

STRENGTHENING MSME BUSINESS CONTINUITY IN FLOOD-PRONE AREAS THROUGH DISASTER PREPAREDNESS AND RESILIENCE

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Abstract

Floods are increasingly frequent and destructive, posing significant threats to the sustainability of micro, small, and medium enterprises (MSMEs), particularly in flood-prone regions. This study aims to analyze the determinants of MSME business continuity in the context of flood risk by examining the roles of disaster preparedness and organizational resilience. A conceptual model is developed to explain how disaster preparedness influences business continuity both directly and indirectly through resilience. The study employs a quantitative approach using Partial Least Squares Structural Equation Modeling (PLS-SEM) to analyze survey data collected from 386 MSMEs in Brebes Regency, Indonesia. The findings reveal that disaster preparedness has a negative direct effect on MSME business continuity, indicating that the implementation of preparedness measures may temporarily disrupt business operations due to limited financial and operational resources. However, disaster preparedness significantly enhances organizational resilience, which in turn positively influences MSME business continuity. These results highlight the critical mediating role of resilience in enabling small businesses to maintain operational sustainability under disaster risk. The study contributes to the literature on disaster management and small business resilience by providing empirical evidence from MSMEs operating in flood-prone areas. The findings also offer practical insights for policymakers and stakeholders in designing programs aimed at strengthening disaster preparedness and resilience to support the long-term sustainability of MSMEs.

Keywords: MSMEs, Disaster preparedness, Resilience, Business continuity, Flood risk

INTRODUCTION

Climate change has been increasing the frequency and severity of floods. Globally, there were 164 major flood events in 2023, which contributed for 41% of the total global natural disasters (CRED, 2024). Around 27% of habitable territory is vulnerable to flooding, with moderate to severe effects. Coastal and estuarine areas, particularly in Southeast and East Asia, are among the most vulnerable (CRED, 2020). Indonesia is no exception, with a total 1255 flood events in 2023; these numbers contributed to 23,24% of 2023 national disasters. The floods inflicted 92 fatalities, 4788 injuries, and 3.78 million refugees (Badan Pusat Statistik, 2024).

Floods inflict damage to various aspects of society, including the private sector. Enterprises suffer from the loss of properties, equipments, raw materials, and workforce post-floods. Floods also compromised business continuity as a result of loss of asset value, decline of stock markets, disruption in communications and utilities, and damage on surrounding environment (Asgary et al., 2020; Sadeghi, 2022). Without proper intervention, enterprises could lose their crucial competitive advantage to maintain business continuity (Neise & Revilla Diez, 2019).

Small businesses are more vulnerable to floods compared to their larger counterparts (Leitold et al., 2021) due to limited resources (Miklian & Hoelscher, 2021). Floods interrupts operational activity (Neise & Revilla Diez, 2019), loss of raw materials and finished products (Lo et al., 2019; Pathak & Olmo, 2021), and disruption of the distribution channel (Neise & Revilla Diez, 2019). The small businesses' lack of a long-term business continuity plan increases their vulnerability (Asgary et al., 2020; Pathak & Ahmad, 2018). The consequences is small businesses higher risk of business interruption or closure after inflicted by floods (Auzzir et al., 2018; Marshall et al., 2015).

The impact of floods on the continuity of small businesses provides an avenue for research. Several scholars have been investigating the impact of floods on small businesses across various backgrounds, including business scale, type, and country (Isa & Mardalis, 2022; Pathak & Ahmad, 2018; Pathak & Olmo, 2021). Another studies explore the small business preparedness (Hashim et al., 2021; Veeravalli et al., 2022) and their adaptation during and after floods (Skouloudis et al., 2023; Wedawatta & Ingirige, 2012). However, the impact of floods on small businesses in developing countries is still underexplored (Sadeghi, 2022). Another gap in the research bodies is the development of a conceptual model that integrates small business resilience, adaptation measures, and post-flood recovery and continuity strategy (Harries, 2021; Sadeghi, 2022).

This study aims to develop a conceptual model for measuring the post-flood sustainability of MSMEs, integrating mitigation and adaptation measures and business resilience. The contribution to the scientific body of disaster management in the business sector is a conceptual model outlining the determinants of post-disaster business continuity. The results also provide practical contributions by providing guides for MSMEs to build capacity in facing floods. Policymakers and stakeholders can also utilize our results to design disaster mitigation programs, small business support, and business sector-based disaster risk reduction policies.

LITERATURE REVIEW AND HYPOTHESIS FORMULATION

Disaster Preparedness

Disaster preparedness is a proactive and continuous action taken by enterprises to reduce the impact of incoming disasters on their operational activities, asset availability, and personnel safety. Efforts to build disaster preparedness include planning, training, resource allocation, and system implementation that ensure business continuity during and after a disaster (Staupe-Delgado & Kruke, 2018; Tharshanth et al., 2020). Enterprises' efforts to build disaster preparedness include risk assessment, Business Continuity Planning (BCP) design, and disaster recovery planning. The risk assessment stage involves identifying potential threats and vulnerabilities, which can be explored by evaluating the potential occurrence and impact of various disaster scenarios on business operations (Altman, 2006; Salmon, 2007). A BCP contains procedures and instructions for when disasters occur. The process includes identifying critical stages in the business and the necessary resources to support them (Zerwic & Rosen, 2016). Post-disaster recovery plans, such as data backup systems, are crucial to maintain business continuity (Lewis et al., 2003).

Disaster preparedness efforts are divided into structural approaches to protect infrastructure and non-structural approaches (Josephson et al., 2017). Examples of structural methods are building drainage systems, flood retention basins, and flood embankments, installing flood-resistant floors, raising building surfaces, and installing pumps (Aguinaldo et al., 2019; Coates et al., 2020; Schaer & Pantakar, 2018). Non-structural approaches include disaster insurance, early warning systems installment, disaster plans and procedures development, waste management systems, and disaster awareness campaigns (Josephson et al., 2017; Schaer & Pantakar, 2018). Companies are also expected to provide regular disaster training and simulations to raise employee awareness and familiarize them with disaster management plans for better implementation during an actual disaster (Altman, 2006). Social approaches like collaboration with stakeholders and local

communities are also useful to improve enterprises' disaster preparedness and resilience (Mohan, 2023).

Disaster preparedness in the form of effective mitigation plans and implementation is crucial to reduce the severity of disaster impacts on business assets, further reducing loss (Xiao & Peacock, 2014). With the disaster adaptation procedures and business continuity plans, small businesses have better capabilities to recover despite their impaired operational capability (Asgary et al., 2012; Sadeghi, 2022). All of these results would improve small businesses disaster resilience.

H1: there is a direct relationship between disaster preparedness and business continuity.

Disaster preparedness is also crucial to ensure the post-disaster operational capabilities and long-term business continuity. Small businesses can benefit from disaster preparedness by enhancing their risk perception toward potential hazards, which motivates them to design disaster mitigation plans (Hashim et al., 2021). They are also more willing to adopt mitigation measures to minimize physical damage. Disaster mitigation planning also helps small businesses to immediately and efficiently start their operational activities after disaster (Xiao & Peacock, 2014). With post-disaster recovery plans that provide critical operational steps and supply chain recovery, small businesses can improve their disaster resilience (Mohan, 2023).

H2: there is a direct relationship between disaster preparedness and resilience.

Resilience

Resilience is the ability of an individual or organization to face and adapt to difficult and challenging conditions (Pérez-López et al., 2016). In a business context, resilience reflects the company's proactive response to adversities by avoiding or minimize operational disruptions and mitigate future vulnerabilities (Cann et al., 2025). Resilience is a crucial ability for entrepreneurs to adapt to unfavorable circumstances (González-López et al., 2019). Entrepreneurs face various obstacles in the form of extreme events (Bullough et al., 2014) or day-to-day hassles (Evans & Wall, 2020). Natural or man-made disasters create challenges for enterprises in the form of resource destruction, community disruption, and trauma (Williams & Shepherd, 2016).

Various approaches can be taken to improve business resilience when facing disasters such as floods. Post-flood adaptation measures are necessary for business owners, including adjusting business operations and allocating business support resources (Cann et al., 2025; Martinelli et al., 2018). Some entrepreneurs can seize emerging opportunities after a disaster by providing goods and services necessary for affected communities (Martinelli et al., 2018). The existence of social networks with fellow business owners, suppliers, and business associations is also a key factor in building business resilience (Patankar, 2019; Schaer & Pantakar, 2018). Resilient business owners have superior capabilities to maintain business performance during and after a disaster, which then improves long-term business continuity (Chowdhury et al., 2018).

H3: there is a direct relationship between disaster preparedness and business continuity.

H4: there is a mediating effect between disaster preparedness and business continuity through resilience

RESEARCH METHODS

This study utilized a verificative approach to identify determinants of SMEs' resilience and business continuity during floods. Our study highlights the limited availability of conceptual models by integrating various determinants (Sadeghi, 2022). The presence of a conceptual model will aid the identification of SMEs' flood resilience and further influence long-term business continuity.

The study involved SMEs from Brebes Regency. Based on the 2024 survey, there were 5433 SMES, which were later used as the study population. The next phase is sample determination. A simple random sampling method is employed to provide equal opportunity to all members of the population to take part in the survey (Sekaran & Bougie, 2021). The Slovin formula was used to

determine the sample amount; with the degree of confidence at 5%, a total of 373 respondents was determined as the minimum sample. The questionnaires were delivered using Google Forms. At the end of data collection phase, we collected 386 valid responses.

Our study employed Partial Least Squares (PLS) to analyze the relations between antecedents and its indicators. PLS combines path analysis and factor analysis into a single structural model. The PLS model divided into outer model and inner model. The main advantage of PLS is its ability to analyze model with multiple indicators and complex relations between variables. Our study employed Partial Least Squares (PLS) to analyze the relations between antecedents and their indicators. PLS combines path analysis and factor analysis into a single structural model. The PLS model is divided into an outer model and an inner model. The main advantage of PLS is its ability to analyze models with multiple indicators and complex relations between variables.

RESULTS AND DISCUSSION

The proposed model utilized disaster preparedness as an exogenous variable with resilience and business continuity as endogenous variables, which is presented in Figure 1.

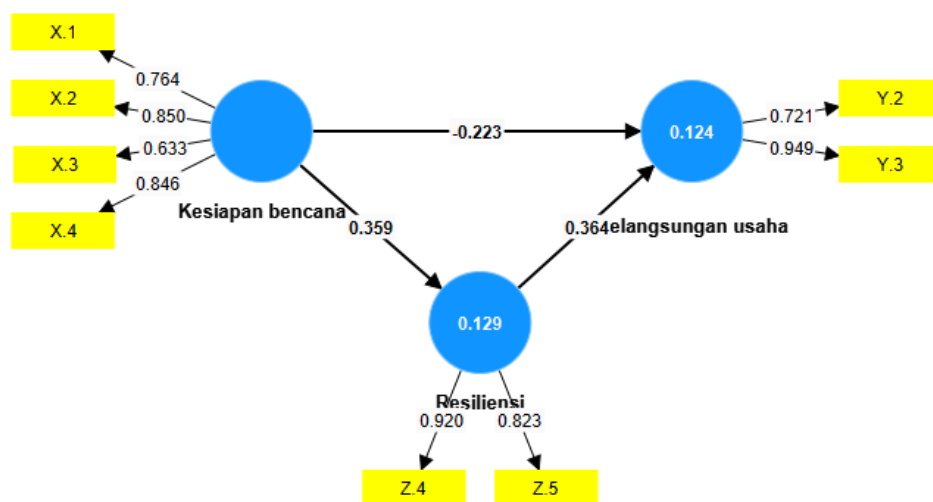


Figure 1. The Full model

The first step in PLS analysis is measuring convergent validity by checking the outer loading value. The minimum value of the outer loading value should be 0.4, with a recommended value above 0.7 (J. F. Hair et al., 2014). The results are shown in Table 1.

Table 1. Results of outer loadings

Indikator	Outer loadings
X.1 <- Disaster preparedness	0,764
X.2 <- Disaster preparedness	0,850
X.3 <- Disaster preparedness	0,633
X.4 <- Disaster preparedness	0,846
Y.2 <- Business continuity	0,721
Y.3 <- Business continuity	0,949
Z.4 <- Resilience	0,920
Z.5 <- Resilience	0,823

After removing the invalid indicators (Y1, Z1, Z2, Z3), the rerun revealed that the remaining indicators were above 0.4, which fulfilled the validity threshold. The next phase of convergent

validity measurement is the Average Variance Extracted (AVE), with the minimum requirements of 0.5 (J. F. Hair et al., 2014). Table 2 presents the results, which revealed that all of the AVE values exceeded 0.5, confirming the convergent validity.

Table 2. Results of AVE

Variable	AVE
Business continuity	0,710
Disaster preparedness	0,606
Resilience	0,762

Discriminant validity was measured using the cross-loading method and the Fornell–Larcker value (J. F. Hair et al., 2014). The cross-loading value of an indicator on a variable must be greater than the cross-loading value of the indicator on other variables in the model (Gefen et al., 2000; Weijters et al., 2010). The results of the cross-loading test are shown in Table 3.

Table 3. Results of cross-loading

Indikator	Disaster preparedness	Resilience	Business continuity
X.1	0,764	0,113	-0,128
X.2	0,850	0,263	-0,110
X.3	0,633	0,114	-0,261
X.4	0,846	0,437	0,049
Z.4	0,384	0,920	0,258
Z.5	0,217	0,823	0,238
Y.2	-0,086	0,112	0,721
Y.3	-0,079	0,312	0,949

Based on Table 3, the cross-loading value of each indicator in a variable is greater than the cross-loading value in other variables. The Fornell–Larcker value compares the square of the AVE value to the correlation value with other constructs. The Fornell–Larcker criterion is considered valid if the square of the AVE value is greater than the highest correlation value with other constructs (Weijters et al., 2010). The results of the Fornell–Larcker test were presented in Table 4. The test results revealed that the Fornell–Larcker value for each variable is greater than its correlation value. Overall, it can be concluded that the model meets discriminant validity.

Table 4. Results of Fornell–Larcker

Variable	Business continuity	Disaster preparedness	Resilience
Business continuity	0,843		
Disaster preparedness	-0,093	0,778	
Resilience	0,284	0,359	0,873

To ensure model reliability, PLS uses Cronbach's Alpha as a reference. This metric reflects the average correlations among indicators, assuming all indicators have equal outer loadings. A threshold between 0.6 and 0.7 is considered satisfactory, although values between 0.7 and 0.9 are more desirable. (J. F. Hair et al., 2014). The results of Fornell–Larcker are presented in Table 5. The test results revealed all of Cronbach's Alpha are above 0.6, confirming the reliability of all of variables.

Table 5. Results of Cronbach's Alpha

Variable	Cronbach's alpha
Business continuity	0,635
Disaster preparedness	0,799
Resilience	0,698

To test the hypotheses, PLS-SEM utilizes the bootstrapping method. The validity of the hypotheses is determined by the T-statistics (greater than 1.96) and P-values (lower than 0.05) (J. Hair et al., 2022). The results of the bootstrapping analysis were presented in Table 6. All of the hypotheses have T-statistics above 1.96 and P-values below 0.05. Hence, all of the proposed hypotheses were accepted.

Table 6. Results of hypotheses testing

Hipotesis	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (O/STDEV)	P values
Disaster preparedness -> Business continuity	-0,223	-0,226	0,059	3,76	0
Disaster preparedness -> Resilience	0,359	0,359	0,052	6,879	0
Resilience -> Business continuity	0,364	0,365	0,045	8,115	0
Disaster preparedness -> Resilience -> Business continuity	0,131	0,132	0,028	4,754	0

The first hypothesis (H1), which posits a direct relationship between disaster preparedness and MSME business continuity, yields a path coefficient of -0.223, indicating a negative correlation with business continuity. This result contradicts several previous studies that demonstrated the role of disaster preparedness in improving post-disaster business continuity (Iqbal et al., 2023). One factor suspected of triggering disruptions to business continuity during the implementation of disaster preparedness is financial disruption. Disaster mitigation and preparedness efforts such as BCM require high initial investment costs, particularly for infrastructure, technology, and training (Lewis et al., 2003). After implementing a disaster preparedness plan, MSMEs must continue to allocate funds periodically to update the plan, conduct training, and enhance the disaster mitigation system. These costs can burden the finances of MSMEs, which often have limited resources (Sakai & Yao, 2023).

Implementing disaster preparedness can also disrupt business operations, potentially impacting business continuity. During disaster mitigation, MSMEs should allocate resources necessary to support critical business operations (Ojha et al., 2013). Integrating disaster mitigation efforts can also cause temporary disruptions to operational activities, which can impact productivity (Lewis et al., 2003). Another challenge faced by MSMEs when implementing disaster mitigation is the emerging operational complexity that can hinder their capabilities. Implementing disaster mitigation can divert MSMEs from core activities because they must constantly update and test disaster preparedness plans. This condition can hinder productivity and financial performance (Bartholomy et al., 2013; Ojha et al., 2013).

The second hypothesis (H2) aims to investigate the direct relationship between disaster preparedness and resilience. With a path coefficient of 0.359, disaster preparedness has a positive relationship with resilience. This result aligns with previous research (de Vries & Hamilton, 2021; Haynes et al., 2019; Orhan, 2016). Another hypothesis, which proposed the alleged direct relationship between resilience and business continuity (H3), also revealed a positive effect with a path coefficient of 0.364. Consistent with these findings, previous research also confirms this result (de Vries & Hamilton, 2021; Liang et al., 2023; Torres et al., 2019).

The fourth hypothesis (H4) was tested to assess the indirect effect of disaster preparedness on business continuity through resilience. The path coefficient of 0.132 indicates the resilience effect to boost MSMEs' business preparedness for business continuity. This finding is supported by empirical studies demonstrating the ability of disaster mitigation efforts to build long-term business continuity by increasing organizational resilience (Liang et al., 2023; Rattanasaeng & Sukhotu, 2024).

CONCLUSION

Disaster preparedness efforts can hinder the business continuity of MSMEs due to the MSMEs' limited resources required for initial investment and maintenance. MSMEs also face operational disruptions during disaster mitigation implementation, which risks compromising disaster preparedness. Nevertheless, disaster preparedness can build MSME resilience. The study also reveals the role of resilience in improving MSME business continuity.

Further research suggestions are modifying the models by adding unobservable variables that influence resilience and business continuity, particularly those with moderating effects. A longitudinal study is also recommended to observe the development of MSMEs disaster preparedness over a certain time period. A practical recommendation based on this research is the urgency for the government and other stakeholders to provide resource assistance, such as funding and operational management training.

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