The Impact of Flood Between 2006 – 2022 on Locals Businesses in Malaysia - A Short Review

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ABSTRACT

The review paper investigates the impact of the flood disaster experienced by small businesses, particularly the small- and medium-sized enterprises (SMEs) in Malaysia. The focus was on the tangible impact of the flood disaster, such as buildings, stocks, crops or infrastructure. This is to understand how flood characteristics such as flood water depth, flood location and flood duration affect the SMEs. Review work was carried out using secondary sources obtained through online search engines, namely Google Scholar and Science Direct. The findings showed that studies on the direct impact of flooding on SMEs in Malaysia are scarce and limited to the loss of sales or production, worker issues and damages to premises and stock. In addition, the costs raised were generally for the benefit of the technical agencies involved in damage repairs to public infrastructures. Information on how the physical flood characteristics, such as location of the affected area, inundation period and depth, associated with the size and infrastructure of the premises was lacking. The raw data on flood characteristics could possibly be inserted in flood modeling, but the data could be important for the technical agencies and those working on a strategic framework on the ground. It is also important for the awareness and preparedness strategy. Thus, study on how these raw data relate to the SMEs' flood damage is urgently required. Further study is suggested to identify the significant level of damage in relation to location, size and infrastructure with the flood characteristics to improve the risk management and strategic framework for SMEs affected by the disaster.

Keywords: Flood disaster, small- and medium-sized enterprises (SMEs), tangible impact

INTRODUCTION

Malaysia is experiencing the global climate change effects just as other countries around the globe. Being in the equatorial region with a tropical climate, it is exposed to weather changes and extreme local condition such as heavy and monsoon rains. The potential of flood events is increasing in many areas in Malaysia due to the rapid physical development activities that unavoidably compromised the needs of sustainability and conservation plan (Abdul Majid et al., 2021; Omran et al., 2018; Elfithri et al., 2017; Mohd Ekhwan & Gasim, 2014). Unregulated land opening for township and housing estate construction as well as timber logging and agriculture activities leave the land expose to erosion which lead to flood events during rainy season.

Flood events in Malaysia seemed more frequent recently which understandably related to the rapid physical development in the country (Ahmada et al., 2025; Saad, 2024). The most recent flood struck five states concurrently to Kelantan, Perlis, Kedah, Perak and Terengganu starting on 24th November 2025. Not only that, Kuala Selangor and Klang Valley also wiped by the heavy rains and flooding starting on the same date. This indicates the need to review the existing flood and natural hazard strategic planning for Malaysia and put more

effort on environmental awareness, disaster preparedness plan and framework and improved risk management system.

Flooding obviously contributed a devastating impact on businesses, especially on small- and medium-sized enterprises (SMEs) who may be unprepared and vulnerable to the range of both direct and indirect impacts. These impacts could be categorized based on their business area, which include market, people, logistic, premises, processes and finances (Wedawatta et al., 2014). Types of businesses might be retail and wholesale, vehicle and services, food and beverages, property, art and craft, bookstore, communication, health and lifestyle among others.

This paper is aimed to review information on the impact of flood towards the locals and SMEs businesses in the affected area in Malaysia and how flood condition such as depth, duration and location relates to the damage. The recent information would be beneficial to minimize loss due to the disaster. The stakeholders and government agencies related to the risk and disaster management would be able to formulate a new strategic planning to help the SMEs.

LITERATURE REVIEW

Flood category and causes

Flood events could be monsoon flood or flash flood that directly give negative impact to the people, land and the nation. The increase in population and assets in a floodplain, the changes in hydro systems and the destructive effects of human activities have been a major cause of flood (Javadinejad, 2022). Geomorphological features, anthropogenic activities (urban changes), network and catchment factors, and rainfall and climatic changes factors were identified as the main cause of major flood events in Jeddah City which damaged 10,000 houses and 17,000 vehicles in 2009 (Youssef et al., 2015). In the mainland of Southeast Asia, tropical cyclone has been identified as the main cause of major flood events in the region (Chen et al., 2020). The seasonality of monsoons was found to affect the intensity of rainfall which further caused floods (Loo et al., 2015). In Sulawesi Indonesia, extreme rainfall showed greater impact at the peak of the flood hydrograph indicating the important role of climate onto flood events in the island (Tunas et al., 2018). Another example is Bangladesh which is situated in the "Indian Monsoon" region, thus, the country experiences heavy precipitation during the tropical monsoon which lead to floods (Rahman et al., 2025). Suhas et al. (2023) confirmed the monsoon low pressure system generated a large amount of rainfall over South Asia and often produced extreme precipitation that leads to the disaster.

In Malaysia, monsoon flood is caused by the Northeast Monsoon season which usually started on October and ends on early March. A study by Muhammad et al. (2020) confirmed that the east coast region received more annual rainfall with higher variability, as compared to the central and south parts of Peninsular Malaysia. In the worst flood event in this decade, the 2014 flood in Kelantan, was largely influenced by atmospheric conditions and they could be explained by dominant factors such as the MJO, cold surges and the existence of Borneo Vortex (Ismail & Haghroosta, 2018). To explain further, Hai et al. (2017) discussed on the strong wind surge from the South China Sea due to very intense cold-air outbreaks of the Siberia and the short-wave trough across the northeastern Indian Ocean towards China that produced these unusual extreme rainfall and flooding events along the east coast of Peninsular Malaysia. In the Muar River Basin, the largest flood hit the area in December 2006 and January 2007 (Ching et al., 2013). It was due to the extremely high percentage of total monthly average rainfall of 31 years (from 1980 to 2010).

On the other hand, flash flood happened in the area with rapid development, rapid rise of water level and have large amounts of debris (Buslima et al., 2018). Flash floods would occur within a very limited time, where there is insufficient to enable effective warnings and preparedness. This could be detected by the highest variability in the hourly-based rainfall dataset of the area (Maqtan et al., 2022). According to Tew et al. (2022), the extreme daily precipitation of up to 230 mm/day was observed and resulted in an inundated area of 77.43 km^2 in Peninsular Malaysia during the 2021-2022 flood disaster. A report from the study on Relau River Basin, Penang, showed the occurrence of cliff erosion and dumping of rubbish into the river also cause blocked water flow which in turn increases the level of the reservoir and the occurrence of flash floods (Saad et al., 2023). In another

case, the flash flood on 23 October 2013 happened due to the increase volume of rainwater in Sungai Bertam Cameron Highland which forced the dam of Sultan Abu Bakar to be opened (Khalid et al., 2015). In Klang Valley, locations prone to flash flood include Kuala Lumpur City Centre, Petaling Jaya and Shah Alam (Noor et al., 2024) where construction sites contributed the most for the incidents.

Community in the flood-prone area

People choose to live in a flood prone area due to many reasons. It could be due to place attachment, good living condition, sense of community, social harmony and flood adaptation (Wani et al., 2022). Furthermore, the risk perception of the people living in the flood prone areas could make them choose to stay (Chiang, 2018; Bera & Petr, 2018; Qasim et al., 2015). Some of the local communities of the flood prone area could already establish an adaptation strategy to reduce vulnerability while others could still struggle to do so (Norizan et al., 2021; Nurul Ashikin et al., 2021; Chong et al., 2019). Instead of moving to other place they could adapt with the situation and find alternative such as shifting to other job or any other financial coping activity (Parvin et al., 2016) or buying flood insurance (Ao et al., 2022). Thus, there is an urgency to evaluate their loss and damages due to flood disaster to enhance the strategic planning in flood risk management and vulnerability.

Vulnerability and risk elements for SME

Vulnerability generally refers to the degree to which human and environmental systems are likely to experience harm due to perturbation or stress (Kasperson et al., 2003). According to the United Nation Office for Disaster Risk Reduction (UNDRR), vulnerability is defined as characteristics and circumstances of a community, systems or assets that make it susceptible to the damaging effect of a hazard (UNDRR, 2015). Vulnerability is associated with all risk elements including physical, biological and economic systems that are exposed to flood related damages. The economic elements cover public infrastructure, housing, agriculture, trade and transports among others. These elements are important when considering flood damage effect along with other elements such as social or cultural elements, to design a flood impact assessment (ASEAN secretariat, 2021). The impact could be tangible or intangible for the same risk elements. In the case of this review, as suggested by ASEAN secretariat (2021) guidelines, the focused elements are the house, human, infrastructure, social, natural and agriculture.

Reports from previous study showed the need to investigate more on the issues of vulnerability of SME to flood disaster in Malaysia. Data collected from 200 SMEs from a studied province in Thailand showed a slow recovery process and government aids (Pathak et al., 2016). Two surveys in Yorkshire and Humber region in the UK involving 417 SMEs showed differences of financial losses, types of damages, business closure, and decreases in sales that SMEs experienced (Sakai & Yao, 2023). Although there could be various measures of improving resilience are available and have been utilized in many instances by SMEs, what is appropriate for individual small businesses depend on a range of factors. Ingirige & Russell (2015) found out their seven cases studied from SMEs in Braunton, UK, the SMEs and other stakeholders that are engaged in examining and identifying their own resilience levels, their needs, constraints and gaps are more likely to deliver appropriate behavioral change than the use of self-assessment toolkits. It was reported by Davlasheridze et al. (2017) that for every additional dollar spent on disaster loans per establishment in a county, four small businesses survive and these effects will have implications nationwide, given the vital role small businesses play in creating jobs.

METHODOLOGY

The study investigates data collected through search engines particularly Google Scholars and Science Direct using keywords. The most appropriate articles related to the topic and scope were then analyzed further and discussed.

RESULTS AND DISCUSSION

Search Engine and Result

There are two main search engines used for the literature survey in this study, the Google Scholar and Science Direct (Table 1). From the vast number of references, keywords were used to refine the search for the articles satisfied our scope of the study.

Table 1: Results from Search Engine for Publication related to flood loss or damage in Malaysia from 2014 to 2025

Keywords	Google Scholar	Science Direct
flood damage, flood loss, Malaysia	18,000	4,046
monsoon flood damage and economic loss for Malaysia	23,100	571
economic impact, flood victim, Malaysia	25,100	765
SMEs, flood disaster, Malaysia	7,800	136

Category of impact

Romali et al. (2025) categorized the negative impact of flood into tangible and intangible effects (Table 2). The tangible effects could be primary where it is direct due to flood exposure or indirect (not directly due to flood exposure). Secondary effect would include clean-up costs, environment recovery or impact on regional and national economy.

Table 2: Category of flood damage according to Romali et al. (2025)

Category	Tangible		Intangible
	Primary	Secondary	
Direct (due to flood exposure)	Buildings and contents damage, infrastructure damage, motor vehicle damage, agricultural soil erosion, crops destruction, livestock damage, evacuation, and rescue measures	Clean-up costs, reconstructing cost, land, and environment recovery	Loss of life, injuries, psychological distress, cultural heritage damage, and negative effects on ecosystems
Indirect (not directly due to flood exposure)	Business interruption, public services/utilities interruption, traffic disruption cost, income loss, tax revenue loss, and loss due to migration of companies in the aftermath of flood	Impact on regional and national economy	Traumatic experience, loss of trust in authorities, deteriorating health, emotional and psychological damage

Impact on economy

Impact of flood on economy can be categorized as tangible. The general economic loss due to flood as experienced by several states in Malaysia is summarized in Table 3, as adopted from Ahmada et al. (2025). Damages cost billions of Malaysia Ringgit, with a number of deaths and thousands of people being evacuated because of the disaster.

Table 3: Confirmed flood loss assessments for certain flood occurrences in Malaysia between 2006 and 2022 for some States in Peninsular Malaysia (adopted from Ahmada et al., 2025)

Year	**Place(s)**	**Damage (RM Million)**	**Number of Deaths**	**People Evacuated**
2006–2007	Johor	489	18	NA
2008	Johor	21.19	28	NA
2010	Perlis & Kedah	8.48	4	NA
2014	Kelantan	300	10	91,441
2015	Sabah & Sarawak	2,400	1	13,878
2016	Sarawak, Johor, Negeri Sembilan	4,500	3	61,107
2017	Kelantan	284	NA	12,615
2017	Terengganu	1,250	NA	12,910
2021–2022	Shah Alam, Kuala Lumpur, Perak, Pahang, Terengganu, Kelantan, Melaka, Sabah	6,500	54	125,000

The restoration cost for the 2014 flood events was about RM1,103 million as reported by the Public Work Department or JKR (Akasah & Doraisamy, 2015). The damages calculated for the restoration budget covered for the public infrastructure and services is shown in Table 4.

Table 4: Damages and restoration cost as reported by JKR during the flood 2014 (adopted from Akasah and Doraisamy (2015)

	Types of effects/damages	Restoration cost (RM)
1.	Public Work Department	100 million
2.	Tenaga National Berhad	10 million
3.	Air Kelantan Sdn. Bhd.	3 million
4.	Police Department	8 million
5.	Roads in Kelantan	100 million
6.	Roads in Terengganu	132 million
7.	Infrastructures in Kelantan	200 million
8.	Schools in 5 states	350 million
9.	Homes	200 million

Impact on SMEs

The study to date on the impact of flood towards the SMEs in Malaysia are limited. Generally, focus was made to those associated with the considered risk elements such as house, human, infrastructure, social, natural and agriculture. Table 5 shows the list of research report on the impact of flood towards SMEs in Malaysia between 2014 and 2025. Most reports were based on review work and only a few investigate directly the damage incidents. There is no doubt on the negative impact of flood to the business and locals of the affected area (Bhuiyan et al., 2022; Buslima et al., 2018) and even the potential loss of life (Ahmada et al., 2025). While at the same time the damages negatively affect the government budget due to the need for restoration of the public infrastructure (Zulkarnain et al., 2020; Ismail et al., 2017) and housing (Tam et al., 2014; Samsudin et al., 2021).

As emphasized by Estrada et al. (2017), the impact of flood on people and business is not linear, and the most affected group is the low-income earners (Kabirzat et al., 2024; Weng et al., 2016). Loss of properties or properties values were reported by Ismail et al. (2014), Khan et al. (2014) and Roosli & Collins (2016). This further could relate to the tourism industry where operators for small resorts and chalets or recreational camp sites being affected by the flood through the cancellation of booking, reduce number of visitors and damages of infrastructure (Sungip et al., 2018; Hamzah et al., 2014).

Auzzir et al. (2018) and Bari et al. (2021) discussed specifically on the effect of flood on SMEs. The flood events contributed 32% of the natural disaster effects where loss of sale or production became the main impact (Figure 1). The average estimated overall losses and damages per shop were RM4,510.07. The amount of loss could be considered high for a small business. This added the report from Weng et al. (2016) on the average direct losses in house damage as RM3,945.00 per family.

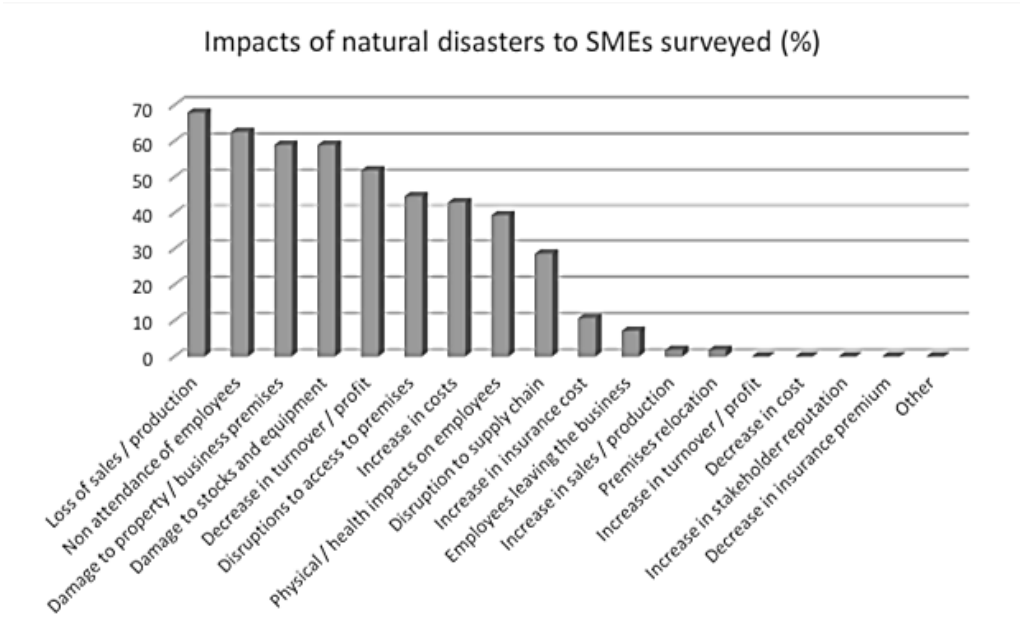

Figure 1: Loss and damage of SMEs (adopted from Auzzir et al., 2018)

Table 5: Impact of flood disaster on locals and SME business in Malaysia

Author/Year	Method of study	Findings
Buslima et al. (2018)	Review on flooding that occurred in December 2014 and affected several states in Peninsular Malaysia	Massive impact on people, properties, agriculture, livestock, and infrastructure facilities
Ahmada et al (2025)	Review on impact on individual safety	A significant danger leading to potential loss of life or severe harm to individuals
Bhuiyan et al. (2022)	Review on the direct and indirect damage cost of 2014 flash floods in Kuala Lumpur between 2010 and 2016	This disaster recorded to affect more than 200,000 people with 21 people were killed. It gives a massive impact on people, properties, agriculture, livestock, and infrastructure facilities
Ismail & Ghani (2017)	Field data on flooding was collected from the Department of Irrigation and Drainage Malaysia for events between 2012 and 2015	It costs more than RM 1 million to reinstate roads damaged by flooding in a typical district annually.
Zulkarnain et al. (2020)	Review on impact of climate change (flood) and values of residential properties	The economic attributes' response to flood hazards for residential properties could be either positive, negative or no effect on the climate change factor
Ismail et al. (2014)	Research survey on loss of property values	The sale price of residential property is significantly decreased by 0.015% due to flood
Khan et al. (2014)	Field survey - Construction of a flood susceptible map for presumptive flood areas around at Kelantan river basin in Malaysia	86.88% of the respondent losses their properties with 56.88% of them losses less than RM1000 every year during the flood event
Estrada et al. (2017)	Research to estimate the impact of water occurrence, movement, and distribution on GNP growth	The disaster impact is far from linear severity of the disaster's consequences and the indebtedness level
Kabirzat et al. (2024)	Survey using questionnaires for direct and indirect effect of flood damage on individual household and business building	Low-income earners affected more than the high-income households and businesses
Samsudin et al. (2021)	Structured questionnaire survey developed a structural equation model (SEM) for assessing several socioeconomic dimensions	Household content and building received direct impact The people significantly received indirect tangible impact
Roosli & Collins (2016)	Survey	Collapses of building and shelter
Tam et al. (2014)	Survey at Kota Tinggi flood affected area	Housing flood damages estimated about RM100/ m^2
Weng et al. (2016)	Survey using questionnaires on losses in Kelantan during 2014 flood	A total of 346 suffered direct losses in house damage averaging RM3,945.00 per family. Another 49 victims reported business loss. The reported overall direct and tangible total losses averaged RM26,622.27 per family.
Auzzir et al. (2018)	Questionnaires survey on effects of flood to SMEs in Malaysia	The impacts of natural disaster to SMEs in Malaysia are severe, 34% contributed by flood
Bari et al. (2021)	Survey using questionnaires, direct face-to-face semi-structured interviews with 41 businessmen	The average estimated overall losses and damages per shop were RM4,510.07
Sungip et al (2018)	Review on impact of monsoon flood on tourism sector in Kelantan	Decline of tourists' influx, loss of hotel revenue and occupancy, drop in retails of city economy, and destroy the nature, cultural and heritage attractions

Hamzah et al. (2012)	Review on effect of flood to tourism industry in Kota Tinggi	An extreme decline, dropped almost 90% from usual tourist arrivals
Yeo et al. (2025)	Review on nine theories and models on behavioral decision theory	To produce this framework through integrated theories and concepts involve psychology, behavioural economics, geoinformatics and disaster management
Hashim et al. (2019)	Interview and questionnaire Target - business owners and managers (n = 253)	Risk perception is the most consistent factors in influencing preparedness actions
Safiah Yusmah et al. (2020)	Interview the victims towards floods in Kuantan, Pahang.	Well aware of the causes of the vulnerability faced by them due to the flooding event

Even though the literature on the impact of flooding on the economy and SMEs recorded the cost of loss and some risk elements such as premises, the data on actual exposure of assets to flood characters such as flood depth or area affected were not found. Estimated asset exposures to a 1-in-20year flood event in Malaysia are presented in Table 6 following the report of the World Bank and Bank Negara Malaysia (BNM) (2024). The results indicated variation across sectors in the extent to which assets are exposed to flood risks, with significantly greater exposures in the agriculture and transport sectors. The related depth of the flood and percentage of assets exposed to flooding showed that a shallow flood significantly affects industry, health, retail and service industry. In contrast, deeper flooding affects agriculture and tourism sectors.

Table 6: Share of assets exposed to flooding (%) and average depth of flooding for exposed assets (meters) for a 1-in-20year flood event in Malaysia as estimated by World Bank and Bank Negara Malaysia (BNM) (2024)

Sectors	Share of Assets Exposed to Flooding (%)	Average Depth of Flooding for Exposed Assets (meters)
Services	8.7	2.0
Retail	9.6	1.6
Health	8.8	1.3
Industry	7.1	1.3
Education	8.6	2.4
Tourism	7.9	4.3
Transportation	32.1	2.3
Agriculture	28.6	3.9

The report also confirmed the reasons of the vulnerability of SMEs towards flood were as follows:

1. SMEs exposed more to direct and indirect loss due to flood than large businesses
2. SMEs are less likely to have disaster preparedness strategies and less likely to have insurance when compared to large businesses, even after taking into account differences in risk exposures and risk perceptions.
3. Malaysian businesses that perceive flood risks as a recurrent risk are more likely to have disaster preparedness strategies and to purchase flood risk insurance.
4. SMEs are less likely to believe they have sufficient information about future flood risks.
5. Limited access to insurance protection and finance for adaptation and resilience

Generally, SMEs and the public need to be well-informed about flood risk and resilience development. Nonetheless, a management reference tool such as a practical framework should be developed and used. Flood damage analysis for Segamat town in Johor showed the application of a flood hazard map and flood damage map to develop a damage and risk assessment framework to minimize the impact of future flood on business areas (Romali & Yusop 2021). The use of correct hard measures (mainly structural, such as engineering interventions) or soft measures (mainly non-structural, such as policy development) at the local, catchment or national levels is vital (Fatdillah et al., 2022). It was proven by the analysis of the flood area in Klang Valley using hydraulic modeling and digital elevation modeling tools. The raw information fed into the modeling could

be important knowledge to be referred by the technical agencies and flood management team to design a workable strategic framework on the ground. Furthermore, the victims and potential victims are expected to understand and be aware of the impact in order to be more prepared.

Comparing the information globally promotes a better justification for strategic planning to help SMEs mishap due to the disaster. A case study from Ghana showed that small businesses lacked adaptive capacity and the take-up of flood resilience, including insurance was low, making them more vulnerable to floods. The results should inform policy and plans to promote flood resilience, and proactive measures to protect businesses and society from disasters (Owusu et al., 2021). Findings from the study on the resiliency of businesses towards flood disaster in Greece support the need for strategic planning to build resilience capacity (Skouloudis et al., 2023). This will improve their ability to adequately prepare their business for the impact of flooding. Adeniyi et al. (2022) confirmed that the resilience and recovery of premises are a function of both structural and non-structural measures; therefore, it might be necessary to measure the flood performance of a property beyond the physical characteristics of the property.

An effective framework should be designed to minimize damage and loss, but it will need comprehensive study and testing on different types of models. As suggested by Yeo et al. (2025), integrated theories and concepts involving psychology, behavioral economics, geoinformatics and disaster management could be applied to help SMEs in making decisions. Hashim et al. (2019) surveyed 253 business owners and managers and found that risk perception was the most consistent factor in influencing preparedness actions. This could change the vulnerability and resilience of flood victims at the same time (Safiah Yusmah et al., 2020).

CONCLUSION

Studies on the impact of flooding to locals and SMEs in Malaysia are still limited. The works carried out to date were more general with a little number of case study from Kelantan, Terengganu, Pahang, Johor and Selangor. The specified impact on SMEs could be depending on some hydrology factors of the flood itself, thus further investigation on the role of physical factors such as flood depth and exposure duration along with the local weather information could give a refined details which help the risk management plan, and strategic framework. The awareness on impacts and resilience strategy towards flood in SMEs could be considered as low, which urgently need to be addressed to support the application of a practical framework for flood damage.

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