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Multifunctional and Technological Clothing During the Flood Disaster in Pasir Mas, Kelantan: Understand Challenges and Identify Areas to Support

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Abstract

Floods have been a continuous natural disaster in Malaysia since 1971 and the state of Kelantan in the Pasir Mas district experienced severe flooding due to the monsoon season. The role of flood disaster response has become increasingly complex and its capacity for individuals has also been proposed. Its needs will change with time and the issue of prolonged flood disaster response needs to be reviewed. This paper aims to identify the main challenges faced during flood disasters and to identify strategies for improvement such as improving self-response capabilities during flood disasters. By using a literature review methodology, general and specific keywords are also used, namely “flood disaster in Kelantan and “flood disaster in Malaysia” on Scopus to analyzes existing works and publications. Two challenges that emerged as themes from past studies: This paper highlights the important role of understanding the impact during flood disasters and to understand behaviour of flood victims. The findings propose a descriptive conceptual framework and strategies for the clothing product with life-saving features during flood that is the development of multifunctional clothing designs supported by artificial intelligence (AI) applications to assist in the prevention of injuries and deaths.

Keywords: Flood in Kelantan, Literature Review Method, Flood Disaster in Malaysia, Multifunctional Clothing, Artificial Intelligence (AI)

Introduction

Malaysia is located outside the "Pacific Ring of Fire" or the Pacific Circle of the Rim around Southeast Asia. Therefore, it is free from volcanic explosions and earthquakes. However, that does not mean that Malaysia is completely "Free" from natural disasters and disasters, as it

is often prone to floods, droughts, landslides, haze, tsunamis, and man-made disasters (Parker et al. 1997). Floods are common in Malaysia, especially on the east coast of the peninsula during the monsoon season, especially in the Pasir Mas district of Kelantan causing massive damage and destroying many houses, lives, property, etc. (Chan, Weng. 2015), causing them to lose their livelihood resources such as food, water, electricity and transportation will be cut off (Suriani et al., 2019, Adli et al., 2018). This situation has forced flood victims to engage in these risky behaviors to save lives such as going to safe destinations, going out in search of food or looking for high ground while waiting to be rescued.

This paper offers an exhaustive examination on the functional needs when performing risky behaviours during the floods in the Pasir Mas district of Kelantan, which experiences more frequent and severe flooding due to overflows from Sungai Golok. By engaging in a comprehensive literature review, research casts a huge net of academic papers, books, and digital repositories. Key findings reveal that there are diverse functional needs as flood victims engage in these risky behaviours. The decision emphasizes the need to produce appropriate functions in life-saving clothing during flood disasters because clothing is the closest to humans. As a result, it will increase one's ability to respond during a flood disaster. This paper identified the importance of design development strategies in life-saving products to meet consumers' needs to support risky behaviors. The diverse functions in clothing and are coupled with technology can not only help risky behaviors during floods but they can make clothes more attractive, encourage wearer participation and even extend the clothing service cycle.

This paper will provide four benefits. First, to the community, namely the consumer, by offering comfort and flexibility to the wearer. Secondly, to designers, students and teaching staff, useful for the innovation of life-saving clothing products during the floods in Malaysia. Third, to the (industrial) economy, to achieve the Sustainable Development Goals and fourth, to the ecological (environmental) level, helping to balance the needs of the eco-friendly and life-saving chain that can help fight climate change. The production of proper function in life-saving clothing is essential because flood disasters occur in a global world.

Literature Review

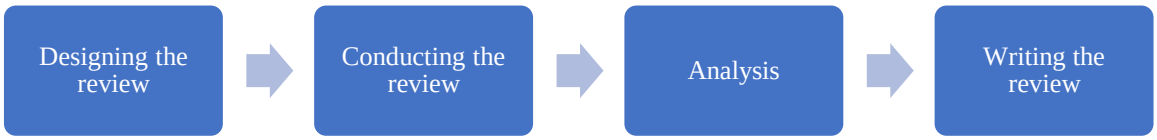
Over the last three decades, flooding is a major risk in the world and nowadays it is becoming common in Malaysia. Malaysia is aware of the risks posed by climate change and has discussed it in the new five-year development plan for the Twelfth Malaysia Plan, 2021-2025 (12MP). Flooding can be defined as high flows that dominate natural or artificial banks in any part of a river system. Therefore, when a river bank is cut off, the water spreads over the flood plain and is generally harmful to the community (Ching et al., 2013). The phenomenon of flood disasters is increasing and affects victims in flood-prone areas (Shafiai & Khalid, 2016). Various impacts during floods as residents living in Pasir Mas district on the Thai border experience more frequent and severe flooding due to overflows from Sungai Golok (i.e. Rantau Panjang town) (Pah et al., 2014).

Methods

In this paper, we used a literature review method, focusing on collecting and analysing existing works and publications related to the flood disaster in Pasir Mas, Kelantan. In the following, the basic steps and important options involved in conducting a literature review

will be proposed and discussed using four phases. This process is developed from practical experience and is synthesized and influenced by various standards and guidelines proposed for literature review (Liberati et al., 2009; Tranfield et al., 2003; Wong et al., 2013, Snyder, H. 2019). The four phases are as follows:

Table 1
Guidelines for literature review method



Phase 1: Designing the review: Through this approach, we understand the problems faced during flood disasters and how to help people affected by floods by comparing different sources of information, we can form a comprehensive understanding of the functional requirements of appropriate clothing during flood disasters. This method allows us to draw conclusions based on various existing knowledge without conducting new field research. *Phase 2: Conducting the review*: In this paper, all related articles from 2020 to 2025 limited to article in social sciences. The data collection in this research includes survey methods based on flood studies that have been conducted in Kelantan. The titles and abstracts of articles published in English and Bahasa Malaysia were searched by surveying previous flood studies in Kelantan on Scopus using specific search strings were complied and search term “Flood AND in AND Kelantan” (n=15) and “Flood And disaster And in And Malaysia” (n=47) . *Phase 3: Analysis*: Records identified (n=62) through database searching and social sciences journal paper, (n=11) records screened the title and abstract. Finally, (n=4) studies were included and analyzed after studying the inclusion and exclusion criteria. This paper is a thematic systematic review aimed to investigate and categorize criteria that save lives during flood disaster. Principles of thematic analysis techniques, such as encoding data, searching for themes, refining themes, and reporting findings (Flick, 2022) as below:

Table 2
Thematic Analysis Framework

Researchers using thematic analysis as a way to identify, understand, analyze and report themes in an interrelated dataset have been widely used (Nowell et al., 2017). *Phase 4: Writing the review*: Previous studies have found that there are several issues during flood disasters that can be divided into two key challenges that emerged as themes. This research highlights the crucial role in understanding the impact of floods during disasters. This will be discussed in research findings and discussion.

Research Findings and Discussion

In this section, we present two key challenges that emerged as themes from previous studies. Based on the results of the analysis of past studies, we have proposed the implementation of a strategy to assist people involved during floods or people entering flood waters in navigating the identified challenges.

Challenge 1: The impact of flood disaster

Floods have become a continuous natural disaster and they affect the flood-affected areas and populations and the water rises at least more than 10 meters with strong currents and affects not only the provinces but also the states, provinces, roads and villages. The picture of the flood in Pasir Mas, Kelantan is as follows.

Figure 1 (from the left): Worst floods in 40 years in Pasir Mas,

(Photo sources: https://majoriti.com.my/berita/2022/02/28/banjir-terburuk-dalam-tempoh-40-tahun-di-pasir-mas---penduduk), **Figure 2 (right):** A four-wheel-drive vehicle nearly sank when wading through floods on the Pasir Mas Main Road to Rantau Panjang following the overflow of river golok water. (Photo sources: NSTP/NIK ABDULLAH NIK OMAR https://api.bharian.com.my/berita/nasional/2023/12/1193097/90-peratus-kawasan-rantau-panjang-dilanda-banjir)

Floods will cause necessities such as food and clean water to be cut off and even worse when the careless attitude of flood victims with life-saving knowledge such as Cardio-Pulmonary Resuscitation (CPR), not providing emergency assistance such as first aid can lead to death. Based on the ebanjir.kelantan.gov.my portal, Pasir Mas is a flood disaster area that resulted in high deaths in Kelantan in 2022 with 3 deaths, in 2021 with 4 deaths and in 2017 with 4 deaths. Table 3 shows the number of deaths from 2016 to 2023 in Kelantan.

Table 3
Total deaths in Kelantan from 01-01-2016 to 11-03-2023

DISTRICT	DROWNED	SUFFOCATION	TOTAL
Tumpat	0	3	3
Bachok	3	0	3
Kuala Krai	0	3	3
Machang	0	0	0
Kota Bharu	0	3	3
Pasir Mas	0	11	11
TOTAL CASES	**3**	**20**	**23**

(Source: https://ebanjir.kelantan.gov.my/p_kmrpt01.php)

In conclusion, there is need of improvement such as improving personal flood response capabilities for survival such as food, drinks and emergency equipment and it must always be by the side of flood victims.

Challenge 2: Risky behaviors during flood disaster

However, the victim received little support as the agency was unable to gain access. This is exacerbated by power outages. Some flood victims had to seek shelter while waiting to be rescued as shown in the figure 3 and figure 4, closed or hidden places make it difficult to find and rescue flood victims and if the flood water rises quickly this will lead to loss of life.

Figure 3 (from the left): Three siblings trapped on the roof in Pasir Mas. (Photo sources: https://sengatdaily.com/banjir-tiga-beranak-terperangkap-atas-bumbung-di-pasir-mas/). **Figure 4 (right)**: 3 days trapped on the top floor of the house in Pasir Mas. (Photo sources: https://www.kosmo.com.my/2024/11/29/15-penduduk-rayu-bantuan-3-hari-terperangkap-di-tingkat-atas-rumah/)

Article in Sinar Harian by Mohammad Khairil Ashraf (20 January, 2022), titled Flood 18 December: statement by former Malaysian prime minister Datuk Seri Ismail Sabri Yaakob at the 14th Special Meeting of Parliament for the Fourth Term in the Dewan Rakyat, PDRM (Royal Malaysian Police), JBPM (Malaysian Fire and Rescue Department), ATM (Malaysian Armed Forces) and APM (Civil Defence Force) have actually mobilized their respective forces to evacuate flood victims but there are still problems such as situations where rescue assets had to be taken to flood-affected areas and delays in rescue work were also due to the poor home address given by the caller could not be identified because it was inundated. This makes it difficult for rescue operations to be carried out as flood victims are difficult to trace and even worse, flood victims are unable to contact rescue teams or authorities for help.

In conclusion, flooded homes cause disconnections and communication requires technology to enable flood victims to be identified wherever they are whether they are open or closed, watered, out-of-water or underwater.

Recommendation

In this section, We have presented two challenges that emerged as themes. Based on the information obtained from previous studies, this paper propose a descriptive conceptual framework as below.

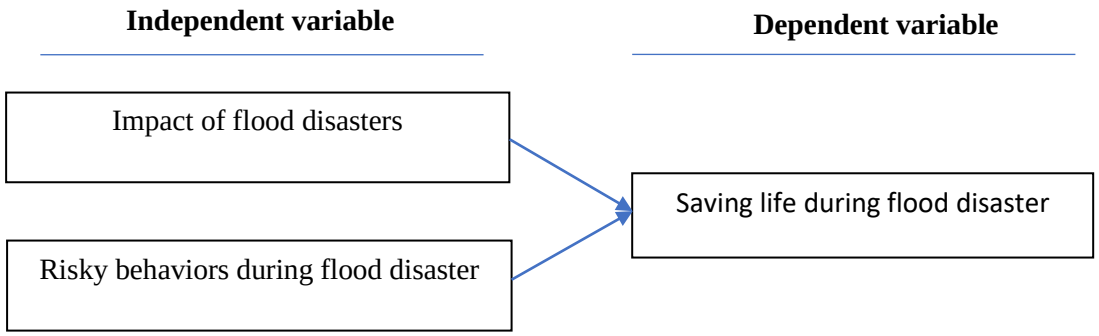


Figure 5: Descriptive conceptual framework

Based on figure 5, in response to the challenges identified, we propose a strategy to save lives during flood disaster, namely the development of multifunctional clothing designs supported by artificial intelligence (AI) applications and the explanation of the strategy is as follows.

Multifunctional Clothing with AI to Support Impact During Flood Disaster

These findings suggest that not all factors of incompetence are solely due to the humanitarian logistics of aid teams but may come from the victims themselves. Therefore, it is hoped that the victims or the public will not easily blame the relief team if the situation does not go according to plan because the relief team has made every effort to ensure that all flood victims can be evacuated to a safe area as soon as possible. Self-preparation is very important to ensure safety during flood disasters. Factors related to the need for multifunctional clothing and technology include *first*, helping flood victims save essential necessities and lives. *Second*, saving lives while they are in the water. L*astly*, AI making it easier for rescuers to identify the location of flood victims and provide early information.

Multifunctional Clothing

Life-saving products are very important and the closest thing to yourself is clothing. The value of multifunctional clothing is determined by the technical aspects of the product. The garment not only has a single product design but also a series of different functions that can even become practical across several seasons and create a unique production marketing chain. It consists of three main characteristics which are diversity, flexibility, and continuity (Li, Chen & Wang, 2018). Multifunctional clothing allows for different uses in different scenarios, such as adapting to different social situations, weather conditions, and more. (Cunha & Broega, 2009). Multifunctional design features include having two or more functions. Each piece of clothing can be easily unfolded to achieve a multifunctional design (Li, Chen, & Wang, 2018). The multi-functional clothing on the water life jackets allows them to store emergency kits, important documents, food and drinks as well as shelter due to the destruction of their homes during the floods. while waiting to be rescued wherever they are or while they are heading to a safe destination.

Risk Reduction and Using AI

The Fourth Industrial Revolution (4IR) is an integration and innovation in the lives of the world's people today (Pereira, Barreto, & Amaral, 2017). The addition of AI such as detectors and communications placed on multifunctional clothing can help save lives during flood disasters and according to Hussain, Nor, Ismail (2014), Goyal, Ghanshala, & Sharma (2021), the development of new technologies can unlock the possibility of minimizing economic

losses in infrastructure damage and, more importantly, the loss of human lives as a result of harmful natural disasters such as floods. An Internet of Things (IoT) assisted communication, Search and Rescue (SAR) framework has been proposed for flood management systems in an orderly manner to establish communication without an efficient infrastructure strategy that provides the ability to quickly locate victims and thus enable timely rescue actions and a study in India found that the rescue of flood victims was effective and efficient. The addition of AI such as detectors and communications placed on multi-pupose clothing can be used to predict the number of people who will be evacuated from their homes and where they are likely to be evacuated. Such insights can help emergency personnel identify the amount of help (water, food, medical care) needed and where to send it (Artificial Intelligence, Jan 14, 2020).

Conclusions

The current study identifies two challenges that emerged as themes from past studies and proposes a descriptive conceptual framework and key strategy to support flood victims and improve public safety. These findings provide valuable information that can inform policies, research, and practices aimed at improving public safety during flood disaster events. Governments should identify weaknesses in disaster relief for future preparedness to deal with disasters, management for the pre-, during and post-disaster phases especially floods will be more effective. In Malaysia, the Fourth Industrial Revolution (4IR) serves as a comprehensive national policy to drive the achievement of the Fourth Industrial Revolution (4IR) agenda and support national development policies such as the Twelfth Malaysia Plan (12MP) and the Shared Prosperity Vision 2030 (WKB 2030). Artificial intelligence (AI) is the driving force behind the Fourth Industrial Revolution (4IR) while Community Integration 5.0 which dominates the virtual and physical realms can be used to understand their role when faced with disasters such as floods and should be used to streamline risk management as well as reduce risks during disasters, especially floods. Therefore, future research should consider the perspective that the design and technology of multifunctional clothing can be realized for use during flood disasters.

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