Mitigating the Impact of Floods: A Holistic Management Approach to Prevention

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ABSTRACT

Floods can increasingly affect the environment, as they can put life in danger, flood homes and businesses, destroy possessions, harm critical infrastructure, and obstruct access to necessary public services. For example, the flood case at Batu Pahat has become the seventh district in Johor that will increase the number of flood victims over the years. This study aims to identify the key components of the impacts of the flood event. In addition, this study also aims to identify the relationship between community involvement, technological solutions and sustainable practices with the flood impacts. Quantitative methods using a survey questionnaire through Google Forms are divided into five sections: Section A (demographic), Section B (community involvement), Section C (technological solution), Section D (sustainable practices), and Section E (flood impacts). The primary data has been distributed to a total sample of 102 respondents, which consists of UTHM students and the communities around Parit Raja, Johor. SPSS software was used to analyse the respondents' data. The result showed that floods may have a lot of impact, making the communities worried and requiring them to make preparations. This study supports the hypothesis that there is a positive relationship between community involvement, technological solutions and sustainable practices with the flood impacts. This study benefits the communities in Malaysia, as they can have the preparation and resilience to overcome flood events. In addition, the government should plan on how to overcome the issues to prevent flood events and ensure the safety of the communities in Malaysia.

Keywords: Flood Impacts, Community Involvement, Technological Solution, Sustainable Practices

INTRODUCTION

A flood occurs when water overflows onto land that is typically dry, submerging it and causing widespread disruption. It is the most common type of natural disaster and generally results from heavy rainfall, rapid snowmelt, or storm surges triggered by cyclones or tsunamis, particularly in coastal regions.

In Malaysia, floods frequently occur due to cyclical monsoon patterns during the tropical wet season, which typically spans from September to December. In 2024 alone, floods across nine states affected 42,329 families (Malay Mail, 2024). According to the Disaster Information Portal managed by the Department of Social Welfare (JKM), the affected states include Kelantan, Terengganu, Kedah, Perlis, Perak, Negeri Sembilan, Selangor, Melaka, and Johor, spanning 38 districts (Malay Mail, 2024).

Despite the recurring nature of floods in Malaysia, research on their root causes remains limited. While annual flooding events are well-documented, there is still an evident gap in comprehensive strategies to address the

underlying factors. The continued occurrence of floods has resulted in severe consequences, including the displacement of families, destruction of property, and even loss of life.

Given these persistent challenges, this study aims to investigate the effectiveness of an integrated flood prevention approach. Specifically, the research seeks to explore how combining infrastructural, environmental, and community-based strategies can mitigate the economic, social, and environmental impacts of flooding. By addressing the root causes and examining holistic solutions, this study aspires to contribute meaningful insights towards improving flood resilience and risk reduction in Malaysia.

RESEARCH BACKGROUND

Flooding is a natural disaster that has increased in both frequency and severity in recent years, posing substantial risks to communities, infrastructure, and ecosystems globally (World Health Organization, 2021). The consequences of flooding are far-reaching, including loss of life, damage to property, disruption of essential services, and long-term economic, social, and environmental impacts. These challenges underscore the urgent need for comprehensive flood mitigation and prevention measures to protect vulnerable populations and promote sustainable development.

In the Malaysian context, floods represent a recurring threat that significantly disrupts lives and livelihoods, particularly in smaller urban and rural areas. For example, Batu Pahat in Johor has witnessed a rising number of flood victims, emphasizing the necessity for locally tailored and context-specific mitigation strategies. However, current efforts are often fragmented, typically focusing either on structural interventions such as levees or on environmental solutions like reforestation. These approaches tend to overlook the interconnected and multifaceted nature of flood risks.

Recent research advocates for a more integrated approach that combines community-based initiatives, technological advancements, and environmental strategies. Such a comprehensive framework promotes inclusive and sustainable solutions while enhancing community flood resilience. Nevertheless, gaps persist in the existing literature, including the absence of clearly defined frameworks to guide holistic flood mitigation, particularly within the Malaysian setting. Furthermore, limited attention has been given to the specific challenges faced by smaller urban centres in developing countries.

This study seeks to address these gaps by evaluating the effectiveness of integrated flood prevention strategies in mitigating the social, economic, and environmental impacts of flooding. The research will be conducted using a mixed-methods approach, including surveys, questionnaires, and interviews with students from Universiti Tun Hussein Onn Malaysia (UTHM) and members of the surrounding community. Google Forms will serve as the primary tool for data collection, supplemented by semi-structured interviews to capture deeper insights. This study aims to assess the role of community engagement, technological applications, and sustainable practices in reducing flood-related damages.

In summary, flooding presents complex and multifaceted challenges that demand integrated and contextually appropriate solutions. This research underscores the importance of adopting holistic flood risk management strategies, particularly in the Malaysian context. By addressing identified gaps, the study aspires to contribute to enhanced resilience and the development of more effective and sustainable flood prevention frameworks.

Problem Statement

Flooding is one of the most pervasive and devastating natural disasters, impacting millions worldwide each year. It leads to the displacement of communities, destruction of infrastructure, loss of life, and significant socioeconomic and environmental challenges. In Malaysia, recurrent monsoon-induced floods have become a critical concern, with regions such as Batu Pahat in Johor experiencing an increase in flood victims as well as severe damage to their infrastructure and economy. Recent events, such as the 2024 floods that displaced over 42,000 families across nine states, highlighted the growing urgency to address this escalating issue. (Mail, M. 2024)

Despite the existence of flood mitigation initiatives, they frequently lack coordination and fail to address the complex, interconnected nature of flood risks. Although levees and dams are frequently prioritised, structural measures by themselves are unable to offer sustainable solutions. Similarly, environmental approaches such as reforestation are frequently implemented in isolation, without considering their constructive interaction with community-based or technology-based solutions. These fragmented approaches overlook the difficulties encountered by Malaysia's rural and smaller urban areas, where resources for flood recovery and prevention are scarce. In addition, existing research focuses on urban megacities, leaving gaps in our knowledge of how comprehensive flood prevention techniques might be implemented in these neglected areas.

The consequences of inaction are profound and far-reaching. Communities remain vulnerable to recurring floods, which have resulted in increased economic losses, environmental degradation, and diminished resilience to future disasters. In the absence of an all-encompassing, integrated flood control strategy, Malaysia would continue to face severe socio-economic losses and rising reconstruction and recovery expenses.

By investigating the key components of flood impacts, the research provides a foundation for understanding the diverse consequences of flood events. Exploring the role of community involvement underscores the critical need for participatory approaches, while examining technological solutions demonstrates their potential to enhance resilience and preparedness. In addition, analysing sustainable practices emphasises their significance in addressing the root causes of flooding and ensuring long-term prevention.

Concisely, this research seeks to bridge gaps in current flood management practices by integrating social, technological, and environmental insights. It is anticipated that the results will help communities, governments, and other stakeholders adopt more sustainable and comprehensive approaches, which would lessen flood risks and support ecosystems and societies.

Research Objectives

1. To identify the relationship between community involvement with the flood impacts
2. To analyse the relationship between technological solutions with flood impacts
3. To explore the relationship between sustainable practices with the flood impacts

Significance of Research

Understanding the integrated approach to flood prevention is essential to cope with the increasing impacts of flooding in Malaysia. The importance of this study lies in its aim to fill the conceptual, empirical, and geographical gaps in flood risk management strategies, especially in the Malaysian context and smaller urban centres. By assessing the interconnections between community participation, technological solutions and sustainable practices, this study contributes to the development of a robust flood prevention framework.

From a scientific standpoint, this study adds to existing understanding about disaster risk management by investigating the importance of integrated approaches in minimizing floods' diverse repercussions. The study's focus includes hitherto unexplored topics such as constructive interaction between structural and non-structural mitigation techniques, resulting in a more comprehensive understanding of similar situations.

On the practical side, the study will help policymakers, urban planners, and local administrations to develop more effective flood prevention measures. The study emphasizes the enhancement of resilience of flood-prone communities through optimal resource allocation, sustainable infrastructure development and public awareness-raising.

Our social study focuses on small urban and rural populations that are typically disregarded when it comes to resource allocation and flood control. The project's goal is to improve community resilience to floods by examining how integrated flood protection measures are implemented in these areas, as well as to help locals reduce property loss and save lives.

This study not only informs academic research and practical applications to advance the field of flood prevention in Malaysia but also provides practical lessons for other flood-affected countries, thus contributing to the realization of the Sustainable Development Goals. By filling the existing knowledge gap, this study not only reduces flood risk but also promotes ecological balance and social well-being.

SCOPE OF RESEARC

The purpose of this study is to evaluate the effectiveness of holistic flood prevention strategies in mitigating flood impacts. It looks at three core areas: community involvement, technological solutions, and sustainable practices. The respondents for this study include UTHM students, UTHM staff, and members of the local community in Parit Raja and Batu Pahat, Johor. These areas were chosen because of their susceptibility to floods brought on by the monsoon and because they might profit from better preventative measures. Quantitative data was collected through surveys and questionnaires. The data collection was conducted in two phases: an initial survey to understand current flood control techniques and a follow-up survey to understand opinions on the recommended strategies. The use of tools such as Google Forms facilitated data collection.

LITERATURE REVIEW

Flooding is one of the most prevalent and destructive natural disasters globally, severely affecting communities, ecosystems, and infrastructure. In Malaysia, recurring monsoon events have exacerbated the frequency and intensity of floods, particularly during the Northeast Monsoon season. In late November 2024, heavy rainfall triggered widespread flooding in nine states, including Johor, Perak, and Kelantan (Relief Web, 2024). The increasing impact of floods is closely linked to urbanization, climate change, and poor drainage planning (Bibi & Kara, 2023).

This literature review aims to critically examine existing research relevant to the study's framework, which consists of flood impacts as the dependent variable, and three independent variables: community involvement, technological solutions, and sustainable practices. Rather than merely summarising past studies, this review analytically compares findings to identify convergences, contradictions, and research gaps.

FLOOD IMPACT

Flood impacts are multidimensional and include economic losses, social disruption, and environmental degradation. Ritter et al. (2020) categorized flood impacts into three core quantitative indicators: affected population, economic loss, and damage to infrastructure. Diakakis et al. (2020) further nuanced this categorisation into ten severity levels across four domains: built environment, mobile objects, natural ecosystem, and human life.

While Salleh et al. (2024) highlighted the consequences of unregulated human activity (e.g., littering and construction near waterways), Leeonis et al. (2024) underscored the deadly nature of floods in Malaysia, noting that annual monsoon floods affect 22% of the population and damage 9% of the land area.

Several theoretical frameworks inform the understanding of flood impact. Guddo (2023) identified three complementary perspectives: (1) Social Vulnerability Theory, which explains how inequality exacerbates disaster vulnerability; (2) Risk Society Theory, focusing on the management and communication of risk; and (3) Adaptive Governance Theory, which emphasizes institutional flexibility in response to disaster. These theories offer valuable lenses through which to develop holistic mitigation policies.

However, while multiple studies agree on the severity of flood impacts, they differ in their emphasis. For instance, Alviar (2024) focused on displacement statistics and emergency shelter responses, whereas NADMA reports stress fatalities and regional disparities in flood damage. This disparity signals the need for integrated assessments that consider both immediate and long-term consequences.

Research has highlighted the multifaceted nature of flood impacts. For instance, studies by Leeonis et al. (2024) show that flooding is the deadliest natural disaster in Malaysia since it occurs frequently, causing many lives, property losses and ecological harm. The Department of Irrigation and Drainage (DID) estimates that

floods can damage 22% of Malaysia's population (4.82 million) and 9% of its landform zone (29800 km2). The annual monsoon floods have had a significant negative influence on Malaysia since it has lately experienced floods due to heavy monsoon rainfall, which is especially dangerous for the states near the east coast, such as Kelantan, Terengganu, and Pahang. Which are similar to the recent studies by Alviar (2024), shows that the number of displaced people has significantly increased from 7209 to 52360 or 15.7 thousand families on the 28th November 2024, across seven states such as Johor, Kedah, Kelantan, Perak, Perlis, Sarawak, and Terengganu, according to the Agensi Pengurusan Bencana Negara Malaysia (NADMA). Authorities have opened 385 evacuation shelters to aid those who have been affected. Kelantan and Terengganu are the two states most hit, and four flood-related deaths have been reported by NADMA since 27th November 2024.

Community Involvement

Community involvement refers to the active participation of local populations in flood planning, preparedness, and response. Definitions vary: Villarojo et al. (2019) described it as personal engagement in community development, while Niilonga (2024) emphasized empowerment and skill-building to enable community-driven development goals. Rijal (2023) linked community participation to inclusive governance.

Naku (2020) outlined a progression of community involvement theories: from tokenistic contribution to empowerment and collaborative decision-making. This evolution reflects a growing consensus that communities must not only be recipients but also co-creators of disaster solutions.

Empirical findings support this notion. Gonzaga et al. (2024) showed that engagement improves institutional performance. De Weger et al. (2023) identified trends toward relationship-building and practical interventions, while Aberese-Ako et al. (2024) demonstrated the importance of community engagement during Ghana’s COVID-19 response.

However, a pattern emerges across studies: community involvement is often limited to implementation rather than planning. Both Atanga (2019) and Getzzg (2024) reported that lack of communication, insufficient training, and poor coordination often marginalize local actors, thereby reducing the effectiveness of flood mitigation strategies. This consistent finding underlines the need for structured, inclusive participation frameworks that go beyond consultation.

Technological Solution

The second independent variable in this study is technology solutions, defined as an instrument, method, or procedure that applies engineering and scientific ideas to a problem or issue to enhance business agility, react to market demands, and manage technological solutions focus on the fundamental elements of the system that oversee motion control, path planning and decision-making, localization and mapping, and observation and modelling. It also pointed out that the Internet of Things (IoT), cloud computing, robotics, artificial intelligence (AI), augmented reality (AR), big data, and machine learning (ML) are some of the technological solutions employed for this integration. Ruess and Müller (2024) emphasise that when the challenge was changed, the focus of the negotiations process completely changed to a technology solution, both at the expense of the people’s suggestions that a social solution be considered, and the very co-creative process of aligning prototypes with the ideas of the citizens.

Theories of technological solutions emphasize how social variables, user perceptions, and resource availability all affect how technology is adopted and used. According to the research (Mazey & Conger, 2023) shows that there are three technological solutions theories provided and one of the theories is the Technology Adoption Model (TAM), first presented by Fred Davis in 1986, states that a user’s adoption of technology is impacted by how beneficial and simple they believe it to be. Five stages are highlighted by the Diffusion of Innovation Theory (DOI), which examines how inventions proliferate in society, such as information, persuasion, decision-making, execution, and confirmation. Concurrently, the Unified Theory of Acceptance and Use of Technology (UTAUT) integrates many acceptance theories and proposes that social influence, performance expectancy, effort expectancy, and enabling factors all have an impact on technology uptake.

The research provides insightful information about how technology may be used to solve a variety of problems and enhance their lives. According to research from Garrels and Zemliansky (2022), research shows that E-learning platforms' ability to improve student learning outcomes has been the subject of several research projects. Well-designed online courses may offer flexibility, individualized learning experiences, and enhanced student engagement. Next, according to the research from Kokudeva et al. (2024), numerous healthcare applications, including drug development, personalised medicine, and medical imaging analysis, are utilizing AI-powered technologies. Research has indicated encouraging findings in terms of enhancing the precision of diagnosis and the effectiveness of treatment. Finally, according to the research from Houser et al. (2023), it shows that solutions for telemedicine have been more popular, particularly during the COVID-19 epidemic. Telehealth has the potential to increase access to medical treatments, especially in underserved and rural regions, according to studies.

Sustainable Practices

The third independent variable in this study is sustainable practices, defined as measures or tactics intended to lessen the impact on the environment, protect resources, and uphold moral business practices. As Rossoni et al. (2019) pointed out, sustainable practices can be defined as fostering actions, goals, concerns, projects, or environmental protection that benefit the earth and its ecosystem. Karia and Michael (2022) emphasised that the idea behind sustainable practices is the development of environmental goals that benefit individuals and social aspects like living quality and the advantages of social safety for all parties involved, as well as the cosmos. Tennakoon et al. (2024) also emphasised that sustainable practices can be defined as a broad variety of measures, regulations, and tactics intended to reduce the negative effects on the environment, preserve resources and advance sustainable development.

Sustainable practice theories place a strong emphasis on incorporating social, economic, and environmental factors into organizational operations. According to Chang et al. (2017), there are four sustainable practices theories, and one of them is corporate social responsibility (CSR), which integrates legal and economic obligations, guaranteeing adherence to regulations and safeguarding stakeholder rights while advancing sustainable and social growth. Organisations must consider the interests of all people or groups impacted by their decisions, according to stakeholder theory. To achieve long-term corporate success, corporate sustainability takes a comprehensive strategy, considering the effects on the environment, society, and economy. To maintain balance between economic growth and sustainability, green economics promotes integrating economies into the ecosystem and giving social and environmental objectives top priority. When combined, these beliefs support ethical and sustainable business operations.

The research provides insightful information on the rising significance of sustainable practices and how they may affect economic and environmental results. According to research from Lintang Auliya Kurdiati and Apit Fathurohman (2024), this study looks at how high school students in Indonesia are becoming more conscious of sustainability. It draws attention to the growing interest in issues like sustainable consumption, renewable energy, and climate change. Next, according to the research from Bhatti and Sulaiman (2022), this study investigates the connection between Malaysian firms' financial success and sustainability initiatives. It implies that board members who place a high value on sustainability typically do better financially. Finally, according to the research from Hariram et al. (2023), the link between sustainable environmental practices and economic sustainability in the US is the main topic of this study. It investigates the financial effects of implementing sustainable farming methods, waste reduction, and renewable energy.

Past Studies Related Both Variables

The Relationship Between Community Involvement And Flood Impact

The research provides insightful information about how community involvement has a positive relationship with the flood impacts that will solve the prevention. According to research from Atanga (2019), the study shows that community leaders' engagement in flood risk management planning is mostly restricted to execution, leaving a considerable vacuum. The strategy's efficacy and fit were diminished by this omission. Poor coordination, insufficient training, and restricted information availability were major obstacles. As a

result, localised expertise was frequently left out of strategies, which resulted in less successful disaster response and preparation. Next, according to the research from Getzzg (2024), the study indicated that community leaders were largely involved in flood management implementation, with minimal engagement in planning and strategy-making. Barriers such as poor communication, budget restrictions, and insufficient training limited their engagement. This exclusion led to a mismatch between the efficacy of policies. The findings underlined the necessity of incorporating community leaders in decision-making to increase disaster resilience and preparation. Lastly, according to the research by Yunus et al. (2021), the study indicates there is a significant positive relationship between community involvement and the effectiveness of flood disaster mitigation. Successful mitigation initiatives were correlated with a higher level of community involvement, underscoring the need for proactive participation in disaster planning and response.

HI: There is a significant relationship between community involvement with the flood impacts

The Relationship Between Technological Involvement and Flood Impact

The research provides insightful information about how technological solution has a positive relationship with the flood impacts that will solve the prevention. Firstly, according to the research from Ringo et al. (2024) pointed out how flood early warning systems have been successful in lessening the effects of floods in Tanzania's Kilosa District. To increase flood resilience, the study most likely emphasises the need of ongoing investment in these systems as well as the necessity of better communication techniques and more robust community involvement. Secondly, according to the research from Bakhtiari et al. (2023), the study indicates that there is a great deal of promise for enhancing urban flood risk management with digital visualisation technologies like 3D modelling and digital twins. Though there are obstacles to their successful incorporation into urban planning, including data accuracy, technological constraints, and the requirement for interdisciplinary collaboration, these technologies improve flood prediction, risk assessment, and response methods. Lastly, according to the research from Samansiri et al. (2022), they pointed out how cutting-edge technologies like remote sensing, machine learning, and data analytics can improve flood warning systems, leading to more accurate predictions, improved monitoring, and better flood management decision-making. There are still issues with data integration, real-time processing, and accessibility.

H2: There is a significant relationship between technological solutions with the flood impacts

The Relationship Between Sustainable Practices and Flood Impact

The research provides insightful information about how sustainable practices have a positive relationship with the flood impacts that will solve the prevention. Firstly, according to the research from Ferreira et al (2021), the possibilities of NBS as sustainable alternatives to conventional engineering approaches are pointed out, while also stressing issues such as maintenance requirements, costs, and the need for multidisciplinary collaborations in urban planning. Nature-Based Solutions (NBS) such as green roofs, permeable surfaces, and urban wetlands effectively reduce urban flooding while offering additional benefits, including improved biodiversity, enhanced urban aesthetics, and climate control. Next, according to the research from Ibrahim et al. (2023), saying that how SDG9's emphasis on technology innovation and resilient infrastructure may greatly increase Malaysia's flood resistance. For long-term success, they discover that combining flood management techniques with sustainable development methods is essential. To effectively plan for responding to flood hazards, the study emphasises the necessity of SDG 9-aligned polices and technical solutions. Lastly, according to the research from Borah et al. (2023), the study shows that in heavily urbanised areas, green infrastructure, such as urban parks and green roofs, can effectively lower the danger of flooding. Additionally, by offering sustainable flood control alternatives to conventional engineering techniques, these green solutions aid in the preservation of cultural heritage sites. The study emphasizes how crucial it is to integrate historical preservation and flood resistance in urban development.

H3: There is a significant relationship between sustainable practices with the flood impacts

Conceptual Framework and Hypothesis

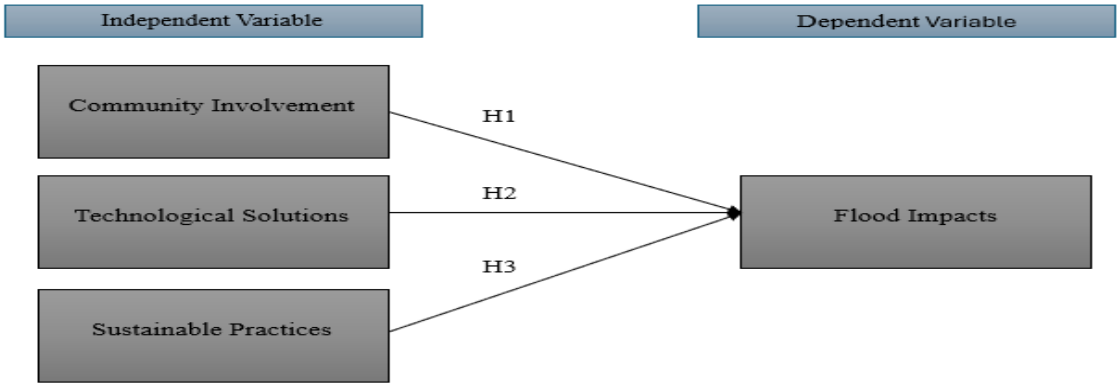

Figure 2.4: Conceptual Framework

HI: There is a significant relationship between community involvement with the flood impacts

H2: There is a significant relationship between technological solutions with the flood impacts

H3: There is a significant relationship between sustainable practices with the flood impacts

METHODOLOGY

This study employs a quantitative research design using a structured questionnaire to examine the relationship between flood impacts (dependent variable) and three independent variables: community involvement, technological solutions, and sustainable practices. The approach facilitates statistical analysis of perceptions and experiences from a targeted population, enabling the identification of patterns and correlations relevant to flood risk mitigation strategies. Flood impacts refer to the measurable consequences of flooding events, including economic losses, environmental degradation, and social disruption. Indicators included loss of property, disruption of daily activities, health risks, and psychological stress. Community involvement is defined as the extent to which individuals and local communities participate in planning, decision-making, preparedness, and response activities related to flood risk. Measured through items assessing participation in community planning, awareness programs, early warning systems, and evacuation drills, using a 5-point Likert scale. Technological solutions refer to the use of digital and engineering innovations (e.g., IoT, flood early warning systems, AI-based predictions) to prevent or mitigate flood-related damage. Sustainable practices involve long-term environmental and planning strategies such as nature-based solutions, responsible waste management, and sustainable urban infrastructure to reduce flood risk. Assessed through items evaluating the adoption of green infrastructure, environmental conservation behaviors, and alignment with sustainable development principles.

Data Collection Process

The target population includes students and community members in Parit Raja and Batu Pahat, Johor, areas that are frequently affected by seasonal floods. A non-probability purposive sampling method was employed due to the need for targeted insights from individuals with potential flood experience. A total of 102 respondents participated in the study. The sample was evenly split between UTHM students and local residents. Participants were recruited via WhatsApp and Facebook using structured invitation messages containing the survey link.

Data collection was conducted in two phases, i) Pilot-test: A pilot test was conducted with a small sample to validate the questionnaire design. ii) Actual Study: The online questionnaire was distributed between November and December 2024. Responses were collected over five days. Ethical considerations have been carefully conducted, which include voluntary participation, informed consent, and data confidentiality.

The collected data were analyzed using SPSS. The following techniques were applied: i) Descriptive Statistics

for demographic and frequency distributions. ii) Reliability Analysis using Cronbach's Alpha to assess internal consistency (threshold $\alpha \geq 0.70$). iii) Normality Tests to determine the distribution of responses. iv) Spearman's Rho Correlation to test hypotheses and examine relationships between variables.

There are several limitations of the study, despite its strengths, for example the use of non-probability sampling limits the generalizability of results. Besides, the limited geographical scope that focuses only on Parit Raja and Batu Pahat, may not represent broader Malaysian contexts.

Data Analysis

Table 1: Profile of Respondents

Socio-Demographic Factors	**No**	**%**	**Socio-Demographic Factors**	**No**	**%**
GENDER			**RACE**		
Male	36	35.3	Malay	63	61.8
Female	66	64.7	Chinese	30	29.4
			Indian	3	2.9
Race			Iban	4	3.9
19 years and below	5	4.9	Bugis	1	1
20-25 years old	55	53.9	Bajau	1	1
26-30 years old	7	6.9			
31-35 years old	11	10.8	**FACULTY**		
36-40 years old	10	9.8	Faculty of Technology Management and Business (FPTP)	35	34.3
41 years old and above	14	13.7	Faculty of Technical and Vocational Education (FPTV)	8	7.8
			Faculty of Engineering Technology (FTK)	1	1
TYPE OF RESPONDENT			Faculty of Applied Science and Technology (FAST)	3	2.9
UTHM Students	51	50	Faculty of Civil Engineering and Built Environment (FKAAB)	1	1
Community	51	50	Faculty of Science Computer and Information Technology (FSKTM)	1	1
			Faculty of Electric and Electronic Engineering (FKEE)	2	2
			Faculty of Mechanical and Manufacturing Engineering (FKMP)	3	2.9
			Others	48	47.1

According to Table 1, most of the respondents are female, with a total of 66 respondents, equalling 64.70%, while the remaining respondents are male, with a total of 36 respondents, equalling 35.30%.

The age group of 19 years old and below have 5 respondents (4.90%), followed by 20 to 25 years old have 55 respondent (53.90%), 26 to 30 years old have 7 respondents (6.90%), 31 to 35 years old have 11 respondents (10.80%), 36 to 40 years old have 10 respondents (9.80%) and 41 years old and above have 14 respondents

(13.70%).

The majority of the respondents are Malay, with the total of 63 respondents equalling to 61.80%, followed by Chinese, with the total of 30 respondents equalling to 29.40%, Indian, with the total of 3 respondents equalling to 2.90%, Iban, with the total of 4 respondents equalling to 3.90%, Bugis, with the total of one respondent equalling to 1.00% and Bajau, also with the total of one respondent equalling to 1.00%.

The vast majority of the respondents are from Faculty of Technology Management and Business (FPTP), with the total of 35 respondents equaling to 34.30%, followed by Faculty of Technical and Vocational Education (FPTV) with the total of 8 respondents equaling to 7.80%, Faculty of Engineering Technology (FTK) with the total of one respondent equaling to 1.00%, Faculty of Applied Science and Technology (FAST) with the total of 3 respondent equaling to 2.90%, Faculty of Civil Engineering and Built Environment (FKAAB) with the total of one respondent equaling to 1.00%, same goes to Faculty of Science Computer and Information Technology (FSKTM) with the total of one respondent equaling to 1.00%, Faculty of Electric and Electronic Engineering (FKEE) with the total of 2 respondent equaling to 2.00%, Faculty of Mechanical and Manufacturing Engineering (FKMP) with the total of 3 respondents equaling to 2.90% and the remaining 48 respondents equaling to 47.10% is the community around Parit Raja.

Many of the respondents are UTHM students, with a total of 51 respondents equaling 50.00%, while the remaining 51 respondents equaling 50.00% are from the communities around Parit Raja.

Table 2: Descriptive Analysis of Dependent and Independent Variables

Descriptive Analysis			
Variables	N	Mean	Standard Deviation
DEPENDENT VARIABLE			
Flood Impact	102	4.564	0.557
INDEPENDENT VARIABLE			
Community Involvement	102	4.238	0.679
Technological Solution	102	4.086	0.778
Sustainable Practices	102	4.273	0.688

According to Table 2, the highest mean is the flood impact (Mean = 4.564, Standard Deviation = 0.557). The second highest mean is the sustainable practices (Mean = 4.273, Standard Deviation = 0.688). The third highest means is community involvement (Mean = 4.238, Standard Deviation = 0.79), and the last is the technological solution (Mean = 4.086, Standard Deviation = 0.778). The levels of the mean range interpretation for all the variables are high.

Table 3: Spearman's rho

Spearman's rho			
Dependent Variable: Flood Impact (Correlation Coefficient = 1.000)			
Independent Variables	N	Correlation Coefficient	Significant Value
Community Involvement	102	0.590	<.001
Technological	102	0.560	<.001

Solution			
Sustainable Practices	102	0.668	<.001

According to Table 3, the Spearman's correlation between community involvement and flood impacts is 0.590, which shows a strong relationship between both variables. The correlation analysis supports a significant positive relationship between community involvement and flood impact, with a p-value of less than 0.001. Next, Spearman's correlation between technological solution and flood impacts is 0.560, which shows a strong relationship between both variables. The correlation analysis supports a significant positive relationship between technological solution and flood impact, with a p-value less than 0.001. Lastly, Spearman's correlation between sustainable practices and flood impacts is 0.668, which shows a strong relationship between both variables. The correlation analysis supports a significant positive relationship between sustainable practices and flood impact, with the p-value being less than 0.001.

Table 4: Hypothesis Testing

Hypothesis	Result		Result Interpretation	Accept or reject
	Standardized Correlation Coefficient	P-Value		
H1	0.590	<.001	Significant	Accept
H2	0.560	<.001	Significant	Accept
H3	0.668	<.001	Significant	Accept

According to Table 4, the summary of the hypothesis testing results in this study is that both variables have a strong relationship, as recorded in the following table above.

FINDINGS

Discussion on the Flood Impact

The first objective of this research was to determine the key components of the impacts of the flood events among the UTHM students and the communities around Parit Raja. Based on the findings, Flood impacts recorded the highest mean score (M = 4.564), highlighting the significant concern regarding property damage, health threats, and disruption of daily activities. According to research by Aldardasawi and Eren (2021), floods constitute a serious threat to people's lives, but they also cause long-term harm to the environment and the mental health of those who are impacted. Sustainable practices (M = 4.273) and community involvement (M = 4.238) were perceived as slightly more impactful than technological solutions (M = 4.086) in managing flood-related risks.

Discussion On The Relationship Between Community Involvement And Flood Impact

The second objective of this research was to identify the relationship between community involvement and the flood impacts. The Spearman's rho correlation coefficient of 0.590 indicates a moderate to strong positive relationship between community involvement and flood impacts. This suggests that greater engagement of communities in flood planning, preparedness, and response is associated with a higher perceived effectiveness in mitigating flood impacts. The p-value of < .001 indicates that the relationship is statistically significant at the 0.01 level, rejecting the null hypothesis of no association. According to the research, Getzzg (2024) pointed out that engaging local people may increase the efficacy of flood prevention techniques. According to the studies conducted in Malaysia, more sustainable and contextually relevant solutions result from involving communities in flood mitigation.

Discussion On The Relationship Between Technological Solution And Flood Impact

The third objective of this research was to analyse the relationship between technological solutions and the flood impacts. The correlation between technological solutions and flood impacts is moderately positive, with a coefficient of 0.560. This implies that increased use and awareness of flood-related technologies (e.g., early warning systems, digital maps) are moderately associated with improved flood preparedness and reduced damages. The result is statistically significant, as evidenced by the p-value of less than 0.001, indicating strong evidence against the null hypothesis. According to research from the International Trade Administration (2023), rising rainfall has made flooding more likely in Malaysia, where catastrophic floods in 2021 caused $1.4 billion in damages. In response to overcoming the floods, state-level programs like Selangor's WARAS and a $3.3 billion Flood Mitigation Plan until 2030 were introduced by the government. Opportunities in flood management technology, such as weather forecasting, infrastructure construction, and stormwater management, are made available to American businesses by these initiatives. Companies interested in working together can contact Malaysia's Commercial Specialists.

Discussion On The Relationship Between Sustainable Practices And Flood Impact

Among all the variables, sustainable practices demonstrated the strongest positive correlation with flood impacts, with a Spearman's rho coefficient of 0.668. This suggests that the implementation of sustainable and nature-based flood prevention measures—such as reforestation, rainwater harvesting, and eco-friendly land use—is strongly associated with lower flood risks and impacts. The highly significant p-value (< .001) further confirms the robustness of this relationship. According to research from Rosmadi et al. (2023), he mentions that for long-term solutions and sustainable development, the flood management plan should not only concentrate on managing the localized flood problem at the specific location but also include nature-based techniques at the overall river basin level

CONCLUSION

Based on the overall findings of this study, it is evident that flood impacts are a major concern, significantly affecting communities and contributing to a range of socio-economic and environmental challenges. The results clearly indicate that flood impacts are positively associated with community involvement, technological solutions, and sustainable practices. These relationships suggest that integrating these elements can enhance resilience and preparedness among UTHM students and the surrounding community in Parit Raja.

PRACTICAL IMPLICATIONS

Considering the increasing frequency and severity of flooding events, it is imperative for the government to take proactive measures to mitigate the impact on communities. One of the foremost suggestions is to enhance public awareness campaigns focused on flood risks and preparedness strategies. By increasing the number and reach of these campaigns, the government can play a crucial role in educating citizens about the potential dangers associated with flooding, as well as the steps they can take to protect themselves and their property.

These campaigns could utilize various platforms, including social media, local radio, and community workshops, to ensure that information is accessible to all demographics. For instance, distributing educational materials that outline emergency procedures, evacuation routes, and safety tips can empower individuals and families to act swiftly and effectively when a flood warning is issued. Furthermore, by fostering a culture of preparedness, communities can develop a collective resilience that not only enhances individual safety but also strengthens the overall response to flooding events.

In addition to awareness campaigns, another vital suggestion is for the government to engage in direct dialogue with community members through interviews and public forums. This approach would facilitate an exchange of ideas and feedback, allowing citizens to voice their concerns, share their experiences, and contribute to the development of flood management strategies. By involving the community in the planning process, the government can gain valuable insights into local vulnerabilities and resources, ensuring that the measures implemented are tailored to the specific needs of each area.

Moreover, these discussions can help build trust between the government and the community, fostering a collaborative spirit that is essential for effective disaster response. By actively listening to the voices of those most affected by flooding, the government can create more comprehensive and inclusive plans that not only address immediate concerns but also promote long-term resilience against future flooding events.

In conclusion, by prioritizing public awareness campaigns and engaging in meaningful dialogue with communities, the government can significantly enhance its flood preparedness efforts. These initiatives not only educate and empower citizens but also create a collaborative framework for developing effective flood management strategies that can save lives and protect property in the face of natural disasters.

POLICY IMPLICATIONS

The findings offer important insights for policy development, particularly in non-metropolitan areas like Parit Raja, which are often underrepresented in national disaster planning.

Empowering Community Participation

The strong correlation between community involvement and flood impact mitigation underlines the need to institutionalize community-led disaster preparedness. Local councils should establish community flood response committees, integrate indigenous knowledge into planning, conduct regular simulation exercises and workshops. As for the Policy Recommendation: Embedding community engagement as a mandatory component in local authority disaster management plans under the National Security Council's Directive No. 20.

Strengthening Technological Integration

While technological solutions scored lower, they still show a strong relationship to impact reduction. However, uptake in rural settings remains limited due to infrastructure and digital literacy. Policy Recommendation to the agencies related, to expand funding for low-cost, scalable early warning systems (e.g., SMS-based alerts), support partnerships with universities (e.g., UTHM) for localized flood modelling tools, and launch public awareness campaigns to build tech confidence in underserved areas

Promoting Sustainable, Nature-Based Solutions

Sustainable practices showed the strongest correlation with reduced flood impact. This reinforces calls for a shift from grey infrastructure (e.g., levees) to green infrastructure like rain gardens, urban wetlands, and reforestation. There are several policy implications that can be recommended: Incentivize nature-based flood solutions in small towns via local government grants, tax rebates for eco-resilient construction, and integration of river basin planning at the district level

These initiatives not only educate and empower citizens but also create a collaborative framework for developing effective flood management strategies that can save lives and protect property in the face of natural disasters.

LIMITATIONS AND SUGGESTIONS FOR FUTURE STUDY

This research has several limitations. Firstly, it is geographically limited to a single region—Parit Johor—which may affect the generalizability of the findings. Future studies should include multiple regions across Malaysia to enable comparative analysis and enhance the validity of the results. Secondly, the study employed a purely quantitative approach using surveys. Future research should adopt a mixed-method approach, combining both quantitative and qualitative techniques, such as interviews or focus groups, to gain deeper insights.

Additionally, the sample was predominantly Malay, female, and within the 20–25 age group, which limits demographic diversity. Future studies should strive for a more balanced sample, including participants from various ethnic groups, age ranges, and rural communities. Lastly, although the target sample size was 100, it

may not be sufficient to reflect the broader population. Future research should involve a larger and more representative sample to improve the accuracy and reliability of the findings.

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