

Flood Resilience Strategies of Relief Shelter at Flood-Prone Region in Kota Bharu

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Abstract

Flood is the most significant natural hazard in Malaysia, which occurs nearly every year. This resulted in the people being evacuated to relief shelters. The situation at relief shelters makes it difficult for the victim to change clothes, and there is no privacy, especially when it involves men and women. Currently, there is a lack of facilities and appropriate shelter for the flood victims; hence, there is a need to revise flood-resilient strategies for relief shelter for the future community in Kota Bharu. Therefore, this research focused on how non-governmental organizations (NGOs)/National Disaster Management Agency (NADMA) decide on providing suitable flood-resilient strategies for the relief shelters that can respond effectively in all flood-prone areas for the community at Kota Bharu. This research used qualitative methodology through in-depth interviews and desk reviews. The findings derived suitable flood resilience strategies for relief shelter for the community that can be applied overall in Kota Bharu. This study will contribute to a better method and long-term solution to help the government, NGOs, and the community in Kota Bharu. Future research can explore more flood-resilient strategies in other shelters that can be applied at the Kota Bharu for the local community.

Keywords: Flood, Flood-Resilient Strategies, Relief Shelters.

Introduction

The study conducted by Abid et al. (2021) sheds light on the urgent need for the Malaysian government to incorporate international disaster risk reduction (DRR) strategies into its national policy framework. The impacts of climate change, particularly floods, have severely affected various regions of the country, hindering socio-economic growth and sustainable development. Flood-prone areas, such as floodplains and deltas, are particularly vulnerable, as they provide favorable conditions for habitation and economic activities but also face the constant threat of natural disasters. This necessitates the adoption of proactive measures to address flood risks and enhance resilience.

One key finding is the correlation between economic growth and increased flood risks. As economic development progresses, investments and property values rise, resulting in higher potential damages in the event of a flood. Traditional flood control measures, such as raising dikes and building embankments, may inadvertently increase the risks by altering flood patterns and exacerbating potential flood depths. This was evident during the severe floods in Sri Muda Shah Alam in November 2022, where heavy rains led to tragic consequences. Hence, it is crucial to strike a balance between economic development and effective flood risk management to ensure the well-being and safety of communities.

The study highlights the importance of integrating DRR into national and local policies and strategies, aligning with the United Nations International Strategy for Disaster Reduction (UNISDR) recommendations. Collaboration between states, local authorities, and communities is essential for developing and implementing comprehensive DRR policies that reduce vulnerabilities, hazards, and the unfolding impacts of disasters. Moreover, local knowledge and practices play a vital role in disaster resilience, and it is crucial to involve and empower disadvantaged communities in the decision-making process.

Efforts to mitigate flood risks have historically focused on river training and embankment construction. However, alternative approaches that focus on minimizing the effects of flooding and adopting resilience strategies have gained recognition. These strategies emphasize risk management rather than hazard control and often involve adapting land use to mitigate negative impacts. In addition, effective DRR policies require coordination among various authorities, including military and civil protection agencies. However, addressing concerns regarding top-down approaches and fostering trust between policymakers and local communities is essential to ensure inclusivity and the incorporation of local knowledge.

The vulnerability of communities to floods and the damages incurred by both infrastructure and personal property further highlight the need for comprehensive flood resilience measures. Inadequate facilities and limited resources at evacuation centers pose challenges for affected individuals, compromising their privacy, comfort, and well-being. The government should prioritize providing sufficient amenities, such as beds, pillows, blankets, restrooms, and private spaces, to ensure the safety and dignity of those seeking shelter during floods. Furthermore, proper infrastructure maintenance, including telecommunication, water supply, power supply, roads, and drainage systems, is crucial for minimizing damage and facilitating post-flood recovery.

The research gap identified in previous studies calls for the development of flood resilience measures specifically tailored to relief shelters in Kota Bharu. By focusing on the architectural design framework and incorporating local knowledge, this study aims to improve the flood resistance and effectiveness of relief shelters. The findings will provide valuable insights for both the Kota Bharu community and government and non-governmental organizations (NGOs) in Malaysia. Thus, implementing the recommendations derived from this research can enhance flood resilience plans, relief shelters, and overall disaster response and recovery efforts, ensuring the safety and well-being of the affected populations in Kota Bharu and beyond.

This study has significantly benefited both governmental organizations like the National Disaster Management Agency (NADMA) and NGOs like Mercy. Policymakers and other

stakeholders can benefit from the study's conclusions by creating improved building and material standards for emergency shelters. As a result, it will be possible to guarantee that the emergency shelters have high-quality building standards and materials that effectively reduce the threats that Kota Bharu's flooding poses. Accordingly, disaster response and relief activities would be more effective and efficient, lessening the impact of floods on the impacted populations. Nevertheless, the Kota Bharu community, as well as the government and NGOs in Malaysia, stand to gain significantly from this research as it offers insights and recommendations that might enhance flood resilience plans and relief shelters in the area.

Literature Review

Flood resilience is crucial for flood-affected individuals and communities to prevent, endure, and recover from flooding disasters. It encompasses a range of actions, such as physical infrastructure, community mobilization, and individual preparedness. However, Malaysia faces human and institutional resilience challenges, including a lack of local awareness and preparedness. Hence, there is a need to build resilience by implementing both structural and non-structural flood mitigation methods and improving disaster risk management.

Flood resilience is closely linked to the Sustainable Development Goals (SDGs) set by the United Nations. SDG 11 focuses on creating inclusive, secure, resilient, and sustainable cities and human settlements, while SDG 13 emphasizes taking immediate action to prevent climate change and its effects, including floods. In addition, achieving flood resilience requires a comprehensive strategy that considers environmental, social, economic, and physical elements. It involves resilient infrastructure development, robust urban design, improved social and economic resilience, and ecosystem preservation and restoration.

Measures to reduce flood risks include both structural and non-structural approaches. Structural measures involve physical infrastructure such as barriers, flood walls, and drainage systems. Non-structural measures include laws, regulations, and education aimed at raising awareness and promoting behavior change related to flood risk. A multidisciplinary approach involving various stakeholders is necessary for effective flood risk reduction. Thus, incorporating cutting-edge technology and innovative practices is important for long-term sustainability in reducing flood vulnerability.

The study emphasizes the importance of factors such as self-efficacy, coping mechanisms, sense of community, and social support in determining the resilience of flood victims. Enhancing these characteristics can increase the resilience of individuals and communities. Providing emotional and informational support, material assistance, and social connections can aid in the recovery and well-being of flood victims. Community networks and social cohesion are vital in building resilience to floods and other disasters.

The theoretical framework on flood-resilient strategies for relief shelters highlights the need to assess public spaces based on minimal shelter design requirements. This assessment considers factors such as layout, location, accessibility to essential necessities, and inclusivity for people with disabilities. Design principles that optimize public space utilization and consider spatial quality and human senses are crucial for the well-being of flood victims. Effective management of evacuation centers is also essential, as many existing facilities are ill-prepared to handle flood disasters.

In summary, building flood resilience is essential for flood-affected individuals and communities. It involves addressing challenges related to awareness, preparedness, and infrastructure. The SDGs provide a framework for integrating flood resilience into broader development objectives. The implementation of structural and non-structural measures,

along with community engagement and support, is crucial for reducing flood risks. Additionally, attention should be given to the design and management of relief shelters to effectively support flood victims. Further research is required to develop more comprehensive strategies for flood resilience in relief shelter settings.

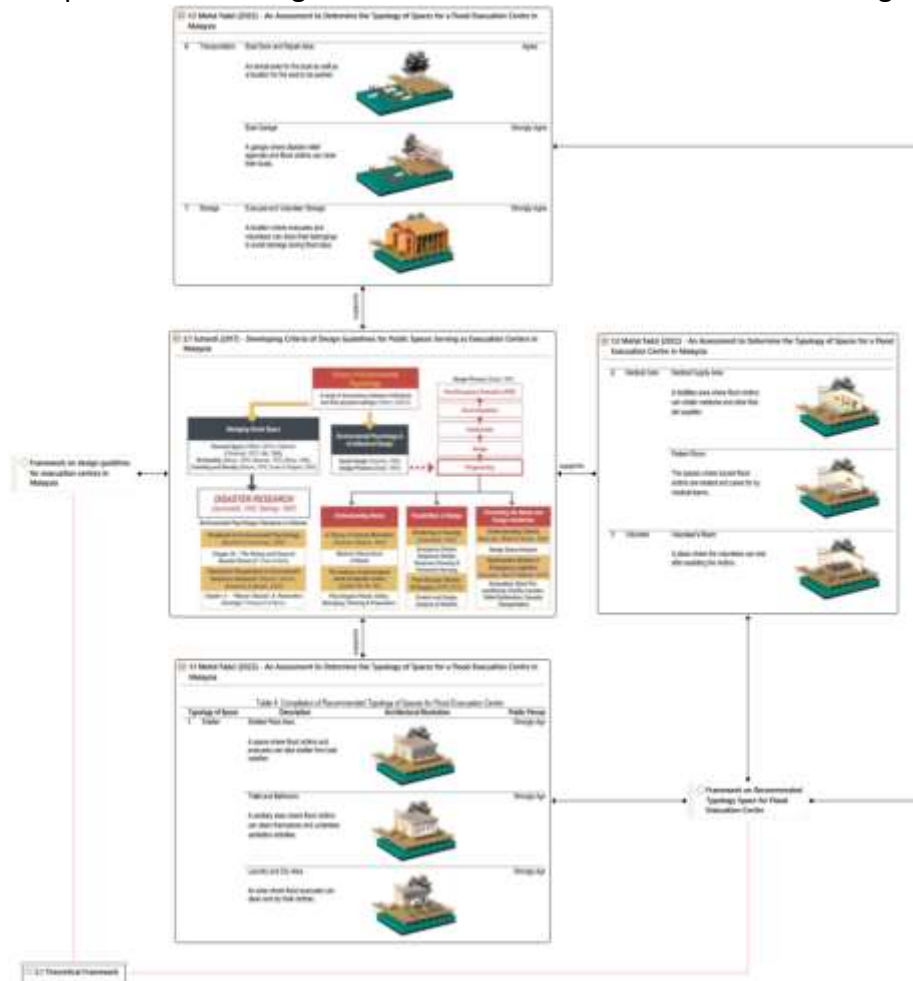


Figure 1: Theoretical Framework on Flood-Resilient Strategies of A Relief Shelter
Source: Author

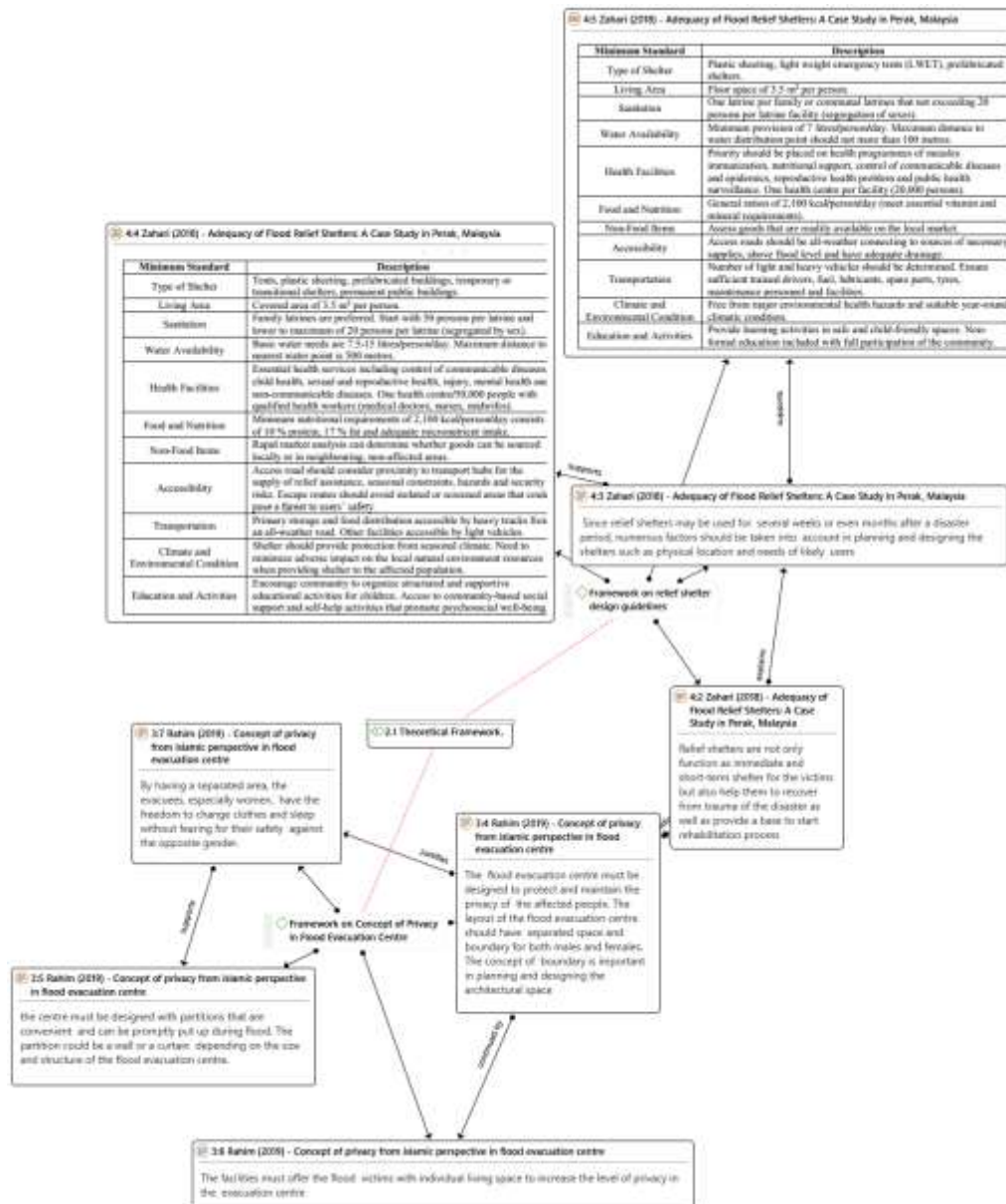


Figure 2: Theoretical Framework on Flood-Resilient Strategies of A Relief Shelter
 Source: Author

Flood-resilient design, material use, and construction techniques are crucial in addressing the challenges posed by floods. Structures need to be developed with flood resilience in mind, employing materials that can withstand flood events and designing them to recover quickly. Additionally, novel approaches like amphibious buildings and eco-friendly design principles have been proposed to tackle environmental issues in flood-prone areas, taking into account the social, cultural, and religious aspects of architectural blueprints. Cost-effective solutions using locally available materials are essential to ensure that flood-resistant housing is accessible to all, including those with low incomes.

Urban flood resilience and risk reduction strategies significantly mitigate the impacts of floods on cities and communities. These strategies involve comprehensive measures such as land-use planning, early warning systems, and flood protection infrastructure to reduce the likelihood of flood events and minimize their effects. Moreover, interactive 3D urban design platforms and rule-based modeling have emerged as valuable tools for improving decision-

making processes, enabling designers and urban planners to create resilient designs considering potential flood risks. Resilience-based strategies promote adaptive measures that coexist with floods, fostering environmental adaptation and enhancing the long-term viability of flood risk reduction initiatives.

Flood resilience can be achieved at the neighborhood level through effective neighborhood planning. Incorporating urban design, green infrastructure, and stormwater management techniques can help reduce flood risk in communities. Design elements such as permeable surfaces, green roofs, and emergency response plans contribute to community resilience and overall social well-being. It is crucial to involve stakeholders and consider the local environment during the planning process to create flood-resistant neighborhoods that address the specific needs and values of the community.

In exploring international practices, amphibious houses have gained attention as a flood-resistant housing solution. These houses are designed to coexist with water by utilizing buoyancy principles, allowing them to float during flood events. Using lightweight materials and buoyant foundations, the structures can adapt to fluctuating water levels. However, further research is needed to identify practical flood resilience measures specifically for relief shelters. It is important to study and develop comprehensive instructions and resources that address the unique challenges faced by relief shelters in flood-prone areas, ensuring their resilience and effectiveness in providing safety and support during flood events.

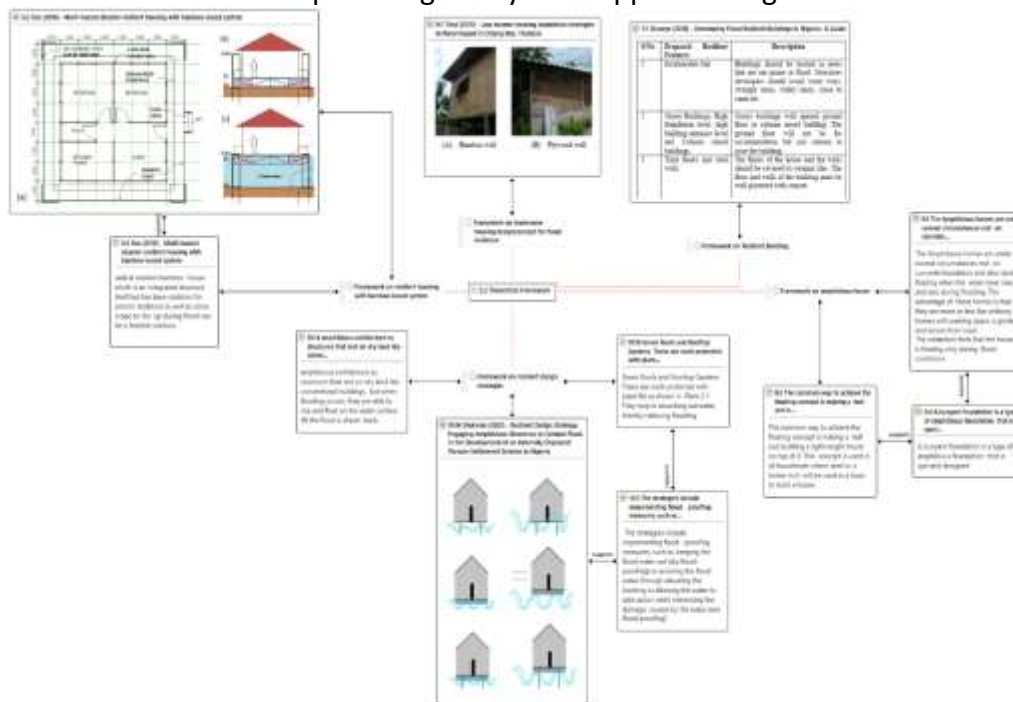


Figure 3: Theoretical Framework on the International Practices of Flood-Resilient Strategies of A Relief Shelter.

Source: Author

Method

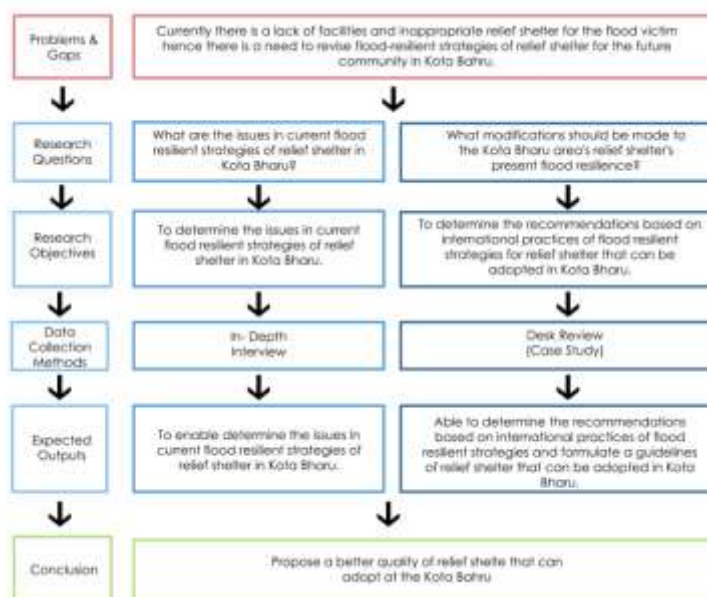


Figure 4: Data Collection Framework

Source: Author

This research focuses on individuals with expertise and experience in managing relief shelters in flood-prone areas of Kota Bharu. To ensure that the sample represents individuals who can provide valuable insights and information, purposive sampling is employed. This sampling technique enables the selection of participants based on specific characteristics or expertise relevant to the research topic. Using purposive sampling, the study aims to capture a targeted and focused perspective that aligns with the research objectives.

A qualitative research design is employed in this study to understand the most effective flood-resilient tactics for relief shelters in all flood-prone locations within the Kota Bharu community. The research question is addressed through in-depth interviews with three informants: representatives from the Kelantan State Civil Defence Force (JKMNK), the NGOs Mercy, and NADMA. These informants, who have been involved in flood relief shelter operations, can provide valuable insights and information on sensitive topics.

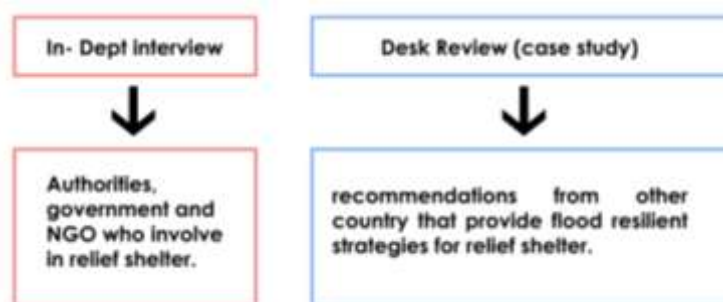


Figure 5: Data Collection Method Used

Source: Author

For research question 1, in-depth interviews serve as the data collection approach or instrument. These interviews aim to determine the issues in current flood-resilient strategies of relief shelter in Kota Bharu.

To address research question 2, a desk review data collection method is utilized. This involves examining existing literature, reports, and relevant documents to gather information and insights related to the research topic. The desk review focuses on selecting case studies that closely align with the criteria and context of Kota Bharu. By analyzing these desk reviews, the research aims to identify similarities, patterns, and relevant strategies implemented in similar contexts. Furthermore, the findings from the desk review will contribute to a comprehensive understanding of flood-resilient strategies and inform recommendations specifically tailored to the context of Kota Bharu. The desk review serves as a valuable source of secondary data, providing a broader perspective and facilitating a comprehensive analysis of flood-resilient strategies beyond the specific context of Kota Bharu. The included case studies offer practical examples and lessons that can be applied to enhance flood resilience strategies in Kota Bharu.

Result and Discussion

Table 1

Thematic Analysis

Main Research Question: How do NGOs/governments decide on applying suitable flood-resilient strategies for the relief shelters that respond effectively in flood-prone areas for the community in Kota Bharu?

Aim of the research: Formulate a design framework for designing suitable flood-resilient strategies for relief shelters that can respond effectively in terms of design/ architecture at flood-prone areas in Kota Bharu.

Informants: NGOs (MERCY), Government (NADMA), (MPKBRI) Local Authority Kelantan.

Sub Research Questions	Deductive codes / Theories	Strategy of Inquiry	Inductive codes Coding	Final theme
Sub RQ 1: What are the current flood-resilient strategies for the Kota Bharu community?	DC 1: Flood-resilient strategies of relief shelter.	In-depth Interviews.	Flood-resilient strategies of relief shelter. Location Accessibility Cost Saving Relationship Good Communication Material Modular Shelter Early Preparedness Current Shelter	Theme 1: Connectivity Theme 2: Construction Theme 3: Social and community Theme 4: Preparedness

Source: Author

The interview results revealed important insights regarding flood-resilient strategies for relief shelters. As provided in Table 4.0 and Figure 4.0, based on the thematic analysis, the first theme aspect is "Connectivity - Location and Accessibility," emphasizing the strategic consideration of shelter location and convenient accessibility for both victims and volunteers?

The experts highlighted the need to assess and optimize shelter placement in flood-prone areas, ensuring easy access during emergencies.

The second theme, "Construction," focused on four key elements: current shelter, cost, materials, and modular shelter. The existing shelter infrastructure was discovered to be insufficient, with temporary tent-like structures being the primary solution. Cost-saving measures and the use of durable and lightweight materials were emphasized, along with the potential benefits of modular shelters that can be easily adapted to community needs.

The third theme, "Social and Community," explored the challenges related to communication and relationships within flood-affected communities. Effective communication and information dissemination during emergencies were perceived as crucial, and fostering positive relationships within the community was identified as a key aspect of building resilience.

The fourth theme, "Preparedness," highlighted the significance of early planning and proactive measures in mitigating flood impacts. Early preparedness through early warning systems, evacuation plans, community training, and awareness campaigns emerged as essential strategies to reduce vulnerabilities and enhance the response and recovery from flood events.

Overall, the interview results underscored the importance of considering location and accessibility, improving construction methods and materials, addressing communication challenges, fostering community relationships, and implementing early preparedness measures to enhance flood resilience in relief shelters.

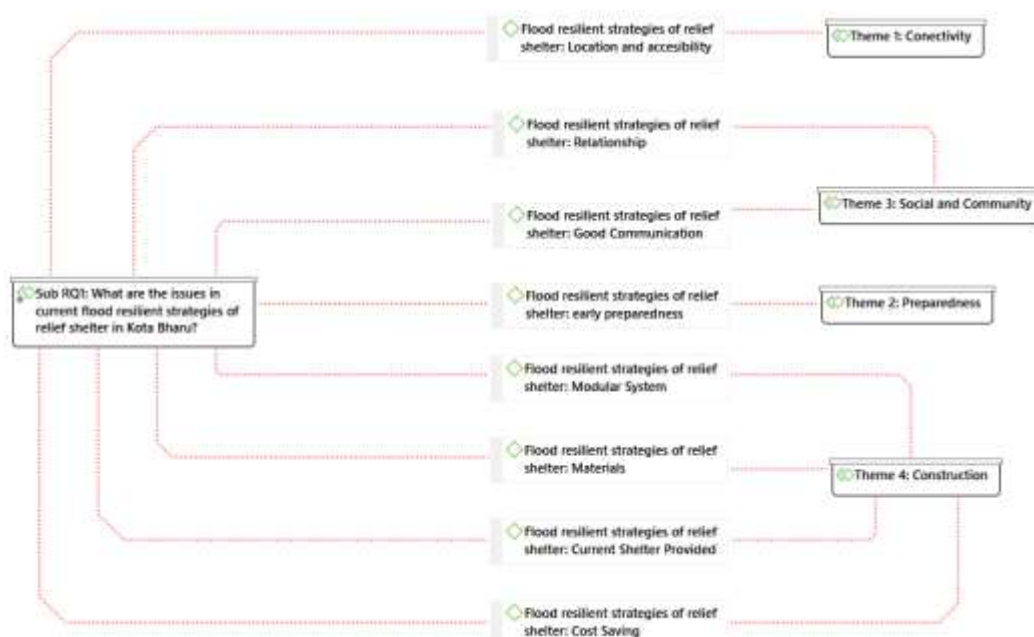


Figure 6. Network of Theme sub RQ1

Source: Author

Table 2

Comparative Analysis of Desk Review

Criteria	Review 1 Hex House	Review 2 Living Capsule	Review 3 Onagawa Container Temporary Shelter
Cost Saving	Need	Need	Need
Modular	Yes	Yes	Yes
Sustainability	Yes	Yes	Yes
Material	Light Weight	Light Weight	-
Unit Space	Considered (can extended)	Considered (limited)	Considered (based on the number of families)
Easy assembly	Yes	Yes	-
Overview	The flexibility of the relief shelter is an important consideration in the design process, particularly when it comes to incorporating the necessary spaces. This aspect is closely tied to the overall flood-resilient strategy for relief shelters. By ensuring adaptability and versatility, the shelter can effectively respond to the evolving needs of the affected population during and after a crisis.	Integrating sustainability into the flood-resilient strategy for relief shelters is paramount, as it ensures the longevity and effectiveness of these structures in supporting victims over time. By incorporating sustainable design principles, materials, and practices, relief shelters can be built to withstand multiple flood events and provide ongoing support to affected individuals.	Furthermore, the study puts forth recommendations for incorporating additional essential spaces within relief shelters. This aspect is crucial in the context of flood-resilient strategies for relief shelters. By acknowledging and addressing the specific needs of individuals impacted by floods, these proposed spaces aim to strengthen the overall resilience and efficacy of shelter designs.

Source: Author

According to the desk review comparison based on Table 4.1, Hex House, Living Capsule, and Onagawa Container Temporary Shelter all three were affordable, adaptable, and environmentally friendly. Light materials were used to construct the hex house and living capsule. All three types were taken into consideration when looking at unit space. In terms of ease of assembly, the Hex house and living capsule were both simple to put together. When giving an overview, flexibility is essential in the design of relief Hex house shelters, including the inclusion of necessary areas and enabling flood-resilient strategy to respond successfully to changing needs during and after disasters. Incorporating sustainable design ideas, materials, and practices into a flood-resilient strategy, as seen in the living capsule, provides

shelter efficacy, longevity, and long-term care for victims. Hence, incorporating crucial places in relief shelters to suit individual and specialized needs would increase flood resistance and efficacy for the Onagawa container temporary shelter.

Table 3

Comparative Analysis Interview and Desk Review

<i>The key term of the design framework of flood-resilient strategy on relief shelter.</i>	<i>Coding identifies in an analysis of interview</i>	<i>Criteria identified in desk review.</i>
<i>Location and Accessibility</i>	Consider but less	-
<i>Type Of Families Space Shelter</i>	No Consider	Yes
<i>Resilience and Adaptability in the Future</i>	No	Yes
<i>Material Selection</i>	Yes, but not efficient	Yes, all are lightweight materials, but each study of the material is different.
<i>Modular and Prefabricated Construction</i>	Should	Yes
<i>Cost</i>	Yes	Yes
<i>Passive Design Strategies</i>	No Consider	Yes
<i>Building Envelope</i>	Without	With
<i>Good Community Engagement</i>	Yes, but less	Yes

Source: Author

Table 4.2 serves as a comprehensive comparison, integrating the conceptual framework, data analysis, and the identified similarities. It demonstrates a cohesive relationship between the key terms highlighted in the conceptual framework, the coding identified during the interview analysis, and the criteria identified during the desk review analysis. By mapping out these connections, the table offers a detailed understanding of how these elements align and reinforce each other within the research context. In addition, it provides a robust foundation for drawing meaningful conclusions and gaining valuable insights from the collected data.

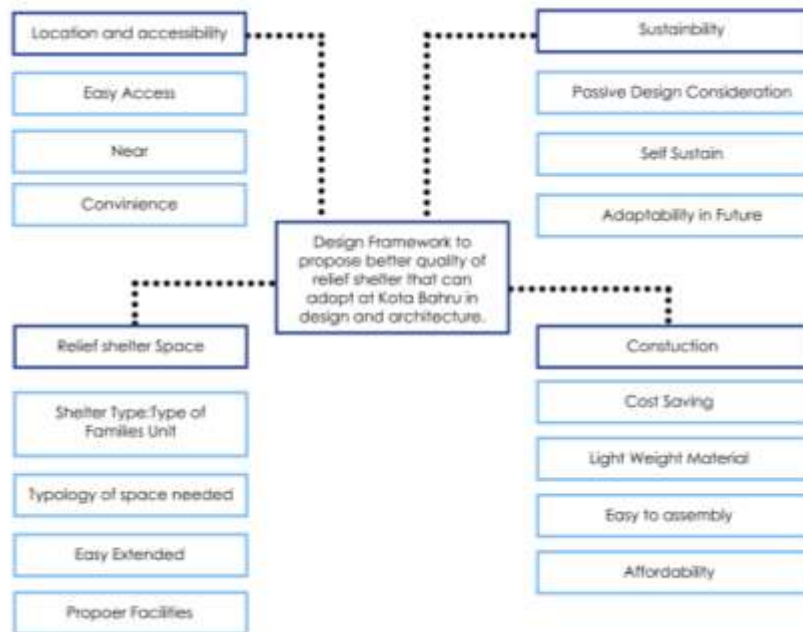


Figure 7. Design Framework to Propose Better Quality of Relief Shelter.

Source: Author

Based on Figure 4.2, the design framework for improving relief shelters in Kota Bharu focuses on enhancing their location, accessibility, space utilization, sustainability, and cost-effectiveness. The framework emphasizes the importance of easy access to relief shelters by selecting suitable locations that are easily reachable and considering proximity to transportation hubs and essential services. The design also prioritizes smooth movement and easy entry for all individuals, including those with disabilities. Additionally, the framework advocates locating relief shelters near essential services to provide convenience and timely access to vital resources for affected individuals and families. The design framework also emphasizes the inclusion of user-friendly facilities and amenities within relief shelters, such as well-designed communal spaces, adequate sanitation facilities, secure storage areas, and reliable power supply. These features aim to enhance shelter occupants' overall comfort and well-being during challenging times.

Furthermore, the framework focuses on efficiently utilizing relief shelter space by considering the diverse needs of families and allocating adequate space for sleeping, common areas, hygiene facilities, and storage. The design framework emphasizes easy extension and adaptability of relief shelters to accommodate changing family sizes and evolving circumstances. It also prioritizes the provision of proper facilities to enhance the quality of relief shelters, including essential amenities such as sanitation facilities, clean water supply, ventilation, and lighting.

Also, the design framework strongly emphasizes sustainability by integrating passive design principles to optimize energy efficiency and minimize reliance on external energy sources. It also promotes the development of self-sustainable features such as renewable energy systems and rainwater harvesting to reduce reliance on external resources. The framework recognizes the importance of future adaptability in relief shelters and incorporates modular

components and flexible design elements to accommodate changing needs and new technologies.

Finally, the framework focuses on cost-saving measures in relief shelter construction by selecting affordable yet durable materials, employing efficient construction techniques, and facilitating easy assembly and disassembly processes. By implementing this comprehensive design framework, relief shelters in Kota Bharu can be more accessible, functional, sustainable, and affordable, ultimately enhancing their effectiveness in assisting individuals and families during times of crisis.

Conclusion

In conclusion, the findings of this study highlight the need for stronger and more resilient relief shelters in Kota Bharu to withstand floods. The design framework presented in this chapter serves as a model for improving the flood resistance of relief shelters and provides valuable recommendations for action. The government and NGOs play a crucial role in ensuring that the citizens of Kota Bharu have access to safe and effective emergency shelter during times of flooding.

The findings of this study have practical implications for builders, such as the Construction Industry Development Board (CIDB), in terms of incorporating flood-resistant measures and constructing flood-resilient shelters in Kota Bharu. The study highlights the importance of addressing unfair distributional impacts and promoting social fairness in flood risk governance. It suggests considering mechanisms like partnership funding, constitutional rights to flood protection, and compensation plans to ensure equity in flood risk management strategies. However, the study acknowledges limitations, including the small sample size of three interviewees and the limited time for data collection. Future research could benefit from larger sample sizes and more diverse perspectives to draw more accurate conclusions.

In terms of recommendations for future research, the Malaysian government is already taking action to assist and rehabilitate damaged facilities in Kota Bharu. Initiatives include rebuilding communities through partnerships, repairing infrastructure, restoring the local economy, providing essential services, and enhancing preparedness for future disasters. Additionally, the government has approved the establishment of a Centre of Excellence for Infrastructure Sustainability, which will provide architectural support, guidance, capacity building, and shared learning programs related to sustainable infrastructure. Incorporating these initiatives and the study's architectural recommendations, such as ventilation and thermal mass considerations, can contribute to constructing effective flood relief shelters in Kota Bharu.

Overall, the study emphasizes the need for stronger architectural capacity and disaster preparedness in Kota Bharu to effectively respond to and mitigate the impact of floods. It highlights the challenges faced by the community, including slow reactions, lack of access to basic necessities, and inadequate communication between government and NGOs. The study calls for restructuring the current flood resilience strategy of relief shelters and provides valuable guidance for architectural guidelines that can be implemented to better handle floods in future monsoon seasons. While NGOs have contributed to reconstruction and community building, there is a need for better coordination and sustained support beyond crisis occurrences. Therefore, by addressing these issues and implementing the study's recommendations, Kota Bharu can improve its disaster response and enhance the well-being of its affected communities.

References

- Abid, S. K., Sulaiman, N., Wei, C. S., & Nazir, U. (2021). Flood vulnerability and resilience: Exploring the factors that influence flooding in Sarawak. *IOP Conference Series: Earth and Environmental Science*, 802(1). <https://doi.org/10.1088/1755-1315/802/1/012059>
- Che Mohd Salleh, M., Razali, S. S., Megat Laksana, N. N., Che Embi, N. A., & Abdullah, N. I. (2020). Developing a sustainable model of Waqf-based Takaful for flood victims in Malaysia. *Journal of Islamic Accounting and Business Research*, 11(9), 1941–1952. <https://doi.org/10.1108/JIABR-10-2016-0114>
- Das, S., & Mukhopadhyay, P. (2018). Multi-hazard disaster resilient housing with bamboo-based system. *Procedia Engineering*, 212, 937–945. <https://doi.org/10.1016/j.proeng.2018.01.121>
- Ehsan, S., Ara Begum, R., Ghani Md Nor, N., & Nizam Abdul Maulud, K. (2019). Current and potential impacts of sea level rise in the coastal areas of Malaysia. *IOP Conference Series: Earth and Environmental Science*, 228(1). <https://doi.org/10.1088/1755-1315/228/1/012023>
- Kamarudin, H. K., Chong, O. N., Lumpur, K., & Petra, S. Y. J. (2019). Factors contributing to Flood resilience among rural community: case study of the east coast of Malaysia related papers planning Malaysia journal 2018-disaster risk management in Malaysia: issues and... Khairul Hisyam Kamarudin *COMPREHENSIVE STUDY ON COMMUNITY DISASTER ADVANCES*, 12(9), 41–49.
- Jongman, B. (2018). Effective adaptation to rising flood risk. *Nature Communications*, 9(1), 9–11. <https://doi.org/10.1038/s41467-018-04396-1>
- Journal, I., Urkude, T., Kumar, A., Upadhye, A., Padwal, M., Year, F., & Student, B. E. (2019). IRJET-Review on Amphibious House Review on Amphibious House. *International Research Journal of Engineering and Technology*, 1558. www.irjet.net
- Karki, T. K. (2020). Flood resilience in Malaysian cities: a case study of two towns in Johor state. *International Journal of Disaster Resilience in the Built Environment*, 11(3), 329–342. <https://doi.org/10.1108/IJDRBE-06-2019-0037>
- Lim, K. Y., Zakaria, N. A., & Foo, K. Y. (2020). Water quality assessment of urban catchment after the large-scale flood event: The worst natural tragedy at Pahang River, Malaysia. *Desalination and Water Treatment*, 175, 32–42. <https://doi.org/10.5004/dwt.2020.24790>
- Luu, H. (2020). From the temporary to reliable relief shelter to study about the adequate design and exploring flood victims living conditions in Malaysia relief shelters from the temporary to reliable relief shelter to study about the adequate design and exploring flood. August. <https://doi.org/10.13140/RG.2.2.16777.88165>
- Akhir, M. N., Mohamad Aun, N. S., Selamat, M. N., & Amin, A. S. (2021). Exploring Factors Influencing Resilience Among Flood Victims in Malaysia. *International Journal of Academic Research in Business and Social Sciences*, 11(6). <https://doi.org/10.6007/ijarbss/v11-i6/10227>
- Mohd Fadzi, M. N., Tajul Hasnan, M. T. I., Hanapi, N. L., & Ghorbani, S. (2022). An Assessment to Determine the Typology of Spaces for a Flood Evacuation Centre in Malaysia. *Environment-Behaviour Proceedings Journal*, 7(20), 95–109. <https://doi.org/10.21834/ebpj.v7i20.3435>
- Rezende, M. O., Ribeiro da Cruz de Franco, A. B., Beleño de Oliveira, A. K., Pitzer Jacob, A. C., & Gomes Miguez, M. (2019). A framework to introduce urban flood resilience into the design of flood control alternatives. *Journal of Hydrology*, 576(June), 478–493.

- <https://doi.org/10.1016/j.jhydrol.2019.06.063>
- Yusmah, S. M. Y., Bracken, L. J., Sahdan, Z., Norhaslina, H., Melasutra, M. D., Ghaffarianhoseini, A., Sumiliana, S., & Shereen Farisha, A. S. (2020). Understanding urban flood vulnerability and resilience: a case study of Kuantan, Pahang, Malaysia. *Natural Hazards*, 101(2), 551–571. <https://doi.org/10.1007/s11069-020-03885-1>
- See, K. L., Nayan, N., & Rahaman, Z. A. (2017). Flood Disaster Water Supply: A Review of Issues and Challenges in Malaysia. *International Journal of Academic Research in Business and Social Sciences*, 7(10), 525–532. <https://doi.org/10.6007/ijarbss/v7-i10/3406>
- Serre, D., Barroca, B., Balsells, M., & Becue, V. (2018). Contributing to urban resilience to floods with neighbourhood design: the case of Am Sandtorkai/Dalmanckai in Hamburg. *Journal of Flood Risk Management*, 11, S69–S83. <https://doi.org/10.1111/jfr3.12253>
- Sholanke, A. B., Chilaka, D. A., Oti, M. A., Nelson, S. A., Nnatuanya, M. C., & Udezi, B. E. (2021). Resilient Design Strategy: Engaging Amphibious Structures to Combat Flood in the Development of an Internally Displaced Persons Settlement Scheme in Nigeria. *IOP Conference Series: Earth and Environmental Science*, 665(1). <https://doi.org/10.1088/1755-1315/665/1/012012>
- Suhardi, A. (2017). Developing Criteria of Design Guidelines for Public Spaces Serving as Evacuation Centers in Malaysia. 2016, 63–68. <https://doi.org/10.17758/urst.u1117301>
- Tikul, N. (2018). Low income housing adaptation strategies to flood hazard in Chiang Mai, Thailand. *Journal of Thai Interdisciplinary Research*, 13(5), 19–26. <https://doi.org/10.14456/jtir.2018.45>
- Wu, C. L., & Chiang, Y. C. (2018). A geodesign framework procedure for developing flood resilient city. *Habitat International*, 75(March), 78–89. <https://doi.org/10.1016/j.habitatint.2018.04.009>
- Zakaria, S. F., Zin, R. M., Mohamad, I., Balubaid, S., Mydin, S. H., & Mdr, E. M. R. (2017). The development of flood map in Malaysia. *AIP Conference Proceedings*, 1903. <https://doi.org/10.1063/1.5011632>
- Zanchetta, A. D. L., & Coulibaly, P. (2020). Recent Advances in Real-Time Pluvial Flash. *Water*, 12.