Enhancing the Resilience of F&B MSMEs Through Mitigating Environmental Uncertainty Risks

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ABSTRACT

The food and beverage (F&B) industry faces significant challenges in risk management due to the unpredictable quality of internal and external environments. This study aims to classify various types of risks and analyze risk management to improve the resilience of the F&B MSME supply chain. This study was conducted in Surakarta City, Indonesia, involving 250 F&B MSME business units, representing approximately 41.12% of the total MSME population. A total of 20 types of risks were classified into 4 groups using a structural model. MICMAC analysis was used to analyze the role of each type of risk. The interactions of 20 types of risks were classified by MICMAC analysis into four groups: linkage, autonomous dependent, and independent, and identify the types of risks that are relatively critical in the system. The findings of this study provide a clear framework for MSMEs to understand the risks they face and how these risks interact in the system. MICMAC analysis categorizes the many risk types inside the system to aid in the development of suitable mitigation strategies. This study provides a comprehensive understanding to MSMEs on how risks can be managed effectively and serves as a basis for further exploration. The novelty lies in the integration of vulnerability analysis and MICMAC-based risk classification in the context of F&B MSMEs. MICMAC analysis offers clear insights for researchers and MSMEs to understand complex risks.

1. Introduction

The business environment is an environment characterized by uncertainty, comprising numerous factors that can impact the performance and sustainability of a business unit (Isa et al., 2024). Each business unit has risks caused by internal and external factors of the organization. Asgary et al., (2020) stated that risk can affect the condition of the organization, and organizational management must be able to identify possible risks. In the MSME business environment, risk and uncertainty are inevitable. One of the important issues of MSME management is managing uncertainty and risk (Paillin et al., 2022), where MSMEs are business units with limited resources and have more difficulty in managing risk. Risk is the possibility of an undesirable event or uncertainty of future outcomes. Although risk cannot be completely eliminated, it may be effectively managed to lessen its negative effects on MSME performance (Paillin & Tupan, 2021); (Rusliana et al., 2023).

The sources of risk for MSMEs are very complex, natural disasters (such as earthquakes, droughts, tsunamis, and floods), government policies, political and economic conditions, technological developments, technical errors, and imbalances between supply and demand. Researchers have differing views regarding the classification risk of food and beverage MSMEs. (Lestari, 2020) and state that they have high risk, while (Faustina & Rusli, 2025) and (Riski et al., 2025) state that they have low and moderate risk. Existing studies generally examine these risks in a fragmented manner, focusing on individual risk categories and assuming independence among risk factors (Safari et al., 2024). This approach limits understanding of how risks interact and jointly affect MSME resilience. This study aims to provide a thorough and methodical explanation of the issue and to explain the many kinds of dangers. F&B differs greatly from other things like clothing, furniture, and everyday essentials because it is a perishable good. These limitations are particularly evident in the food and beverage (F&B) MSME sector. Due to product perishability, strict quality and safety requirements, and time-sensitive supply chains, F&B MSMEs are more vulnerable to cascading disruptions than non-perishable sectors (Zhao et al., 2020)(Nakandala et al., 2017).

Owners and/or managers of MSMEs must understand the various types of risks in order to operate the entire supply chain effectively and control risks. The study's analysis may provide a methodical comprehension of the issues they might encounter and assist them in better managing and averting associated risks to reduce losses. F&B MSMEs in developing countries are potentially facing various risk threats, such as natural disasters and climate change, politics and economy, demographic changes, technology, policies, laws and regulations, market demand fluctuations, target market risks, availability of raw material and product supplies, raw material price fluctuations, availability and quality of labor, product quality, product shape, packaging and logo, stall/shop appearance, website, company costs and benefits, information asymmetry, distortion and delays, pricing strategies, and selection of supplier and customer partners. Although prior research has identified various risks in agri-food and fresh food supply chains, it largely emphasizes isolated risks such as logistics inefficiency or product safety without

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systematically analyzing their interdependencies. As a result, the structural relationships among F&B MSME risks remain underexplored. In such a situation, identifying the right type of risk is very important for MSMEs to achieve a resilient and sustainable business unit. Furthermore, F&B MSMEs are systemically important, accounting for 23% of Indonesia's manufacturing GDP. A fragile MSME is linked to negative externalities such as: 1) Financial draining from bailouts, 2) poverty traps, and 3) supply chain contagion. Thus, resilience-building serves as a public benefit. Previous studies on supply chain risk in the F&B sector have largely focused on individual or isolated risk factors, often neglecting the complex interactions among risks within an integrated system. This limitation results in an insufficient empirical foundation for formulating effective and prioritized risk mitigation strategies for MSME actors and policymakers. This study aims to classify various types of risks and analyze risk management to improve the resilience of the F&B MSME supply chain.

This study fills the research gap by identifying various risk threats and analyzing their interactions using a stakeholder approach, namely the Matrixed Impacts Cruoses Multiplication Applique a un Classement (MICMAC) analysis. MICMAC is particularly suitable for capturing interdependencies and identifying key driving risks within complex systems (Isa et al., 2019); (Dibihantoro & Suasih, 2024). By identifying various risk threats and analyzing their structural interactions, this research contributes to the literature by providing a systematic and comprehensive risk classification framework.

2. Literature Review

Risks

Because they deal with perishable goods, F&B business risks are more complex. (Zhao et al., 2020). Risks may arise because the perishability of products will affect product quality, customer satisfaction and business unit performance (Nakandala et al., 2017). (Nakandala et al., 2017) created a hybrid risk assessment model by identifying and evaluating the various risks within the fresh food and beverage supply chain. Zhao et al., (2020) identified and classified the types of risks in the agri-F&B supply chain using structural modeling. The primary source of risk in the F&B supply chain was the sluggish transfer of information, according to Love et al.'s (2021) investigation on product safety issues in F&B imports to the US. The various vulnerabilities in the fresh grape supply chain were discovered and assessed by (Jianying et al., 2021). In contrast, there is still a dearth of research on traditional F&B risk assessment, and what is available primarily concentrates on the supply chain of perishable items. Consequently, the literature offers limited understanding of risk interdependencies, feedback mechanisms, and cascading effects, which are especially critical in perishable F&B supply chains. To the best of the author's knowledge, these types of F&B risks have not been clearly identified and analyzed to date. Thus, the key gap lies not in the absence of risk identification, but in the lack of a systemic and interaction-oriented analysis of F&B risks, particularly in MSME

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contexts. We hope to bridge this gap and build a basic framework for F&B business risk analysis.

Source of Risks in the Supply Chain

Uncertain events cause risk (Isa et al. 2021). The fundamental causes and antecedents of supply chain risks are divided into environmental, demand, supply chain, organizational, operational, and network/control risk categories that might affect MSME performance. Supply chain risk and resilience are considered in MSME groups and in many F&B processing industries.

Table 1. Risk Classification

External	External Environment	Natural disasters and climate change, Politics and economics, demographic change, and technology, Policy, laws and regulations.
Internal	Demand	Demand fluctuation, and target market risk.
	Supply Chain	Availability of raw material and product supplies.
	Operational	Fluctuations in raw material prices, availability of labor, quality of labor, product quality, product shape, packaging and logo, appearance of stalls/shops, websites.
	Organization	Company costs and benefits, information asymmetry, distortion and lag, and pricing strategy.
	Networking	Selection of supplier partners and customers.

Table 1 presents the risk classification adopted in this study, distinguishing between external and internal risks and further grouping them into environmental, demand, supply chain, operational, organizational, and networking risks. The contribution of this classification does not lie in introducing entirely new risk categories, but in integrating existing risk dimensions into a framework designed for systemic analysis. This integration allows the classification table to support interaction-based analysis and subsequent prioritization of risk mitigation strategies.

a. Risk of the External Environment

These risks include risk events originating from the external environment of the business unit, such as natural disasters; political and economic conditions; demographic changes; technological developments; and changes in policies, laws and regulations. Natural disasters, including earthquakes, floods, volcanoes, and fires, can occur anywhere in the supply chain. Various studies related to natural disasters (Heinzlef et al., 2019) recommend various strategies to reduce risks in the supply chain process. Utilizing technology is one way to reduce the negative impact of the Covid-19 pandemic on the supply chain. Economic and policy risks focus on external issues such as recession, fuel price fluctuations, exchange rates, and government intervention and assistance. Demographic and socio-cultural changes can also cause supply chain disruptions for MSMEs.

1) Natural disasters and climate change. Force majeure caused by natural disasters and climate change creates great uncertainty for the production and distribution

of raw materials and products. In the short run, natural disasters and climate change will lower product output, raise prices, and disrupt infrastructure and information transmission, as demonstrated by Zhao et al. (2020).

2) Political, economic, technological and demographic changes. Uncertainty in the political and economic environment, rapid technological and demographic developments, pose great risks to supply chain performance. While economic risk will result in a lack of economic support, income uncertainty, and economic policies, which will impact product production and market availability, political risk will have an impact on tax and import/export regulations. Political and economic uncertainties will affect the operational performance of MSMEs. Likewise, the rapid development of technology and demographics has an impact on the performance of MSMEs.
3) Policies, laws, and regulations. Imperfect policies and regulations can create great uncertainty in the production and supply of products. Market and tax policies as well as government assistance to MSMEs have an impact on supply chain performance (Marucheck et al., 2011).

b. Risk of Internal Environment

These risks consist of supply chain risk (availability of raw materials and products), demand risk (fluctuations in market demand, and target market risk), operational risk (selection of supplier partners and customers, fluctuations in raw material prices, availability and quality of labor, product quality, product shape, packaging and logo, stall/shop appearance, website), organizational risk (company costs and benefits, information asymmetry, distortion and delays, and pricing strategy.

1) Demand. Short life cycles, innovative competitors, and demand fluctuations lead to changes in demand. Demand risks can be addressed through various proactive and reactive policies and solutions, including collaboration, coordination, information and communication technology, and top management support (Mishra et al., 2021). Market demand drives supply chain operations. Demand fluctuation risks occur at every point in the supply chain. Sudden changes in demand will disrupt the supply chain, resulting in losses. Nyamah et al. (2017) believe that demand fluctuation risks stem from unpredictable consumer preferences and lack of information. Kumar et al. (2021) believe that demand management for product supply chains is important. People's income and consumption ability have weakened to varying degrees, and the uncertainty of product demand is increasing. In addition, several policies and news can also affect consumer preferences and consumption behavior.
2) Supply Chain. This risk refers to disruptions to production inputs. Supply risks include dependence on key suppliers, consolidation in the supply market, and quality issues. Supply chain uncertainty, price and market issues, information asymmetry, and logistics-related issues are also considered as supply risks.

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Creating dynamic capabilities and developing effective supplier relationship management are some of the many suggested solutions proposed by researchers.

3) Operational Risk. These risks are about problems and disruptions in the process of producing goods or providing services. This includes receiving inputs and transforming them into outputs using human resources, physical and non-physical resources, and distributing outputs. Therefore, the risks include issues related to product quality, safety, long setup times and inflexible processes, variability in production output, equipment reliability and breakdowns, limited capacity/bottlenecks, and outsourcing of critical business processes. Companies need to be proactive and complete demand forecasting, operations planning, and resource allocation. Product supply plans are based on accurate demand forecasts and can be affected by product characteristics, the company's industry environment, differences in corporate culture, etc. Forecast errors will in turn affect the accuracy of the product supply plan. Magalhães et al. (2021) believe that inaccurate demand forecasts and inappropriate supply plans will lead to product waste. Seasonality and short product life cycles, coupled with demand fluctuations, can lead to excess product supply, such as overproduction or inventory holdings. Feng et al. (2021) identified the risk of market forecast deviation and consumer preference forecast deviation as the main types of risks that can lead to deviations from the product supply plan. Since products are perishable, their quality usually needs to be strictly controlled at every link in the supply chain, such as production, packaging, and transportation. Unreliable and defective products can also result in loss of reputation. (Papargyropoulou et al., 2014) believe that unclean and unhealthy production and processing relationships can affect product quality. Wu and Hsiao (2021) believe that improper temperature control and long operating times can affect product quality.
4) Organization Risk. Organizational capabilities are important to drive supply chain resilience, which include flexibility, agility, collaboration, and integration of digital solutions (Gerd, 2020). Each link in the supply chain involves capital flows, which means relevant costs and benefits, such as production costs, purchasing costs, transportation costs, and sales costs. If these costs cannot be controlled properly and revenue cannot be guaranteed, SME operations will face great uncertainty. In a highly competitive industry with an increasingly complex business environment, SMEs must consider operational costs, the level of competition in the industry, and future developments when setting product prices to maximize their revenue. Inappropriate pricing will not only pose risks to SMEs but also impact the entire supply chain and even end consumers. Losses from unsold goods and abrupt shifts in product demand are two possible outcomes, which raise the possibility of supply chain instability and disruption (Balaji & Arshinder, 2016). According to Magalhães et al. (2021), a low-price strategy to draw customers can result in numerous needless expenses due to product waste because of erroneous demand forecasts.

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5) Network Risk. Network risk is related with the risk of unbalanced power relationships, inadequate visibility along the supply chain, lack of collaborative planning and forecasting, unsuitable rules that distort demand, and the bullwhip effect owing to many echelons. For the purpose of organizing and managing their commercial affairs and supply chain-related operations, including asset management and control, transportation management, and safety stock, each company has its own policies, regulations, methods, and systems. According to Christopher and Peck (2004), control risk results from the application or improper application of these regulations and processes. In the process of selecting suppliers and customers, MSMEs may fail to select the right suppliers and customers due to imperfect selection mechanisms. For example, the selected supplier or customer may fail to perform work according to the contract or order, resulting in supply chain disruption and losses. MSMEs that rely solely on certain suppliers and customers can cause potential disruptions to supply sources, transportation disruptions, inventory backlogs, and many other risks, so that the entire supply chain is exposed to the risk of disruption or even disruption. According to (Marucheck et al., 2011), the entire supply chain transportation process may be disrupted if the wrong supplier is chosen. Because supplier selection is linked to sustaining the flow of raw materials, MSMEs typically care about it, according to Tang and Musa (2011). According to Feng et al. (2021), Poor consumer choice in the fresh grape supply chain can also affect the end product's quality, according to Feng et al. (2021). Customers' financial risks, such as bankruptcy and layoffs, make client selection crucial from the demand side as well.

The reviewed literature demonstrates that F&B supply chain hazards have been fully identified and categorized. Theoretically, information moves through the whole supply chain and in both ways. In reality, there are dangers associated with information asymmetry, distortion, and delays in the information flow process within the supply chain. Business actors with more information may prioritize their own interests and act opportunistically as a result of information asymmetry. Such actions will damage other people's interests and eventually lead to a crisis of trust among SMEs. This can result in operational inefficiencies throughout the supply chain (Tromp et al., 2017); Zhao et al., 2020). Operational inefficiencies across the supply chain may arise from this (Tromp et al., 2017); Zhao et al., 2020). According to Tang and Musa (2011), issues with data quality, information availability, and information transmission efficiency all contribute to the risk of information accuracy. However, three key gaps remain. First, existing studies largely adopt descriptive or linear approaches that overlook interaction effects among risks. Second, MSME-specific constraints such as limited adaptive capacity, informal practices, and institutional vulnerability are insufficiently integrated into risk analysis frameworks. Third, risk classification tables are often disconnected from analytical methods that can reveal causal structure and priority risks.

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These gaps indicate the need for an interaction-oriented methodological approach. Structural methods such as MICMAC enable analysis of influence–dependence relationships among risks and are therefore suitable for capturing systemic vulnerabilities in F&B MSME supply chains. By building on existing classifications while explicitly modeling interdependencies, this study addresses unresolved theoretical and practical issues in MSME risk management.

3. Methods

This study was conducted after the Covid-19 pandemic in Surakarta, Indonesia. F&B businesses are a superior regional product, and during the pandemic have a high risk, where the industry has a negative growth of -16.20%. Sampling using purposive random sampling based on a minimum business length of 2 years, experiencing the Covid-19 pandemic, and not street vendors. Data collection was carried out through structured interviews with the use of questionnaires (Chu, PH. and Chang, 2017).

Index analysis is used to determine the degree of vulnerability. Three factors—exposure, sensitivity, and adaptive capacity—are used to create the vulnerability index (Kamalipoor et al., 2023). Compiling all the values of each vulnerability indicator yields the susceptibility index to the Covid-19 threat (Isa et al., 2021; Kamalipoor et al., 2023). Furthermore, all indicator scores from each aspect of vulnerability and risk are compiled and normalized to obtain a value between 0–1 using the following formula (Isa et al. 2018).

$$I_j = \sum_{i=1}^{k} b_i \left[\frac{a_{ji} - x_i}{s_i}\right] \quad \text{...} (1)$$

I stand for vulnerability or risk index, b for weight value, a for indicator value, x for average indicator value, s for indicator standard deviation value, i for individual business actor, and j for vulnerability variable type.

Each variable is weighted according to how each factor contributes to the formation of the risk and vulnerability aspects. The greater the influence of the aspect, the higher the weight given. Weighting is obtained through FGD with stakeholders related to reducing the risk of COVID-19 at the research location. Each variable is weighted by taking into account how each component contributes to the vulnerability aspect. An aspect's weight increases with its level of influence. Focus group discussions (FGD) with stakeholders are used to determine weighting. The vulnerability index is calculated by multiplying the exposure, sensitivity, and adaptive capability weights by the total score of all indicators. The SMEs vulnerability index is expressed in the following formula (Isa et al. 2021):

$$V = \sum_{i=1}^{3} (w_1 x_1) + (w_2 x_2) + (w_3 x_3) \quad \text{...} (2)$$

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Where W1 stands for exposure weight, X1 for exposure score, W2 for sensitivity weight, X2 for sensitivity score, W3 for adaptive capacity weight, and X4 for adaptive capacity score. V is the Covid-19 vulnerability index for food and beverage enterprises.

Utilizing a qualitative method to analyze important factors related to F&B business risks. This study uses 20 variables to assess the risks of MSMEs. In order to obtain a thorough understanding of the 20 hazards that impact the profitability of F&B firms, this study conducted focus group discussions (FGDs) with academics, businesses, government, and society (ABGC). MICMAC, an analysis tool for determining the degree of influence and dependence between factors, was employed in the data analysis (Ariyani et al., 2025). Autonomous factors, linked factors, and dependent and independent factors are the four categories into which the risk variables are divided based on their influence and dependency (Isa, 2019). The analysis's findings highlight a number of risk categories that have an impact on F&B companies' ability to succeed.

4. Results and Discussions

Surakarta City has 1,413 MSMEs that focus on F&B production businesses. These business units are spread across 5 sub-districts, namely 26.76% in Jebres Sub-district, 25.76% in Banjarsari Sub-district, 19.11% in Pasar Kliwon Sub-district, 17.20% in Laweyan Sub-district and 11.18% in Serengan Sub-district. Of this number, food (and beverage) businesses are very dominant, namely 43.03%. Jebres Sub-district has the most food (and beverage) establishments (30.76%), followed by Banjarsari (26.48%), Laweyan (19.57%), Pasar Kliwon (17.11%), and Serengan (6.09%).

The study involved 250 business units as samples or 41.12% of the total population in Surakarta City in determining the level of vulnerability of F&B MSMEs. The sample consisted of 52.40% male business actors and 47.60% female. As many as 86.80% were micro businesses and 12.80 were small businesses.

a. Business Vulnerability Level

Halal F&B products are part of the creative economy and halal tourism products that are greatly impacted by environmental uncertainty, both internal and external. These F&B products are superior products of the Surakarta City area, the performance and sustainability of F&B businesses in the supply chain are vulnerable to environmental uncertainty, such as the availability of raw materials, the availability of labor, and reduced demand. Kamalipoor et al., (2023) stated that the level of vulnerability affects the magnitude of the performance and sustainability of business units. Low MSME performance has a positive effect on decreasing community income (Davlasheridze and Geylani, 2017), increasing poverty (Nursini, 2020), and regional economic growth rates (Goel, 2022), (Isa et al. 2015).

The level of vulnerability is influenced by exposure, sensitivity and adaptive capacity (Lo et al., (2019); (Setyawan, A.A., Isa, M., Wajdi M. F., 2018) and Kamalipoor et al., (2023). Vulnerability assessment is important to determine the level of vulnerability and to determine the causal aspects so that it can be used as material for government

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policy making and strengthening business performance. One of the three factors that determine a business unit's susceptibility to the threat of environmental change is exposure. According to Kamalipoor et al. (2023) and (Weis, S.W., Agostini, V.N., Roth, L.M., Gilmer, B., Schill, S.R., Knowles, J.E., Blyther, 2016), exposure is a component of vulnerability that explains how much environmental changes impact business unit risk.

Sensitivity is an aspect of vulnerability that represents the condition of the owner or manager of a business unit in facing risk threats (Kamalipoor et al., 2023). Sensitivity is composed of 3 (three) dimensions, namely business characteristics, owner/manager demographics, and supplier, product and market characteristics. The business characteristics dimension has 5 indicators, namely business size, business age, sales volume, legal ownership, and capital sources. Additionally, the four factors that make up the Owner/Manager demographics dimension are gender, education level, business experience, and prior disaster experience. The four variables that make up the supplier, product, and market characteristics dimension are supplier availability, raw material prices, selling pricing, and market reach. These findings demonstrate that the owner/manager demographics dimension is the most vulnerable for business units and has the greatest impact on the sensitivity index.

The third factor that determines a business unit's vulnerability is adaptive capacity. Isa et al., (2015) stated that adaptive capacity is an aspect of vulnerability that explains the ability of business units to reduce the risk of environmental change threats. The first dimension of the adaptive capacity variable is human capital, which contains 3 indicators, namely the availability of labor, the willingness and ability to change and take risks, and knowledge of how to serve the market, and customer problems. The type of income source, sales volume, and the distribution of cash for risk reduction are the three variables that make up the second dimension, economic capital. Institutional capital is the third dimension. Government support, the simplicity of launching a firm, and the ease of acquiring a business license are the three indicators in this dimension. Moreover, managerial capital is the fourth dimension. This dimension has 3 indicators, namely the ability to establish business strategies, the ability to make judgments in times of uncertainty, and the ability to direct business units. The last dimension is supply chain capital. This dimension has 4 indicators, namely the availability of product information, price affordability, dependence on one partner, and changes in consumer behavior.

The values of all exposure, sensitivity, and adaptive capacity indicators are used to create the F&B business vulnerability index. The weight of each component of exposure, sensitivity, and adaptive ability is then multiplied by the value. FGD with stakeholders yields the weight of the vulnerability-forming factors, which is 30% for exposure, 35% for sensitivity, and 35% for adaptive capability. The F&B business vulnerability index value of 0.54, which falls into the moderate category, was the outcome of the vulnerability index calculation.

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Table 2. Vulnerability Index of F&B businesses to environmental uncertainty

	Exsposure		Sensitivity		Adaptif Capacity		Vulnerability Index	
	Score	Weight	Score	Weight	Score	Weight	Score	Level
Vulnerability Index	0.28	0.30	0.71	0.35	0.59	0.35	0.54	Intermediate
	0.08		0.21		0.35			

Source: Data Processed (2025).

The vulnerability of F&B businesses is in the moderate category (0.54), ranging between 0.40-0.60. The higher the level of vulnerability of a business unit, the greater the risk (Li, et al. 2023; (Isa & Mardalis, 2022), so various mitigation strategies are needed from the government and business actors to reduce the level of vulnerability of business units. Each indicator's index value is crucial information for developing corporate strategy and governmental regulations. In order to raise people's income, lower unemployment and poverty, and reach the desired level of economic growth, vulnerability must be strengthened.

The factor that shapes the vulnerability index the most is sensitivity, which is followed by exposure and adaptive capacity. This finding supports previous research that found that sensitivity is the most vulnerable aspect. Compared to exposure and adaptive capacity, owner/manager demographics is the sensitivity dimension with the greatest indicator value, making sensitivity the most vulnerable element. According to the owner/manager demographics indication, a large number of business actors are female and have completed high school. They have little prior experience managing disruptions or disasters, and many of them have been in business for less than five years. To preserve business sustainability, dimensions and indicators with high susceptibility values need to be monitored right away. Owner demographic sensitivity (average education: high school) is associated with 27% less adaptive capacity, reflecting the shortcoming in human capital seen in developing nations. Based on Becker's human capital theory, the low education of business owners reduced risk-management return on investment (ROI) due to skill gaps. Moreover, a short business tenure (less than 5 years) means they have not sufficiently developed the "risk literacy" that can be translated to having a low intangible capital.

Three aspects of adaptive capacity with high indicator values include supply chain capital, managerial capital, and economic capital. Strengthening these 3 dimensions must be done immediately because they are key aspects of the success or failure of a business unit. Business owners and managers must respond to this immediately in order to increase the output of the business unit. Vulnerability analysis is important for business actors and the government. The study's findings offer a solid basis for sustainable economic development strategies and the F&B industry's continued existence (Davlasheridze & Geylani, 2017).

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b. Business Risk

This study collected empirical evidence from 21 stakeholders, namely academics, MSME actors, local governments, and the community. The number of stakeholders involved meets the minimum number of key person requirements for exploratory research proposed. This is also consistent with Kamble et al.'s (2020) assertion that 20–30 stakeholders are the ideal number. The uniformity of opinion is insufficient if the size is too small. If it is too large, viewpoints are difficult to combine. In detail, the stakeholders in this study consist of academics and researchers in relevant fields, representatives from various government institutions, and MSME managers, and the community as consumers, which ensures the universality of opinion.

Based on previous studies and field observations, 20 types of internal and external risks or uncertainties were obtained, namely natural disasters and weather changes, politics and economics, policies, laws and regulations, biological and environmental pollution, demographic changes, information asymmetry, distortion and delays, technology and equipment risks, market variations (targets), market demand fluctuations, selection of supplier partners and customers, availability of raw material and product supplies, raw material price fluctuations, product quality, product shape, packaging and logo, stall/shop appearance, website, company costs and benefits, pricing strategies, workforce availability, workforce quality, and capital/equipment/training assistance from the government.

MICMAC analysis shows that business unit owners or managers should focus on factors in the independent area (quadrant 1) and related areas when controlling risks (quadrant 2) in the MSME supply chain. In particular, risk aspects in the dependent factors (quadrant 3) and related factor areas (quadrant 2) need careful attention. Business owners and managers should also pay attention to autonomous factors (quadrant 4) and dependent factors (quadrant 3) to avoid cross-area impacts and minimize interactions between factors within those areas to prevent further impacts on risk (Ariyani et al., 2025).

The MICMAC approach is used to identify and analyze risk types, providing a new perspective on effective risk management. This method systematically identifies the degree of influence of various risk types, obtains the driving force and dependency of risk types, and identifies potential and appropriate actions to reduce risks.

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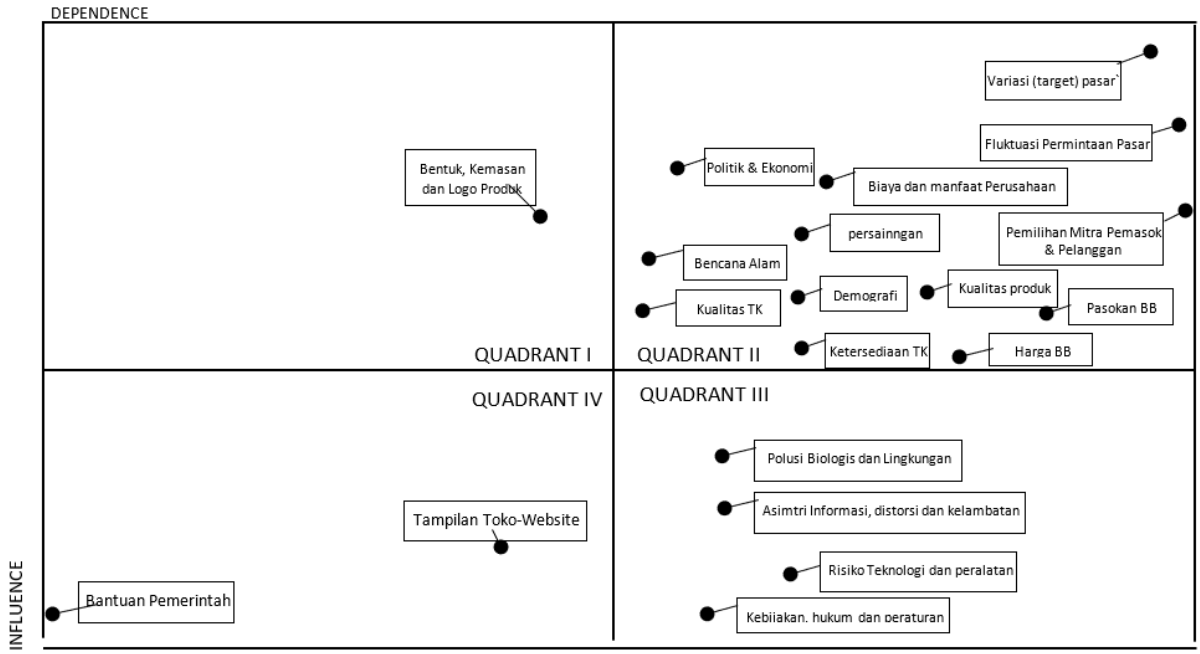

Figure 1. The Characteristics of the 20 Types of Risks
Source: The results of MIC-MAC analysis (2025)

Organizations are advised to take mitigation measures based on the traits of the 20 different types of risks in order to lower losses brought on by pertinent hazards, enhance supply chain security overall, and lessen its vulnerability:

1) Improving the supplier and customer selection mechanism. One of the independent factors that MSMEs can somewhat control is the risk associated with choosing suppliers and customers. Choosing top-notch suppliers is the first step in risk management and quality control for the supply chain. On the one hand, by taking into account supplier resources (like raw material quality level), capabilities (like financial status, management level), and competitiveness (like price), MSMEs can enhance the supplier selection process and optimize the supplier evaluation system. However, MSMEs need to tailor their procurement approach to the external environment and their degree of risk aversion. Business actors are in charge of choosing their customers. The danger of stagnating sales and late payments can be decreased by reputable and competent sellers. Other alternative is to establish MSME procurement cooperatives to establish monopsony power. This can reduce search cost and enables cheaper bulk insurance purchasing (e.g., Batik MSME in Semarang).
2) Increasing sensitivity to dynamic changes in cross-border politics, and economic environments. MSMEs must become more sensitive to the ever-changing political, policy, technological, and economic landscapes. Other hazards in the system as a whole will then be impacted by these considerations. MSMEs must constantly monitor the state of the national and local economies, keep up with the most recent developments (such as interest rates and pricing), be conscious of how quickly information can be obtained, and increase the precision of risk assessments. Ensuring product quality and safety. The analysis's findings indicate that risk management for product quality is the

most important aspect of risk control. Numerous issues, including the external environment, knowledge asymmetry, and improper supplier selection, have an impact on product quality. The way other factors, like supplier selection, are managed will also affect the quality and safety of the product, which will then affect other kinds of risk (like price).

3) Strengthen professional training and introduce innovative equipment and technology. The entire logistics chain, from manufacturer to client, involves a number of manual operations. Workers with inadequate professional training or experience will lower product quality and operational effectiveness.

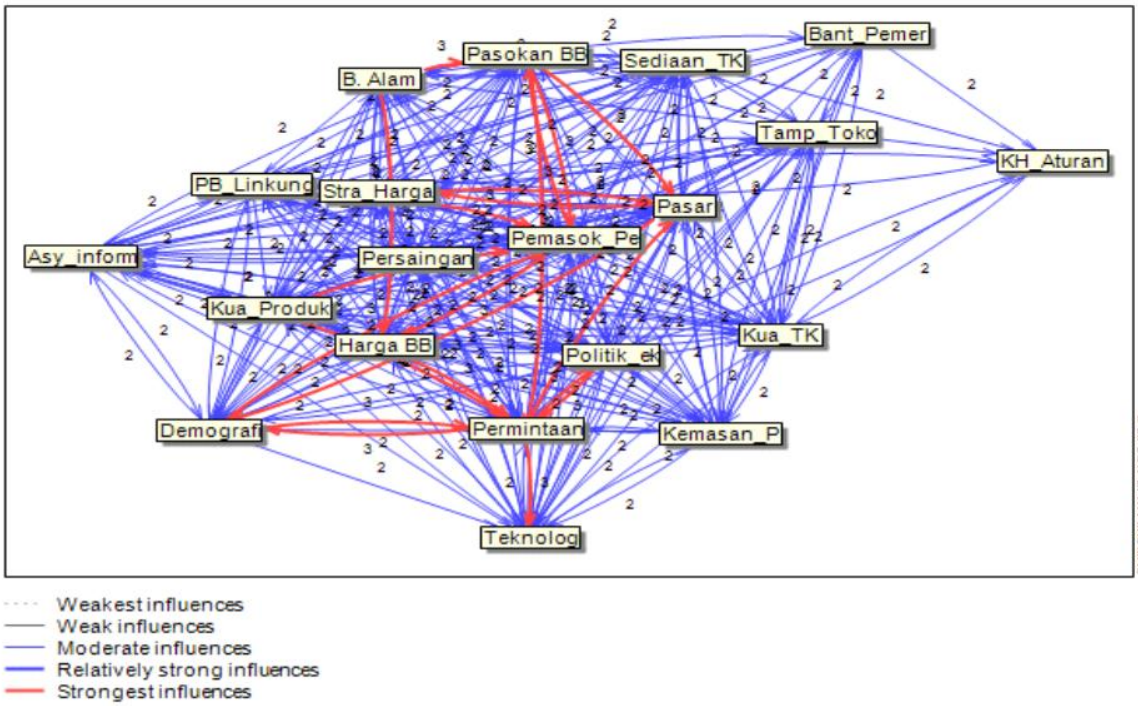

Figure 2. Direct Influence Graph
Source: The results of MIC-MAC analysis (2025)

The findings of this study reinforce and extend insights from previous international research on MSME risk and resilience, while also highlighting context-specific differences in food and beverage (F&B) MSMEs in developing economies. Similar to Tran et al. (2018) and Paillin and Tupan (2021), this study confirms that effective risk management is critical for sustaining performance. However, unlike these studies, the study demonstrates that risks in F&B MSMEs are very complex interdependent and structurally connected.

Consistent with (Asgary et al., 2020) external risks such as natural disasters, policy uncertainty, and macroeconomic instability emerge as significant drivers of MSME vulnerability. Nevertheless, this study shows that in F&B MSMEs, external risks often interact strongly with internal operational risks such as raw material availability, product quality, and labor constraints amplifying their overall impact on supply chain resilience.

Overall, compared to international studies, this research contributes additional empirical evidence from a developing-country context and demonstrates that MSME resilience cannot be adequately explained by isolated risk factors alone. Instead, understanding the systemic interactions among risks as revealed through MICMAC analysis is essential for effective risk prioritization and resilience-building strategies in F&B MSMEs.

Fiscal Policy options:

Instrument	Mechanism
Cooperative Reinsurance	500+ MSMEs form "Surakarta F&B Resilience Cooperative" negotiates bulk reinsurance with Jasindo.
Public-Private Trust Fund	Pemkot Surakarta + BRI/BNI + CSR funds (e.g., Sampoerna) create emergency loan facility.
Islamic Finance Structures	a. Qard al-hasan (interest-free loans) from BMTs/BPR Syariah during disasters. b. Sukuk wakalah for infrastructure.
Special Allocation Fund (DAK)	Advocate for DAK Bidang Penanggulangan Bencana to prioritize Surakarta (based on 0.54 vulnerability index).

5. Conclusions

This study explains the vulnerability of F&B MSMEs and various types of risks in the F&B business supply chain. A total of 20 types of risks were identified based on a literature review and various previous studies. Using the MICMAC approach, all types of risks identified and their interdependencies were analyzed systematically. There are still some limitations of the study that need to be improved in further research. First, the supply chain has grown rapidly in recent years, and continuous changes in the business environment imply that MSMEs face increasing uncertainty in the development process. In future research, it is necessary to pay attention to business developments in detail in identifying the types of risks that continue to develop. Finally, the research object of this study is F&B products, which may be sufficient as an exploratory study of risk analysis utilizing a new research approach. However, the hazards associated with particular product categories, like halal food, can be investigated in order to offer more precise managerial guidance. The kinds of risks found and the analysis's conclusions can be more narrowly focused by looking into the supply chain, which will aid in the creation of more precise risk mitigation strategies.

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