty risk sources (e.g., technical failures, and inadequate maintenance) were assessed (Table 6).

Risk Assessment: ARP analysis highlighted 10 priority risk sources (e.g., equipment issues, ARP = 1324), accounting for 80% of risks (Figure 5).

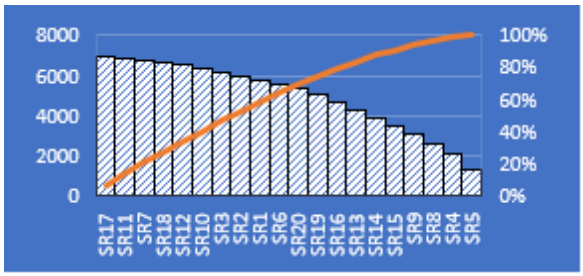


Figure 5. Pareto diagram of production risk sources

Mitigation Strategies: Ten actions were prioritized, with preventive maintenance of equipment ranking highest (ETD = 7215) (Table 7). This addresses production disruptions effectively.

Table 5. Production planning risk events

Business Process	Risk Code	Risk Event	Severity
Predict the amount of product demand.	KR1	Fluctuating product demand	3
	KR2	The discrepancy between predicted results and actual product demand	4
	KR3	Changes in consumer preferences and consumption and market trends	4
Determine the production formula.	KR4	The mismatch between production formula and capital adequacy	4
	KR5	Delays in production and inconsistency with the production plan	4
	KR6	Sudden changes in the formula and production plan	4
Checking the readiness and availability of production raw materials	KR7	Delay in receiving raw materials for production	4
	KR8	Delay in production process due to mechanical failure	4
Perform the production process	KR9	Machine breakdown during production	4
	KR10	Limited human resources/ labor force	4
Production process results	KR11	Power outage during the production process	4
	KR12	Inefficient production process and a lot of loss	4
	KR13	Factory capacity is not capable of large and mass production	3
	KR14	The number and capacity of machines are few and limited	3
	KR15	Product inspection results do not meet industry standards	4
	KR16	There is damage to the machine, so the production yield is low	4
	KR17	A lot of production waste is generated	2
Performing storage	KR18	Damage to raw materials and products during storage in the warehouse	5
	KR19	Products are mixed with other raw materials	5
	KR20	There is shrinkage in the number and quality of products	5

Table 6. Production planning risk agen

Risk Code	Risk Agent	Occurrence
SR 1	Competitiveness and competitors of coffee products are getting tougher	4
SR 2	Incomplete and limited historical sales data	4
SR 3	Lack of consistent market research and product consumption patterns	4
SR 4	Planning does not consider and take into account capital adequacy	4
SR 5	Technical problems with processing equipment and machinery	4
SR 6	Disruption of industrial infrastructure and labor occurs	2
SR 7	Accidents occur during the delivery process and disruption of processing machinery	2
SR 8	No maintenance is carried out on processing equipment and machinery regularly	2
SR 9	Old machines are not used and not properly maintained	2
SR 10	Labor wages are high; performance is not yet skilled and competent	3
SR 11	PLN is doing repairs, and there is no prior notice	1
SR 12	Lack of skilled labor and not yet applying technology	3
SR 13	Limited facilities and infrastructure at the processing plant	4
SR 14	Little capital, infrastructure, and production capacity capabilities	4
SR 15	The production process does not follow the established SOP	3
SR 16	Processing technicians do not check the machine before the production process begins	2
SR 17	Production process using wet processing method (fermentation)	3
SR 18	Limited industrial capacity and poor condition of storage room (warehouse) and not integrated with remote monitoring system	2
SR 19	The layout of the storage room is not optimal	4
SR 20	Product moisture content when stored is still above 12%	3

Table 7. Classification of production planning risk sources

Ranking	Code	Risk Agent	ARP	Cumm	Cumm %	Classification
1	SR5	Technical problems with processing equipment and machinery	1324	1324	19.15%	
2	SR4	Planning does not consider and take into account capital adequacy	740	2064	29.85%	
3	SR8	No maintenance is carried out on processing equipment and machinery regularly	490	2554	36.93%	A
4	SR9	Old machines are not used and not properly maintained	490	3044	44.02%	
5	SR15	The production process does not follow the established SOP	420	3464	50.09%	
6	SR14	Limited capital, infrastructure, and production capacity capabilities	408	3872	55.99%	
7	SR13	Limited facilities and infrastructure at the processing plant	396	4268	61.72%	
8	SR16	Processing technicians do not check the machine before the production process begins	394	4662	67.42%	B
9	SR19	Storage room layout is not optimal	388	5050	73.03%	
10	SR20	Product moisture content when stored is still above 12%	288	5338	77.19%	
11	SR6	Disruption of industrial infrastructure and labor force	256	5594	80.90%	
12	SR1	Competitiveness and competitors of coffee products are getting tougher	196	5790	83.73%	
13	SR2	Incomplete and limited historical sales data	196	5986	86.57%	
14	SR3	Lack of consistent market research and product consumption patterns	196	6182	89.40%	
15	SR10	Labor wages are high; performance is not yet skilled and competent	174	6356	91.92%	
16	SR12	Lack of skilled labor and not yet applying technology	174	6530	94.43%	C
17	SR18	Limited industrial capacity and poor condition of storage space (warehouse) and not integrated with remote monitoring system	142	6672	96.49%	
18	SR7	Accidents occur during the shipping process, and disruptions in processing machinery	104	6776	97.99%	
19	SR11	PLN is doing repairs, and there is no prior notice	73	6849	99.05%	
20	SR17	Production process using wet processing method (fermentation)	66	6915	100.00%	

Based on the analysis and evaluation of priority risk mitigation measures in production planning, several strategic steps can be implemented to enhance the reliability of the production process and reduce operational disruptions. Firstly, preventive maintenance and routine servicing of equipment and machinery are essential to maintain optimal performance, prevent sudden breakdowns, and extend machine lifespan. This approach is proactive, focusing on anticipation rather than repair after failure. Secondly, establishing a schedule and standard operating procedures (SOPs) for machine maintenance ensures systematic and consistent execution, facilitates supervision, and guarantees that each production unit receives maintenance according to its technical requirements. Thirdly, regular preventive maintenance, including inspections, replacement of worn components, and technical adjustments based on the machine's condition, effectively reduces downtime and improves overall production efficiency. Finally, training machine operators on proper usage and maintenance

procedures is crucial. Skilled operators can detect early signs of problems and take prompt action, while also enhancing technical skills and operational responsibility.

Managerial Implication

The study provides a robust framework for risk management, identifying critical risks in procurement (e.g., supplier reliability) and production (e.g., equipment reliability). Implementing recommended strategies such as GAP training and maintenance schedules can enhance efficiency, reduce losses, and strengthen industry resilience.

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

This study developed a more efficient and organised business process model for raw material procurement planning and production planning activities, contributing to improved operational effectiveness while reducing potential risks within the supply chain. A total of 11 risk sources in raw material procurement planning and 10 risk sources in production planning were identified as priorities based on the Priority Risk Analysis (PRA) values. These priority risk sources formed the basis for formulating the risk mitigation strategies to be implemented. For raw material procurement planning, the primary mitigation measures recommended are training and technical assistance for farmers in the application of Good Agricultural Practices (GAP), as well as the development of partnerships with plantation research institutions such as the Indonesian Coffee and Cocoa Research Centre (Puslitkoka). Meanwhile, in production planning, the focus of mitigation is on carrying out preventive maintenance and routine servicing of processing equipment and machinery to prevent technical disruptions. The findings of this study offer an adaptable and scalable approach to enhancing the sustainability and competitiveness of the coffee agroindustry. This study developed a more efficient and organised business process model for raw material procurement planning and production planning activities, contributing to improved operational effectiveness while reducing potential risks within the supply chain.

Recommendations

Future research should extend risk analysis to strategic levels and evaluate mitigation effectiveness longitudinally. Industry stakeholders should adopt the proposed model to optimize operations and mitigate risks effectively.

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