

Design Approach on Flood Effect of the Durable Goods in Disaster Risk Reduction and Preparedness Phase

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DOI: <https://doi.org/10.51584/IJRIAS.2024.909013>

Received: 27 August 2024; Accepted: 03 September 2024; Published: 03 October 2024

ABSTRACT

This research summarizes flood risk management with a primary focus on protecting durable goods during floods. This research acknowledges the need for a comprehensive approach to managing flood risks across various phases. This research examines the vulnerabilities and coping strategies of flood victims in safeguarding their possessions during floods, highlighting their general vulnerability and lack of concrete protective measures. To address these challenges, the research recommends innovative solutions for flood victims. Furthermore, researchers identify durable goods, particularly furniture and electronics, as most at-risk during floods and suggest measures to mitigate this vulnerability, including vehicle internal compartments. This research also uncovers the explicit and implicit needs of flood victims concerning their belongings, proposing design concepts that encompass item wrapping and safeguard mechanisms. In conclusion, this research contributes essential insights into flood risk management and innovative design solutions for safeguarding durable goods during floods. It underscores the importance of community involvement, government policies, and ongoing research in reducing flood-related losses and damage.

Keywords: Flood Effect; Disaster Risk Reduction; Disaster phase; Design Approach; Conceptual Idea

INTRODUCTION

This research explores the impact of urban floods on victims, focusing on the loss and damage to durable goods. It is based on an analysis of news clippings, articles, and Google Scholar that shed light on the effects of flooding, with a particular emphasis on property losses such as house collapses, furniture damage, discarded electrical items, and the total loss of vehicles. Floods in urban areas, notably Kuala Lumpur (Samsuri, 2018), have led to significant damage and losses to both durable goods (Bhuiyan, 2018). Even though these flood events have occurred over the years (Mohamad Yusoff, 2018), the losses associated with properties and vehicles continue to be of significant concern. Many flood victims, despite their past experiences, appear to lack preparedness to effectively mitigate these issues. This literature review endeavors to investigate the factors contributing to this lack of preparedness (Shariff, 2018) and to evaluate the weaknesses, strategies, activities, and roles of flood victims in managing the risks (D'Ayala, 2020) associated with the protection of their durable goods during floods.

An important finding of this research is that flood victims often struggle to save their valuable belongings beyond ensuring their safety (Salleh, 2020). This challenge arises partly from the lack of experience among urban residents, particularly those in Kuala Lumpur, who may not have encountered severe flooding in the past. Moreover, it is observed that low-income communities within the city (Sardi, 2019) tend to suffer more during floods, resulting in the loss of their homes and possessions. In such instances, government agencies have intervened to provide shelter, clothing, and essentials to affected communities (Selvaraj, 2019). To address the challenges faced by flood victims, the study seeks to encourage them to equip their homes with safety devices that can help protect durable goods (Nasiri, 2018). Notably, many flood victims lack awareness of these safety

measures, partly due to their limited exposure to such severe flood events. By promoting the use of safety items (Marzukhi, 2018) designed to protect durable goods, this research aims to contribute to resolving these issues. A significant observation from this literature review is that urban floods are often exacerbated by uncontrolled human activities (Shah, 2017). The ongoing infrastructure development near river areas and the unchecked littering that clogs drains and waterways contribute to the severity of flooding (Selvaraj, 2019). Consequently, it is essential to address these factors to better manage flood risks and reduce the damage to durable goods. In summary, this literature review synthesizes information from various sources and identifies the need to improve preparedness and disaster management strategies to safeguard durable goods during urban floods, particularly in areas like Kuala Lumpur. The study aims to explore the weaknesses and challenges faced by flood victims and to develop effective strategies to mitigate these issues. The following sections will outline the specific aims, objectives, problem statement, and research questions derived from the insights gained through this literature review.

Research Background

Urban areas in Malaysia, including Kuala Lumpur, have been unexpectedly affected by significant floods (H, 2021). This has caught many Malaysians off guard, as they have not been adequately prepared to deal with these disasters despite recurrent flooding over the years. Urban floods in Kuala Lumpur often result from river overflow due to heavy rain and high tides (D'Ayala, 2020). These floods have caused substantial material losses, reduced disaster resilience, and increased property damage and destruction (Sardi, 2019). The delayed or incomplete construction of certain projects exacerbates the flood situation in these urban areas (Bhuiyan, 2018). Moreover, the flooding in Kuala Lumpur has had far-reaching consequences, affecting various emergency facilities such as the SMART tunnel, which was originally designed to mitigate flooding and alleviate traffic congestion during peak hours. Unfortunately, due to various factors, including the use of the tunnel as a primary travel route, the situation has become complex (Isah, 2015).

Predicting the optimal timing for flood preparedness is challenging (Rahman, 2022), given the unpredictability of rainfall trends and the likelihood of flooding. Vulnerable groups, particularly low-income communities, are disproportionately affected by flooding due to their limited preparedness and resilience. This results in injuries, loss of life, property damage, and a considerable psychological toll. Notably, inadequate addressing of flood victims' suffering can lead to long-term mental health issues, persisting for up to nine months following the disaster (Sipon, 2013). During flood events, many victims are housed in temporary evacuation centers, which have experienced overcrowding and posed challenges for managing standard operating procedures such as social isolation and quarantine, particularly during the COVID-19 pandemic (Ng, 2021). To mitigate the adverse effects of flood disasters, all Malaysians need to take proactive measures. This research seeks to address the pressing issue of durable goods affected during floods by identifying significant items and vehicles damaged by floods. The total flood-related losses in Malaysia are estimated at RM6.1 billion, based on information from the Department of Statistics, equating to USD1.46 billion (Bernama, 2022).

This research aims to propose a conceptual design solution for protecting durable goods during floods. The main objectives supporting this aim are to identify important household items and types of vehicles damaged by floods. To investigate public vulnerabilities, strategies, activities, and roles in managing flood risks on household items during floods and lastly to identify the salient and non-salient needs of flood victims regarding durable goods during floods. The study faced three primary constraints: time limitations, cost constraints, and challenges related to obtaining adequate survey responses. Due to time constraints and pandemic-related restrictions, physical data collection involving close contact was challenging. This necessitated the use of online surveys as the primary data collection method. Additionally, cost limitations hindered extensive travel for observational studies or experiential learning in Kuala Lumpur. The study focused on addressing the limitations and constraints by utilizing various research methods, including brainstorming, 5W1H methods, PESTEL research, Existing Product Analysis (EPA), and Remote Field Research, to collect in-depth data and generate ideas for the design solution. Furthermore, the study included three main parts in the questionnaire: background information about the respondents, questions about the impact of flash floods on communities, assets, and utilities, and inquiries about flood preparedness. The study involved 13 respondents who provided survey responses, and observational surveys were conducted based on flood situations in Kuala Lumpur and nearby areas, further supplemented by online images and articles. This delimitation allowed for a comprehensive examination of household items and

vehicle effects during urban floods in Kuala Lumpur and the development of a suitable design solution.

METHOD

In the pursuit of investigating flood-related challenges and devising effective solutions for safeguarding durable goods, a meticulously structured research methodology was adopted. Each facet of the chosen methodology played a pivotal role in enabling a comprehensive understanding of the subject matter and, subsequently, the generation of innovative design solutions.

RESEARCH METHODOLOGY INVOLVED

The research journey commenced with an exhaustive review of pertinent literature. This scholarly exploration immersed researchers in the intricate dynamics of floods, their consequences, and their intersection with various aspects. This foundational step was crucial for gaining deep insights into the problem space (Hamid, 2013). Empirical observation was conducted to understand how flood victims respond to such crises (Liu, 2022). This approach, albeit constrained by the pandemic, provided valuable qualitative data on victims' behaviors, coping mechanisms, and the impact of floods on their possessions. An online questionnaire, thoughtfully crafted with 20 questions, served as a powerful tool to delve deeper into the lived experiences of flood victims. This self-administered survey not only ensured the safety and anonymity of respondents during the COVID-19 pandemic but also facilitated comprehensive data collection. Collaborative brainstorming sessions (Toyong, 2021) involving stakeholders and experts were instrumental in shaping the research focus and generating creative solutions (Nasir, 2022). This collective ideation process enriched the research endeavor.

The PESTEL framework (Buye, 2021) guided the categorization of external factors affecting flood occurrences. This method afforded a structured approach to identify and analyze political, economic, social, technological, environmental, and legal dimensions. Insights extracted from the PESTEL analysis were meticulously categorized into opportunities and threats. These categories informed concrete proposals within four critical clusters: technology, behavior, property, and facilities. The identified clusters—technology, behavior, property, and facilities—emerged as focal points necessitating in-depth exploration, given their prominent roles in flood scenarios. A comprehensive analysis of existing products was undertaken, considering parameters like cost, safety, quality, and material. The findings from this analysis informed us of the criteria for the proposed product design. Evaluation of non-tangible solutions was crucial for identifying strengths and weaknesses that could be integrated into the proposed conceptual product design. Exploration of solutions from related fields expanded the scope of innovative ideation and adaptation to the proposed conceptual product design. Anchoring the research within contemporary biotechnology trends ensured alignment with emerging technologies and potential biotechnological solutions. Products were strategically positioned based on specific target audiences and brand-specific strategies, facilitating a nuanced understanding of market dynamics.

Detailed analysis of existing products provided essential insights into functionality, design, and features, guiding the development of the proposed conceptual product. Employing the A.E.I.O.U methodology (Chen, 2012), valuable data about product dimensions, shape, systems, and usability was remotely acquired from experts and users. To maintain unwavering focus within the research scope, the four core clusters—Technology, Behavior, Property, and Facilities—played a pivotal role in defining design considerations.

This research methodology embodies a holistic and dynamic framework, harmonizing a diverse range of techniques, analyses, and ideation processes. The robust combination of literature review, observational surveys, questionnaire administration, brainstorming, sophisticated analytical frameworks, and diverse forms of analysis collaboratively constitutes a multifaceted approach characterized by depth, nuance, and scholarly rigor. This methodology serves as a robust foundation for the study's overarching objectives and the formulation of innovative design solutions.

RESULTS AND DISCUSSION

This research extensively analyzes data collected through various research methods to derive solutions to the impact of floods on durable goods. The research primarily relies on literature reviews to enhance researcher

comprehension of flood disasters, evaluate challenges, and propose solutions. The central issue identified is the struggle faced by flood victims in protecting their belongings during such crises. These findings pave the way for the development of an emergency rescue product as a pragmatic solution.

Data Collection

To ensure the accuracy and reliability of the findings, researchers employed a range of research methods. Each method contributes to a holistic understanding of the research area and is instrumental in shaping the subsequent steps and product design. Figure 1 illustrates the researcher's strategic curation of pivotal data concerning flood-related topics. Specifically, it focuses on unmanageable individual behaviors, notably widespread littering, and its consequential role in obstructing drainage systems, consequently contributing to flood occurrences. It underscores the concern of unregulated human activities, such as river occupation, forest degradation, and the influence of climate change-induced extreme weather events. This complex interplay of factors contributes to elevated river water levels and is instrumental in the initiation of floods in the region of Kuala Lumpur. Researchers identified a significant issue wherein flooding in urban areas stems from the substantial proliferation of rapid spatial transformations in the terrain. Additionally, inadequate drainage systems exacerbate the situation, resulting in inundated roads and the consequential manifestation of severe traffic congestion. The researcher has delineated the research focus as an investigation into the vulnerabilities, strategies, activities, and potential contributions of stakeholders in mitigating flood risks to household items during inundations. This approach facilitates a comprehensive assessment of flood causes, the recognition of household belongings, and the formulation of the strategies for safeguarding during and post-flood incidents.

NO	YEAR PUBLISHED	FULL TITLE & WEBSITE LINK	AUTHOR'S NAMES	ISSUE/ PROBLEMS	RESEARCH AIM/ PURPOSE/ OBJECTIVES	RESEARCH METHOD	RESEARCH QUESTIONS/ HYPOTHESIS
09	2020	Opportunities and Challenges for Building Community Preparedness towards Disasters in Malaysia a Selangor https://www.researchgate.net/profile/Sali-Salleh/publication/349715350_Opportunities_and_Challenges_for_Building_Community_Preparedness_Towards_Disasters_in_Malaysia/links/60e895d01b4604b6d6d55/Opportunities-and-Challenges-for-Building-Community-Preparedness-Towards-Disasters-in-Malaysia.pdf	Salleh, S. H., Yusof, N. A. M., Saimy, I. S., & Ismail, F.	1. Unplanned urbanization, global warming, and climate change among others	1. To focus on the relevant agencies and infrastructure preparedness to become a disaster-resilient nation	Qualitative research Having analysis and interviews conducted with officers in the related government agencies	How do the agencies handle the preparedness including the cost of infrastructure?
10	Jan. 2017	Disasters Worldwide and Floods in the Malaysian Region: A Brief Review https://www.researchgate.net/profile/Khamaruzaman-Wan-Yusof/2/publication/314160587_Disasters_Worldwide_and_Floods_in_the_Malaysian_Region_A_Brief_Review/links/58f530eaca27233517e91f/Disasters-Worldwide-and-Floods-in-the-Malaysian-Region-A-Brief-Review.pdf	Shah, S. M. H., Mustafa, Z., & Yusof, K. W.	1. Human activities that have caused changes to the physical characteristics of the hydrological system 2. Continued development of the areas that are prone to flooding 3. Destruction of forests and hill slope development	To highlight the disaster type that has severely affected the continent of Asia, particularly Malaysia.	Qualitative research Observe the flood loss estimates for selected flood events and budget allocation for flood projects under Malaysian plan	Is the cost of a flood project sufficient within a certain time?
11	2018	Flash flood impact in Kuala Lumpur—Approach review and way forward https://www.ukm.my/jalma/wp-content/uploads/makalahjalma-2018-06311-10.pdf	Samsun, N. O. R. A. S. H. I. K. I. N., Abu Bakar, R., & Urjah, T. A. N. O. T.	1. Global change in climate, severe weather in the form of heavy rains and river discharge conditions 2. Rapid urbanization with extreme increase in migration thus rapid spatial change in the land use and land cover 3. Consist of lithology, terrain, torrential rainfall, and natural drainage (river) system	1. To understanding of the impact of flash floods is carried out by identifying the main causes of flooding	Qualitative research Survey the frequency of disasters according to categories in the world and the economic cause by the most severe disaster	How far the flooding impact the urban city and economy?
12	2018	Direct impact of flash floods in Kuala Lumpur City: secondary data-based analysis https://www.researchgate.net/profile/Mohammad-Reza-3/publication/32990794_Direct_impact_of_flash_floods_in_Kuala_Lumpur_City_Secondary_data-based_analysis/links/5c2b00ba6f0d0c70750899/Direct-impact-of-flash-floods-in-Kuala-Lumpur-City-Secondary-data-based-analysis.pdf	Bhuiyan, T. R., Reza, M. H., Choy, E. A., & Pereira, J. J.	1. The roadways are mostly affected by flash floods in Kuala Lumpur, a proper drainage system 2. A large portion of forest and agricultural areas have been cleared up	3. To identifies the direct impact of the flash flood events in Kuala Lumpur city from both tangible and intangible dimension	Qualitative research Record the data to analyse the graphical approach for two different time period and sources	What the main impact of the flash floods in that place?

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05	October 2019	Assessing disaster risk and resilience: a case study in urban flood vulnerable community in kampung asahan, kuala selangor https://www.researchgate.net/profile/Mohamad-Fazli-Sandi/publication/336249671_ASSESSING_DISASTER_RISK_AND_RESILIENCE_A_CASE_STUDY_IN_URBAN_FLOOD_VULNERABLE_COMMUNITY_IN_KAMPUNG_ASAHAN_KUALA_SELANGOR/links/5b403a6f5c4d76c581f1/ASSESSING-DISASTER-RISK-AND-RESILIENCE-A-CASE-STUDY-IN-URBAN-FLOOD-VULNERABLE-COMMUNITY-IN-KAMPUNG-ASAHAN-KUALA-SELANGOR.pdf	Sardi, M. F., Razak, K. A., & Zaimi Bakri, R.	1. Lack of ability, resources and skills have been causing the community to experience the negative after effect of the disaster. 2. Having a construction of houses low-lying area and poor drainage system	1. To provide a new insight into the assessment of urban resilience and the development of social resilience strategy for reducing disaster risk in Malaysia	Qualitative research A questionnaire survey was organized to establish the baseline data, analysed local risk profiles while preparing an action plan and flood preparedness toolkit towards strengthening urban resilience. An interview session to validate the proposed action plan and flood preparedness toolkit	What is the level of community resilience in terms of connectedness risk and vulnerability, procedures and resources that support community disaster planning, response and recovery?
06	August 2020	Flood vulnerability and risk assessment of urban traditional buildings in a heritage district of Kuala Lumpur, Malaysia https://hness.copernicus.org/articles/20/20221/2020/	D'Oyala, D., Wang, K., Yan, Y., Smith, H., Massam, A., Filipova, V., & Pereira, J. J.	1. Unrestrained occupation of rivers by human activities, destruction of forest and extreme weather events caused by climate change	1. To evaluate the flood risk to residential buildings in Kampung Baru, Kuala Lumpur. 2. To quantify the flood risk in terms of replacement cost, considering both specific vulnerability and a normalized depth-damage ratio function	Observe the material and form of two substantial characteristics related to the local environment condition.	How they manage or apply the characteristic elements in that condition?
07	June 2021	Factors influencing flood disaster preparedness initiatives among small and medium enterprises located at flood-prone area https://reader.elsevier.com/reader/pii/S221420921002657?token=078f236215d10328ff0719e786ad37eeeb87599e7f203929f84b2824338e224146c14b44f7e64109cf9bcb345c30ca&originRegion=eu-west-1&originCredential=20220529264016	Hashim, H. M., Na, Y. G., Talib, O., & Tamrin, S. B. M.	1. Affecting SMEs flood disaster preparedness located in Segamat District of Malaysia	1. To analysis of regression provided insights into the various factors affecting the contribution of small and medium-sized businesses towards flood preparedness activities. 2. To enhance the ability of businesses in undergoing emergency actions to protect properties, contain disaster damage and promote engagement of post disaster restoration and early recover	Qualitative research An interviewer-assisted survey using a set of flood disaster preparedness questionnaire (developed and validated by a team of disaster management experts from various backgrounds) were implemented among Small and Medium Enterprises (SMEs) business owners and managers (n = 253)	1. Do SMEs with high-risk perception, good hazard knowledge, and previous experience have correspondingly high levels of disaster preparedness? 2. Do SME business owner's characteristics such as age, gender, and race relate to the level of disaster preparedness?
08	January 2018	Preparedness plan for flood: a bottom-up approach. file:///C:/Users/USER/Downloads/168307-Article%20Text-433014-1-10-20180316.pdf	Shariff, N. N. M., & Hamidi, Z. S.	1. Heavy rainfall above the norm compared with the flood season before which caused riverbank flood 2. Low lying flat terrain 3. Deforestation that reduces the role of forests as natural flood attenuation systems	1. To highlight preparedness six months before the expected flood	Qualitative research Interviewing community members about preparation 6 months before the expected flood	Is there have any challenges when they manage their work with the long or short timing?

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01	2018	Exploring the managing of flood disaster: A Malaysian Perspective http://journalarticle.ukm.my/12818/1/22285-62962-1-PB.pdf	Izhani Mohamad Yusoff, Aznarahayu Ramli, Nurul Azmi Mhd Alkasirah, Norashila Mohd Nasir	1. Floods often occur in Malaysia due to the increase in the frequency of rainfall and the rise of the sea level in certain parts of the country (Aliaqha et al., 2015). 2. Uncontrolled human activities such as infrastructure development near the river areas and uncontrolled littering cause clogged drains and waterways (Othman et al., 2014; Siron et al., 2015)	1. To give attention of the situation caused by the disaster 2. To discuss flood risk including the impact and how the floods can be controlled	Qualitative research Research about the information of flood issues by database includes management phases, the agencies involved and technologies	How can we make more awareness and readiness in facing the flood disaster indispensable so that the negative impacts resulting from the disasters can be minimized?
02	2018	Disaster risk management in Malaysia: Issues and challenges from the perspective of agencies https://www.planningmalaysia.org/index.php/pmj/article/view/415/335	Chong, N. O., & Kamarudin, K. H.	1. Disaster management planning imbalanced between top-down and bottom-up approaches 2. Lack of coordination in the disaster management cycle, with greater focus only on the disaster emergency response stage 3. Lack of planning for long-term recovery	To identify the agencies responsible for carrying out activities	Qualitative research Observe the coordination in Executing the Disaster Management Cycle (DMC) between agencies	How to manage the coordinated efforts and commitment among related disaster management agencies at all levels?
03	September, 2021	A cluster-randomized trial study on the effectiveness of health education-based intervention (HEBI) in improving flood disaster preparedness among the community in Selangor, Malaysia: a study protocol https://bmcpublishing.biomedcentral.com/articles/10.1186/s12893-021-11719-3	Tariq, M., Shahar, H. K., Baharudin, M. R., Ismail, S. N. S., Manaf, R. A., Salmiah, M. S., ... & Muthiah, S. G.	1. Heavy rainfalls cause a flash flood in an area, which collects a large volume of water rapidly 2. An inadequate drainage system or waste or segregated material blockage	To develop, implement, and evaluate the impact of health education-based intervention (HEBI) based on knowledge, skills, and preparedness to improve flood disaster preparedness among the community in Selangor	Qualitative research A validated questionnaire will assess participants' background characteristics, knowledge, skills, and preparedness for disaster preparedness and perception of disaster	How the characteristics, Knowledge, and skills can be improved for flood disaster
04	November, 2019	Discourses of Flood Disaster Preparedness by NGOs: Humanitarian Aid, Teamwork and Victimization https://climatescience.ru/uploads/pubs/8/89/894/894460139101e3ebe58f2943a8f59f5.pdf	Selvaraj, S., & Sandaran, S. C.	1. Natural phenomenon (heavy monsoonal and conventional rainfall, flat topography on both coasts of Peninsular Malaysia, heavy siltation of rivers) 2. Human activities (changed land use due to deforestation, agricultural practices and urbanization)	1. To discourses of flood disaster preparedness employed by NGOs 2. To investigate the discursive construction of knowledge about flood disaster preparedness in Malaysia of the various parties such as government, NGOs and flood-risk communities	Qualitative research Having two-stage of interviews and three by collecting the data (transcribing the data, coding the data and analysing)	What are procedures that support community disaster planning?

TOPIC 1	RESEARCH AIM (RA)	RESEARCH OBJECTIVES (RO)	PROBLEM STATEMENT (PS)	RESEARCH QUESTIONS (RQ)	DEVELOP RA, RO, PROBLEM STATEMENT, RQ Based on Literature Gap
Flood Effect on Household Items	To study their vulnerabilities, strategies, activities, and the role they could play in managing flood risks on household items during flood	1. To identify important household items damaged by floods 2. To focus on the solution that can safe their belongings on track from rafting away 3. To identify many victims who had no experience when the floods occurred	1. Has found people with low incomes, and with less education to be less prepared for disasters 2. Don't have experience of a disaster may involve more material losses, less protection from disasters, and perhaps greater damage to or destruction of their homes 3. Found that the poor and other groups with less power in their communities suffered more injuries and were even more likely to lose their lives.	1. Do victims prepare their important belongings as a precaution during the flood? 2. How did the victims save their important things? 3. What was it like seeing all your things destroyed or damaged? 4. How high did the water get around the house? 5. What was your reaction when seeing the house and property covered and surrounded by water?	DEVELOP RA, RO, PROBLEM STATEMENT, RQ Based on Literature Gap
Demographic Age Gender Income level Geographic location Races Respondent	Vulnerabilities: 1. What are the factors affecting vulnerability? Strategies: 1. What is your strategy when floods occur? Activities: 1. What victims can do when a flood occurs? Role: 1. How do individuals and families play an important role during floods?	1. The most important things affected by floods. 2. How do you want to identify items when a flood occurs? 3. What are the effects of flooding outside your property area? 4. Where did the victims live when the floods were happening?	1. Do you lack understanding of action before facing a flood? 2. What is the budget to fix your belongings? 3. Which material do you find most difficult to repair? 4. How do not capable victims want to repair their homes or belongings? 5. What kind of organization you will ask for help?	1. How long were the victims trapped when the floods occurred? 2. How can awareness about disasters be made known to everyone? 3. How long does it take to repair the house? 4. Would you like to register for flood warnings?	

Figure 1: Literature Review to extract RA, RO PS, and RQ.

Given the constraints posed by the COVID-19 pandemic and government-imposed emergencies, field observations were carried out remotely by dedicated volunteers in specific locations. This remote observation method provides valuable insights into the immediate aftermath of flood disasters, the trauma experienced by victims, property damage, and the strategies adopted by victims to safeguard their durable goods.



Figure 2: Situation of the house during flood.

In Figure 2, floodwaters encroach upon a residential structure, submerging household items and prompting animals to seek refuge on elevated surfaces. The observation reveals extensive damage to virtually all the victim's belongings, as they become engulfed by a viscous sediment. Furthermore, transportation assets, such as motorcycles, also bear the brunt of the inundation. Regrettably, the overarching implication of this depiction is the inevitable disposal of these items, as they become irreparably compromised. It becomes apparent that floodwaters possess the capacity to saturate and irreversibly impair a wide array of household items.



Figure 3: Observation Situation when cleaning the house.

The volunteer-led cleaning process for the victim's residence, as demonstrated by the researcher, highlights the imperative need to address the substantial mud accumulation within and around the house. Figure 3 comprehensively portrays the conditions during and after the flood event. Within the second image, researchers discern the adverse effects on personal belongings, with a clear indication of extensive damage to household items, including motorbikes. The third image captures volunteers diligently engaged in the laborious task of cleansing the residence, which involves the extraction of items such as bed frames from the affected rooms.

The questionnaire comprised three sections, encompassing a total of 20 questions, designed to ensure data quality and objectivity. Respondents were granted five days for questionnaire completion, commencing on July 20, 2022, and concluding on July 25, 2022. Section one of the questionnaire focused on gathering background information from respondents, with a primary emphasis on occupational categorization, including students, business professionals, government employees, and private sector workers. In this survey, the predominant gender among respondents is female, comprising 9 individuals, whereas the male respondents are limited to 4 individuals. The data predominantly represents respondents aged above 25 years, constituting the majority at 53.8%, corresponding to 7 participants. Furthermore, the highest income bracket falls within the range of B40 to M40, accounting for 46.2% of respondents, while the T20 category represents a considerably smaller proportion at only 7.7%. Subsequently, in sections two and three, inquiries centered on the impact of flash floods on societal assets and utilities. A notable majority of the victims identified economic factors, particularly the presence of uninsured assets within the informal sector and the vulnerability of livelihoods, as significant factors contributing to their distress during flood incidents. The items most significantly affected by the flood, as indicated by the highest percentages, are vehicles, including cars and motorcycles, alongside furniture. A substantial 69.2% of respondents acknowledged a lack of preparedness in terms of pre-flooding actions, while a minority of 30.8%, comprising 4 respondents, reported a different perspective. Notably, 38.5% of respondents identified furniture and 23.1% mentioned electrical appliances as challenging to repair following flood damage.

The researcher employed brainstorming techniques to extract crucial insights regarding floods, categorizing the effects of disasters, victims' needs, solutions, concerns, and systemic issues. During floods, victims typically save only essential items, like documents, due to limited capacity. Solutions, such as using buoys for self-preservation and carrying important tools, emerged as practical during dire situations. Figure 4, titled "Extracted Points from Brainstorming," provides a visual representation of these categories, illustrating flood consequences, needs, solutions, and systemic issues. Flooding frequently results in victims being stranded on rooftops, and facing food shortages, particularly detrimental for children. Priority during floods remains to rescue vital documents, while other possessions like furniture and electronics are often lost in the deluge. Comprehensive questionnaire surveys and literature analysis unveiled negative human behaviors like careless waste disposal, unauthorized logging, and illegal construction as primary drivers of flooding. These behaviors lead to drain blockages due to waste accumulation. This concise summary underscores the importance of understanding the

consequences, needs, and solutions related to floods and the detrimental impact of certain human behaviors on flooding occurrences.

CATEGORIES
EXTRACT THE POINT

EFFECTS	NEEDS	TOOLS/SOLUTION
Stranded	Document	Buoy
Starving	Household item (Electric, Furniture, etc)	First aid kit
Food supplies	Transport	Emergency response kit
		Tracker
		Government/Agency
		Power system

COMMON ISSUES	ISSUES EQUIPMENT and SYSTEM
Garbage is not thrown away	Control system
Draining system	Dam
Urban area	Industry & Infrastructure
Rainfall	Material
Construction	Structure building
Illegal logging	Tunnel: SMART
No regular cleaning	Late response Alert system



Figure 4: Extract points from brainstorming.

Additionally, the researcher methodically applied the "PESTEL" analysis framework, encompassing political, economic, social, technological, environmental, and legal dimensions, to dissect the intricate web of factors underlying the recurrent flooding predicament, with a specific focus on Kuala Lumpur. This comprehensive analysis unveiled critical external influences and dynamic changes that necessitate careful integration into flood mitigation strategies. From a political perspective, the presence of multiple stakeholders and the sluggish governmental response in the face of disasters exacerbate flooding concerns, occasionally demanding international aid when fiscal allocations prove inadequate. On the economic front, flooding inflicts adverse consequences on infrastructure, roads, and vehicular mobility, leading to traffic snarls, while logistical disruptions disrupt the import and export processes. Socially, the protracted response times and transportation bottlenecks generate public disgruntlement and pose tangible threats to safety. On the technological front, deficiencies in the flood alert system's capacity to promptly identify flood-prone zones and the sluggish dissemination of pertinent information compound the challenge. Environmental factors, notably the scarcity of water catchment areas attributed to impermeable urban surfaces and the dearth of efficient drainage systems, aggravate the flooding predicament. Legally, haphazard constructions by unscrupulous entities and the non-uniform nature of drainage systems contribute to the heightened flood risks. These multifaceted insights, derived from the meticulous "PESTEL" analysis, underscore the imperative of formulating holistic flood mitigation strategies that conscientiously account for the multifarious external factors that collectively engender recurrent flooding. This research serves to underscore the profound and interrelated impact of political, economic, social, technological, environmental, and legal facets on the complex issue of flooding in Kuala Lumpur.

PESTEL ANALYSIS							
CLUSTER ISSUES	POLITICAL	ECONOMIC	SOCIAL	TECHNOLOGICAL	ENVIRONMENT	LEGAL/ILLEGAL	WEBSITE
Draining systems	<ol style="list-style-type: none"> 1. EBNL enforcement does not improve the Drain and Development Act 2. Elections in the monsoon season, warning that people's lives will be at risk if the government goes ahead with its plans. 	<ol style="list-style-type: none"> 1. Lack of infrastructure such as clean water supply, drainage and its increase in the price of items, the uneven cost of living with the increase in wages 2. Businesses that are affected due to flooded premises or cut-off road connections 	<ol style="list-style-type: none"> 1. Interference with the smoothness of the drainage system is caused by the attitude of the people who like to throw away garbage 	<ol style="list-style-type: none"> 1. Slow release of another forecasting technology systems 2. The alert system takes time to give accurate results 3. Late improved and upgraded the flood information system 	<ol style="list-style-type: none"> 1. Many concrete surfaces built in the city that do not absorb or become water catchment areas 	<ol style="list-style-type: none"> 1. Unplanned and non-uniform drainage systems in terms of size and construction material cause flooding to occur and it is difficult to drain out. 	<p>https://www.bharian.com.my/bharian/2022/09/17/10248699-longkang-sistem-salinan-dengan-kempak-elak-banjir-kilat</p> <p>https://www.siput.com.my/siput/melaka-banjir-lake-tinggalkan-sistem-perpartan-di-kuala-kumpu-untuk-tangani-banjir-kilat-1967759</p> <p>https://www.bharian.com.my/bharian/konvensional/2022/09/01/10248699/176jelaskan-penggunaan-teknologi-peranti-pertanian-aman-banjir</p> <p>https://www.bharian.com.my/bharian/siaran/2022/10/10/1053363sajaperticap-bertindak-elak-keban-ekonom</p> <p>https://www.thevoles.com/articles/news/7337-flooding-would-benefit-during-flood-why-are-they-against-it</p> <p>https://www.theboomtells.com/articles/cover-story/sajaperticap-tech-revent-and-predict-floods</p> <p>https://www.bharian.com.my/makalah/2020/12/648153sistem-perpartan-lak-sempurna-punca-banjir</p>
Construction	<ol style="list-style-type: none"> 1. Estimates that an allocation of RM352 billion would be needed to overcome the country's flood problems 	<ol style="list-style-type: none"> 1. Destruction of infrastructure and residential property due to mud floods in the area 	<ol style="list-style-type: none"> 1. Negligence of developers and contractors, causing mud and construction site waste to flow into ditches and drains 	<ol style="list-style-type: none"> 1. Limited water flow tunnel due to making other constructions 2. The use of sandbags requires energy and a long time to install 	<ol style="list-style-type: none"> 1. Water overflows until there is a flood because there is construction mud stack in rivers, drains and so on 2. Uncontrolled and illegal logging activities 	<ol style="list-style-type: none"> 1. Unplanned construction will increase the risk of major floods 	<p>https://www.bharian.com.my/bharian/nasional/2022/09/09/10248699/m4003-needed-to-overcome-flood-issues-untill-2100-sajaperticap</p> <p>https://www.bharian.com.my/bharian/nasional/2021/11/09/121589215sajaperticap-antara-punca-banjir-kumpu</p> <p>https://www.bharian.com.my/bharian/nasional/2021/11/09/121589215sajaperticap-antara-punca-banjir-kumpu</p> <p>https://www.bharian.com.my/bharian/nasional/2021/12/29/19733-pembangunan-lak-terancam-punca-banjir-kemp</p>

PESTEL ANALYSIS							
CLIENTS ISSUES	POLITICAL	ECONOMIC	SOCIAL	TECHNOLOGICAL	ENVIRONMENT	LEGAL/ILLEGAL	WEBSITE
<p>Loss Response</p> <p>1. The misery and anger of the people against the government's late actions in dealing with the flood issue</p> <p>2. Only appeared after 24 hours of flooding that in the nation's capital</p>	<p>1. Supply chain and distribution of consumer items will be affected</p> <p>2. Low- and middle-income households living in high-density and rural areas are more vulnerable to flood risk</p>	<p>1. Caused thousands of people to be stranded on the roofs of their homes and some even survived for days without food</p> <p>2. Fuel the effects of disaster for up to six months after the disaster and if not managed properly can lead to mental health problems</p>	<p>1. Widespread disaster early warning system technology that can detect floods throughout the country not limited to hot spot areas only</p>	<p>1. Taking into environmental aspects such as non-catchment areas, drainage systems and rivers that need to be constantly monitored</p>	<p>1. N/A</p>	<p>1. https://www.bharian.com.my/borneo/lan-lan/2021/12/21/berkenaan-ke-atas-tindakan-tindakan-tercepat-ke-banyu-bukan-tersehat-di-kawasan-unik-kita-penggunaan/</p> <p>2. https://www.stribosan.com/borneo/malaysia-penggunaan-emo-pompa-banyu-276196</p> <p>3. https://www.malaysiakini.com/berita/2021/09/27/berita-penggunaan-teknologi-penerbit-penerbit-amanah-banyu</p>	
<p>Transport</p> <p>1. Lack of political incompetence, and particularly those that Malaysia is still far from being ready to deal with the effects of climate change</p>	<p>1. Shoppers are advised to carry supplies for further information regarding the impact on their daily chains</p> <p>2. The effect caused by the event of transportation such as travel delays, congestion, etc</p>	<p>1. Transport infrastructure can be directly or indirectly damaged, posing a threat to human safety, and causing significant disruption and associated economic and social impacts</p>	<p>1. Developed countries have also shifted their attention to reducing their carbon footprint, which, he said, Malaysia was not examining rigorously enough</p> <p>2. Have no policy plan for electric (EVs) or consumption is still very high, electricity power generation, and very dependent on coal, and our recycling policy</p>	<p>1. Floods have direct effects on transportation networks through physical damage to infrastructure</p> <p>2. The impacts of a flood on a specific infrastructure network can be difficult due to the sheer variety in the types of damage and conditions (topography, environmental, etc.)</p>	<p>1. Malaysian Family Automotive Assistance claim application for unregistered workshop can be made online</p>	<p>1. https://www.bharian.com.my/borneo/lan-lan/2021/12/01/55/banyu-perlu-cepat-berhenti-elak-kecan-erisom</p> <p>2. https://www.stribosan.com/borneo/malaysia-penggunaan-emo-pompa-banyu-276196</p> <p>3. https://www.malaysiakini.com/berita/2021/09/27/berita-penggunaan-teknologi-penerbit-penerbit-amanah-banyu</p>	
<p>Household Items (Furniture, Appliances, etc)</p> <p>1. Many steps have been taken by the government to prevent these incidents, but they seem gone unnoticed</p>	<p>1. Household salvaged vehicles and house damage</p> <p>2. A large number of furniture and electrical appliances were submerged and associated activities were disrupted</p>	<p>1. Impact in terms of income due to not being able to do business due to disrupted items</p> <p>2. Many victims feel sad and think about restoring or buying a new one</p>	<p>1. N/A</p>	<p>1. Dumping of household waste and industrial waste that also led to floods</p> <p>2. Furniture is damaged and none of the cooking appliances or their premises is functioning</p>	<p>1. Traders to not take advantage by raising the price of items during flood</p>	<p>1. https://www.bharian.com.my/borneo/lan-lan/2021/12/01/55/banyu-perlu-cepat-berhenti-elak-kecan-erisom</p> <p>2. https://www.bharian.com.my/borneo/lan-lan/2021/12/01/55/banyu-perlu-cepat-berhenti-elak-kecan-erisom</p> <p>3. https://www.bharian.com.my/borneo/lan-lan/2021/12/01/55/banyu-perlu-cepat-berhenti-elak-kecan-erisom</p>	
<p>Flood Alert Systems</p> <p>1. The agency responsible should inform the local people from time to time about the increase in the water level of the items</p> <p>2. Toward the agency responsible for releasing water from the dam, because they noted that the water had been released without the flood operating regulations having been followed and this led to property damage and death</p>	<p>1. Supply chain will cause the price of items that have risen to rise even higher</p> <p>2. Failure to deliver early information to emergency and transportation units during flash led to loss of property</p>	<p>1. Failure to react positively to the flood early warning system during an emergency as a result of the explanation of the warning system</p> <p>2. Failure to react positively to the flood early warning system during an emergency as a result of the explanation of the warning system, and no actions were taken by the community to get ready to face floods</p>	<p>1. The current flood situation is related to the public through mass media and social media (i.e. radio, television, newspaper, Twitter, and Facebook)</p> <p>2. The usage of the system is limited to certain areas and regions only as crucial information regarding floods only reaches the public in certain areas and regions</p>	<p>1. Environmental calamities which will be hugely costly, both in human and economic terms</p>	<p>1. N/A</p>	<p>1. https://www.bharian.com.my/borneo/lan-lan/2021/12/01/55/banyu-perlu-cepat-berhenti-elak-kecan-erisom</p> <p>2. https://www.bharian.com.my/borneo/lan-lan/2021/12/01/55/banyu-perlu-cepat-berhenti-elak-kecan-erisom</p> <p>3. https://www.bharian.com.my/borneo/lan-lan/2021/12/01/55/banyu-perlu-cepat-berhenti-elak-kecan-erisom</p>	

OPPORTUNITY	THREATS	TOP CITED CLUSTER (Consolidate Colour Coded)	
		TECHNOLOGY	BEHAVIOUR
<ul style="list-style-type: none"> • Attitude for those early the garbage • Weather forecasting technology systems • Alert system take time to give accurate result • Late improved and upgraded information systems • Destruction of infrastructure and property • Limited water flow tunnel • Using sandbags requires energy and takes time to install • Late action dealing the flood issues and takes 24 hours to appear • Supply chain of the items be affected • The warning system technology is limited for hot spot areas only • Late carbon footprint and electric vehicles to the transportation • Malaysian Family Automotive assistance claim application for unregistered workshop can be made online • A large number of furniture and electrical appliances were submerged and associated activities were disrupted • Many victims feel sad and think about restoring or buying a new one • The usage of the system is limited to certain areas and region only as crucial information regarding floods only reach to the public certain area and region. 	<ul style="list-style-type: none"> • Drainage system increase of clogging • Business and cut off road affected due flood • Concrete surface can't absorb in water catchment area • Unplanned and non-uniformed construction material causing flood • Negligence of developers and contractors causing site waste to flow into drains • Unplanned construction will take risk of major floods • Uncontrolled and illegal logging activities • Low- and middle-income household living in rural area are more vulnerable to flood risk • People are stranded on the roofs of their homes for days without food • Not managed properly can lead to mental health problems • Transport infrastructure damage causing human safety and associated to economic and social impact • Dumping of household waste and industrial waste that also led to floods • Furniture is damaged and none of the cooking appliances in their premises is functioning • Traders to not take advantage by raising the price of items during flood • The water had been released without the flood operating regulations having been followed and this led to property damage and death • Environmental calamities which will be hugely costly, both in human and economic terms 	<ul style="list-style-type: none"> • Weather forecasting technology systems • Alert system take time to give accurate result • Late improved and upgraded information system • The warning system technology is limited for hot spot areas only • The water had been released without the flood operating regulations having been followed and this led to property damage and death • Drainage system increase of clogging 	<ul style="list-style-type: none"> • Attitude for those early the garbage • Late action dealing the flood issues and takes 24 hours to appear • Many victims feel sad and think about restoring or buying a new one • Uncontrolled and illegal logging activities • Negligence of developers and contractors causing site waste to flow into drains • Not managed properly can lead to mental health problems
		<p>PROPERTIES</p> <ul style="list-style-type: none"> • Destruction of infrastructure and property • Supply chain of the items be affected • Malaysian Family Automotive assistance claim application for unregistered workshop can be made online • A large number of furniture and electrical appliances were submerged and associated activities were disrupted • Business and cut off road affected due flood • Unplanned construction will take risk of major floods • Low- and middle-income household living in rural area are more vulnerable to flood risk • People are stranded on the roofs of their homes for days without food • Environmental calamities which will be hugely costly, both in human and economic terms 	<p>FACILITIES</p> <ul style="list-style-type: none"> • Using sandbags requires energy and takes time to install • Limited water flow tunnel • Late carbon footprint and electric vehicles to the transportation • Dumping of household waste and industrial waste that also led to floods • Unplanned and non-uniformed construction material causing flood • Concrete surface can't absorb in water catchment area • People are stranded on the roofs of their homes for days without food • Transport infrastructure damage causing human safety and associated to economic and social impact

Fig. 5. PESTEL Analysis and Opportunity and Threats

In Figure 5, the researchers harnessed the framework of opportunities and threats to discern inherent strengths and weaknesses within the domains of technology, human behavior, assets, and communal facilities, to illuminate avenues for future enhancements. Employing a four-color scheme strategy, distinct elements were accentuated for enhanced clarity. Notably, yellow denoted facets associated with technology, blue symbolized behavioral aspects exhibited during flood events, pink encapsulated assets, infrastructure, and environmental considerations, and finally, the green hue connoted community-centric facilities, including transportation, profoundly impacted by flooding incidents. This systematic approach enabled the researchers to decipher, with precision, the critical areas necessitating further development or fortification in the context of technology, human conduct, assets, and communal amenities, providing a structured basis for future improvements. These four prominently cited clusters offer a potential framework for analyzing recent and prospective disasters, considering various internal and external factors.

The technological cluster encompasses tools designed to aid users in flood response, including weather forecasting and alarm systems. While these systems provide precise data, they exhibit certain limitations necessitating rectification. Conduct was identified as a contributing factor to flooding, notably the indiscriminate littering habits of some individuals and illicit logging activities. Additionally, the response times of relevant agencies in assisting flood victims were found to be suboptimal. The infrastructure cluster, encompassing properties, and facilities, demands prioritization as they are integral to community welfare. The study unveiled the flood's adverse impact on the food supply, the disruption of essential services such as electricity, and severe damage to furniture.

These clusters are intrinsically linked to environmental degradation, incurring substantial recovery costs. This holistic approach to clustering provides a comprehensive framework for assessing potential disaster occurrences.

The researcher also employs a technique known as the EPA to assess existing products, aiming to establish a set of criteria for the proposed conceptual product design. This approach allows researchers to refine and enhance these criteria based on their findings and incorporate them into the design of new products.

EPA Existing Product Analysis	Sandbags	Movable Flood Prevention Barrier	Body Vacuum Mattress	Safety Jacket
Aesthetic	Applying a rectangle shape for the product. Using earth tone colors which is white, brown, and green for easy-to-recognize.	The product has used a rectangular shape and its using a red colour which is used for caution sign.	The product has used a rectangle shape which is like fit with human body. Then, using bright colour to make people aware about the rescuer survival equipment.	The product has used a simple shape which is like shirt. Then, using cool bright colour to attract the buyers to buy. This product may be used a lot by all the people.
Cost	The prices per bag is Rm22 following their sizes that the buyers want to.	This range pricing of this product is Rm100 to Rm 700 above.	The prices is Rm5000 and it is reasonable for buy it.	This product a bit pricey around Rm129 because using a quality material and also it is a branded product.
Customer	For adult and also those who in field of heavy-duty carrier.	The user is those like their house always having a flood during the monsoon season.	For those who are injured and for the rescuer or medical department.	Mostly the buyer and user are those like adventurous activities like swimming or go to camping.
Environment	suitable for the basement, driveway, garden, kitchen, and anywhere water overflow happens.	Using at outdoor and indoor During a day and night.	Having disaster either outdoor or indoor purpose.	Adventurous activities indoor or outdoor: - Camping - Swimming pool.
Safety	Does not using any kind of chemical that will harm for the user.	The frame barrier uses the weight of the flood water itself to hold it in place. Temporary barriers can also be added to permanent flood defences, such as raised embankments, increasing the level of protection.	The contoured pillow and vacuum pump are removable. This mattress includes three adjustable patient restraints with buckles and six carry handles.	Having single central buckle make it easy to put on or off. Using a neon orange colour that can easily be recognised when used it and have a whistle.
Size	30 x 70cm, 25 x 100cm, 25 x 120cm, 25 x 150cm optional, it can meet your different needs.	70x68x52 - 4.1kg, 80x65.5x52.5 - 4.3kg, 70x68x52 - 4kg 100x50x60-9kg	Length 72 in, Width 17	0 to 115 kg from 5 to 30 kg from 30 to 40 kg
Function	Can be effective for preventing floods, leaks, dips, and more. Sandless flood barriers protect the home during raining season.	To control the movable of water from getting inside the house or some places.	Secures the patient and conforms to their shape during inflation.	A life jacket helps to stay afloat and prevent from drowning.
Material	Non-woven Fabric.	The panels are made of either aluminium or composite material.	Construction Nylon Webbing	Polyester stuffed with foam cubes
Advantage	The bags are compact and lightweight for easy storage and transportation. They can be brought to a site empty and filled with local sand or soil.	Stops water pressure from causing structural damage to the home inside the protected area.	Reduces the pain and fear patients face when injured. By moulding to patients' bodies without applying pressure, vacuum mattresses reduce pressure point tenderness and increase patient comfort.	Make the user keep floating in the water and easily spotted from far distance.
Disadvantage	Without proper training, sandbags walls can be constructed improperly causing them to fail at a lower height than expected, when used in flood-control purposes.	May affect local drainage, possible resulting in water problems for others. May restrict access to structure.	Relatively fragile (useless unless a perfect vacuum is maintained). Increased cost relative to a traditional long spine board. The time taken to evacuate the bag.	May not adequately float some wearers unless partially inflated.

EPA Existing Product Analysis	Walkie-talkie	Outdoor emergency AMFM radio	Zoomable torch light	Inflatable boat	Towing strap
Aesthetic	A compact rectangular shape and it is fit with the user with using a bold black colour on it.	This product has rectangle shape and square form. It is also using bold colour to attract buyer to buy it.	The product using cylinder shape. Then fit with the user hand because it is a portable product.	The product using cylinder shape. Then fit with the user hand because it is a portable product.	The product using roller circle shape. It is a portable product.
Cost	The range of the pricing is Rm 40 also it cheaper and afford to buy it.	The prices are affordable because it is costing around Rm 50. The price of its product also it according by material that it used.	The prices are Rm 30 and it is reasonable for the buyers.	The pricing is about Rm 3000 and above. It is because of the material and the functionality.	The costing is around Rm 60 and above according to the material that been used on it.
Customer	This product suitable for all ages, and more for boys or men who are a simple guy.	Suitable for middle age and above. Either for (students, workers or adult or middle of age).	Suitable for everyone, rescuer, student, victims, traveller or hikers.	Suitable for everyone, rescuer, student, and victims.	Suitable for everyone, rescuer, student, and victims.
Environment	whether in a recreational context like camping or on site at your business.	Widely used for homes, shops, accountants, villas, and residential communities.	Have been trapped in dark situation - Blackout in the forest.	- Have been using at outdoor activities.	- Have been using at outdoor activities.
Safety	The shape is round corner and its safe for all users and it is secure from any harm.	The shape is round corner and its safe for all users and it is secure from electric shock.	The shape is round corner and its safe for all users and it is secure from any harm.	The characteristic of the boat is using safety gap, anti-seepage valve and side protection to make it easier and safe for the user.	It has anti slip gripper and the buckle also secure and easy to use.
Size	102 mm (L) X 51 mm (W) X 11.35 mm (T)	12.2 x 4.5 x 6.3 cm	16.5cm x 4cm x 3.3cm	3.3 m to 3.8 m	2.8-meter length and 50mm width
Function	Portable devices that feature a transmitter, receiver and antennas for sending and receiving radio waves.	Having features that can change the channel, volume of sound and siren to attract the attention.	Used as a light source outdoors, in places without permanently installed lighting, during power outages, or where a portable light source is needed.	Having air chamber independently support the hull to float on the water surface and with support technology that can control the boat from make any problems.	Helping to tow the car away from the place where it breaks down and the forged hook with safety latch can prevent it from falling off the car and make, it easier to take off or put up.
Material	Often brightly coloured plastic, though some more expensive units have ruggedized metal high-quality plastic cases.	Lithium-ion polymer battery, plastic case and consists of small-diameter insulated copper wire wound around a ferrite core.	Aluminium Alloy Aluminium + Explosion proof glass	Neoprene/CSM (Also called Hypalon), PVC, or Polyurethane.	Polyester and metal
Advantage	Has a long battery life and will work for long hours with a single charge. Easy way of spreading the news and information.	Flexibility. Advertisers can target listeners based on time, geographic location, channel and program.	The wide-to-narrow beam zoom of torch can adjust bright intensity illumination range with easy-controlled head pulling zoom.	Have thermal fusion technology, through high temperature to heat two pieces of fabric together. Portable handle. Durable.	For heavy duty car. Able to use while in heat temperature. Durable and portable.
Disadvantage	It has limited research data and frequency bandwidth. Due to bad weather, the radio is not audible properly.	Not waterproof. Take space to keep.	It could seriously damage user eyes if they look directly.	Limit of passengers. Using human energy.	Do not use it on rough surface. Do not use required low rope. Tow the rope slowly. Need to check the rope regularly to ensure.

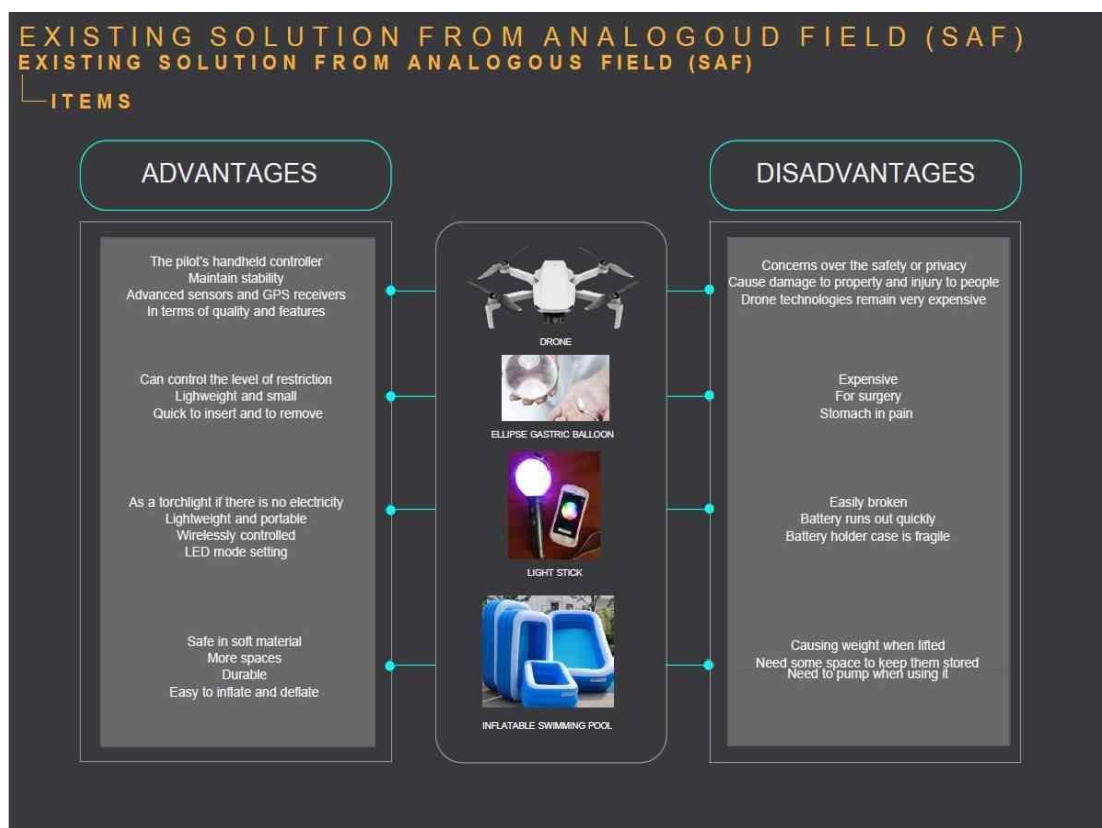
EPA Existing Product Analysis	WiFi Smart Flood Leak Alarm Detector	Colour Weather Temperature Screen	Solar Sound Flash Warning Sound	Water Pump	Solar Light Remote Control
Aesthetic	A small round corner shape with white colour that easy to notice by user.	This product has square shape with white form. It is using black colour and white. The design seems flat and simple.	The shape of this product is cylinder with curly edges. The colour using red for sign of warning.	Round shape with cylinder form have been chosen to apply to this product. The colour is more to bright colour and it is attracted for those who middle of the age or above.	This product has square shape with square form. It is using black colour and white. The design seems slim and simple.
Cost	The range of the pricing is Rm 44, it is expensive because of the material and technology.	The prices around Rm 99 and it is expensive by following the technology that the product's used.	The pricing is around Rm 30 above depends on the material that have been used.	The prices almost Rm 200 and its affordable with the material that have been using on it.	The prices almost Rm 112 and its affordable with the material that have been using on it.
Customer	It's suitable for student and officer (adult or middle adult age) because of it is simple and can bring anywhere.	Its suitable for those like (adult or middle of adult).	Its suitable for those like (adult or middle of adult).	For adult and also those who in field of heavy-duty carrier.	Its suitable for those like (adult or middle of adult).
Environment	Widely used for homes, shops, accountants, villas, and residential communities.	Widely used for homes, shops, villas, and residential communities.	Widely used for homes, shops, villas, and residential communities.	- suitable for household pool drainage, garden irrigation and aquaculture use.	- Widely installed in warehouses, workshops, entrances, walkways, gardens, sheds, patios, garages, driveways and other places.
Safety	The shape is round corner and its safe for all users and it is secure from electric shock.	The frame is round corner so its does not sharp at all. This product is wireless and does not give an electric shock.	Having steel bracket that can make the product keep hanging and the cover is protect from making any harm for the user.	Make sure all safety guards and shields are in place while operating your water pump. Never use a pump in a flammable or explosive environment.	It is using solar system so the electricity that been using on this product is low.
Size	71 x 64 x 21mm / 2.8 x 2.5 x 0.8in	19cm x 27.5cm x 3.6cm	69 mm x 120 mm	30 cm x 16 cm	21.5 x 5 x 8 cm
Function	The water monitor detector can be used in weather, bathrooms, basements, sinks, water heaters, aquariums, dishwashers, refrigerators, fish tanks, plumbing toilets, behind toilet, water filtration units, garbage disposals, etc.	It has a simple function with date and week display. Its suitable for indoor and outdoor temperature and having 7 of weather forecasts display on it. The product can bring anywhere because the sizing is light and slim.	It has a sirenning display and angle. It also has beeping sound to easy for recognised the signage.	Allow the ground water and flood water to be drained away effectively. Sump pumps generally have higher flow rates than sabbler pumps.	It having a light reflecting area and lens layer so it easier to accept the sunlight to make the energy.
Material	High quality plastic and metal.	High quality plastic and metal.	High quality plastic and lithium battery.	High quality plastic and metal.	Aluminium + Iron.
Advantage	Wi-Fi Smart Water Leak Alarm Detector support Smart Life App Remote Monitor Prevent Water Leak to Damage Your floor and furniture.	Hangable wireless outdoor and indoor sensor. Suitable in highest and low temperature. Having frost point alarm function.	Hangable wireless outdoor. Have solar charging that can easily recycling the battery. Temperature resistance.	The product has novel appearance, light weight and strong rust and corrosion resistance. Good motor performance, light working noise, energy saving and environmental protection.	Saving the cost. Waterproof. Battery ensures enough power in rainy days. Heat resistant.
Disadvantage	The product has a wire. Sticker glue is not very strong.	Using battery to stay function. Not waterproof instead of water resistant. Does not have Wi-Fi setting connection.	Need to use battery. The beeping sound is low. Limited of features.	Use rotation instead of suction to move water, and therefore have almost no suction power.	Need remote control. Charging time about 6 to 8 hours.

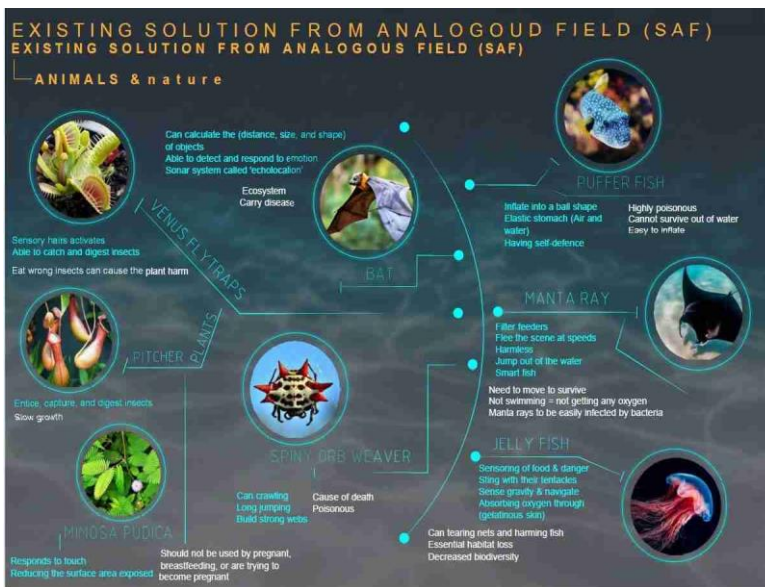
Figure 6: EPA Data Analysis

Figure 6 investigates products that were used during floods or have features that can be improved for future use. Notable examples include alarm systems, water detectors, and solar-powered devices. It also examines products in terms of their behavior and properties. Items such as walkie-talkies, radios, torches, inflatable boats, and towing straps are discussed in the context of behavior, as they are portable and useful during emergencies. Products like boats and towing straps are highlighted for their importance both during and after a flood, given their potential to save lives and protect belongings. The researcher also identifies four essential items, including sandbags, portable floodlights, body Hoover mattresses, and safety jackets. These products play a critical role in enhancing the safety of flood victims and safeguarding their belongings. The research emphasizes the importance of user safety and encourages the use of these products by victims. The researcher points out that most existing products lack safety systems. The overall goal is to identify design requirements for products that can assist flood victims. The researcher notes that existing products are somewhat limited in their design features, highlighting the need for innovation in this area. The primary objective is to propose conceptual design products with enhanced functionality and integrated systems, addressing the strengths and weaknesses of existing products. The researcher's goal is to propose conceptual products that are more effective in assisting flood victims.

Current non-product solutions (NPS) have both advantages and disadvantages, as per the study (NPS). Researchers can leverage these solutions to identify skill sets and make improvements for future products. Users often resort to NPS spontaneously in situations where specific equipment for attention is lacking. For example, they may employ techniques like tapping on a hard surface or using a whistle to signal for help in emergencies. The researcher utilizes a technique known as item and animal or natural solution from the analogous field (SAF), which encompasses two distinct categories. SAF serves as a reference point for researchers to identify elements that can be integrated into future products, particularly when it comes to items. It can be a valuable tool in situations where victims lack safety equipment. For instance, it can involve signaling for help in the dark by using a light stick as a makeshift torch. Furthermore, the researcher seeks to explore the full range of capabilities in animals and plants that can be used as reference or inspiration for product development in the SAF category of animals and nature. This approach allows researchers to expand their search beyond conventional product concepts, drawing from unique abilities such as sensing, floating, and evading.

Figure 7 illustrates this concept of future product design, including the incorporation of biotechnology. Researchers employ this method to assess the systems integrated into the product. For instance, a device may include GPS for tracking its movement and the capacity to operate autonomously or via smartphone control.





BIOTECHNOLOGY TREND STUDIES

PRODUCT	EXPLANATION	LINK WEBSITE	PRODUCT	EXPLANATION	LINK WEBSITE
	The drone is something that can be tracked through an application on the smartphone	https://www.biotechnology.com/foreally-drone-ideal-escort/		self-powered electric water rescue device which is directed by a remote controller	https://www.pearsonthe.com/product/RemoteControlledLifebuoy/
	The victims can save themselves while floating	https://www.pearsonthe.com/2015/09/04/sea-safety-for-dummies/		Lifeboat that is kinda flat packed and can be stored at convenient spots on a big boat	https://www.pearsonthe.com/2017/05/02/the-power-of-being-convinced/
	self-powered surface-diffing buoy with integrated GPS sensor that can come handy during locating distressed ships or desert weather	https://www.pearsonthe.com/2017/05/02/2017/05/02/2017/05/02/2017/05/02/		Build a barrier with sand bags to help defend and stop water from getting inside vulnerable doors and around foundations	https://www.pearsonthe.com/2017/05/02/2017/05/02/2017/05/02/
	Light as a tag allows to be carried along while searching the items	https://www.pearsonthe.com/2017/05/02/2017/05/02/2017/05/02/		Can breaking the window glass from being trapped	

Figure 7: NPS, SAF, and Biotechnology Data Analysis

Figure 8 provides the researcher with the means to examine various aspects of the product, including material, system, form, size, and other relevant factors through product positioning. This approach enables the development of a customer-centric strategy that encompasses essential elements such as brand image, distinctive

features, quality, and identity. In the event of a disaster, this strategy is deployed to pinpoint the user target market and discern trends associated with user suitability.



Figure 8: Product positioning of the EPA

To confirm the findings, the researcher conducted remote online research to gather data. This research involved analyzing information and trends in a virtual environment, rather than physically visiting locations, or conducting face-to-face interviews. The purpose was to study different aspects related to technology, human behavior, and the use of items before, during, and after disasters. The research utilized colors, as seen in Figure 9, to represent technology and behavior. This allowed the researcher to observe various scenarios and user experiences. In Figure 9, the focus shifted to everyday items that could be helpful after a disaster.





Figure 9: Color coding in Remote Research

The research aimed to identify how these items could be utilized in different ways to assist people in challenging situations. Data from the remote online research, presented in Figure 10, highlighted products that are effective in disaster situations. These products were found to be well-suited for dealing with challenges like thick mud, power outages, or the need for quick and easy transportation. The research also revealed the importance of easy-to-carry and waterproof products.

Overall, the remote online research provided valuable insights into the strengths and weaknesses of various products and how they could better serve people during and after disasters. This information guides the design of products that prioritize user safety, comfort, and effectiveness. It also helps in determining the key features needed for technology, behavior, and the use of items in disaster scenarios. The researcher explored solutions to address the challenges faced by disaster victims. One approach involved incorporating sensory products into the design of new products intended for disaster-affected individuals. Additionally, the researcher proposed the development of a sensing system to enhance responsiveness during flood situations. Subsequently, the researcher initiated a design process and focused on imbuing the product with sensory system capabilities. This included features like adaptable wrapping that can transform into a floating device through the sensing system. Throughout the design phase, careful attention was given to human factors to reduce the potential for human error.

REMOTE RESEARCH FIELD				
REMOTE RESEARCH FIELD (A . E . I . O . U)				
PRODUCTS				
A.E.I.O.U	Waterjet	Screwdriver drill	Torchlight	
A ACTIVITIES	 1. Spraying the water 2. Cleaning the mud	 1. Unscrew the window grill 2. Enter the house to rescue the elderly 3. Open the window	 1. Searching the victims 2. Searching the usable items / belongings	
E ENVIRONMENTS	 1. Outside of the house / porch / road 2. Inside the house (room, etc) Many damaged items outside the house / Dirty road	 1. At the side of the house 2. At night	 1. At the rooftop 2. Trapped inside the house 3. The water level is increase	
I INFORMATIONS	 1. The waterjet is too heavy, need to lifting with two people 2. Only one hose that can connect with the product 3. It is still difficult to clean the mud because the limited pressure by depending on the sizing of nozzle	 1. Need to climb the stairs to get to the window 2. Need more than two rescuer to save the victims	 Victims stranded on the rooftop until morning	
O OBJECTS	 1. Waterjet 2. Hose 3. Power energy engine	 1. Screwdriver grill 2. Ladder 3. A set of safety out t 4. Torch light	 1. Using torchlight for searching 2. Post as the transportation to send the food or saving	
U USERS	 1. Volunteer 2. Family members	 1. Rescuer 2. Volunteer	 1. Children 2. Elderly 3. Residents	

REMOTE RESEARCH FIELD

REMOTE RESEARCH FIELD (A . E . I . O . U)

PRODUCTS				
A.E.I.O.U	Bucket	Construction Hand trolley	Tub	Indoor disaster tent
A ACTIVITIES	 1. Throw the bucket to the rescuer 2. Receive food from rescuers	 1. Carrying the garbage 2. Clearing the house area	 1. Scooping the water inside their house 2. Clearing the house	 1. Saving themselves from flood 2. Resting 3. Searching their belongings provided by NGOs
E ENVIRONMENTS	 1. Infront of the house 2. Victims at 2nd floor of their house	 1. Inside / outside the house 2. Living room, others room	 Infront of the house - Ponds area	 1. Crowded / messy 2. A lot of stu
I INFORMATIONS	 1. Need to be a rope to the bucket 2. Using the hands to hold the product 3. Cannot put to much food can cause fall	 1. Have a bit of damaged items 2. Need to clean the whole house	 1. Need to clean by themselves 2. Limited of rescuer 3. Does not have other product to remove the water	 Their house or items are destroyed and damaged
O OBJECTS	1. Rope 2. Bucket	1. Hand trolley 2. Wheel 3. Grab	Medium large tub	1. Having a medium large string of tent 2. Have received rescuities
U USERS	 1. Elderly 2. Family members	 1. Rescuer 2. Family members	 Family members	 1. Children 2. Elderly 3. Family members

REMOTE RESEARCH FIELD

REMOTE RESEARCH FIELD (A . E . I . O . U)

PRODUCTS			
A.E.I.O.U	Thin mattress	Life jacket	Basket stretcher
A ACTIVITIES	 1. Save victims by lifting together 2. Move the victim to put inside the boat	 Saving the children and elderly from carried away by flood	 Saving the victims that have loaves problem
E ENVIRONMENTS	 1. Headed a request to move the victims 2. At the 2nd floor of their house	 1. At house area / school	 1. At night 2. The victims house
I INFORMATIONS	 1. Need to lift together 2. Move slowly to be brought into the boat 3. Level of the water getting increase	 1. The sizing of life jacket most of it are same (adult) 2. Children still need monitoring even if they are wearing a jacket	 1. Need to carry and lifting overweight men 2. Cannot out and bring to the safe place
O OBJECTS	1. Lifting mattresses 2. Pillow 3. Boat	1. A set of safety life jacket outfit 2. Rope	1. Basket stretcher 2. Life jacket
U USERS	 1. Family members 2. Rescuer	 1. Children 3. Rescuer 2. Teenagers 4. Elderly	 1. Elderly

DESIGN CONSIDERATION

DESIGN CONSIDERATION - CONCLUSION

TECHNOLOGY	The technology needs to be used with its own power and also requires solar energy and a detector sensor system that can prevent the flood from getting worse. This product needs protection and materials that can reduce costs.
BEHAVIOUR	This product can help users to communicate when in an emergency or any situation. It needs to be portable and the period of use needs to be long because it also can affects the market and human behavior.
PROPERTIES	The product should be easy to learn and easy to use. It usually happens with information according to user needs, consider the context of usage (user environment), and use conventional design patterns that help good discoverability and learnability.
FACILITIES	ensure the health and safety of individuals who will interact with the product throughout its life. This product needs to be improved in terms of the use of structures and materials so that users are always in a safe condition

Figure 10: Data Analysis using AEIOU in Remote Research

The researcher proceeds to create ideation sketches to refine the product's design for the subsequent stage. The chosen design will serve as the basis for developing the proposed conceptual final design, complete with its functionalities and systems. These designs are developed with specific criteria, considering not only functionality but also aesthetic and ergonomic considerations. The final conceptual design is selected after several

development iterations.

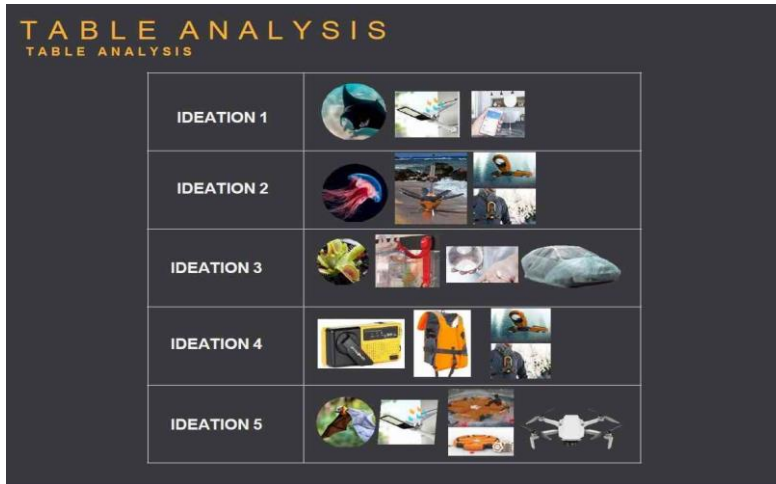


Figure 11: Ideation Table Analysis

The initial design concept presented in Figure 11 outlines a device capable of submerging underwater, identifying objects around the home, and utilizing a solar system. This design aims to assist flood victims in locating their missing belongings and draws inspiration from the sleek, water-resistant shape of stingrays. Ideation 2 is derived from data analysis. This design features elements inspired by jellyfish and futuristic items, with a focus on object detection and floating capabilities. It also incorporates a buoy-like float for protecting the victim's possessions. Systems such as the solar system, lighting, and alert systems are integrated, and the device activates when it meets water. Ideation 3, centers on the concept of protective wrapping for personal objects, particularly those that are easily portable, such as dining tables, chairs, and cupboards. The design is adapted from earlier research to ensure ease of use during floods. Ideation 4, which initially emphasizes substantial objects like cars. It incorporates a wrapping method and a detector for locating goods. Additionally, it features a radio for communication in case the victim is stranded within the vehicle. The last concept envisions a product that can save both individuals and household items while flying like a drone. It utilizes a special system that deploys a float, inflating upon contact with water. The sensor system is designed to recognize the user's belongings. Overall, Concept Ideations 2 and 3 can be further refined and combined to create an effective product. The key distinction lies in the application of protective wrapping to domestic items and specific car compartments, reducing the frequency of damage to homes and cars.

CONCLUSIONS

The concluding section of this research serves as a synthesis of findings aimed at managing flood risks in Kuala Lumpur, with a particular focus on their impact on vehicles and household items. This discussion reflects on the various aspects of disaster response, notably mitigation, preparedness, response, and recovery, with an emphasis on improving the management of flood risks. It is apparent from the available literature that a substantial portion of the research predominantly concentrates on the preparedness phase. Thus, it becomes increasingly important to ensure the efficient and effective management of flood risks, especially concerning the protection of durable goods. The research's conclusions are centered on the overarching research goal, which is to propose a conceptual design solution capable of safeguarding the durable goods of flood victims. These conclusions align with the research objectives as follows:

Research Objective No.1: To investigate the vulnerabilities of flood victims, their strategies, activities, and roles in managing flood risks concerning household items during floods. Conclusively, it is apparent that flood victims are undoubtedly vulnerable to this disaster. They frequently lack strategies or a comprehensive community or individual plan, rendering them ill-prepared to protect their durable goods from flood damage. This observation is consistent with survey results that have been gathered during this research. Whether individuals are first-time victims or possess some experience with flooding, their primary concern often revolves around relocating household items to higher ground or securing their cars in elevated areas. However, their capacity to effectively manage these items during floods is often limited, with the potential for damage being beyond their control. This

limitation underscores the need for the proposed design concept, which can protect household items, particularly furniture such as dining tables, chairs, cabinets, and important documents. Additionally, a vacuum system has been integrated into this concept to enhance item safety.

Research Objective No. 2: To identify significant durable goods commonly damaged during floods and explore how such damage can be mitigated through preparations. The research identifies that typical durable goods that fall victim to flood damage are furniture, electrical and electronic products, and vehicles. It is observed that with better preparedness and proactive measures, these losses can be significantly reduced. Flood victims who anticipate and prepare for such events can better safeguard their belongings. Notably, only a select few items may need to be prioritized for preservation during floods, with the remainder being salvaged during the post-flood recovery phase. Consequently, the proposed design solution should focus on protecting these specific categories of items and mitigating flood-related damage.

Research Objective No. 3: To ascertain the essential and non-essential needs of flood victims concerning their durable goods during floods. The research has led to the development of a design concept that addresses the identified needs of flood victims, particularly in safeguarding their durable goods. The proposed design involves a protective wrapping system that is suitable for furniture such as dining tables, chairs, cabinets, and essential documents. The system can be easily activated, ensuring the items' safety during floods. The integration of a vacuum system adds an extra layer of security, guaranteeing the preservation of valuable items.

RECOMMENDATIONS

The findings from this research suggest that future studies should incorporate direct, face-to-face interactions with flood victims during flood events. This methodological approach will allow researchers to gain a more nuanced understanding of the challenges and critical needs experienced by victims, thereby facilitating the development of more targeted and effective solutions. Furthermore, collaboration with government agencies and other relevant stakeholders is imperative to broaden the scope of insights and ensure that research is grounded in practical experiences.

It is recommended that government agencies take a proactive role in organizing specialized workshops and seminars for personnel engaged in flood-related operations. These training sessions should equip participants with the necessary skills and knowledge to mitigate economic losses and enhance operational preparedness during flood events. Additionally, there is a critical need for increased investment in the acquisition, storage, and systematic management of flood-related data. This effort should be accompanied by the development and dissemination of comprehensive guidelines based on best practices to improve the effectiveness of flood response strategies.

For future research and design endeavors, it is advisable that designers conduct thorough interviews with flood victims to identify optimal design solutions. Additionally, exploring current technological advancements is essential to address the specific needs and aspirations of affected communities, contributing to broader national development goals. Active community participation is also crucial for reducing vulnerability and enhancing the resilience of urban populations to flood events. Raising awareness of disaster preparedness and management within these communities can significantly bolster the nation's long-term resilience to flooding.

In conclusion, flash floods represent a significant threat in Malaysia, particularly in urban areas such as Kuala Lumpur, where they have caused extensive losses and damage to durable goods. Addressing this complex challenge requires a collective and coordinated effort involving government authorities, community members, researchers, and designers. By working together, it is possible to mitigate the severe impacts of flooding and minimize associated losses and damages. This research supports the national Disaster Risk Reduction (DRR) plan by proposing practical, evidence-based solutions tailored to the needs of flood victims, with the ultimate goal of enhancing the well-being and resilience of the nation.

ACKNOWLEDGMENT

The researchers would like to express their gratitude to the College of Creative Arts for initiating grant opportunities that foster research practices among academic staff. We also extend our appreciation to ReNeu,

and UiTM, for their invaluable support and expertise, which has been instrumental in the preparation of this manuscript.

REFERENCES

1. Bernama. (2022, January). Malaysia incurs a loss of RM6.1 billion following nationwide floods. News Straits Times. <https://www.nst.com.my/news/nation/2022/01/766996/malaysia-incurs-loss-rm61-billion-following-nationwide-floods>
2. Bhuiyan, M. A. (2018). Direct impact of flash floods in Kuala Lumpur City: Secondary data-based analysis. <https://www.researchgate.net/publication/329907594> Direct impact of flash floods in Kuala Lumpur City Secondary data-based analysis
3. Buye, R. (2021). Critical examination of the PESTEL analysis model. <https://www.researchgate.net/publication/349506325> Critical examination of the PESTEL Analysis Model
4. Chen, C.-H. (2012). Workshop process for design education by using AEIOU approach to ... Proceedings of the Design Research Society Conference. <https://dl.designresearchsociety.org/drs-conference-papers>
5. D'Ayala, D. (2020). Flood vulnerability and risk assessment of urban traditional buildings in a heritage district of Kuala Lumpur, Malaysia.
6. H, H. (2021, December). Two dead, thousands evacuated after floods hit several Malaysian states. The News Straits Times. <https://www.straitstimes.com/asia/se-asia/two-dead-thousands-evacuated-after-floods-hit-a-number-of-malaysian-states>
7. Hamid, L. A. (2013). Experiential approach as a design innovation solution to prevent housebreaking crime. *Procedia - Social and Behavioral Sciences*, 123, 228-235.
8. Isah, N. (2015). A thematic analysis on the roles and functions of Smart Tunnel in flood disaster and traffic flow management in Kuala Lumpur, Malaysia. *International Journal of Research and Review*.
9. Liu, C. (2022). An empirical study of the effect of a flooding event caused by extreme rainfall on preventive behaviors against COVID-19. *Frontiers in Public Health*. <https://doi.org/10.3389/fpubh.2022.758970>
10. Marzukhi, M. A. (2018). Flood detection and warning system (FLoWS).
11. Mohamad Yusoff, I. (2018). Exploring the management of flood disaster: A Malaysian perspective. *Jurnal Kejuruteraan*. Retrieved from <http://journalarticle.ukm.my/12818/1/22285--8296282962--11->
12. Nasir, N. M., & Nasir, N. M. (2022). Design thinking in learning and innovation towards design process in IR 4.0. *Environment-Behaviour Proceedings Journal*, 7(19), 227-235.
13. Nasiri, H. (2018). District flood vulnerability index: Urban decision-making tool.
14. Ng, Y. J. (2021). Floods amidst COVID-19 in Malaysia: Implications on the pandemic responses.
15. Rahman, S. (2022). Malaysia's floods of December 2021: Can future disasters be avoided? ISEAS-Yusof Ishak Institute. <https://www.iseas.edu.sg/articles-commentaries/iseas-perspective/2022-26-malaysias-floods-of-december-2021-can-future-disasters-be-avoided-by-serina-rahman/>
16. Salleh, H. (2020). Opportunities and challenges for building community preparedness towards disasters in Malaysia.
17. Samsuri, M. (2018). Flash flood impact in Kuala Lumpur: Approach review and way forward.
18. Sardi, M. (2019). Assessing disaster risk and resilience: A case study in an urban flood vulnerable community in Kampung Asahan, Kuala Selangor.
19. Selvaraj, S. (2019). Discourses of flood disaster preparedness by NGOs: Humanitarian aid, teamwork, and victimization.
20. Shah, S. (2017). Disasters worldwide and floods in the Malaysian region: A brief review.
21. Shariff, S. M. (2018, January). Preparedness plan for flood: A bottom-up approach. 10.4102/jamba.v11i1.598
22. Sipon, S. (2013). Stress and Religious Coping Among Flood Victims. <https://www.researchgate.net/publication/275543925> Stress and Religious Coping among Flood Victims
23. Toyong, N. M., & Toyong, N. M. (2021). Data collection instrument in designerly intuition study. *Environment-Behaviour Proceedings Journal*, 6(15), 301-308. <https://doi.org/10.21834/ebpj.v6iSI5.2925>