Strengthening Sustainable Development Goals – SDG 9 Concerning Flooding in Malaysia

Emeritus Prof. Dr Mansor Ibrahim[1] & Sharika Tasnim[2]

[1] Department of Urban and Regional Planning, Kulliyyah of Architecture and Environmental Design, International Islamic University Malaysia, Gombak, Selangor, Malaysia

[2] Department of Architecture, Kulliyyah of Architecture and Environmental Design, International Islamic University Malaysia, Gombak, Selangor, Malaysia

Correspondence: Sharika Tasnim, Department of Architecture, Kulliyyah of Architecture and Environmental Design, International Islamic University Malaysia, Gombak, Selangor, Malaysia. E-mail: sharikatasnim11@gmail.com

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Abstract

The Sustainable Development Goals (SDGs), commonly known as the Global Goals, were approved by the United Nations in 2015 as an international call to eradicate poverty, safeguard the environment, and guarantee that by 2030, everyone may live in peace and prosperity. The 17 SDGs are interconnected; they acknowledge that actions in one area will impact others and that sustainable development must balance social, economic, and environmental sustainability. SDG 9 aims to develop resilient infrastructure, advance sustainable industry, and support innovation. This is because economies with a diverse industrial sector and resilient infrastructure suffered less harm and recovered faster. Malaysia experiences flood disasters more frequently than any other ASEAN nation, coming in second after Indonesia. According to a special report on flood impact in Malaysia by the Department of Statistics, overall losses for public assets and infrastructure recorded Rm 2 billion in 2021 and Rm 232.7 million in 2022. Hence, this data reveals that public assets and infrastructure record the highest losses due to flood occurrences in Malaysia. The paper identifies the resilient infrastructure currently existing in Malaysia in response to flooding. The research implements a qualitative approach by examining secondary sources such as studies, print, and online sources. In addition, open-ended questionnaires were used to interview key stakeholders to better understand the situation. This study summarizes that flood-resilient infrastructures require further implementation to safeguard people and the environment. Given the frequency and severity of flooding in Malaysia, it is necessary to concentrate more on SDG 9. Further research is recommended to explore the issues in the implementation of SDG 9 in Malaysia.

Keywords: flood disaster, Malaysia, resilient infrastructure, sustainable development goals, safeguard people, environment

1. Introduction

Implementing the Sustainable Development Goals (SDGs), New Urban Agenda (NUA), and Sendai Framework are some of Malaysia's most imperative international obligations in disaster management (The PLANMalaysia Magazine, 2022). Four of the Sustainable Development Goals (SDGs) place a focus on disaster risk management, including ecosystem protection, access to clean water, adequate sewage systems, resilient infrastructure, sustainable cities and communities, and the idea of resilient cities that can withstand the effects of climate change and natural disasters (Terblanche et al., 2022). A resilient city can recover from a disturbance or disaster and return to its former shape. It represents the city's future based on resilience, flexibility, and transformability (Al-Sayed & Alanizi, 2023). Disaster risk management in the framework of a resilient city implements disaster risk reduction concepts, which encompass four (4) primary areas: prevention, preparedness, response, and recovery (Oyando, 2022). In order to ensure that the goal of a livable nation may be fulfilled cooperatively in line with the agenda of the Prihatin Government, the implementation of iDAM will build holistic contact and collaboration among ministry agencies, state authorities, and local governments. The Malaysian Dayahuni Index (iDAM) framework, which will serve as the source for the implementation of the urban well-being and sustainability evaluation and measurement systems, is being developed by the Ministry of Housing and Local Government (KPKT) through PLANMalaysia (Department of Town and Country Planning). iDAM seeks to be a high-impact measuring technique to assess the public's well-being at

Malaysia's Local Authority (PBT) level (The PLANMalaysia Magazine, 2022).

Sustainable Urban Drainage Systems (SUDS), such as Bio-Ecological Drainage (BIOECODS) are an eco-friendly concept for controlling rain runoff. Methods that can be used include rain gardens, bioswales, constructed wetlands, and bioremediation (Filho & De Vasconcelos, 2022). (MSMA) Edition 2.0, published by the Department of Irrigation and Drainage (DID), should fully apply to all projects and new developments to ensure "zero net runoff" (The PLANMalaysia Magazine, 2022). The drainage system needs to be adapted for existing development, considering the current situation and potential land use. Implementation of rainwater reuse on a large scale can adopt the concept of "Sponge City". Reusing the rainwater absorbed as a public water supply revolves around the idea of "Sponge City". It is a comprehensive approach to managing water cycles in municipalities other than to help mitigate the risk of flash flooding (Koster, 2021; Koster et al., 2019).

Artificial wetlands are built to distil and keep rain runoff. In embracing the idea of low-carbon cities, this space may also be used for recreation and to adopt a low-carbon lifestyle. Green areas, gardens, rivers, ditches, and ponds are interconnected in the neighbourhood, naturally storing and distilling water. In addition, it also encourages biodiversity and creates an area for relaxation, leisure, and cultural settings (Stefanakis, 2019). Flood water can also be stored in a dual-functional structure like a playground. Construction of bioswales and bio retention systems and porous roads and pavements facilitate water run infiltration downland. The drainage system helps runoff flow into the green space for distillation and natural absorption (Garofalo, 2023). However, this effort confronts two challenges: finance management and a lack of local government expertise to organize activities (The PLANMalaysia Magazine, 2022). Rainwater can be stored by constructing lakes, former mines, off-river storage reservoirs (ORS), and dam construction downstream (Coastal Reservoir). A rainwater harvesting system is encouraged (Lani et al., 2018). Water conservation may also be improved through increments in water tariffs, running awareness campaigns, and using the smart monitoring system for identifying leaks and waste water (The PLANMalaysia Magazine, 2022).

National disasters such as floods should not be exhibited as "business as usual" in the present or future. The country has no alternative but to develop urbanized areas and villages comprehensively to accommodate the features of resilient cities and the consequences of climate change. As for the time being, disaster management has been done reactively, with no proactive effort in place to reduce catastrophe risk (The PLANMalaysia Magazine, 2022). As a result, the government was compelled to cover the extra expenditures associated with repairs, reconstructing public facilities and infrastructure, and carrying out follow-up operations following the disaster (Reuters, 2021).

Floods significantly impact Malaysia, affecting a larger population than any other natural disaster. Consequently, it hinders the country from achieving its Sustainable Development Goals (SDGs) through various means (Nurlambang, 2022; Flood Management and Climate Change Adaptation in Malaysia | Department of Economic and Social Affairs, 2030). The lack of flood resilience can potentially undermine or even reverse the progress made towards attaining the SDGs (Echendu & Georgeou, 2021). This study aims to address the flooding issue in Malaysia to achieve Sustainable Development Goal 9. In light of rapid urbanization, it is essential to incorporate resilient infrastructure, and innovation, and research, which are mentioned in Sustainable Development Goal 9. The paper identifies Malaysia's current resilient infrastructures that respond to flooding and highlights the perspectives of key stakeholders on sustainability and flood resiliency. Detailed and reliable information is obtained by adopting a qualitative approach and considering local perspectives with open-ended questionnaires. The results reveal a knowledge gap and a lack of recognition that sustainability can be better achieved by incorporating flood-resilient structures in Malaysia. However, the study concludes with constructive recommendations to further this research, which can help the appropriate authorities implement the most suitable approach to overcome this challenge. The research findings are significant not only for Malaysia but also for other developing countries. By addressing the issue of flooding and achieving Sustainable Development Goal 9, it positively impacts the environment and the lives of people.

2. Literature Review

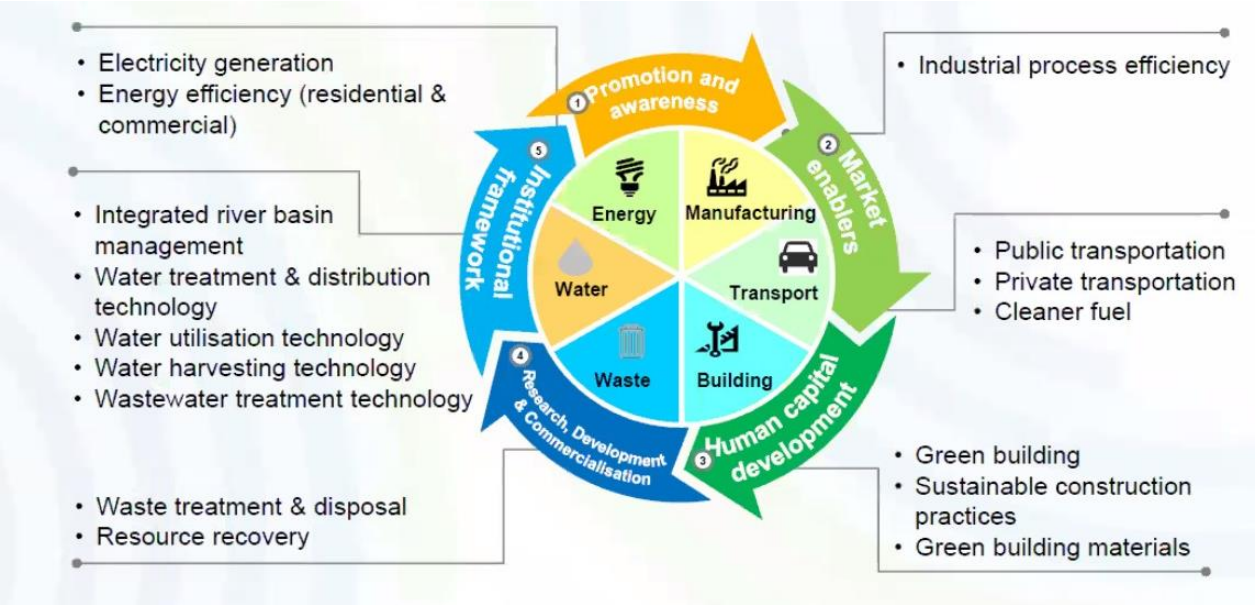

Figure 1. Key areas to facitiate green growth in Malaysia.

Source: Malaysia Green Technology and Climate Change Corporation

The Sustainable Development Goals include Goal 9, which strives to create dependable, sustainable, and resilient infrastructure, both regionally and across borders, to boost economic growth and human well-being. An essential aspect of this goal is ensuring everyone can access affordable infrastructure (Velázquez, 2021; Lee, 2020). Another aim of this goal is to retrofit industries and upgrade infrastructure to make them sustainable, focusing on increasing resource-use efficiency and adopting clean and environmentally friendly technologies and industrial processes by 2030. Countries worldwide are expected to take action based on their respective capabilities. Goal 9 also aims to support domestic technology development, research, and innovation in developing countries by ensuring a favourable policy environment for industrial diversification and value addition to commodities (Faremo, 2015).

Frameworks are some of Malaysia's most imperative international obligations in the area of disaster management. Four of the Sustainable Development Goals (SDGs) place a focus on disaster risk management, including, SDG 6: Clean Water and Sanitation, SDG 9: Industry, Innovation, and Infrastructure, SDG 11: Sustainable Cities and Communities, SDG 15: Life on Land (The PLANMalaysia Magazine, 2022). One of the key themes within the 12th Malaysia Plan (12MP) is 'Advancing Sustainability'. This theme seeks to uphold Malaysia's dedication to international objectives while ensuring the continuation of economic progress. For the establishment of a healthier, more environmentally sustainable, and more socially just Malaysia in the aftermath of the COVID-19 pandemic, this framework is founded upon two transformative principles: integrated water resources management and the circular economy. The main focal points of 12MP encompass green growth and clean and resilient development, particularly advancing sustainability (United Nations Development Programme, 2021).

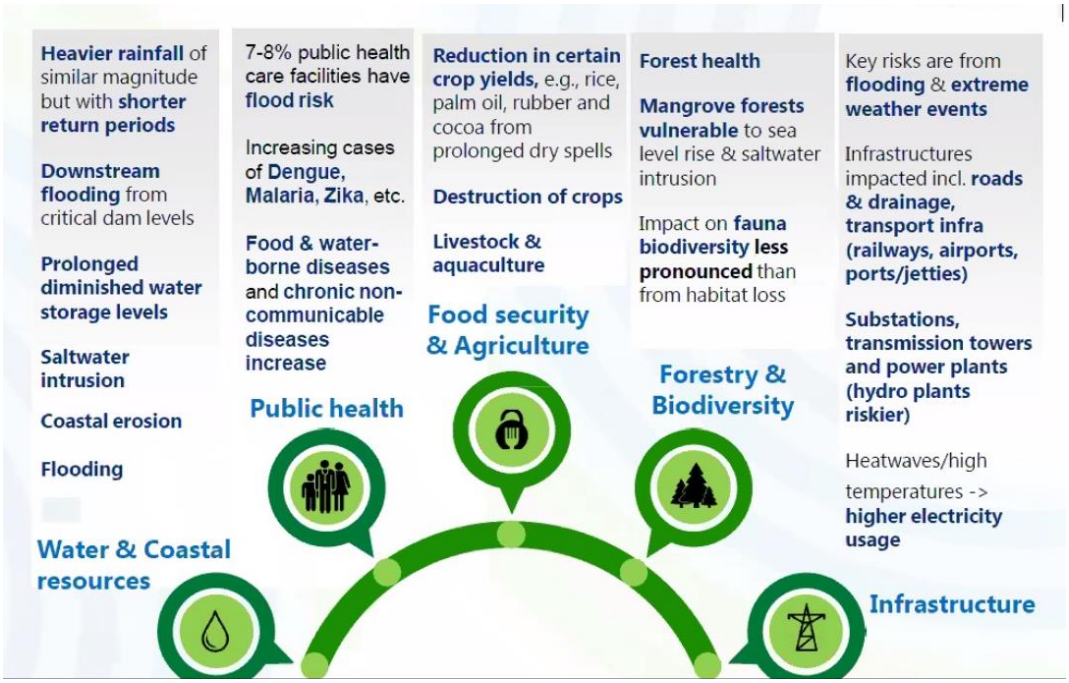

Figure 2. Key risks of infrastructure are from flooding.

Source: Malaysia Green Technology and Climate Change Corporation

Furthermore, the proposed actions outlined in the Fourth National Physical Plan (RFN4) encompass several key strategies, including enhancing preparedness measures, strengthening basin management practices, enhancing coastal resilience, and effectively managing at-risk areas. Accordingly, while flood risk management is not directly aligned with any specific Sustainable Development Goals (SDGs) outlined in Transforming our World: The 2030 Agenda for Sustainable Development by the United Nations (2015), it is intricately interconnected with SDGs related to water management, resilient infrastructure, climate change, sustainable cities and communities, and sustainable utilisation of terrestrial ecosystems (Tasnim et al., 2023). Innovation is crucial in the construction industry and helps promote sustainable building practices (Hwang et al., 2020). This, in turn, supports the United Nations' Sustainable Development Goal 9 (SDG9), which focuses on 'Industry, Innovation, and Infrastructure' ('Transforming Our World: The 2030 Agenda for Sustainable Development | Department of Economic and Social Affairs', n.d.). Therefore, in Malaysia, the achievement of SDG 9 takes on added significance, as it involves managing and mitigating flood-related risks, thereby creating a safer and more sustainable future for all (Mal et al., 2017).

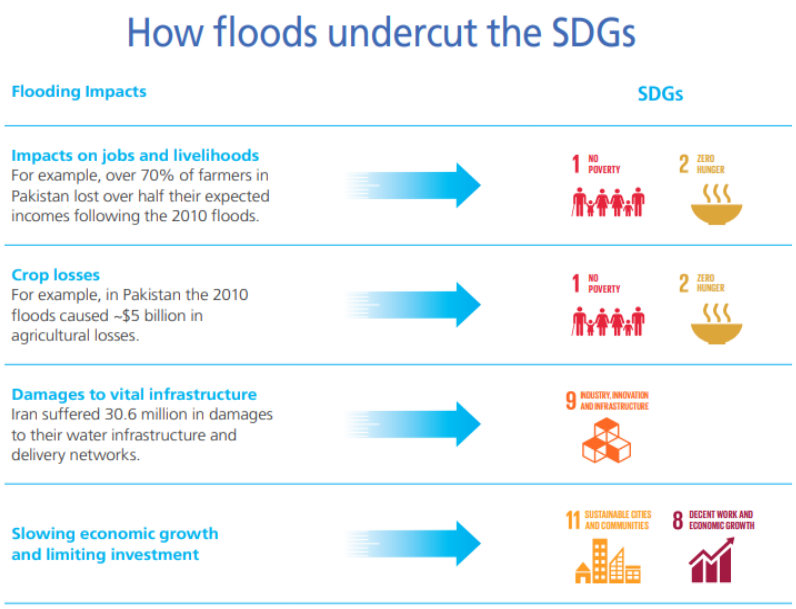

Figure 3. How floods undercut the SDGs.

Source: (How Can Flood Resilience Help Reach the SDGs - Flood Resilience Portal, 2022)

Malaysia experiences one of the world's highest average annual rainfall amounts, with 2,500mm. The increasing frequency of flooding in Malaysia can be attributed to several factors, including heavy rainfall, the effects of global warming, and rapid urbanization (Khalid et al., 2015). Klang, Petaling, and Hulu Langat districts in Selangor state of Malaysia were particularly hard hit by flooding on December 18, 2021, due to their higher population density and urban setting (Onn, 2022). The estimated damages caused by flooding are higher in densely populated urban areas compared to rural areas (Yusmah et al., 2020). For instance, the recent flood incidents in Selangor, Malaysia, from December 18 to 22, 2021, caused damages totalling at least MYR 20 billion (Rosmadi et al., 2023). Chan (1997) found that the likelihood of experiencing severe flood damage is high in densely populated urban areas like Kuala Lumpur, Georgetown, and Pulau Pinang. Heightened flood risks, mainly due to urban development in floodplain areas of major rivers, increase flooding damage (Ahmed, 2018; Tahir, 2022). Flash floods in urban areas are becoming a more serious issue. This is primarily due to removing vegetation, paving, and replacing ground cover with impervious surfaces. These changes lead to increased runoff and the construction of drainage systems that further accelerate the speed of runoff (Multi-Hazard Identification and Risk Assessment: A Cornerstone of the National Mitigation Strategy| National Technical Reports Library - NTIS, 1997). According to a study by Malalgoda et al. (2014), various factors can increase the likelihood of floods, including the impact of climate change, discrepancies between structural designs and potential hazards, insufficient attention to risk management in urban planning, non-compliance with building codes and regulations, and unlawful occupation of high-risk areas.

This hazard could be further exacerbated as urbanisation progresses. In urban areas, urbanisation has increased the susceptibility of the area to the risks of natural hazards (Malalgoda et al., 2013). According to Albrito (2012), in 2008, the urban population surpassed the rural population for the first time. It is projected that by 2050, the urbanisation rate will increase to 70 percent. This increasing urbanisation poses significant challenges, including heightened population density, which places strain on both land and services, leading to settlements in areas susceptible to hazards. The areas also grapple with insufficient capabilities and ambiguous responsibilities for mitigating disaster risks at the local level, as well as ineffective local governance. Inadequate management of water resources, degradation of ecosystems, deterioration of infrastructure and unsafe buildings, lack of coordination among emergency services, and the detrimental impacts of climate change further compound the challenges faced by urban areas (UN-ISDR Annual Report 2012, 2013). Nonetheless, the impact of a disaster that occurs in an urban area extends beyond that specific location and affects the entire country and its population (PWC, 2013). Thus, the impacts of natural disasters on urban areas can be more severe than in other areas (Malalgoda et al., 2013).

Over the past few years, Malaysia has experienced a notable surge in its population. The Malaysian Department of Statistics (2023) reported that the population in Malaysia grew to 33.4 million in 2023 from 32.7 million in 2022. The rapid growth leads to increased property ownership, urban development, and the need for accommodation (Eves

& Wilkinson, 2013). As a result, more flood-prone areas undergo the transformation into viable locations for human settlement. Flood-prone areas in Malaysia include Kelantan, Johor, Pahang, Perak, Kuala Lumpur, Selangor, Sabah, and Sarawak (DID 2007). The growth in property demands and the alterations in water collection and flows, a substandard drainage system, heavy monsoon rainfall, intense convection rainstorms, and other local factors in these areas have led to seasonal floods in Malaysia (Chan, 1995; Eves & Wilkinson, 2013). The frequency and severity of weather events, the ongoing development of settlements in flood-prone areas, and the increasing vulnerability of assets contribute to the growing impacts of floods on housing. However, these parameters may be limited to income, education, occupation, access to resources, and social support systems (Golz et al., 2015).

As Malaysians are heavily reliant on a top-down government-controlled techno-centric approach to flood management, flood risk management (FRM) in Malaysia has been a top-down government responsibility (Ahmed et al., 2018; Aldrich et al., 2015; Chong & Kamarudin, 2018). After the devastating flood in 1971, the Malaysian government took several measures to address the flooding issue. Several initiatives were undertaken, including (i) establishing the permanent flood control commission, (ii) the creation of flood disaster relief machinery, (iii) conducting river basin studies and preparing drainage master plans for major towns, (iv) implementing structural measures, (v) implementing non-structural measures, (vi) establishing flood forecasting and warning systems, and (vii) setting up a nationwide network of hydrological and flood data collection stations (Yusmah et al., 2020). Non-structural methods are proposed when engineering measures are not applicable or viable or when additional measures are needed. Some measures that can address flood risks include restrictions on development, land-use zoning, population resettlement, flood proofing, flood forecasting and warning systems, flood hazard maps, and public awareness campaigns for sustainability (Kundzewicz, 2002; Chan et al., 2019).

Table 1. Existing structural and non-strucutural flood-mitigation measures in Malaysia

Types of Measure	Structural Measures	Non-Structural Measures
Structural Measures Non-structural measures	Flood reservoir in Batu Jinjan (Flood Mitigation—Activities, 2023).	The Kuala Lumpur Multi-Hazard Platform in Malaysia is an innovative forecasting tool for creating a hazard map (The Kuala Lumpur Multi-Hazard Platform for Disaster Resilient Cities – Asian Network on Climate Science and Technology (ANCST), 2023).
	Klang Gates Dam, located in Gombak, Selangor (Chan et al., 2019).	Awareness campaigns (DID, 2006, 2008)
	Flood wall located in Batu Jinjang. (Chan et al., 2019).	Flood-proofing guidelines for buildings with basements (DID, 2006, 2008).
	River improvement has also been carried out in the Kelantan River basin. (Chan et al., 2019).	An Internet-based National Flood Monitoring System (http://infobanjir.moa.my) to provide public access to data on rainfall and water levels (Hussaini, 2007).
	Storm Water Management and Road Tunnel (SMART) in Kuala Lumpur (Umar, 2007)	The National Resource Study (Hussaini, 2007).
		Infrastructure development for a flood forecasting and warning system (Hussaini, 2007).
		The National Flood Monitoring System (Hussaini, 2007).
		Flood Watch (Hussaini, 2007).
		The Urban Storm Water Management Manual for Malaysia (MSMA) (Hussaini, 2007).
		Flood early warning system called the Integrated Atmospheric and Radar Satellite Model-based Rainfall and Flood Forecasting (AMRFF) (Malaysia: National Progress Report on the Implementation of the Hyogo Framework for Action (2011-2013) - Interim, 2012).

Numerous interventions have been implemented to address the consequences of flooding in Southeast Asian countries, including Malaysia (Torti, 2012). Collaboration, coordination, and community engagement have played a crucial role in the success of certain interventions. However, specific interventions have not adequately addressed this population's

needs and require additional attention, action, and improvement (Rosmadi et al., 2023). The study conducted by Ridzuan et al. (2022) highlights a pressing need for improved infrastructure to mitigate flood risks in Malaysia. The research findings reveal that existing infrastructure may not be sufficient to address the challenges posed by floods. Therefore, investments in resilient infrastructure are critical to safeguarding public safety and reducing property damage from flooding. Furthermore, a recent study by Muzamil et al. (2022) supports these recommendations, stating that managing floods in Malaysia faces significant challenges due to poor drainage systems and infrastructure damage. Mngutyo & Ogwuche's (2013) study found that improving infrastructure is crucial to effective flood disaster risk reduction and management. The study conducted by Najib and Ghazali (2019) analyses the Construction Industry Transformation Plan (CITP) implemented by the Malaysian government from 2016 to 2020. The primary objective of this plan is to facilitate a transition within the construction industry towards a more ecologically sustainable framework. This study identifies floods and landslides as the predominant natural disasters in Malaysia, posing significant obstacles to sustainable development, like many other developing countries (Jamshed et al., 2023). Ayog et al. (2017) examined the vulnerability of specific critical infrastructure in a flood-prone catchment area in Sabah, Malaysia. The findings revealed that infrastructure, such as the transport system, experiences the most significant consequences as flood inundation levels rise. Notably, 92% of the respondents believed that transport access should be discontinued when flood depths exceed 0.6m.

Figure 4. Sustainability Targets 2020-2030.

Source: Malaysia Green Technology and Climate Change Corporation

While Malaysia has progressed in managing flood disasters, the country still faces significant losses and damages. (Rosmadi et al., 2023). Also, though the practice of resilient structures has existed for centuries, it has only recently been recognised as an integral component of a comprehensive flood risk management strategy (Proverbs & Lamond, 2017). Flood management is a global challenge due to the rising frequency and severity of floods, insufficient flood risk assessment procedures, inadequate resilient infrastructure and resources, and shifting climate patterns. Therefore, to achieve sustainable flood management, adopting a holistic approach that considers social and environmental factors is imperative (Rosmadi et al., 2023).

3. Method

In this section, the methodology of the research will be discussed. The research aims to investigate and strengthen the implementation of Sustainable Development Goal 9 in relation to flooding in Malaysia. As discussed above, the research will be carried out using a qualitative research methodology. Hence, the research implemented interviews, facilitating open-ended questionnaires with 17 respondents and content analysis. The data collection methods will be highlighted in this section, along with the evidence that will be used to present solutions to the research questions.

3.1 Respondent Characteristics

The key stakeholders, such as local authorities and developers, were selected based on their relevant experiences to ensure a diverse range of perspectives. Respondents were chosen based on their diverse backgrounds, and only those who were willing to participate and had given consent were interviewed for the study.

3.2 Sampling Procedures

For this research, purposive sampling was used to select respondents based on their experience and involvement in flood disasters. This method was chosen to gather data closely related to the research questions. By selecting respondents with expertise and knowledge about flood disasters, their insights become valuable for the study. Furthermore, respondents with direct experience can provide in-depth insights and real-world examples that may not be as readily available to people without such experience. Lastly, the respondent's perspective put on direct involvement in flood disasters enhances the credibility of the research, as their experiences are more likely to be perceived as valid and trustworthy.

3.3 Questionnaire Design

As part of this research, a questionnaire was created to gather comprehensive information on Sustainable Development Goal 9 (SDG 9) and flooding in Malaysia. The questionnaire included open-ended questions: "How do you perceive the current progress in achieving the SDG 9 goals related to flooding?" and "What strategies or initiatives do you believe could enhance the implementation of SDG 9 in the context of flooding?" The majority of the interview questions were open-ended and introspective, with some spontaneous inquiries made during the conversation.

3.4 Ethical Considerations

Respondents are clearly informed of the research purpose, and their personal information is kept confidential for ethical reasons.

3.5 Data Collection

Interviews were conducted with respondents using open-ended questionnaires. Before conducting the interviews, the researchers carefully reviewed the biographies of potential respondents to select the most suitable candidates. Contact information, such as phone numbers and email addresses, was collected for further communication. However, collecting the contact information of multiple respondents proved to be quite challenging. In cases where certain respondents were difficult to access, snowball sampling was employed, where respondents referred researchers to other relevant respondents.

Conducting interviews posed a significant challenge, especially when securing respondents' participation, such as local authorities and developers. To make appointments, the researcher contacted the respondents through WhatsApp, direct calls, or email, according to their preferences. Some interviews were conducted online due to time constraints and the respondents' busy schedules. Each interview lasted between thirty to forty-five minutes. The researchers faced language barrier challenges during the interviews, which were overcome by having a local accompanying them during the interview sessions conducted in Malay. The interviews were conducted in English and Malay and later translated into English, as necessary.

3.6 Data Analysis

After analyzing the recordings, the recurring themes are identified and coded accordingly from the transcribed texts. This process helps to establish a structure for thematic concepts, making it easier to identify patterns and trends within the data. Essentially, the coded themes act as a framework that enables researchers to organize and interpret the information clearly and meaningfully. This approach is advantageous in this research when dealing with large amounts of data or complex topics with multiple themes or sub-themes.

4. Results

The following section presents the organized data obtained from interview sessions, which were analyzed qualitatively. Based on the perspective of local authorities and developers, the following findings were gathered:

'We are more focused on the infrastructure because that is a prominent issue than on the design of the building. The design part has not been developed yet. As a local authority, let us say that a developer comes to submit their plans and their site is in the flood zone; we will give them extra requirements they must follow. We did not make it as mandatory yet. However, in the area where we believe that flooding might affect the residents, we might ask them to build an underground tank or widen their drainage system. Nevertheless, that condition is not mandatory since Shah Alam is not a flood zone area.' (Respondent 1)

Respondent 1 is a senior official working under the local authority.

Government entities, particularly local authorities, have been gradually implementing measures to improve flood resilience in response to floods. The focus is on infrastructure and introducing requirements for developers to consider flood risk when planning new projects.

‘Regarding flood mitigation efforts, the authorities are doing what they can, but it seems insufficient. Developers could help by building bigger waterways or drains and providing retention ponds, but this would be an added cost. I understand their reluctance to do so. To tackle this issue, I believe laws and regulations must be considered to find a win-win solution.’ (Respondent 2)

Respondent 2 is a university professor.

Respondent 2 acknowledges that authorities are trying to mitigate flooding but suggests that these efforts are insufficient. He proposes that developers could contribute to flood mitigation efforts by taking specific actions. These actions include building larger waterways or drains and providing retention ponds within their development projects. Furthermore, he states that developers may hesitate to adopt these flood mitigation measures because of additional costs. Developers typically aim to maximize profits, and investing in flood mitigation infrastructure can be seen as an expense. Respondent 2 highlights a solution that benefits both developers by not overburdening them with costs and the broader community by enhancing flood resilience and reducing the impact of flooding.

‘The local authority must produce a comprehensive guideline and a mitigation strategy if a developer wishes to develop in the flood-prone area. They must justify their decision and ensure the guidelines are detailed enough to follow. In addition to providing approval, they must also include technical requirements.’ (Respondent 3, 4, 5 & 6)

Respondent 3 is an urban planner working under the local authority; Respondent 4 is an engineer working under the local authority; Respondent 5 is an architect working under the local authority and Respondent 6 is a university lecturer.

In areas prone to flooding, local authorities have an important role in regulating and managing development. To achieve this, they must fulfill several responsibilities. Firstly, they must create comprehensive guidelines and regulations that outline the standards and criteria for development in flood-prone areas. These guidelines should consider flood risk assessments, building design standards, elevation requirements, and floodplain management. Additionally, local authorities should have a well-defined flood mitigation strategy, including structural and non-structural measures. This may involve providing flood retention basins, improved drainage systems, and flood-resistant infrastructure.

Developers must adhere to precise technical requirements when planning and constructing buildings in flood-prone areas. These requirements should cover building elevations, flood-resistant materials, foundation design, and flood-proofing measures. The approval process for proposed developments in flood-prone areas must involve thoroughly reviewing design plans, flood risk assessments, and compliance with established guidelines and technical requirements. Local authorities must also have mechanisms to ensure developers comply with approved flood-resilient design and construction plans. Site inspections during construction should verify that flood mitigation measures are implemented correctly. After construction, local authorities should monitor flood mitigation infrastructure to ensure it is well-maintained.

‘I have not seen any published research or seminars on flood-resilient structures in Malaysia. Increasing publications on these floods-resilient designs and potentially executing pilot projects with government approval may be beneficial. It is vital to prioritize factors such as resilience and other measures to improve safety for people.’ (Respondents 7 & 14)

Respondents 7 & 14 are urban planners and architects working under the local authority.

Further research and development are necessary, particularly in urban city design and flood prevention. Respondent 7 indicates a significant gap in research and publications concerning housing and urban city design, specifically flood prevention. This lack of knowledge dissemination could impede progress in creating flood-resilient urban environments. The absence of seminars or educational events on this topic implies that there may be limited awareness and discussion in the professional community and the general public regarding flood-resilience. Moreover, he suggests that government involvement and approval could be crucial in promoting pilot projects and research in this field. Government support can facilitate the implementation of flood-resilient structures on a larger scale.

‘We receive floods yearly in Klang because Klang is downstream, so we have a lot of tidal gates to control tidal river water. A local authority and DID have a plan for doing the mitigation project for flooding. When we try to do the mitigation project, funding is required. For the flood event, we have budget constraints, even though this is a national issue. There are not enough detention ponds or storage catchment areas for which flooding occurs." (Respondent 8)

Respondent 8 is an engineer working under the local authority.

The local authorities and the Department of Irrigation and Drainage (DID) are working together on flood mitigation

projects, highlighting the importance of government agencies in addressing flooding issues. However, one of the main obstacles to these projects is funding. It is clear that flooding is not just a localized problem but a national issue that requires coordinated efforts at the national level to be effectively addressed. Respondent 8 underscores the complex interplay between geographical factors, infrastructure, funding challenges, and the prioritization of resources when managing flood risk in specific regions like Klang, Malaysia.

‘As a developer, I believe in using low-carbon and green building materials to construct green buildings, which can help reduce carbon emissions.'(Respondent 9)

Respondent 9 is a senior official from a developer company.

Respondent 9 prioritizes using low-carbon and green building materials, showing a dedication to environmentally sustainable construction practices that can help reduce carbon emissions and mitigate climate change.

‘We should encourage developers to create a flood-resilient environment and instill this awareness while they are still students. This can be achieved through courses and workshops focused on this issue during their university education. Research and development are also essential for consultants and professionals to adequately address this field. By increasing awareness through education and research, stakeholders can better understand the importance of flood resilience.’ (Respondent 10)

Respondent 10 is a licensed architect.

Respondent 10 emphasizes the significance of education and awareness in promoting flood resilience, especially among developers and students in construction and urban planning. Education plays a crucial role in raising awareness about flood resilience. To encourage developers to create flood-resistant environments, they must have the knowledge, expertise and tools to do so effectively. One effective strategy is to introduce flood resilience concepts during university education. By incorporating courses and workshops focused on flood mitigation and resilience in construction, urban planning, and architecture curricula, future developers can be better prepared to incorporate these principles into their projects.

‘Regarding any development, the developer holds the final decision-making power, as they are investing their funds into the area's development. The developer needs to be informed of potential environmental impacts, and the consultant needs persuasive in advocating flood-resilient structures. Ultimately, the consultant may need to work hard to convince the developer to agree to such measures.’ (Respondents 11 & 12)

Respondent 11 is a university professor, and Respondent 12 is an architect.

Developers who invest in development projects have considerable decision-making authority because they provide the funding. They need to understand the potential environmental impacts of their projects, including the effects on the ecosystem, water management, and flood resilience. This reflects the growing importance of sustainable and environmentally responsible development practices. Consultants, such as architects or engineers, play a critical role. They provide technical expertise and advocate for designs prioritizing flood resilience and environmental considerations. Achieving flood-resilience often requires convincing developers that it is worthwhile despite additional expenses. Consultants must make a persuasive case for the long-term benefits of flood resilience, including reduced damage from floods and increased property value. Developers may prioritize profit maximization, while consultants advocate for sustainability and resilience. Balancing these interests is a challenge in development, requiring effective communication and negotiation between all stakeholders.

‘First, we need to raise awareness about the change and understand SDG 9 goals so that they will never forget that they should incorporate flood-resilient design.'(Respondent 13)

Respondent 13 is an urban planner working under the local authority.

It is important to raise awareness about the Sustainable Development Goals (SDGs) and incorporate flood-resilience early in project planning. This global commitment addresses challenges such as climate change and disaster resilience. Understanding and aligning with the SDGs can guide sustainable and resilient development practices.

Respondent 13 advocates for awareness and understanding of the SDGs as a key strategy for mitigating flood-related risks. When planners, architects, and developers are familiar with these goals, they are more likely to incorporate flood-resilient measures into their designs, ultimately reducing vulnerabilities. He highlights the need for a proactive and enduring approach to flood resilience by embedding awareness of the SDGs into development projects. This aligns with broader global sustainability goals and seeks to prevent and reduce the impacts of flooding through informed and deliberate design choices.

‘As a township developer in Shah Alam, our primary focus and allocation of resources currently revolve around the following areas:design against global warming, design for energy sustainability, design for natural lighting and cross ventilation, and reducing carbon footprint in the built environment. Considering our existing commitments and the urgency of these pressing matters, we have decided to prioritize these initiatives over flood-resilience.’ (Respondent 15)

Respondent 15 is working for a developer company.

Respondent 15 mentions that they have prioritized the issues of global warming, energy sustainability, natural lighting, cross ventilation, and reducing the carbon footprint as more urgent and significant in their urban development projects. This decision likely reflects disregarding flood resilience which is one of the most pressing environmental and sustainability concerns in Malaysia.

“It is contested that the developer only thinks about the economic benefits. For example, if the residential buildings are on stilts, there is more protection, but the extra cost is a barrier. Then the government may give more subsidies and offer more incentives.’ (Respondent 16)

Respondent 16 is a senior government official associated with flood management in Malaysia.

Offering homeowners financial incentives and subsidies can encourage them to invest in flood-resistant measures. These incentives may be tax rebates, low-interest loans, grants, or subsidies tailored to flood resilience enhancements.

‘To achieve sustainable development goals, incorporating flood resilient infrastructures should be a top priority in Malaysia.’ (Respondent 17)

Respondent 17 is a university professor.

Malaysia is a country that is prone to flooding. As such, to achieve sustainable development goals, it is imperative to incorporate flood-resilient infrastructure. This means developing infrastructure that can withstand floods, such as elevated roads and buildings, and effective drainage systems that can handle high volumes of water. By prioritizing the incorporation of flood-resilient infrastructure, Malaysia can not only address the immediate challenges posed by flooding but also work towards long-term sustainable development that benefits its citizens and the economy.

5. Discussion

The interview garnered a variety of perspectives on strengthening flood resilience to achieve Sustainable Development Goal 9. While some respondents noted limitations in recognition and funding for this issue, others highlighted the potential for a win-win situation by making flood resilience a requirement. Those who emphasized the need for increased funding and recognition pointed out that flood resilience is often overlooked in broader sustainable development discussions. Government policies, incentives for sustainable construction, and partnerships with NGOs, industry experts, and local communities can significantly contribute to realising Malaysia's vision for achieving the Sustainable Development Goals. Additionally, respondents agreed on the importance of local authorities in creating comprehensive guidelines and technical requirements for developers. They noted that effective regulations and guidelines are necessary to ensure developers prioritize flood resilience in their projects. Education and awareness were also highlighted as crucial in promoting flood resiliency to achieve Sustainable Development Goal 9, with respondents suggesting that public campaigns and seminars could help raise awareness and promote the adoption of flood-resilient structures.

Respondents also emphasized the significant role that developers and consultants play in advocating for flood-resilience. Developers were seen as key decision-makers, and their decisions could significantly impact the success or failure of flood resilience efforts. Consultants were also seen as important advocates for flood resilience, as they possess the technical expertise and knowledge needed to design and implement effective flood-resilient structures. While opinions varied on the priority of flood resilience within the broader sustainable development framework, there was a consensus on the need for increased awareness, education, and potential regulations. Respondents suggested that research, pilot projects, and seminars could help to address the significant gap in knowledge and awareness of flood-resilient structures. Overall, the responses underscore the importance of clear recognition that flood resilience in Malaysia is vital to achieving Sustainable Development Goal 9. Incorporating flood resilience into the broader sustainable development framework and emphasizing the potential benefits can help stakeholders work together to create a more resilient and sustainable future for all.

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