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RISK ANALYSIS OF FARMERS AND RICE MILLING BUSINESSES: A STUDY ON THE RICE SUPPLY CHAIN IN YOGYAKARTA

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Abstract

Background: Rice is a staple food consumed by more than 98% of households in Indonesia. However, risks along the supply chain create an imbalance between high rice consumption and domestic rice production.
Purpose: In response to this circumstance, this study aims to identify the risks in the upstream sector of the rice supply chain involving rice farmers and millers, and then to develop a mitigation strategy for those priority risks.
Design/Methodology/Approach: A case study approach was adopted, and primary data were collected through in-depth interviews and questionnaires from farmers and rice millers in five different districts of Yogyakarta Province. Furthermore, the Failure Mode, Effect, and Criticality Analysis (FMECA) method was utilized for risk analysis.
Findings/result: The results showed that there are 19 types of risks encountered by farmers, where biological risks (weeds, pests, and diseases) are a priority risk with a moderate criticality level. In addition, the rice millers faced 17 types of risks, with the priority risk being the uncertainty of the raw material supply (rice and grain) with a high criticality level.
Conclusion: To manage biological risks, we suggest that farmers utilize applied technology and optimize extension management to improve quality and avoid the risk of decreasing crop yields. For rice millers, we propose the use of diversified supply sources, inventory management, and make-to-order production systems to reduce risk intensity and increase production effectiveness.
Originality/value (State of the art): This study is relevant to current affairs considering that rice production has an impact on national food security and that the risk of the rice supply chain is still inevitable. This study cascades the key risks in the rice supply chain, specifically in Yogyakarta, and assists relevant stakeholders in effectively addressing these risks.

Keywords: farmer risk, rice milling, supply chain, risk management, FMECA

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INTRODUCTION

Rice is an important staple food for most Indonesians. The national per capita rice consumption was calculated to be 81 kg per year in 2023 (BPS, 2023), which is the consumption figure for 98.35% of households in Indonesia (Susenas BPS, 2022). This is equivalent to the national annual rice consumption of 35.8 million tons in 2023 according to the USDA Foreign Agricultural Service (USDA, 2023) which places Indonesia as the fourth largest rice consumer in the world after China (149.9 tons), India (118 tons) and Bangladesh (37.6 tons). However, the national rice problem still needs to be explored more deeply, as many external and internal risks occur in the supply and demand. The annual increase in Indonesia's population is not balanced by the increase in rice production security in the country. This illustrates that supply is a more vulnerable and problem-solving aspect than demand is.

The rice supply is closely related to its production process. Indonesia has eight rice-producing regions. These include West Java, Central Java, East Java, Yogyakarta, West Nusa Tenggara, South Sulawesi, Lampung, and South Sumatra. However, 52.5% of the rice production is concentrated in Java, with varying production capacities in each province. The different levels of rice production in each province make the inter-regional rice trade in Indonesia inevitable. As a result, rice from production centers is distributed not only on one island, but also throughout Indonesia. Therefore, this trading system creates a complex level of rice supply chain risk in each production center. However, the rice production process depends mainly on the role of rice farmers and rice milling businesses as actors in the upstream sector of the rice supply chain.

This leads to another concern that the risks faced by rice farmers and rice milling businesses in Indonesia are generally similar but with different levels of urgency in each region. This is because each region of Indonesia has different challenges and opportunities. This is evidenced by the results of previous studies showing that there are different risk priorities for each region in Indonesia. For instance, the priority risk for farmers in Penajam Paser Utara is low seed quality (Ullya et al., 2022), Mojokerto is an untrained human resource, and Demak is a pest attack. The priority risk of the rice milling business in Penajam Paser Utara is damage to machinery and equipment (Ullya et al., 2022), in Blora district, slaughter is miscalculated by farmers (Deni, 2019), and in West Sumatra is the delay in milling and preparation, which is mixed with the rice storage process (Rahmadani and Hafiz, 2022).

The Special Region of Yogyakarta is a rice-producing region targeted by the Ministry of Agriculture to achieve a rice production of 649,000 tons by 2024. This is possible because the agricultural sector is one of the main sectors in Yogyakarta. However, total land size and rice harvest in Yogyakarta decreased over time. In 2024, The Special Region of Yogyakarta is only able to produce 258,000 tons (a decrease of almost 15 percents from production in 2023), whereas the land size decreases from 105,69 thousand hectares to only 97,47 thousand hectares in the same period (BPS, 2024). Farmers and rice milling businesses still perceive certain risks as the main actors in rice production in Yogyakarta.

However, research on upstream supply chain risk assessment involving rice farmers and rice milling businesses in Indonesia is still limited to a few regions, including Penajam Paser Utara (Ullya et al., 2022), Demak and Sleman (Guritno et al., 2019), Mojokerto (Astuti et al., 2019), Blora (Deni, 2019), and West Sumatera (Rahmadani and Hafiz, 2022).

Based on this background, it is necessary to conduct research to understand the risk factors and priorities in rice production centers, such as the Special Region of Yogyakarta. This study aimed to analyze priority risk based on its severity level to develop the most appropriate and effective risk-mitigation strategies for farmers and rice milling businesses in the Special Region of Yogyakarta.

METHODS

This study used a case study approach through in-depth interviews and questionnaires to collect primary data. Qualitative data through interviews and semiquantitative data obtained through questionnaires were collected from key informants: farmers and rice milling businesses. The key informants of farmers were purposively selected using the following criteria: (1) being a landowner and manager, land manager, or part of a joint farmer group; (2) the managed land is located in Sleman, Bantul, Kulonprogo, and Gunung Kidul; (3) having a minimum of two years of experience in managing rice farming land; and (4) managing land area of at least one hectare. While the rice milling business resources must be (1) the owner of a rice milling business, (2) the rice milling business located in the Sleman, Bantul, Kulonprogo, and Gunung Kidul districts, and (3) the milling business has been established for at least two years. Finally, a sample of 12 key informants was selected, comprising six farmers and six rice milling businesses.

This research was conducted in four districts of Yogyakarta: Bantul, Sleman, Kulonprogo, and Gunung Kidul, through interviews and questionnaire distribution to farmers and rice milling businesses. These four districts in Yogyakarta were selected as samples because they represent a large amount of rice production and land size, with an average land area ranging from 11,000 to 24,000 ha in each district. Yogyakarta City was excluded from this study because it has only one rice milling business (BPS, 2020) and is classified as a small-scale business. In addition, Yogyakarta City is not a center of rice production in the Special Region of Yogyakarta because it only has a total of 46.74 hectares of paddy fields.

This research method employs an embedded single-case study design because the analysis focuses on a sub-unit of the rice supply chain, namely the upstream sector of the rice supply chain, which includes rice farmers and rice milling businesses. Embedded single cases involve more than one unit of analysis and are not usually limited to qualitative analysis alone (Yin, 2003). This methodology provides a means of integrating quantitative and qualitative methods into a single study (Scholz and Tietje, 2022; Yin, 2003).

For qualitative data collection, semi-structured interviews were conducted to encourage interviewees' viewpoints and opinions (Creswell, 2014). The target interviewees were determined based on sampling criteria using the judgment sampling method, where the research participants were selected based on their expertise. To obtain data, the researchers used questionnaires as a survey method.

The questionnaire acts as a technique for collecting primary data. This study used a closed questionnaire in the form of an FMEA table. The interviewees were asked to complete an assessment based on the severity, occurrence, and detection of the rice supply chain risks listed in the questionnaire on a 1-10 rating scale. The list of risks in the questionnaire was obtained through a literature review to gather the risks associated with farmers and rice milling businesses in Indonesia.

The current literature review of 24 sample articles on the risk research of rice farmers and rice milling businesses in Indonesia resulted in the same risk categories as the research in Vietnam by Ruth et al. (2022). However, rice farmers in Indonesia face 19 risk factors and there are some differences in the risk details for each classification (Table 1). Meanwhile, rice milling businesses in Indonesia face 17 risk factors, which are classified into two risk categories: supply and process risks (Table 2).

Table 1. Classification of Risk Factors of Rice Farmers

Farmers' Risk Factors	Count	Reference
Process Risk		
Lack of financial capital	5	Ullya et al. (2022), Asih et al. (2019), Saragih et al. (2018), Kaleka et al. (2020), Wadu et al. (2019)
Mistakes and adverse effects of fertilizer and/or pesticide use	8	Ullya et al. (2022), Zakaria et al. (2023), Suharyanto et al. (2015), Aguslina et al. (2022), Dolorosa et al. (2016), Wadu et al. (2019), Arifin et al. (2023), Nainggolan (2022)
Biological risks (weeds, pests, diseases)	8	Ullya et al. (2022), Guritno et al. (2019), Asih et al. (2019), Saragih et al. (2018), Yuda et al. (2022), Aguslina et al. (2022), Kaleka et al. (2020), Deni (2019)
Lack of knowledge and experience in farming	3	Zakaria et al. (2023), Aguslina et al. (2022), Arifin et al. (2023)
Supply Risk		
Low quality of rice seeds	9	Ullya et al. (2022), Astuti et al. (2019), Zakaria et al. (2023), Asih et al. (2023), Suharyanto et al. (2015), Dolorosa et al. (2016), Wadu et al. (2019), Arifin et al. (2023), Nainggolan (2022)
Lack of equipment and machinery	2	Ullya et al. (2022), Astuti et al. (2019)

Table 1. Classification of Risk Factors of Rice Farmers (continue)

Farmers' Risk Factors	Count	Reference
Scarcity or shortage of fertilizer supply	1	Ullya et al. (2022)
Reduction in agricultural land area due to land conversion	8	Ullya et al. (2022), Zakaria et al. (2023), Suharyanto et al., (2015), Saragih et al. (2018), Dolorosa et al. (2016), Wadu et al. (2019), Arifin et al. (2023), Nainggolan (2022)
Fluctuations in the supply of raw materials (pesticides, seeds, medicines)	1	Ullya et al., (2022)
Lack of human resources (workers)	7	Astuti et al., (2019), Zakaria et al., (2023), Asih et al., (2023), Suharyanto et al., (2015), Dolorosa et al., (2016), Wadu et al., (2019), Nainggolan (2022)
Lack of young rice farmers	2	Aguslina et al., (2022), Dolorosa et al., (2016)
Demand Risk		
Fluctuations in rice and grain selling prices	5	Ullya et al. (2022), Yuda et al. (2022), Kaleka et al. (2020), Prabowo et al. (2021), Deni (2019)
Market Competition	1	Ullya et al. (2022)
Environment Risk		
Inadequate irrigation system	3	Ullya et al. (2022), Saragih et al. (2018), Kaleka et al. (2020)
Lack of extension services & government regulations	2	Ullya et al. (2022), Kaleka et al. (2020)
Weather instability	4	Ullya et al. (2022), Asih et al. (2023), Aguslina et al. (2022), Kaleka et al. (2020)
Natural disasters (drought, floods, landslides, el nino)	4	Ullya et al. (2022), Guritno et al. (2019), Yuda et al. (2022), Kaleka et al. (2020)
Lack of infrastructure conditions (road access, electricity)	1	Kaleka et al. (2020)
Company waste around farmland	1	Ullya et al. (2022)

Primary data gathered from interviews and questionnaires were validated using data source triangulation and analyzed using the Failure Mode, Effect, and Criticality Analysis (FMECA) method. FMEA is a bottom-up inductive analysis method that can be performed at the functional or part level. FMECA extends FMEA to include criticality analysis, which is used to map the probability of a failure mode against the severity of its consequences (Stamatis, 2019). The FMECA assessment is based on three main components: severity, occurrence, and detection, with an assessment score range of 1-10. Analysis using the FMECA method involves the calculation of the Risk Priority Number (RPN), and then the score results are categorized based on the level of criticality, as shown (Table 3).

This study begins with problem identification, followed by a literature review and a research object study to establish a theoretical foundation. The research design phase sets the methodology, which leads to data collection through in-depth interviews and questionnaires. The gathered data were then analyzed using Failure Modes, Effects, and Criticality Analysis (FMECA) to assess risk levels. Based on this analysis, risk-mitigation strategies were developed to address the identified vulnerabilities. Finally, the study concludes with recommendations for enhancing the resilience and efficiency of the rice supply chain (Figure 1).

RESULTS

Risk assessment identification was carried out by applying calculations based on the FMECA method, as described in Tables 4 and 5, which were performed by entering the results of data processing into a criticality matrix. Risk mitigation strategies were compiled based on the potential causes and impacts of the risks. The results of the analysis are illustrated through a risk criticality graph for rice farmers and rice milling businesses (Figure 2 and 3).

Table 2. Classification of Risk Factors of Rice Milling Businesses

Milling Businesses' Risk Factors	Count	Reference
Supply Risk		
Quality of machinery and equipment	1	Ullya et al. (2022)
Outage of packaging raw materials	2	Ullya et al. (2022), Yahman et al. (2020)
Uncertainty of raw material supply (grain and paddy)	4	Rahmadani and Hafiz (2022), Prihantini et al. (2023), Putri (2019), Dani (2010)
Uncertainty in the price of raw materials (grain and paddy)	4	Rahmadani and Hafiz (2022), Prihantini et al. (2023), Putri (2019), Deni (2019)
Diversity of paddy and grain quality	5	Rahmadani and Hafiz (2022), Putri (2019), Dani (2010), Deni (2019), Hastuti (2019)
Lack of human resources (workers)	1	Putri (2019)
Production Process Risk		
Delay in production process	3	Ullya et al. (2022), Rahmadani and Hafiz (2022), Yahman et al. (2020)
Utility issues during the production process (gasoline, electricity)	2	Ullya et al. (2022), Yahman et al. (2020)
Machinery and equipment breakdowns (grinders, ovens)	3	Ullya et al. (2022), Putri (2019), Yahman et al. (2020)
Low product quality during the production process	5	Ullya et al. (2022), Rahmadani and Hafiz (2022), Yahman et al. (2020), Deni (2019), Hastuti (2019)
Lack of worker skills	1	Putri (2019)
Storage Process Risk		
Damage to rice and packaging during storage	4	Ullya et al. (2022), Rahmadani and Hafiz (2022), Putri (2019), Yahman et al. (2020)
Delivery Process Risk		
Delay in product distribution to consumers	3	Ullya et al. (2022), Rahmadani and Hafiz (2022), Yahman et al. (2020)
Market competition	2	Ullya et al. (2022), Yahman et al. (2020)
Consumers are late in making payments	2	Ullya et al. (2022), Yahman et al. (2020)
Market demand uncertainty	1	Prihantini et al. (2023)
Fluctuations in the selling price of rice products	3	Prihantini et al. (2023), Yahman et al. (2020), Dani (2010)

Table 3. Category Level of Risk Priority Number (RPN)

Criticality		Interpretation
Criticality Level	RPN Number	
Very Low	1 – 50	Acceptable
Low	51 – 100	Acceptable
Moderate	101 – 150	Avoidable
High	151 – 200	Mitigatable
Very High	201 – 250 (>250)	Mitigatable

Source: The Chartered Quality Institute in Maghfiroh and Wibowo (2019).

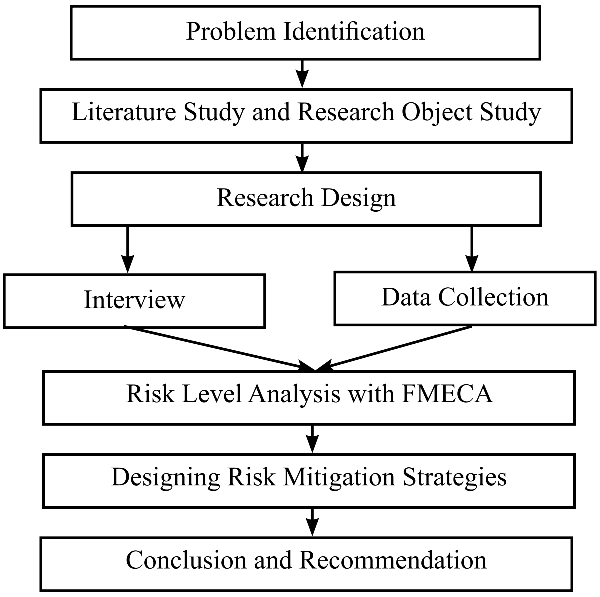

Figure 1. Research Framework

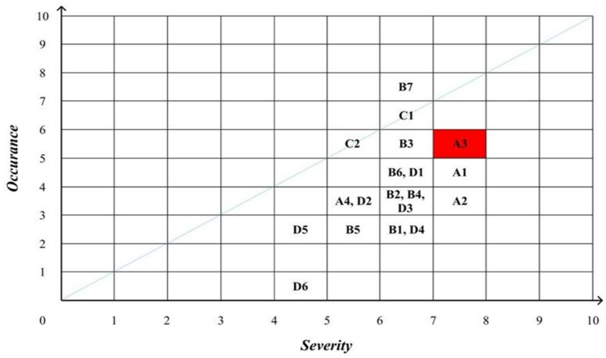

Figure 2. Risk criticality matrix of rice farmers

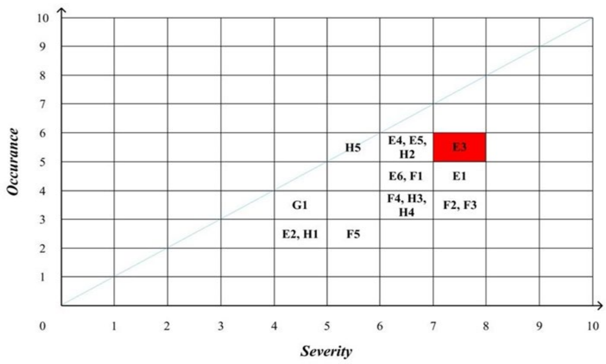

Figure 3. Risk criticality matrix of rice milling businesses

Risk Investigation of The Rice Farmers

The risks to rice farmers have a criticality level classified as very low to moderate (Table 4). Furthermore, a criticality matrix is required to assess risk prioritization based on severity and occurrence. The risk criticality matrix for the rice farmers is shown in Figure 2.

Through calculations using the FMECA method and risk prioritization using a criticality matrix, it was found that the risks to rice farmers are, on average, on the lower right side of the matrix, which means that they have a high severity with a low intensity of occurrence, so they are not a priority in risk mitigation. The risk factor for rice farmers that needs to be prioritized is A3, which is a biological risk that includes pests, animals, and diseases. Based on Figure 2, this risk is colored red, which means that it has the highest severity and occurrence value among the A1 and A2 risks with the same severity value. This finding is in line with previous research on the risk analysis of the rice supply chain in the Sleman region by Guritno et al. (2020), where biological risks, especially rat infestation, were the highest risks that caused crop failure. Furthermore, based on in-depth interviews, most rice farmers in DIY still rely on human labor to manage pests, insects, and diseases in rice plants. Consequently, rice farmers require more time, manpower, and operational costs to cover pest prevention in all fields. In fact, each rice farmer or farmer group in Yogyakarta can manage more than 1–10 ha of rice fields. Manual prevention and management systems can result in delayed and unoptimized risk management, causing the risk of reduced yields or even crop failure.

Risk Investigation of The Rice Milling Businesses

The risks in the rice milling business have a criticality level classified as very low to high (Table 5). Furthermore, a criticality matrix is required to assess risk prioritization based on severity and occurrence. The risk criticality matrix for the rice farmers is shown in Figure 3.

Through calculations using the FMECA method and risk prioritization using a criticality matrix, it was found that the risks in the average rice milling business are on the lower right side of the matrix, which means that they have high severity with a low intensity of occurrence; therefore, they are not a priority in risk mitigation. The risk factor in the rice milling business that needs to be prioritized is E3, namely the risk of uncertainty in the supply of raw materials for rice and grain. Based on Figure 3, this risk is colored red, which means that it has the highest severity and occurrence value compared with risks E1, F2, and F3 with the same severity value.

Table 4. Results of risk assessment of rice farmers in Yogyakarta

Code	Risk Factors	S	O	D	RPN	Criticality
Process Risk						
A1	Lack of financial capital	8	5	2	80	Low
A2	Mistakes and adverse effects of fertilizer and/or pesticide use	8	4	3	96	Low
A3	Biological risks (weeds, pests, diseases)	8	6	3	144	Moderate
A4	Lack of knowledge and experience in farming	6	4	2	48	Very Low
Supply Risk						
B1	Low quality of rice seeds	7	3	2	42	Very Low
B2	Lack of equipment and machinery	7	4	2	56	Low
B3	Scarcity or shortage of fertilizer supply	7	6	3	126	Moderate
B4	Reduction in agricultural land area due to land conversion	7	4	3	84	Low
B5	Fluctuations in the supply of raw materials (pesticides, seeds, medicines)	6	3	3	54	Low
B6	Lack of human resources (workers)	7	5	2	70	Low
B7	Lack of young rice farmers	7	8	2	112	Moderate
Demand Risk						
C1	Fluctuations in rice and grain selling prices	7	7	2	98	Low
C2	Market Competition	6	6	3	108	Moderate
Environment Risk						
D1	Inadequate irrigation system	7	5	3	105	Moderate
D2	Lack of extension services & government regulations	6	4	2	48	Very Low
D3	Weather instability	7	4	4	112	Moderate
D4	Natural disasters (drought, floods, landslides, el nino)	7	3	5	105	Moderate
D5	Lack of infrastructure conditions (road access, electricity)	5	3	2	30	Very Low
D6	Company waste around farmland	5	1	4	20	Very Low

Table 5. Results of risk assessment of rice milling businesses

Code	Risk Factors	S	O	D	RPN	Criticality
Supply Risk						
E1	Quality of machinery and equipment	8	5	2	80	Low
E2	Outage of packaging raw materials	5	3	2	30	Very Low
E3	Uncertainty of raw material supply (grain and paddy)	8	6	4	192	High
E4	Uncertainty in the price of raw materials (grain and paddy)	7	6	2	84	Low
E5	Diversity of paddy and grain quality	7	6	2	84	Low
E6	Lack of human resources (workers)	7	5	2	70	Low
Production Process Risk						
F1	Delay in production process	7	5	2	70	Low
F2	Utility issues during the production process (gasoline, electricity)	8	4	5	160	High
F3	Machinery and equipment breakdowns (grinders, ovens)	8	4	3	96	Low
F4	Low product quality during the production process	7	4	3	84	Low
F5	Lack of worker skills	6	3	2	36	Very Low
Storage Process Risk						
G1	Damage to rice and packaging during storage	5	4	2	40	Very Low
Delivery Process Risk						
H1	Delay in product distribution to consumers	5	3	3	45	Very Low
H2	Market competition	7	6	3	126	Moderate
H3	Consumers are late in making payments	7	4	3	84	Low
H4	Market demand uncertainty	7	4	3	84	Low
H5	Fluctuations in the selling price of rice products	7	6	4	144	High

The findings of this study show that the critical risk for farmers in Yogyakarta is biological risk, and that for the rice milling business is uncertainty in the supply of raw materials for rice and grain, which is different from previous studies on rice supply chain risks in other regions or countries, such as those conducted by Rath et al. (2022), Pakdeenarong and Hengsadeekul (2020), Ullya et al. (2022), Astuti et al. (2019), Rahmadani and Hafiz (2022), and Deni (2019). This indicates that the prioritization of rice supply chain risks is context-specific to each region or country based on its complexity and conditions.

Risk Mitigation Strategy for Farmers and Rice Milling Businesses

Based on the results of the data analysis, biological risks to rice farmers and the uncertainty of raw materials for rice and grain in rice milling businesses are priority risks in the upstream sector of the rice supply chain in Yogyakarta, which are important to mitigate. When depicted in the rice supply chain scheme (Figure 4), these two risks play an important role in the success and sustainability of rice supply chain operations.

Risk Mitigation Strategies for Farmers

Biological risks related to pests, diseases, and pesticides can result in a 10–50% decrease in yield and reduced quality of rice yields (Iqbal, 2020). Based on the results of the assessment of rice farmers using a questionnaire, several rice farmers assessed the severity of the biological risks of 8-9. This is because some rice farmers not only experienced a 50% reduction in yield, but also increased the possibility of total crop failure on their land and several rice farms in the Special Region of Yogyakarta. Rice farmers are individuals (non-GAPOKTAN) because they do not receive assistance from the government in the form of tools or plant pest medicines. The severity of biological risk is caused by non-optimal prevention, namely manual prevention methods, non-routine monitoring, and the difficulty of rice farmers in carrying out effective prevention and handling strategies. If there is a decrease in crop yields to the potential for crop failure, this will be one of the root causes of priority risks in the rice milling business, namely the instability of the supply of raw materials in the form of rice and grain. Hence, these are mitigation strategies for the rice farmers' risks (Table 6).

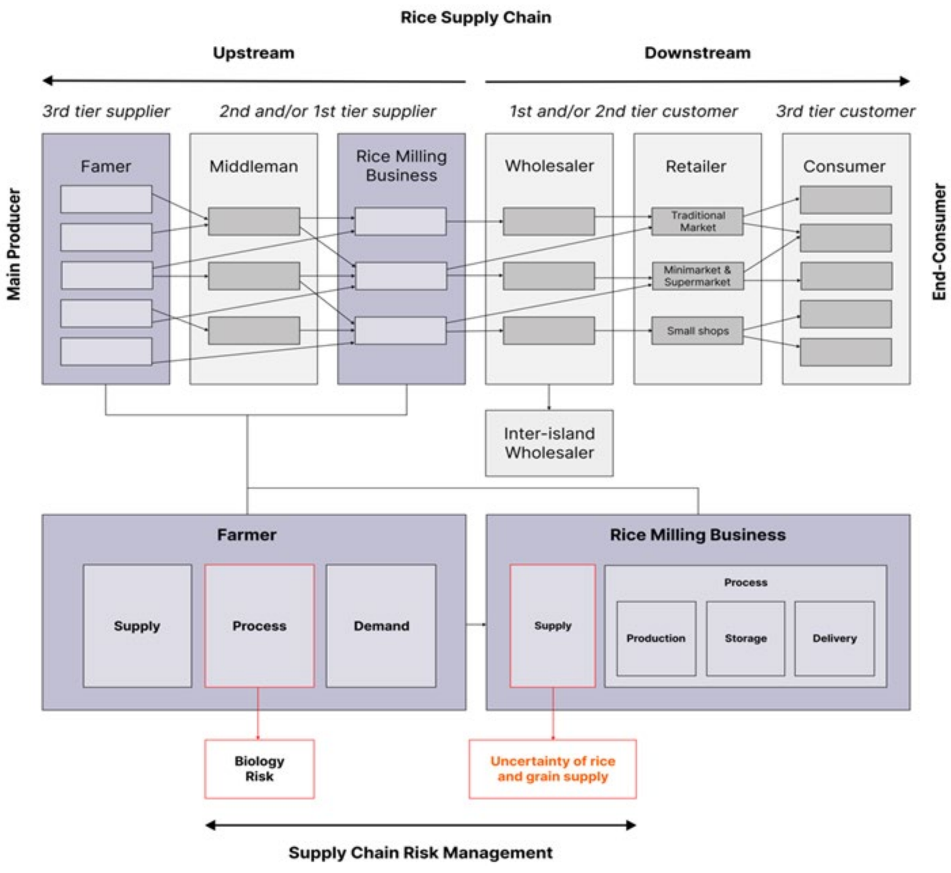

Figure 4. Rice Supply Chain Upstream Sector Risk Critical Point Scheme

Risk Mitigation Strategies for Rice Milling Businesses

Since 2020, the Yogyakarta Special Region has had 2,121 rice milling businesses recorded in the BPS report (Kusumaningtyas, 2020). A total of 98.11% of the rice milling businesses in Yogyakarta are small-scale, with an average daily production capacity of two tons of milled dry grain. If calculated, the production capacity of grain mills in the DIY is approximately 1,500,000 tons per year. In 2023, the total annual production of rice in the DIY was 534,110 tons of milled dry grain. This number can be exacerbated if biological and other risks in the rice production process cannot be prevented properly. This shows that total rice production is not equivalent to the milling capacity in Yogyakarta; therefore, the risk of rice supply uncertainty is a major concern for rice milling business owners. Hence, this concern can be mitigated by implementing the following strategies (Table 7).

Biological risk is an important risk factor because it plays a role in determining the success of rice harvesting in DIY. Looking back at the critical point scheme of the upstream sector of the rice supply chain (Figure 4), biological risks are in the main position in the supply chain; therefore, they play an important role in realizing optimal supply chain operational performance. However, biological risks are still classified as medium criticality, meaning that they can be avoided by implementing appropriate and effective mitigation strategies. Meanwhile, the risk of raw material supply uncertainty is classified as having high criticality, which means that it can be mitigated, but is difficult to avoid completely. Therefore, it is necessary to implement a risk-mitigation strategy to reduce the severity and incidence of risks that can result in losses to the rice-milling business.

Managerial Implication

The Special Region of Yogyakarta is one of the eight rice-producing provinces in Indonesia, whose production is also the focus of the Ministry of Agriculture. However, the potential for rice production in Yogyakarta cannot be separated from the risks involved in the supply chain, particularly upstream. When compared to the general risks faced by farmers and rice milling businesses in Indonesia, the results show that the risk assessment in the Special Region of Yogyakarta is unique in its risk prioritization results. Research shows that Yogyakarta has a risk urgency related to addressing biological risks and the uncertainty of the rice supply from farmers to rice millers. Therefore, the government, farmers, rice millers in Yogyakarta, and other stakeholders need to implement solutions and special treatments, as shown above, in the risk mitigation strategies to solve the existing risk problems to achieve competitive advantage in the rice supply chain in Yogyakarta.

Table 6. Risk mitigation strategies for rice farmers

Risk Priority		Impacts	Causes	Mitigation Strategy
A3	Biological Risks (pests, animals, and diseases)	- Reduced number of rice harvests by an average of 10 - 50% - Reduced crop quality - Possible crop failure	Prevention and monitoring is less than optimal because it is done using manual methods	Technology applications for pest, insect and disease management
			Uneven counselling from the government	Optimization of extension management

Table 7. Risk mitigation strategies for rice milling businesses

Risk Priority		Impacts	Causes	Mitigation Strategy
E3	Uncertainty in the supply of raw materials (rice and grain)	- Uncertainty in the amount of revenue - Increased lead time throughout the production process	Limited and uncertain rice production capacity of rice farmers	Diversified Supply Sources
			Uncertainty in rice farmers' yields	Inventory Management
				New Business Line: Make-to-Order Services

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

Two main conclusions were drawn from the results of this study. First, the risks associated with rice farmers are classified into four categories: process, supply, demand, and environmental risks. Overall, rice farmers in the Yogyakarta Special Region face 19 risk factors, and the priority risk is biological. Risks associated with rice milling businesses are classified into two categories: supply and process. The results of the analysis show that of the 17 risks faced, the priority risk in the rice milling business in the Special Region of Yogyakarta is the risk of uncertainty in the supply of raw materials in the form of rice and grain. Risk mitigation strategies are then developed by considering the causes of prioritized risks, so that the strategic solutions provided follow the root problems that occur in the field. Biological risk (A3) in rice farmers with an RPN value of 144 is caused by prevention and monitoring, which is less than optimal because it is performed using manual methods and uneven government counselling. Meanwhile, the risk of uncertainty in the supply of raw materials (E3) experienced by the rice milling business has an RPN value of 192 because of the limited production capacity of rice in DIY and uncertainty in the harvest of rice farmers.

Recommendations

The risk-mitigation strategy that can be applied to prevent or minimize the biological risk (A3) of farmers is to apply technology for plant pest management and to improve extension management. One technology considered effective for implementation is the use of drones. Drones are an unmanned aircraft technology that is well-known to most people, including rice farmers. Drones are a well-known technology in the agricultural sector that can be used to help rice farmers in various ways, including seed distribution, pesticide spraying, and plant pest detection. Apart from their capabilities, drones are also considered cost- and time-effective compared with deploying many farm laborers. The implementation of these strategies will involve the government as the main support, as rice farmers and farmer groups do not have enough capital to buy technology such as drones; therefore, there is a need for the government to take part in efforts to realize this strategy. The implementation of this strategy also needs to be balanced with evenly distributed extension management to farmer groups and individual farmers, for effective and efficient crop pest management education.

On the other hand, the risk-mitigation strategy that needs to be implemented for uncertainty in the supply of raw materials (E3) is to diversify supply sources, inventory management, and open a new business line, namely, make-to-order services. This strategy is directly aimed at rice milling business owners, supported by the government as socialization instructors.

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