



Vulnerability Analysis: A Tool for SMEs' Business Resilience

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Received: 05/04/2024 / Accepted: 18/10/2024 / Published online: 26/11/2024

Abstract This study is aimed at examining the vulnerability levels of businesses and assessing the influence of vulnerability on business resilience. This study was undertaken in Surakarta, Central Java, Indonesia. The sample selection method utilizes purposive random sampling. Data is gathered through structured interviews. The vulnerability level of businesses is gauged using an index. The vulnerability index was formulated based on three pivotal variables: exposure, sensitivity, and adaptive capacity. The vulnerability index was ascertained through the aggregation of values derived from all vulnerability indicators. The impact of vulnerability on changes in the external business environment resilience is analyzed through multinomial logistic regression. The research outcomes indicate that SMEs in the food and beverage sector fall within the bracket of moderate vulnerability. Sensitivity emerges as the most pivotal factor influencing the vulnerability index of business units, closely followed by adaptive capacity and exposure. These variables demonstrate a robust impact on SMEs resilience. The critical need for both government and business manager to prioritize ensuring access to suppliers and raw materials, manage raw material pricing, optimize product pricing strategies, and maintain market reach after macro-environmental uncertainty (disaster). This study emphasizes the importance of the durability of SMEs the nimble external environment, where access to suppliers and the price of raw materials, product prices, and market reach often change. It also reveals that sensitivity is a vital variable that affects the durability of SMEs.

Keywords: vulnerability analysis, business resilience, SMEs, food and beverage, disaster

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1. INTRODUCTION

Tourism plays a pivotal role in Indonesia's economic landscape, contributing significantly with a pre-coronavirus disease 2019 (COVID-19) share of 4.8% in the GDP (Adiwilaga et al., 2022; Yudha et al., 2022). The food and beverage industry, predominantly constituted by SMEs, stands as a vital pillar supporting the tourism sector (Abhari et al., 2022). The food and beverage supply chain generally starts with agricultural businesses producing the food and beverage stuff that is then processed and served to individual consumers. Therefore, the F&B service stands for the integral last step of a long chain that ends with a meal on a plate or a drink in a glass (Husin et al., 2021).

Amid the COVID-19 pandemic, businesses within this sector exhibited a notable lack of resilience (Isa et al., 2021; Wieczorek-Kosmala, 2021; Yudha et al., 2022), with a substantial number facing operational setbacks (Giones et al., 2020). In contrast, both governmental bodies and society hold high expectations for the food and beverage industry, attributing to its significant role in job creation (Zainuri et al., 2021), augmented income for the populace (Davlasheridze & Geylani, 2017; Purnomo et al., 2021), regional economic expansion (Goel, 2022), and poverty alleviation (Nursini, 2020). SMEs dominate the Indonesian market, comprising 99.9% of the sector, employing 97% of the national workforce, and contributing 60% to the national GDP (BPS, 2022).

Indonesia boasts a diverse and robust food and beverage industry, serving as a catalyst for the growth of the tourism sector. SMEs within this industry face heightened risks due to the looming threat of changes in the external business environment, leading to income contractions and, in some cases, bankruptcy (Setiyawan & Isa, 2022). The varying risk profiles and resilience levels of SMEs are hypothesized to be intrinsically tied to the persistently high vulnerability of these businesses (Kamalipoor et al., 2022). The analysis of vulnerability and resilience emerges as a crucial foundation for devising effective business strategies (Cowan & Wright, 2016; Eltantawy, 2016; Messabia et al., 2022), making it a compelling and pivotal area of investigation.

A production function is used to conceptualize company resilience against the threat of changes in the external business environment. According to a production function, resilience is seen as an output that is fashioned by different combinations of inputs (Isa & Mangifera, 2019; Gaffar et al., 2022). Despite the significance of this issue, there exists a noticeable dearth in research exploring the impact of vulnerability on business resilience. Hence, this lacuna presents an intriguing avenue for exploration. Understanding and mitigating the vulnerability of SMEs emerge as imperative steps in fortifying their business resilience amid the uncertainties of the current era. This article builds upon preceding research on risk reduction across diverse disaster types, exemplified by Wedawatta and Ingirige (2012), who investigated the influence of structural and non-structural mitigation, as well as community participation in risk reduction. Additionally, Kamalipoor et al. (2022) identified vulnerability factors to reduce risk, Eziyi (2011) recommended development programs for risk mitigation,

and Zein (2010) underscored the pivotal role of individual capacity and awareness in disaster risk.

The business climate is changing quickly and uncertainly, which presents external obstacles for small and medium-sized enterprises in the food and beverage sector (Gaffar et al., 2022; Otengei & Ahebwa, 2021). They are forced to react to these changes on a regular and ongoing basis, which calls for a continuous assessment of their internal capabilities (Otengei & Ahebwa, 2021). Business operators must remain vigilant in managing their ventures within the backdrop of business environment uncertainties (Gamil et al., 2023). Only a limited number of enterprises can withstand the uncertainties in the business environment (Lo et al., 2019). Hence, it becomes imperative to identify and analyze the vulnerability levels of food and beverage businesses, the factors influencing vulnerability, and the impact of vulnerability on business resilience. This information serves as a foundation for both business operators and the government to enhance performance and sustain the food and beverage industry.

2. THEORETICAL FRAMEWORK

2.1 Risk

Conant and Brewer (2022) and Mitra and Shaw (2023) define risk through the equation $R = f(H \times V)$, where Risk (R) is the interaction between hazards (H) and vulnerability (V). Hazards (H) represent phenomena with the potential to threaten human life and cause damage. Vulnerability (V) is the condition of a business unit that leads to or results in an inability to face hazards. Isa et al. (2015) explains that if there is a hazard but the business unit is not vulnerable, the business can manage the disruptive event independently. Conversely, if the business unit is vulnerable but there is no threatening event, there will be no risk. To ensure business sustainability, risk must be reduced (Mitra & Shaw, 2023). The approach to handling the risk of changes in the external business environment involves risk reduction concepts (Oliver-Smith, 2016; Setiyawan & Isa, 2022; Conant & Brewer, 2022).

Post COVID-19 pandemic, many managers and employees in the food and beverage industry are still infected and declared to have recovered from the virus. The threat has resulted in many fatalities or individuals being unable to work, thereby posing a risk to businesses. The Risk Level indicates the strength of a business unit in confronting the threat of changes in the external business environment. A low risk level is perceived as high resilience. High resilience is considered a product of the business unit's ability to face the threat of changes in the external business environment (Isa et al., 2015). Resilience, in this context, is conceptualized as a product, with the resilience function modeled after a production function. The production function signifies the relationship between inputs and outputs, where the output, in this case, a high level of resilience, is determined by production

factors, including vulnerability aspects such as sensitivity, exposure, and adaptive capacity (Kamalipoor et al., 2022).

2.2 Vulnerability

Resources are an essential input for managers, and entrepreneurs, in carrying out their daily activities. Internal resources and capabilities influence the strategic decisions made by SMEs to remain competitive in the industry. Previous studies have been formulated the concept of utilising the SMEs internal resources in order to gain competitive advantage, which then known as Resource Based View Theory. RBV holds that the organisational resources are the main factor to influence the SMEs performance.

SMEs internal resources and capabilities indicate the level of vulnerability of a business that can affect the amount of risk or resilience of the SMEs (Kamalipoor et al., 2022). When hazards are present, the higher the vulnerability, the greater the risk (Isa et al., 2021). Vulnerability is elucidated by Isa and Mardalis (2022) and Kamalipoor (2022) as the predisposition of a business unit influenced by a threatening hazard. Three dimensions constitute vulnerability, as explained by Isa et al. (2018), Lo et al. (2019), and Kamalipoor (2022). The terms "exposure," "sensitivity," and "adaptive capacity" refer to the degree to which a business unit is impacted by, exposed to, and able to adjust to changes in the external business environment (Table 1).

Table 1. Variable and dimension of vulnerability

No.	Variable	Dimension
1	Sensitivity	Business characteristics
		Owner/manager demographics
		Supplier, product dan market characteristics
2	Adaptive Capacity	Human capital
		Economic capital
		Institutional capital
		Managerial capital
		Supply chain capital
3	Exposure	Coronavirus disease

2.2.1 Exposure

The disaster led to substantial losses for many food and beverage businesses, with a significant 92.47% experiencing a revenue decline due to the pandemic (BPS, 2022). The pandemic depleted raw material supplies and resulted in reduced demand (Seetharaman, 2020; Eggers, 2020), leading many businesses to cut their workforce (Nicola et al., 2020). Factors such as the number of exposed workers, frequency, intensity, length of exposure, and place of business contribute to the exposure, causing vulnerability to business units (Yang, 2020; Khan et al., 2022; Wang et al., 2022).

2.2.2 Sensitivity

The sensitivity to external perturbations, notably the challenges posed by the changes in the external business environment, is expounded upon across three distinct dimensions: business characteristics, proprietor or entrepreneur demographics, and supply chain attributes. Business characteristics play a pivotal role in shaping the adaptive capacity of business entities in the context of the pandemic (Kamalipoor, 2022). Particularly, the scale of the business emerges as a salient business characteristic (Davlasheridze & Geylani, 2017; Eggers, 2020). SMEs cultivate closer affiliations with suppliers and clientele, affording them access to information of strategic import. However, amidst the pandemic, SMEs grapple with resource scarcity and dwindling demand, rendering them more susceptible to environmental vicissitudes. A discernible inverse correlation is posited between business scale and susceptibility to the pandemic. Moreover, nascent enterprises are deemed more vulnerable than their established counterparts, primarily owing to their limited experiential reservoirs and network resources. (Eggers, 2020). In addition to scale, other business characteristics influencing sensitivity encompass antecedent business performance (Sydnor et al., 2017; Orhan, 2016), legal status (Sydnor et al., 2017; Orhan, 2016), and financial endowments (Khan & Sayem, 2013).

Concurrently, business sensitivity is further delineated by proprietor or managerial demographics, specifically encompassing gender (Lo et al., 2019; Sydnor et al., 2017), educational attainment (Lo et al., 2019; Orhan, 2016; Sydnor et al., 2017), business acumen (Sydnor et al., 2017), managerial competence (Isa & Mardalis, 2022), and prior disaster management experience (Orhan, 2016). A negative correlation is posited between female gender and entrepreneurship (Zapata-Huamani et al., 2019). Female business proprietors exhibit a proclivity towards risk-averse strategies, such as temporarily shuttering their enterprises and reinstating operations upon the restoration of normalcy. Proprietors with higher educational credentials display a propensity to sustain business operations, contrasting with their less-educated counterparts (Sydnor et al., 2017). Educated and knowledgeable managers or proprietors evince heightened proficiency in knowledge transfer, thereby mitigating the vulnerability of business entities. Furthermore, the experience in navigating antecedent disasters is identified as an augmentative factor fostering an enhanced disposition and capability for mitigation and adaptation (Isa et al., 2015; Orhan, 2016).

The third dimension of sensitivity encompasses the characteristics of suppliers, products, and markets. Due to the pandemic's disruption of the product supply chain from manufacturers to customers, small and medium-sized businesses (SMEs) have suffered significant losses. (Stecke & Kumar, 2009; Isa et al., 2021). Critical determinants of vulnerability in this context include the nature of products, services, pricing strategies, supplier availability, raw material access, and market scope (Orhan, 2016; Khan & Sayem, 2013).

2.2.3 Adaptive Capacity

Adaptive capacity defined as a system's efficacy in adjusting to external changes, plays a pivotal role in assessing vulnerability (Isa et al., 2021). Diminished adaptive capacity is indicative of heightened susceptibility to disasters (Davlasheridze & Geylani, 2017). The significance of adaptive capacity lies in its influence on the ultimate vulnerability of businesses, delineating the extent of potential impacts. Multiple capitals, including human, institutional, managerial, financial, and supply chain, intricately contribute to shaping vulnerability (Marshall & Schrank, 2014). Human capital, denoting the intangible assets represented by the unique and knowledgeable individuals within an organization (Johannesson & Jorgensen, 2017), assumes particular importance. In the context of food and beverage business units, human capital is construed as the explicit knowledge possessed by individuals, encompassing aspects such as knowledge, experience, learning aptitude, and knowledge creation capability (Delgado-verde et al., 2016). Key indicators of human capital include employee competencies, satisfaction levels, and resilience. Academic education, public information, and specialization emerge as pivotal facets of human capital in this nuanced evaluation. The critical determinants of adaptive capacity other government support include technological and critical infrastructure are electricity, water, transportation (Orengo Serra & Sanchez-Jauregui, 2023; 2022; 2021; Lazoda-Contreras et al., 2021).

3. METHOD

This investigation was undertaken after of the COVID-19 pandemic in Surakarta, Central Java, Indonesia. The locale is noted for its concentration of food and beverage enterprises, a sector fraught with heightened risk during the pandemic, as evidenced by a deleterious industry growth rate of -16.20%. Sampling methodology employed purposive random sampling, predicated upon criteria such as a minimum operational history of 2 years, direct exposure to the COVID-19 pandemic, and exclusion of street vendors from consideration. Data collection transpired through structured interviews facilitated by a meticulously designed questionnaire, following the methodological guidance of Creswell and Creswell (2018).

This study determined 304 SMEs or 50% of the total food and beverage SMEs as potential respondents. Food and beverage businesses were chosen because they have special characteristics, where their products are not durable and different from other business sectors. Food and beverage SMEs characteristics others include high levels of stress, strenuous physical labor, long hours, and relatively low wages.

Of that number, 250 SMEs agreed to be respondents and each SME determined 1 executive to be interviewed. Question items as described in Tables 4, 5, and 6.

The quantification of vulnerability levels was accomplished through index analysis. The vulnerability index, a composite metric, was formulated based on three pivotal variables: exposure, sensitivity, and adaptive capacity, drawing from the conceptual framework elucidated by Kamalipoor et al. (2022). The vulnerability index was ascertained through the aggregation of values derived from all vulnerability indicators, aligning with the methodological framework delineated by Isa et al. (2021) and Kamalipoor et al. (2022). Subsequently, all indicator scores pertaining to each facet of vulnerability and risk were collated and subjected to normalization, yielding a scalar output within the range of 0 to 1. The normalization process was executed through a prescribed formula, as articulated by Isa et al. (2018):

$$I_i = \sum_{i=1}^k b_i \left[\frac{a_{ji} - x_i}{s_i} \right] \dots\dots\dots (1)$$

where I represents the vulnerability or risk index, b denotes the weight value, a signifies the indicator value, x is the average indicator value, s represents the standard deviation of the indicator, i denotes the individual business actor and j represents the type of vulnerability variable.

The weighting of each variable was undertaken based on the influence of respective aspects in shaping vulnerability and risk. Larger influences led to higher assigned weights. The weighting process was informed by Focus Group Discussions (FGD) with stakeholders related to risk reduction at the research location. Each variable's weighting considered the influence of each aspect in shaping vulnerability. The larger the impact of a particular aspect, the higher its assigned weight. The weighting was derived through further Focus Group Discussions (FGD) with relevant stakeholders. The weights of exposure, sensitivity, and adaptive capacity were multiplied by the total scores of all indicators to determine the vulnerability index. The following formula represents the vulnerability index for SMEs (Isa et al., 2021):

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

where V represents the vulnerability index for food and beverage businesses, W1 is the weight of the exposure variable, X1 is the score of the exposure variable, W2 is the weight of the sensitivity variable, X2 is the score of the sensitivity variable, W3 is the weight of the adaptive capacity variable, and X4 is the score of the adaptive capacity variable. Five groups are created from the vulnerability index results: very low ($\leq 0,20$), low ($0,21 - 0,40$), moderate ($0,41 - 0,60$), high ($0,61 - 0,80$), and very high ($\geq 0,80$).

The influence analysis of vulnerability on resilience utilized multinomial logistic regression. Multinomial logistic regression was chosen due to the multinomial nature of the dependent variable (Y), which has more than two categorizations (Yuniarti et al., 2022). This method is deemed appropriate as the dependent variable utilized, the level of resilience, is

multinomial in nature, with three attributes representing high-risk level, two for moderate risk level, and one for low risk level. The econometric model is expressed as follows:

$$\left[\frac{p}{1-p} \right] = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \mu \quad \dots\dots\dots (3)$$

where $\left[\frac{p}{1-p} \right]$ is the resilience index, β_0 is the intercept, $\beta_1, \beta_2, \dots, \beta_3$ are the parameters, μ_i is the error term (Disturbance Error), X_1 is the Exposure Index, X_2 is the Sensitivity Index, and X_3 is the Adaptive Capacity Index.

4. RESULT

4.1 Descriptive Statistic

Descriptive statistics are used to provide an overview of the average respondent's answers regarding the vulnerability of food and beverage SMEs.

Table 2 below describes 250 respondents' answers about the level of vulnerability of food and beverage SMEs in Surakarta, Central Java, Indonesia. The vulnerability variables consisting of exposure, sensitivity and adaptive capacity have minimum values, maximum values with standard deviations. The exposure variable has a minimum value of 0.40 and a maximum value of 0.80 with a standard deviation of 0.07. The mean value of 0.78 is closer to the maximum value of 0.80. The sensitivity variable has a minimum value of 0.33 and a maximum value of 0.67 with a standard deviation of 0.09. The mean value of 0.48 is closer to the minimum value of 0.33. The adaptive capacity variable has a minimum value of 0.25 and a maximum value of 0.75 with a standard deviation of 0.15. The mean value of 0.56 is closer to the maximum value of 0.75 (Table 2).

Table 2. Descriptive statistict

No	VULNERABILITY		
	Exposure	Sensitivity	Adaptive capacity
Mean	0.78	0.48	0.56
Max	0.80	0.67	0.75
Min	0.40	0.33	0.25
SD	0.07	0.09	0.15

4.2 Vulnerability Level

This study includes a cohort of 250 Small and Medium-Sized Businesses (SMEs) in Surakarta, Central Java, Indonesia that are involved in the food and beverage industry. These enterprises were operational prior to the advent of the COVID-19 pandemic and are integral components of the processing industry, significantly impacted by the pandemic-induced

economic downturn. Given their regional nature, these SMEs exhibited heightened susceptibility to the multifaceted challenges, with outcomes ranging from financial distress to substantial sales contractions, juxtaposed against instances of resilient profitability. In the year 2021, a peak annual revenue of IDR 7,300,000,000.00 (USD 486,666.67) was documented amid the pandemic, with an accompanying average turnover of IDR 523,329,600.00 (USD 34,888.64). Notably, struggling SMEs faced losses reaching a zenith of IDR 2,080,000,000.00 (USD 138,666.67), with an average loss amounting to IDR 75,521,260.00 (USD 5,034.75). Conversely, successful units reported profits of IDR 5.475.000.000.00 (USD 365,000,00), averaging IDR 239,011,800.00 (USD 15,934.12). Dynamic elements, encompassing raw material supply, production capacity utilization, and demand fluctuations, markedly influenced operational performance during the pandemic.

The nexus between the performance and sustainability of SMEs and their vulnerability to the threat is unmistakable. Elevated vulnerability invariably aligns with diminished performance. This vulnerability is gauged through multifaceted dimensions, including exposure, sensitivity, and adaptive capacity, drawing from established frameworks (Lo et al., 2019; Isa et al., 2018; Kamalipoor, 2022). The evaluative process is deemed indispensable for comprehending the magnitude of vulnerability and discerning its underlying determinants, thereby offering strategic insights for governmental policymaking and business management. The development of the vulnerability index for food and beverage SMEs in response to the threat integrates average values across all pertinent dimensions, including exposure, sensitivity, and adaptive capacity. These values are meticulously calibrated by respective weights derived from comprehensive Focus Group Discussions (FGD) with stakeholders, assigning weightages of 30% to exposure, 35% to sensitivity, and another 35% to adaptive capacity. The resultant index value, calculated at 0.539, categorizes the vulnerability level as moderate, as delineated in Table 3.

Table 3. Vulnerability index of food and beverage SMEs

Description	Exposure		Sensitivity		Adaptive Capacity		Index	
	Score	Weight	Score	Weight	Score	Weight	Value	Category
Index	0.22	0.30	0.71	0.35	0.59	0.35	0.539	Medium
	0.084		0.248		0.206			

The vulnerability of SMEs falls within the moderate category (0.539). The higher the vulnerability level, the greater the associated risks (Li et al., 2023; Isa & Mardalis, 2022). Consequently, various strategies are required for both the government and business actors to mitigate the vulnerability of enterprises. The indicators of the vulnerability index (Tables 3-6) serve as crucial elements for formulating strategies for the business world and policymaking for the government. In order to increase business actors' profits, lower unemployment and poverty rates, and reach targeted economic growth targets, vulnerability is being strengthened.

Sensitivity is a component of vulnerability that characterizes how business unit owners or managers are coping with the possibility of changes in the external business environment (Kamalipoor et al., 2022). Sensitivity has the highest impact as a determinant of the vulnerability index of business units (0.248), followed by adaptive capacity (0.206) and exposure (0.084). This finding supports previous research that identified sensitivity as the most vulnerable aspect. Supplier, product, and market characteristics (0.82) are dimensions of sensitivity with the highest indicator values, making sensitivity—as opposed to exposure and adaptive ability—the most susceptible factor. The dimension of Supplier, product, and market characteristics (0.82) explains the availability of suppliers and raw materials, the prices of raw materials, the selling prices of products, and market reach. Dimensions and indicators with high vulnerability values should be promptly addressed to ensure business sustainability.

Sensitivity is composed of three dimensions (Table 4): business characteristics (0.69), owner/manager demographics (0.64), and supplier, product, and market characteristics (0.82), all falling within the high vulnerability category (0.71). Business characteristics (0.69) comprise five indicators, with two indicators classified as moderate and three as high. Owner/manager demographics (0.64) include two indicators in the moderate category and one in the high category. Supplier, product, and market characteristics (0.82) involve five indicators, with three in the high vulnerability category and two categorized as moderate. This dimension underscores that supplier, product, and market characteristics exert the greatest influence in shaping the sensitivity index, acting as the area where business units are most exposed to risks and dangers.

Table 4. Business unit vulnerability levels based on sensitivity aspects

No	Dimension	Indicators	Value of Index	Category
1	Business characteristics (0,69)	Business size	0,90	High
		Business age	0,64	Moderate
		Pre-disaster sales	0,38	Moderate
		Legal ownership,	0,81	High
		Funding Source	0,74	High
2	Owner/manager demographics (0,64)	Gender,	0,52	Moderate
		Level of education,	0,61	Moderate
		Previous disaster experiences	0,78	High
3	Supplier, product dan market characteristics (0,82)	Availability of suppliers,	0,66	Moderate
		Availability of raw materials,	0,65	Moderate
		Raw material prices,	0,88	High
		Selling price,	0,96	High
		Market reach	0,97	High

Isa et al. (2015), Sahu et al. (2021) and Kamalipoor et al. (2022) introduced adaptive capacity as an integral facet of vulnerability, elucidating its role in enhancing the ability of business units to mitigate the risks associated with the threat. The Adaptive Capacity Index

(ACI) is comprehensive, comprising five dimensions (Table 5): human capital (0.78), economic capital (0.76), institutional capital (0.57), managerial capital (0.43), and supply chain capital (0.41). Each dimension incorporates 3-4 indicators. Notably, human capital emerges as the most vulnerable dimension compared to the remaining four. Within this dimension, three indicators, including labor availability and the willingness and ability to adapt and take risks, are classified as high, while indicators related to knowledge about market service and customer issues fall within the medium category. The economic capital dimension, with three indicators, sees one in the medium category (pre-disaster sales level) and the other two in the high category. Similarly, the institutional capital dimension, managerial capital dimension, and supply chain capital dimension each include three indicators, all categorized as medium. Additionally, the supply chain capital dimension comprises four indicators, with three falling into the medium category and one, indicating dependence on a single partner, classified as low.

Table 5. Level of vulnerability of adaptive capacity aspects

No	Dimension	Indicators	Value of Index	Category
1	Human capital (0,78)	a. Employee Availability	0,95	High
		b. Willingness and ability to change and take risks	0,88	High
		c. Knowledge of how to serve the market and customer problems	0,50	Moderate
2	Economic capital (0,76)	a. The kind of revenue stream	0,83	High
		b. Sales levels before to the crisis	0,56	Moderate
		c. Funds allocated for risk reduction	0,89	High
3	Institutional capital (0,57)	a. Government support (electricity, water, transportation)	0,79	Moderate
		b. The ease of launching a company	0,37	Moderate
		c. The simplicity of acquiring business licenses	0,54	Moderate
4	Managerial capital (0,43)	a. Capacity to create business strategies	0,47	Moderate
		b. Capacity to decide under ambiguous circumstances	0,48	Moderate
		c. Availability of product information	0,35	Moderate
5	Supply chain capital (0,41)	a. Price affordability	0,46	Moderate
		b. Dependence on one partner	0,43	Moderate
		c. Changes in consumer behavior	0,31	Low
		d. Availability of product information	0,43	Moderate

Economic capital, managerial capital, and supply chain capital emerge as three dimensions of adaptive capacity characterized by high indicator values. Immediate attention and

reinforcement are imperative for these dimensions, given their pivotal role in determining the success or failure of a business unit. In order to improve the company unit's performance, managers and owners must act quickly. The examination of the susceptibility of small-scale food and beverage enterprises carries noteworthy consequences for government agencies and enterprises alike. The study's conclusions provide a strong basis for maintaining the food and beverage sector's viability and creating policies for sustainable economic growth (Davlasheridze & Geylani, 2017).

Exposure is identified as the third-ranking determinant of business unit vulnerability. Kamalipoor (2022) asserts that exposure serves as an aspect of vulnerability, elucidating the extent to which the threat impacts the risks faced by the food and beverage business.

Exposure constitutes a singular dimension, namely the threat posed by the coronavirus (Table 6). The vulnerability of the food and beverage industry to the threat of coronavirus is categorized as low (0.22). This dimension encompasses five indicators, with four indicators falling into the low vulnerability category and one indicator categorized as high vulnerability (Table 6). Indicators in the low category include workers susceptible (0.03), The typical duration of time a worker is subjected to calamity (0.07), How often do workers get exposed to disasters? (0.04), and Employees' comorbidity count (0.01). The indicator related to the business zone classifications is classified as high vulnerability (0.94). Business units operating in the red zone are required to close during the pandemic, directly experiencing its impact. Stringent social restriction policies in this zone lead to a significant reduction in community mobility, negatively affecting various economic activities.

Table 6. Level of vulnerability for exposure aspect

No	Dimension	Indicators	Value of Index	Category
1	Coronavirus (0,22)	The quantity of workers who are susceptible to disasters	0,03	Low
2		The typical duration of time a worker is subjected to calamity	0,07	Low
3		Business zone classifications	0,94	High
4		How often do workers get exposed to disasters?	0,04	Low
5		Employees' comorbidity count	0,01	Low

4.3 Influence of Vulnerability on Business Resilience

Multinomial logistic regression analysis was employed to assess the likelihood of resilience among food and beverage SMEs, categorized into high, medium, and low levels. Resilience served as the response variable, while predictor variables included factors related to vulnerability, such as exposure, sensitivity, and adaptive capacity. The analysis results revealed a strong alignment between the model and the data, evident in the Pearson Value (0.913) and Deviance Value (0.999). Both indicators yielded Chi-Square significance values exceeding 0.05, suggesting a well-fitted model to the empirical data. Additionally, a *Nagelkerke* value of 0.125 indicated that

exposure, sensitivity, and adaptive capacity variables explain 12.5% of the resilience of food and beverage SMEs, with the remaining 87.5% attributed to other independent variables not incorporated in this model.

The likelihood ratio test, as applied by Yuniarti et al. (2022), was utilized to assess the model's overall significance. The significance value in the model fitting information was 0.000, indicating that the variables of exposure, sensitivity, and adaptive capacity collectively exert a positive and significant impact on the resilience of food and beverage SMEs.

The coefficients for sensitivity and adaptive capacity exhibit positive values with significance levels below 0.05, indicating a statistically significant and positive impact on resilience at a 5% significance level. Conversely, the exposure variable displays a negative coefficient with a significance value exceeding 5%, suggesting a negative, yet statistically insignificant, influence on resilience at $\alpha=5\%$. The formulated regression equation model is articulated as follows (Table 7):

$$g1(x) = -2.987 - 0.004X_1 + 0,056 X_2 + 0,012 X_3 \dots\dots\dots (4)$$

$$g2(x) = 10,010 - 0.992X_1 + 0,081 X_2 + 0,092 X_3 \dots\dots\dots (5)$$

where: $g1(x)$ represents the probability of moderate resilience, $g2(x)$ represents the probability of high resilience, X_1 is the exposure variable, X_2 is the sensitivity variable, and X_3 is the adaptive capacity variable.

Table 7. Summary of multinomial regression results

	High Resilience	Moderate Resilience
Exposure	-0.992 (0.049)	-0.004 (0.835)
Sensitivity	0.081 (0,048)	0.056 (0.003)
Adaptive Capacity	0.092 (0.048)	0.012 (0.037)
Intercept	10.010 (0.000)	-2.987 (0.000)
Number of observations	250	
Negelkerke	0.125	
Deviance	0.999	
Chi Square	26.848	
Df	6	
Sig	0.000	

Resilience stands as a pivotal concept in mitigating the risks. Given the elevated risk posed by the pandemic, it becomes imperative to fortify business resilience through strategic

measures. The threat of disaster introduces both direct risks, such as mortality, and indirect risks, including economic losses. These factors invariably diminish the operational capacity of businesses, exerting adverse effects on their overall performance (Gaffar et al., 2022). According to Kamalipoor et al. (2022), the degree of vulnerability plays a critical role in determining the magnitude of business risk, where heightened risk correlates with reduced income (Purnomo et al., 2021), increased poverty rates (Nursini, 2020), and diminished regional economic growth (Goel, 2022; Isa et al., 2015). Risk, in this context, reflects the capacity of businesses to contend with the threat of disaster (Isa et al., 2021). Consequently, low risk becomes synonymous with a heightened level of resilience among business units in the face of the threat.

Kamalipoor (2022) delineates vulnerability into three distinct variables: exposure, sensitivity, and adaptive capacity. Exposure elucidates the extent to which the threat influences risk, encompassing factors such as the number of employees exposed, the duration of exposure, the disaster zone category at the business location, frequency of exposure, and comorbidity among employees. This dimension imparts a negative impact on business resilience, necessitating concerted efforts to attenuate such vulnerabilities. Sensitivity, a crucial aspect of vulnerability, delineates the condition of business unit owners or managers in confronting the threat (Kamalipoor et al., 2022). It holds the highest influence within the business vulnerability index. Specifically, the dimension of Supplier, Product, and Market Characteristics, with a score of 0.82, emerges as the most vulnerable aspect, surpassing exposure and adaptive capacity. This dimension encapsulates aspects such as supplier and raw material availability, raw material pricing, product selling prices, and market reach. Immediate attention is warranted for dimensions with high vulnerability values to ensure sustained business continuity. Sensitivity encompasses three dimensions: business characteristics (0.69), owner/manager demographics (0.64), and supplier, product, and market characteristics (0.82), all falling within the high vulnerability category (0.71). Another aspect of vulnerability is adaptive capability, which describes how well business units can reduce risks. It encompasses five dimensions: managerial capital, economic capital, human capital, institutional capital, and supply chain capital.

5. CLOSING

Food and beverage (F&B) small and medium-sized enterprises (SMEs) exhibit moderate vulnerability to disruptions. Among the three key factors influencing vulnerability – exposure, sensitivity, and adaptive capacity – sensitivity emerges as the most impactful, followed by adaptive capacity and exposure. These factors significantly impact the resilience of F&B SMEs during and after such crises. Notably, supplier, product, and market characteristics emerge as the most influential dimensions within sensitivity, indicating their heightened vulnerability related threats and risks. This finding strengthens the Resource Based View theory in its application to SMEs' ability to face external environmental uncertainty. This

finding underscores the critical need for governments and businesses to strengthen F&B SMEs clusters in ensuring access to suppliers and raw materials, managing raw material prices, optimizing product pricing strategies, and maintaining market reach during times of external environmental uncertainty (disasters). Addressing these vulnerabilities, both internally and externally, is crucial for ensuring high business performance and long-term sustainability for F&B SMEs.

This study acknowledges limitations in its focus on a single type of SMEs (F&B) and a single disaster type. Future research should explore the impacts of such disruptions on other sectors significantly affected by disasters, such as trade, construction, entertainment services, processing industries, and transportation. Additionally, future studies could investigate the effects of other types of disasters, including floods, droughts, earthquakes, and others, to provide a more comprehensive understanding of vulnerability and resilience in SMEs across diverse industries and contexts.

ACKNOWLEDGEMENT

Financial support for the research was provided by the DRTPM DIKTI and LRI Universitas Universitas Muhammadiyah Surakarta.

CONFLICT OF INTERESTS

The author(s) declare that there is no conflict of interests.

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