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A Review of Major Flood Events in Malaysia Between 1970-2024

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ABSTRACT

This study compiles comprehensive data on significant flooding incidents throughout the historical narrative of Malaysia and presents the official estimates of flood-related losses for the chosen major flood occurrences spanning from 1970 to 2024. Additionally, it offers details regarding the underlying factors and consequences of floods, as well as an explanation of the flood prevention strategies implemented in this area. In addition, it provides information on the distribution of financial resources for flood mitigation initiatives by the Malaysian government as part of the Malaysia Plan (1971 to 2020). Past flood experiences have shown that a significant danger leading to potential loss of life or severe harm to individuals arises from the scale and strength of the floods, encompassing factors such as water levels, flow rates, and the speed at which the flood occurs. Intense floods characterised by elevated water levels and sudden occurrence, such as flash floods, have the potential to overwhelm flood defences and escape routes, hence increasing the risk of drowning and injuries. Nevertheless, it is recommended that Integrated Smart Alarm System will be deployed in flood-prone regions to decrease fatalities.

Keywords: Flood; disaster; Malaysia; rainfall; monsoon

INTRODUCTION

Malaysia is often affected by disasters such as floods, landslides, haze and other man-made disasters, as well as some rare cases of earthquake and tsunami. Malaysia has an INFORM 2019 Natural Hazard and Exposure risk of 3.4/10. Globally, floods remain the most frequent and damaging disaster. Each year, floods cause the highest frequency of damage and are accountable for a substantial number of human fatalities, disease outbreaks, property and agriculture destruction, and other negative impacts. Figure 1 shows the occurrence by disaster type around the world from EM-DAT (2024). In 2023, a total of 399 catastrophic events were recorded, which is considerably higher than the average of 369 annual catastrophic events for 2003-2022. Floods dominated these events, with 164 occurrences, up from an average of 170 annual flood occurrences recorded across the 2003-2022 period. Malaysia has encountered 51 notable natural disaster occurrences between 1998 and 2018 had the highest flood exposure rate among ASEAN Member States from 2012 to 2019. During that era, 281 fatalities occurred, with over 3 million individuals impacted, and disasters resulted in nearly US $2 billion (MYR8 billion) in damages. Over the course of the last century, more than a dozen of major flood events have occurred in Malaysia, each displacing tens of thousands of people and costing millions of Ringgits in damage. Examples include the flood of 1971, 1973, 1988, 2001, 2005, 2007, 2010, and 2014. In total, there were 31 major flood events considered as disasters between year 1980 to 2010, resulting on average of 41 deaths, 20,000 victims being displaced, and costing up to RM100 million each year in damages. For example, the flood that hit Kuala Lumpur and many other states in January 1971 resulted in the death of 61 people and losses of nearly RM35 million

(based on Malaysian Ringgit value in 1971). A report of the flood was published in an international newspaper as shown in Figure 2. In 2000, floods resulting from heavy rainfall claimed the lives of 15 individuals in Kelantan and Terengganu, prompting over 10,000 residents to evacuate their residences in northern Peninsular Malaysia. The floods in Johor in December 2006 and January 2007 resulted in 18 fatalities and required around RM1.1 billion for disaster assistance and relief.

Recent media emphasise the severity of flash floods in Malaysia. They cause property damage, interfere with daily life, and endanger public safety. The economic consequences are significant; however, it is frustration and anxiety they bring in communities that have the most profound impact. Rapid urbanisation plays a significant role. As urban areas grow, the disappearance of green spaces results in the absence of adequate space for rainfall drainage. Climate change worsens the problem, resulting in heavier rainfall. However, the issue extends beyond nature and include obsolete flood management systems. The government has undertaken initiatives to improve drainage infrastructure and enhance flash flood management. Nevertheless, the issue continues to exist due to the requirement of a comprehensive solution. Efficient flood prevention necessitates meticulous strategizing and active involvement from all parties involved. This study used secondary data from the Department Irrigation and Drainage (DID), National Disaster Management Agency (NADMA), the media and a scholarly article regarding the flood catastrophe in Malaysia.

This study concentrated on flood disasters resulting from flood events occurring between 1970 and 2024. The year selected in this study is due to the terrible flood within these half-century especially in year 2014, 2017 and 2021 in Klang Valley that caused 54 deaths, and it resulted in the simultaneous displacement of about 71,000 residents and impacted more than 125,000 individuals in total. The aim of this article is to furnish information for an initial assessment of the flood catastrophe occurring between 1970 and 2024.

Monsoon rains flood Malaysia, toll heavy

KUALA LUMPUR (UPI) — Authorities evacuated flooded villages today in the populous Kuala Lumpur area in the wake of one of the worst monsoon rains to hit Malaysia.

Prime Minister Tun Abdul Razak said "this year's flood might come up to the 1931 flood" which left hundreds dead.

Official reports said at least 24 persons had been killed as a result of heavy rains since Dec. 26. Four more persons, including three youths, were reported to have drowned in rising flood waters.

At least 28 persons have been killed since the monsoons lashed west Malaysia with 27 inches of rain beginning Dec. 26. Police said 18 of the fatalities were victims of drownings. The rest were passengers of a Thai motor boat that capsized in the northeastern seas.

Razak was briefed on the latest flood situation throughout this nation of 10.5 million people at the Royal Malaysian police headquarters in Kuala Lumpur.

The premier warned residents of flood-prone villages "to evacuate to higher grounds immediately before they are caught by the sudden rise of water."

Authorities told Razak the situation, particularly in Pahang state, has deteriorated during the past 24 hours.

More than 35,000 persons in the flooded areas in the states of Pahang, Trengganu, Kelantan, Johore and Selangor, which includes Kuala Lumpur, have been evacuated.

Food supplies, gasoline and fuel oil were flown today to Pahang, worst affected area. River boats and patrol craft were sent to help evacuate flooded villages, most of them built around rivers.

Floods and landslides cut off road and railway links to key cities of the east coast and to the island republic of Singapore, about 200 miles south of Kuala Lumpur.

Hijackers force jetliner to Cuba

FIGURE 2. The 1971 flood reported in The Bulletin, an Oregon-based newspaper on January 4, 1971

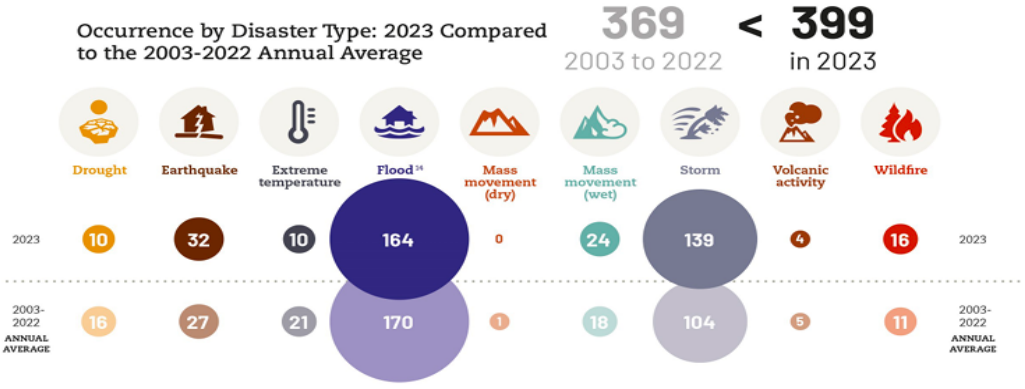
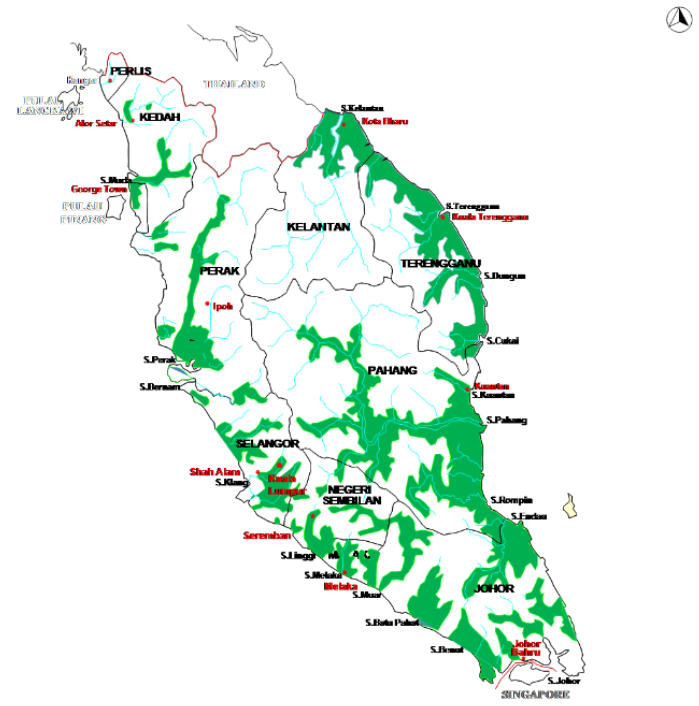


FIGURE 1. Incidence by disaster category: 2023 in comparison to the annual mean from 2003 to 2022 (EM-DAT, 2024)

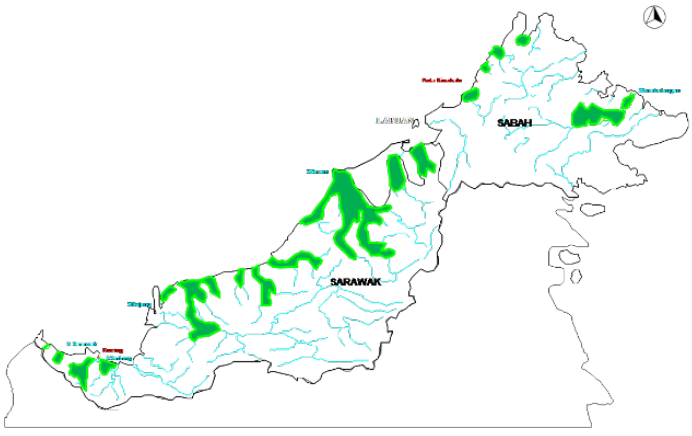
FLOOD HISTORY IN MALAYSIA

Malaysia, a Southeast Asian nation known for its diverse landscapes and vibrant culture, has experienced its fair share of natural disasters over the past five decades. Flooding, in particular, has been a recurring challenge, with the country facing a significant number of devastating flood events during the period of 1970 to 2024. Malaysia is situated between latitudes 2° N and 7° N, and longitudes 99.5° E and 120° E in Southeast Asia. This nation comprises two principal regions: Peninsula Malaysia and Borneo Island, encompassing a total area of 330,200 km². Figure 3 illustrates the geographical distribution of flood-prone areas in Malaysia.

Floods are a significant disaster occurring globally, especially in Malaysia. Such occurrences may result in the destruction of facilities, infrastructure, and properties, causing significant damage and disruption to the lives of the affected communities. Flooding in Malaysia is recurrent, covering a large, inhabited areas compared with other natural disasters. The World Meteorological Organisation states that flooding ranks among the three most devastating natural catastrophes globally, resulting in thousands of fatalities and the damage of property valued in the hundreds of billions. A historic number of floods have been documented in Malaysia with events occurred in 1926, 1931, 1947, 1954, 1957, 1963, 1965, 1967, 1969, 1971, 1973, 1983, 1988, 1993, 1998, 2001, 2006, 2007, and 2010.



a) Peninsular Malaysia



b) East Malaysia

FIGURE 3. Flood Prone Area in Malaysia (DID, 2023)

In 2010, floods disrupted transport in Kedah and Perlis, leading to the closure of rail services, roads including the North-South Motorway, and the airport in Alor Setar, the capital of Kedah. Helicopters were the only available aerial transport to Perlis and Kedah during that time. Water in Perlis and Kedah was polluted, leading them to request water from Perak. The Department of Irrigation and Drainage has reported that over 29,000 square kilometres, including 9% of the total territory, and over 4.82 million individuals, representing 22% of the total population, are impacted by flooding annually.

In December 2014, five states in Peninsular Malaysia experienced severe flooding, with Kelantan being the worst affected. The rainfall in Kelantan over 10 days was double the usual amount for the month of December. 232,913 evacuees were recorded in many evacuation facilities throughout Peninsular Malaysia, setting a new record. Figure 3 shows the Northeast Monsoon flood statistics where the numbers of evacuees, families, evacuation centres, death, missing, houses destroyed, houses damaged, losses and number of states affected had been reported between 2014-2020.

Another worst flooding event that hit Malaysia were on 4 & 5 November 2017. Meanwhile, extensive bridge damage due to scouring also was reported at Sungai Sembrong in 2006, Sungai Jeniang in 2009, Sungai Nenggiri (destroyed by floating debris during Dec 2014 flood), Sungai Tanum Kuala Lipis (Abutment scour during Dec 2014 flood). The worst scour effect due to the terrifying flood was on 4 January 2021 at Raub, Pahang where the bridge was collapse and leaving a huge gap between the land and the bridge pier and thus making it impossible for any vehicle to pass through.

According to the Malaysian Government, the disruption due to flood caused the total economic damage was estimated at more than RM 420 million. Faizah et al. (2019) indicate that the Government of Malaysia has invested approximately RM 3 billion in structural measures to mitigate flood disasters, including structural and non-structural, during the 1970s to the present. Nonetheless, this figure remains inadequate, and this sum will continue to escalate because to the rising project costs in inundated regions. Figure 3 depicts the chosen photographs of flood incidents in Malaysia and Table 2 displays the reported flood damage projections combined with the amount of fatalities and people rescued for the selected flood occurrences in Malaysia from 1967 to 2024.

(a) Flood in Kelantan, 2014

continue ...

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(b) Flood in Terengganu, November 2023

(c) The worst flood in Klang Valley on 19 Disember 2021

FIGURE 3. Selected images of Malaysian floods.

FACTORS AND IMPACTS OF FLOODING IN MALAYSIA

Kong et al. (2010) presented seven causes of flooding in Figure 4. The findings indicated that 28% of individuals attribute flooding to inadequate drainage systems, 20% to pollution, 18% to urbanisation management, 16% to environmental factors, 11% to weather conditions, and 7% to dam failures.

Ooi et al. 2004 concluded that the primary causes of floods in Malaysia are the country's susceptibility to heavy monsoonal rains particularly throughout the northeast monsoon period from November to March. The analysis shows that intense and prolonged rainfall, especially during the monsoon seasons, significantly contributes to flooding. The northeastern states of Pahang, Terengganu, and Kelantan are especially prone to these flooding incidents, with records dating back to the 1920s.

Furthermore, the impacts of climate change, including elevated sea levels and intensified precipitation, have exacerbated the problem, leading to more frequent and severe flooding occurrences (Siti et al. 2020). Meanwhile, the tropical storms and typhoons in the South China Sea and adjacent regions also impact flood frequencies in Malaysia, contributing to extreme rainfall events (Kato and Kuroiwa, 2005).

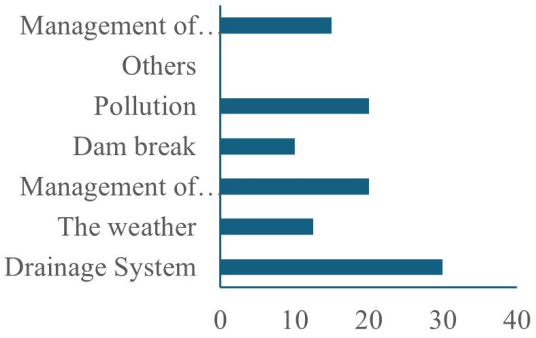

FIGURE 4. Seven Causes of flooding (Kong et al. 2010)

In addition to natural factors, human activities have also played a significant role in the increasing prevalence of floods in Malaysia. The rapid urbanization and development of infrastructure alongside rivers, coupled with the poor maintenance of drainage systems, have contributed to the worsening of flood events. Rapid urban development in Malaysia has led to increased impervious surfaces and inadequate drainage systems, contributing to higher flood risks (Abidin and Nordin, 2018).

Deforestation is another significant element that contributes to flooding in Malaysia. Deforestation for agricultural and development reasons diminishes the land's capacity to absorb and retain water. Vegetation and trees have a crucial role in stabilising soil and aiding in the absorption of water. Deforestation increases the risk of soil erosion and reduces the land's ability to manage rainfall. This can lead to increased runoff and higher chances of flooding, particularly in areas previously covered by dense forest (Sharma and Sreejith, 2017). The effectiveness of drainage infrastructure is crucial in managing flood risks. In many parts of Malaysia, particularly in urban areas, existing drainage systems are often outdated or insufficient to handle the volume of water during heavy rains. Wong and Mak (2019) pointed out that blocked or poorly maintained drains can lead to localized flooding, which can quickly escalate into more severe flooding if not addressed promptly. Inadequate flood management practices and insufficient investment in infrastructure exacerbate these problems. Meanwhile, climate change is an increasing issue that impacts flood patterns worldwide, and Malaysia is not exempt from this. Increasing global temperatures contribute to the prevalence of extreme meteorological phenomena, including increased precipitation and exacerbated storms. In addition, the rise in sea level caused by the melting of polar ice and the expansion of seawater due to thermal effects could increase the risk of coastal flooding. The convergence of heavy precipitation with increasing sea levels in Malaysia presents a dual danger, rendering both inland and coastal regions increasingly susceptible to flooding.

TABLE 2. Confirmed flood loss assessments for certain flood occurrences in Malaysia from 1970 to 2024 (Public InfoBanjir 2024; Diya et al. 2014; Sulaiman 2009)

Year	Place	Damage (RM Million)	Number of Deaths	People Evacuated
1971	Pahang River. Basin	93.1	24	153,000
1971	Kuala Lumpur	84.7	24	NA
1979	Peninsular Malaysia	NA	7	23,898
1982	Peninsular Malaysia	NA	8	9,893
1983	Peninsular Malaysia	NA	14	60,807
1984	Batu Pahat River Basin	20.3	0	8,400
1986	Peninsular Malaysia	NA	0	40,698
1988	Peninsular Malaysia	NA	37	100,755
1988	Kelantan River Basin	33.0	19	36,800
1988	Sabah	NA	1	NA
1991	Peninsular Malaysia	NA	11	NA
1992	Peninsular Malaysia	NA	12	NA

continue ...

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1993	Peninsular Malaysia	NA	22	17,000
1995	Peninsular Malaysia	NA	0	14,900
1996	Sabah in June	NA	1	9,000
1996	Sabah in December	130.0	200	15,000
1997	Kedah, Terengganu	NA	5	5,321
1999	Pulau Pinang, Kedah, Perak Utara	NA	1	15,500
2000	Kelantan, Terengganu	7.1	NA	NA
2001	Johor, Pahang	NA	15	13,195
2002	Kuala Lumpur	NA	NA	NA
2003	Kedah, Penang, Kuala Lumpur	NA	5	31,046
2004	Kelantan, Terengganu, Pahang	NA	17	17,080
2005	Kedah, Perlis, Kelantan, Terengganu	240.1	14	99,405
2006	Johor, Negeri Sembilan, Melaka	NA	15	107,000
Dec. 2006 & Jan. 2007	Flooding in Johor State	489 million	18	NA
2008	Flooding in Johor State	21.19 million	28	NA
2010	Floods in Perlis and Kedah	8.48 million	4	NA
2011 & 2012	La Nina (that resulted in flooding)	NA	NA	NA
2014	Kelantan	300 million	10	91,441
2015	Sabah, Sarawak	2.4 billion	1	13, 878
2016	Sarawak, Johor, Negeri Sembilan	4.5 billion	3	61,107
2017	Kelantan Terengganu	284 million 1.25 billion	NA NA	12, 615 12, 910
Dec 2021-Jan 2022	Shah Alam, Kuala Lumpur, Perak, Terengganu, Pahang, Kelantan, Hulu Langat, Melaka, Terengganu, Sabah	6.5 billion	54	125,000

The issue of flooding in Malaysia has become chronic and severe, with wide-ranging implications for individuals, communities, and the environment. These effects have many aspects, impacting various parts of society and natural systems. Gaining comprehensive knowledge about the various implications of floods is crucial for developing efficient flood control measures and minimising the effects of future incidents. Rahman and Hanif (2020) provide a quantitative assessment of the economic damage caused by floods, including infrastructure and property damage. They have presented that floods can affect both personal finances and national economic stability. For personal level, flooding can cause significant damage to residences, commercial establishments, and personal belongings, resulting in considerable financial difficulties for those impacted. The expenses related to repairing and reconstructing, along with the loss of income for individual's dependent on farming or other enterprises, can be quite burdensome. For the national economy, floods have negative effects by disrupting economic operations and damaging infrastructure. Infrastructure damage, such as that to roads, bridges, and public buildings, can impede mobility and diminish productivity, resulting in increased expenses for repair and maintenance. Furthermore, floods can have a significant influence on vital industries, such as agriculture, which plays a crucial role in Malaysia's economy. Reduced production of food and increased food prices can result from crop losses and damage to agricultural land, impacting both consumers and producers.

Kong et al. (2010) have classified the effects of flooding by four categories. Figure 5 shows the four elements that have been taken in the study. It was found that, over 33% of individuals agree that flooding leads to water damage to houses, structures, and appliances. Closing of businesses resulting from flooding also leads to a loss of income. Approximately 25% of individuals agree with these effects, while 17% belief that transportation disruption is an additional consequence of floods (Kong et al. 2010). Research by Tan and Lai (2017) stated that floods have significant effects on the environment, such as causing soil erosion, vegetation loss and disturbance to ecosystems. Flood-induced erosion can result in the depletion of nutrient-rich topsoil, adversely affecting agricultural yield and causing lasting damage to the land. In addition, floodwaters have the ability to disseminate contaminants and debris, so polluting water sources and causing harm

to aquatic life. Furthermore, floods have the potential to cause the destruction of ecological habitats. Forests, wetlands, and mangroves are highly susceptible to damage, and their destruction can lead to a series of negative consequences for biodiversity and ecological equilibrium. Wetlands, such as those mentioned, have a crucial function in filtering water and regulating floods, and their destruction can worsen flooding problems.

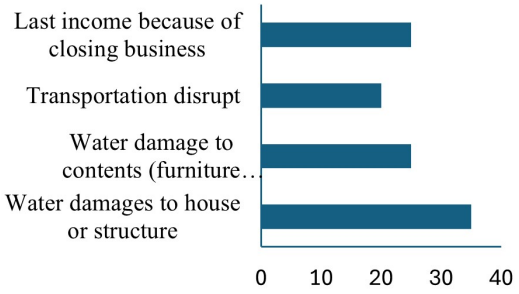

FIGURE 5. Effects of flooding (Kong et al. 2010)

The damage to infrastructure during floods is extensive and can have long-lasting effects. Transportation infrastructure, including roads and bridges, as well as essential public utilities like electricity and water systems, are frequently subject to significant damage, resulting in service disruptions and higher expenses for repairs. Infrastructure destruction not only disrupts daily living but also hinders the progress of rehabilitation operations and adversely affects economic activities. The most recent major flood on 16 December 2021 was hit seven states in Peninsular Malaysia where it gives significant impacts on transport infrastructures. Flooding has impacted 126 state roads and 98 federal roads and across Terengganu, Selangor, Kelantan, Negeri Sembilan, Melaka, Terengganu, Pahang, Kelantan, Melaka, Pahang, and Kedah. The National Disaster Management Agency (Nadma) reported sunken roads, flash floods, landslips, floods, road collapses, sunken roads, and damaged bridges at 224 sites across seven states following three days of severe rainfall over the peninsulaThe resultant floods have resulted in a minimum of 54 fatalities and 2 individuals unaccounted for, concurrently displacing over 71,000 people and impacting more than 125,000 individuals overall. The Malaysian government has classified it as a “once in a century” disaster, marking it as the most severe flood in terms of displaced people since the 2014–2015 Malaysia floods. It has also been historically juxtaposed with the 1971 Kuala Lumpur floods. Many bridges were destroyed or damaged during this hazard. The primary reasons of the highest percentage of documented bridge collapses are hydraulic in nature, including flood and scour impacts, which may be intensified by climate change (Tang, 2019). Unprecedented precipitation levels were recorded at meteorological stations in Kuala Lumpur and Selangor. Extensive damage has been observed in the states of Pahang and Selangor, particularly in the city of Shah Alam and area of Hulu Langat. Figure 6 shows one of the locations of the collapsed bridge in Raub due to high discharge of river and extensive scour around pier and abutment in January 2021.

FIGURE 6. Bridge collapse in Raub, Pahang in January 2021 due to high discharge of river and extensive scour around pier and abutment.

FLOOD MITIGATION MEASURES IN MALAYSIA

To address this issue, Malaysia has been actively exploring a range of flood mitigation strategies, with a focus on integrating these measures into local development plans. The incorporation of flood risk mitigation strategies into local development plans is essential. To address this issue, Malaysia has been actively exploring a range of flood mitigation strategies, with a focus on integrating these measures into local development plans. Incorporating flood risk mitigation strategies into local development plans is essential since it not only mitigates risk but also diminishes vulnerability and enhances preparedness within local communities (Wardah et al. 2021).

One of the key findings from the literature suggests that the rapid change in catchment land use, along with a lack of compliance with recommended practices, has contributed to the increased frequency of flooding within metropolitan regions of Malaysia. To mitigate this, the study proposes that the removal of bridge constrictions, in conjunction with further flood mitigation measures, might markedly diminish flood levels (Shahrulnizam et al. 2020).

In addition to these centralised efforts, Malaysia has also implemented grassroots-level initiatives to address the issue of flooding. The creation of a real-time flood monitoring system utilising Raspberry Pi technology, for instance, has proven to be a valuable tool in enhancing early warning capabilities and facilitating the timely dissemination of critical information to affected communities (Fairuz et al. 2020). This system not only allows for the rapid detection of flood events but also enables the enforcement of safety precautions, ultimately enhancing the resilience of local populations.

Moreover, the country has recognized the importance of proactive measures in mitigating the impact of flooding. Initiatives to monitor precipitation levels have been implemented to aid preliminary prediction of floods, although these methods cannot entirely avert flooding events (Parvin et al. 2018). By leveraging such data, communities can be better prepared to respond to impending flood events, minimizing the potential for loss and damage.

In view of the prolonged rainfall and frequent flood incidents that pose a threat to the safety and property of citizens, the The Malaysian government has resolved to allocate national budget monies for flood mitigation initiatives in each of its five-year plans. Figure 7 illustrates the financial allocations by the Malaysian government for mitigation of floods initiatives within the framework of the Malaysia Plan from 1971 to 2020. The financial allocations for flood mitigation initiatives under the 2nd, 3rd, 4th, 5th, 6th, 7th, and 8th Malaysia Plans were 155 million MYR, 14 million MYR, 431 million MYR, 56 million MYR, 545 million MYR, 2700 million MYR and 141 million MYR, respectively. A total of 17 billion dollars has been budgeted for flood-control programs under this plan from 2005 to 2020.

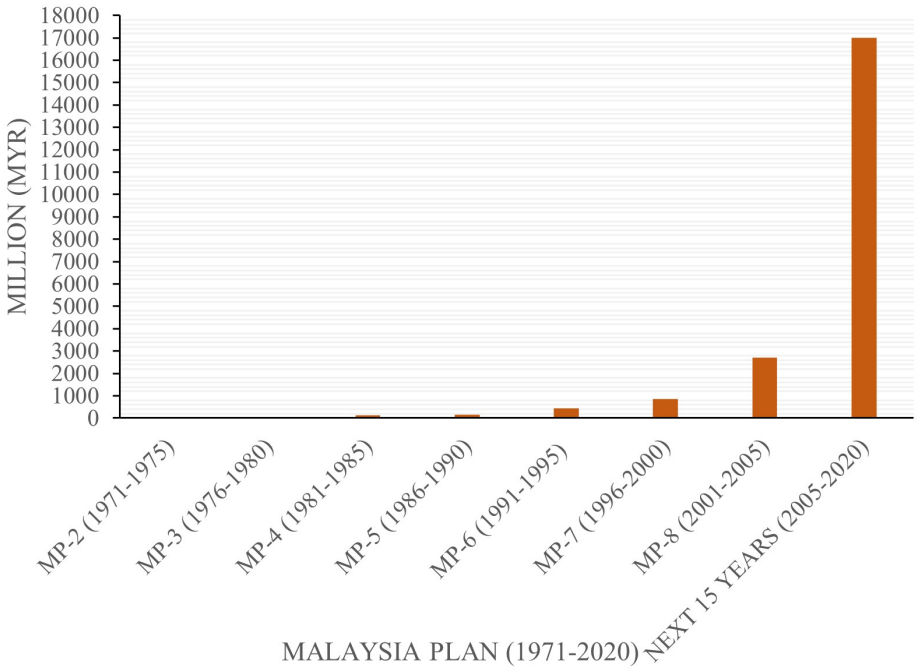

FIGURE 7. Financial distribution for flood prevention initiatives within the Malaysia Plan

Besides that, structural measures involve physical interventions designed to control or redirect floodwaters. These include flood barriers and levees (Rahman and Wong, 2020), retention basins and reservoirs (Abu Hasan and Ali, 2017) and river dredging and embankments (Yusof and Aziz, 2019). Non-structural measures focus on planning, policy, and community involvement to mitigate flood risks. These include urban planning and zoning (Tan and Lim, 2016), flood forecasting and early warning systems (Idris and Mohamad, 2018) and community education and preparedness (Haris and Hasan, 2021). Figure 8 shows some flood mitigation projects that have conducted in Malaysia.

RESEARCH GAPS

This study has compiled, categorised, organised, and consolidated all dispersed information pertaining to the floods in Malaysia into a single database. The study employed systematic approaches to examine various aspects related to disasters worldwide. These aspects included the most affected continent, the number of deaths caused by different types of disasters, The historical prevalence of floods in Malaysia, their causes and repercussions, the distribution of financial resources for flood prevention as outlined in the Malaysia Plan, and the duties and responsibilities of governmental agencies during flood events.

a) The Kg Melayu Subang flood mitigation project is scheduled for 2023.

b) The Kg Melayu Subang flood mitigation project

c) Flood Mitigation Projects at Sungai Pahang

FIGURE 8. Flood Mitigation projects in Malaysia.

Although most flood-related deaths occur in developing nations, most of the studies on this topic focus on the United States, with a limited number being executed in Australia and Europe. Past flood experiences have shown that a significant danger leading to potential loss of life, or severe injuries is the magnitude and intensity of the floods including water levels, flow rates, and the speed at which the flood develops. Severe floods with high water levels and rapid onset (such as flash floods) can overwhelm flood defenses and escape routes, increasing the risk of drowning and injuries.

Besides that, the instability of cars while submerged in floodwaters also significantly affects the potential for loss of life and injury. Hence, the Environmental Agency in the United Kingdom and many global floods control organisations have recently expressed interest in the stability of vehicles during urban flooding incidents.

Areas that have been flooded might provide challenges in terms of accessibility, which can complicate rescue efforts and cause delays in providing assistance to people who require it. This can increase the risk of fatalities and injuries. This is because floodwaters have the potential to block highways and cause harm to communication equipment, so hindering the effectiveness of emergency response operations.

Besides that, the design, construction, and maintenance of infrastructure, including buildings, roads, and levees, have an impact on the magnitude of damage and level of risk associated with a flood event. The reason for this is that infrastructure that is badly designed or not properly maintained might collapse or malfunction, resulting in injuries, deaths, and challenges in carrying out rescue efforts. With the exception of minor variances, especially in language, the traffic signs in Malaysia closely resemble those found in other countries.

It continues to be believed that an Integrated Smart Alarm System is necessary in flood-prone locations to reduce the fatalities.

CONCLUSIONS

In Malaysia, the occurrences of floods are primarily attributed to inadequate drainage resulting from developmental activity. Data on floods and fatalities from 1970 to 2024 demonstrate a correlation between the rising incidence of floods and the escalating number of fatalities. Research indicates that inadequate drainage systems were the primary source of flooding incidents, particularly in Kuala Lumpur and Selangor. Inadequate or poorly maintained drainage systems in cities can lead to waterlogging. Blocked drains, insufficient drainage capacity, and lack of proper planning contribute to this issue. Accelerated urbanisation frequently results in the development of structures, roadways, and additional infrastructure that diminishes the extent of natural land available for absorption of water. This exacerbates surface runoff, potentially inundating drainage systems. Nonetheless, the impact of a flood will vary by region and in comparison, to individuals who have frequently seen catastrophic flooding events. The principal consequences of flooding include damage to residences and appliances, with some asserting that removing individuals from flood-

prone regions is the foremost strategy for mitigating flood-related losses.

In conclusion, Malaysia's flood history highlights the importance of sustainable development, effective flood management systems, and preparedness strategies. Efforts to mitigate the impact of floods include improving drainage systems, river management, early warning systems, and public awareness campaigns. As Malaysia continues to develop, balancing economic growth with environmental conservation will be crucial in reducing the long-term risks and impacts of flooding in the country.

ACKNOWLEDGEMENT

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DECLARATION OF COMPETING INTEREST

None.

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