Integrating Humanitarian Logistics And Good Distribution Practices (GDP) In Flood Disaster Management: Case Study In Malaysia

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ABSTRACT
Flood disasters in Malaysia have become increasingly frequent and severe due to climate change, leading to significant socio-economic and environmental challenges. Effective flood disaster management necessitates an integrated approach that incorporates geospatial analysis, sustainable planning strategies, and efficient distribution systems to enhance flood resilience. This study examines the integration of humanitarian logistics and Good Distribution Practices (GDP) in optimizing flood relief operations, ensuring systematic resource allocation while minimizing socio-economic and environmental impacts. A quantitative research approach was employed, with data systematically collected through structured questionnaires distributed to flood-affected communities across five states: Kedah, Perak, Selangor, Johor, and Melaka. A total of 430 responses were analyzed to identify key logistical and planning factors influencing flood disaster management. The findings underscore the critical role of geographic distribution strategies and optimized supply chain networks in mitigating flood-related disruptions. Integrating spatial logistics planning with GDP principles enhances resource efficiency, reduces operational losses, and improves coordination among government agencies, non-governmental organizations (NGOs), and communities. Based on these findings, this study proposes evidence-based recommendations to improve flood risk assessment through the development of sustainable distribution frameworks that strengthen disaster response strategies. The proposed framework offers a structured approach to enhancing flood disaster management in Malaysia and other regions vulnerable to climate-induced flooding.

1. Introduction

Flood disasters in Malaysia have become increasingly frequent and severe, primarily due to the impacts of climate change (Chan et al., 2022). These events disrupt entire communities, causing widespread displacement, loss of livelihoods, and an increased vulnerability to waterborne diseases (Mohd et al., 2021). Additionally, significant damage to infrastructure hampers recovery efforts, exacerbating long-term socio-economic consequences. Given the rising frequency and severity of such disasters, particularly in climate-sensitive regions like Malaysia, it is imperative to develop and implement robust disaster management strategies to mitigate their adverse effects (Ngai et al., 2020). Humanitarian logistics plays a central role in disaster management by ensuring the timely and efficient delivery of essential resources such as food, water, medical supplies, and shelter to affected populations (Van Wassenhove, 2006). Effective logistics operations can significantly alleviate the suffering of disaster-affected communities, improving their access to basic needs and expediting recovery. However, Malaysia continues to face persistent challenges in its humanitarian logistics operations, including coordination gaps among stakeholders, misallocation of resources, and delays in aid distribution (Anoop & Kumar, 2023). These inefficiencies undermine the effectiveness of flood disaster responses, highlighting the need for more structured and systematic approaches to humanitarian logistics.

Good Distribution Practice (GDP) is a framework initially designed to ensure the quality and integrity of products in the pharmaceutical and food industries. It offers a valuable model for disaster logistics. GDP focuses on standardizing procedures, implementing strict quality control measures, and

optimizing resource allocation all of which are essential for effective humanitarian logistics (WHO, 2019). By adopting GDP principles, disaster management agencies can enhance resource tracking, minimize losses, and improve coordination between government agencies, non-governmental organizations (NGOs), and local communities (Wang, 2021).

This paper investigates the integration of humanitarian logistics and GDP in managing flood disasters in Malaysia, focusing on how this integration can address the challenges in disaster response and improve the efficiency of aid distribution. The study focuses on five flood-prone states, Kedah, Perak, Selangor, Johor, and Melaka, during major flood events from 2021 to 2023. This article critically analyses case studies from the region to reveal effective strategies for combining humanitarian logistics with GDP principles, ultimately improving the efficiency of flood disaster management. By concentrating on the key factors that drive effective flood disaster response, this case study emphasizes the importance of optimizing resource allocation, minimizing operational losses, and strengthening collaboration among all stakeholders involved. This strategic approach not only enhances response efforts but also saves lives and ensures sufficient resources to cope with future flood disasters.

2. Problem Statement

Flood disasters in Malaysia have exhibited an alarming increase in frequency and intensity, largely intensified by the ramifications of climate change. These recurring occurrences disrupt societal structures, resulting in the displacement of individuals, the erosion of livelihoods, and an amplified susceptibility to waterborne diseases (Mayo & Lin, 2022). Furthermore, the destruction of infrastructure markedly hinders recovery initiatives, thereby inducing enduring ramifications for the populations impacted. Notwithstanding these obstacles, Malaysia continues to grapple with considerable inefficiencies in disaster management, particularly the coordination of humanitarian logistics and the distribution of resources during flood events (Muzamil et al., 2022).

Humanitarian logistics is critical in facilitating the rapid and efficient provision of relief during flood-related disasters. However, the current logistics framework in Malaysia often proves inadequate in addressing the complexities associated with such events. Critical challenges, including inadequate infrastructure, ineffective communication among stakeholders, and improper resource allocation, significantly affect the effectiveness of relief efforts (Pujiana et al., 2024). Despite increasing awareness of these issues, the Malaysian disaster management system remains fragmented and characterized by a lack of a coherent integrated methodology. There is a significant demand for integrating Good Distribution Practices (GDP) to improve logistics efficiency, ensure equitable resource allocation, and maintain quality benchmarks (Burak, 2023). This article aims to address these shortcomings by investigating how incorporating humanitarian logistics with GDP principles can enhance the effectiveness and sustainability of flood disaster relief operations in Malaysia as well as the research gaps identified (Ayoub et al., 2023; Mansoor et al., 2024).

The implementation of GDP principles has the potential to significantly improve resource tracking, reduce waste, and foster better coordination among government agencies, non-governmental organizations (NGOs), and communities (Gazi, 2020). Despite the growing recognition of the importance of community resilience in flood disaster management, Malaysia's state of preparedness remains suboptimal due to disjointed efforts among stakeholders and the absence of standard operating protocols. Furthermore, the frequent lack of disaster response training exacerbates this issue, resulting in delays and inefficiencies in the provision of relief services (Ludin et al., 2016; Whittaker et al., 2020). Therefore, this research aims to address this pressing weakness by investigating the integration of humanitarian logistics and GDP principles to enhance the effectiveness of flood disaster management in the Malaysian context. By focusing on the challenges of logistics coordination, resource allocation, and collaboration among stakeholders, this investigation develops a conceptual framework to guide disaster preparedness, strengthen community resilience, and contribute to sustainable practices in flood disaster management. The results of this study provide practical recommendations to improve response systems, reduce vulnerabilities, and increase community and national resilience.

3. Literature Review

3.1 Humanitarian Logistics Management

Humanitarian logistics are critical in disaster response because they ensure that essential resources like food, water, medical supplies, and shelter are delivered to affected populations efficiently (Holguin-Veras et al., 2012). Logistics face significant challenges in flood disaster scenarios, including disrupted supply chains caused by damaged transportation networks, inadequate infrastructure in rural and urban areas, and poor communication among stakeholders such as government agencies, NGOs, and communities (Tatham et al., 2017). By addressing these challenges, humanitarian logistics contributes significantly to disaster risk reduction. For example, pre-positioning resources and establishing resilient supply chains help to reduce aid delivery delays (Frennesson et al., 2021).

Moreover, effective logistics minimize resource waste, optimizing the utilization of available help and fostering sustainability in disaster-affected communities. These enhancements also foster trust and cooperation among stakeholders, promoting long-term development and preparedness.

3.2 Good Distribution Practices (GDP)

Good Distribution Practices (GDPs) ensure the quality, safety, and traceability of products during storage and transport. Originally developed for the pharmaceutical and food industries, the principles of GDPs such as clear documentation, robust quality control, and transparent resource tracking are increasingly being applied in disaster management to improve logistics efficiency (European Medicines Agency's data protection, 2022; Salgar et al., 2023). Integrating GDPs into humanitarian logistics ensures that resources are allocated equitably and that quality is maintained even in challenging conditions (Baffoe & Luo, 2020). By integrating GDPs, contributing to Disaster Risk Reduction and Sustainable Development of communities and humanitarian organizations by ensuring standardized practices, GDPs can minimize misallocation and waste of resources, which is critical in flood-prone areas where aid is often limited. It also fosters accountability and transparency in aid distribution, builds community trust, and strengthens stakeholder partnerships. These improvements align with the goal of disaster risk reduction by increasing the reliability of aid systems and contributing to the resilience of affected communities (Rosli et al., 2020; Shafai & Khalid, 2016).

3.3 Flood Disaster Response

Floods are a recurring natural disaster in Malaysia, causing substantial societal, economic, and infrastructural impacts. Frequent flooding underscores the need for a more effective approach to humanitarian aid distribution. Flood disaster management in Malaysia requires collaboration among various stakeholders, including government agencies, NGOs, and communities to ensure a rapid and effective response (Ridzuan et al., 2022). According to Tanti et al., (2023), flood disaster management encompasses four main phases: preparedness, response, recovery, and mitigation. During the response phase, humanitarian logistics plays a pivotal role in ensuring timely aid delivery to flood victims. Effective distribution minimizes the disaster's negative effects, while a lack of collaboration and coordination among actors often leads to significant delays, exacerbating the suffering of the affected population (Isik & Dinler, 2023). One critical aspect of humanitarian relief operations during floods is managing the flow of goods and services required by disaster victims (Graham et al., 2018).

In Malaysia, effective humanitarian logistics expedites the delivery of essential aid, including food, clean water, clothing, and medical supplies. Selecting appropriate distribution methods, such as establishing temporary depots and aid distribution centers is crucial for ensuring logistics operations' efficiency during disaster response (Nikkhoo & Bozorgi-Amiri, 2018). However, challenges such as resource scarcity and stakeholder misalignment hinder the effective implementation of these frameworks. Addressing these issues is essential for maximizing the potential of humanitarian logistics and GDP in flood disaster management (Agarwal & Kant, 2021).

Flood disaster management aims to reduce the impacts of floods while increasing adaptive capacity. This strategy integrates advanced forecasting systems, infrastructure improvements, and community-based preparedness programs. For instance, forecasting models and early warning systems facilitate

early action, such as evacuation and resource mobilization, thereby minimizing human and economic losses (Ibrahim et al., 2023). Therefore, combining humanitarian logistics with GDP provides a robust framework for addressing the challenges posed by frequent flood events. This integrated approach not only mitigates the adverse effects of floods but also enhances community resilience and establishes a foundation for sustainable disaster management. A comprehensive approach to asset management enhances the resilience of critical infrastructure against extreme floods. This involves risk-informed strategies that adapt to evolving environmental conditions, ultimately fostering sustainable community growth (Nkwazema et al., 2024).

3.4 Disaster Response Strategies

Previous studies have demonstrated that integrating humanitarian logistics with Good Distribution Practices (GDP) is essential for enhancing flood disaster management efforts in Malaysia. This combined approach not only supports sustainable humanitarian relief operations but also improves community preparedness and adaptability, ultimately reducing reliance on external assistance. Nevertheless, challenges persist in the realm of humanitarian logistics related to flood disaster management. These challenges include a lack of coordination among government agencies, non-governmental organizations (NGOs), and communities, as well as insufficient community understanding of the role of humanitarian logistics in managing flood disasters.

Despite the numerous theoretical frameworks proposed in earlier research, empirical validation of these conceptual models in flood disaster management in Malaysia remains insufficient. This gap is particularly evident in the difficulties encountered by various stakeholders when effectively implementing these models, especially in the context of flood and climate change disasters (Liew & Ros, 2021; Saad et al., 2024; Tasnim et al., 2023a). This highlights the necessity of integrating empirical data and real-world applications to enhance the effectiveness of flood management strategies.

Based on these findings, the study emphasizes the urgent need to develop this conceptual model, which combines humanitarian logistics with the principles of Good Distribution Practices (GDP) in flood disaster management in Malaysia. Humanitarian logistics is crucial for improving the efficiency and effectiveness of relief responses. The insights gathered from this study lay the foundation for empirical research and inform policy formulation in the country, acting as a proactive measure to address the impacts of floods and ensuring that aid can be delivered quickly and accurately to those affected for effective recovery. Key Concepts:

- Humanitarian Logistics: Improves the efficiency of resource allocation, minimizes waste, and fosters trust among stakeholders, thereby contributing to immediate disaster relief and long-term community resilience.
- Good Distribution Practices (GDP): Ensure quality assurance, equitable resource allocation, and transparency, promoting sustainable practices in disaster management.
- Flood Disaster Management: Aims to reduce vulnerability through proactive strategies, strengthen community and national resilience to disasters, and promote sustainable development among flood-affected populations.

Accordingly, it is important to establish a conceptual framework that enhances the efficiency and effectiveness of flood disaster management by integrating humanitarian logistics and Good Distribution Practices. The proposed framework integrates these elements to address the inefficiencies prevalent in flood disaster response mechanisms in Malaysia. It consists of three essential components: community understanding of humanitarian logistics; coordination facilitation between government agencies, NGOs, and communities to address issues related to humanitarian assistance, such as delays in aid delivery, limited resources, and aid dropout. This approach enhances community engagement and builds trust, thus improving the efficiency of relief responses during flood disasters. Furthermore, the integration aims to enhance the effectiveness of coordination between humanitarian

organizations and communities through training and incorporating GDP principles into humanitarian logistics operations.

By bringing together these components, the framework seeks to optimize resource allocation, improve traceability, and ensure the prompt delivery of assistance during flood disasters. In alignment with these observations, the proposed framework offers a comprehensive and systematic approach to integrating humanitarian logistics with GDP principles within the context of flood disaster management in Malaysia. Figure 1 illustrates the conceptual framework for this integration.

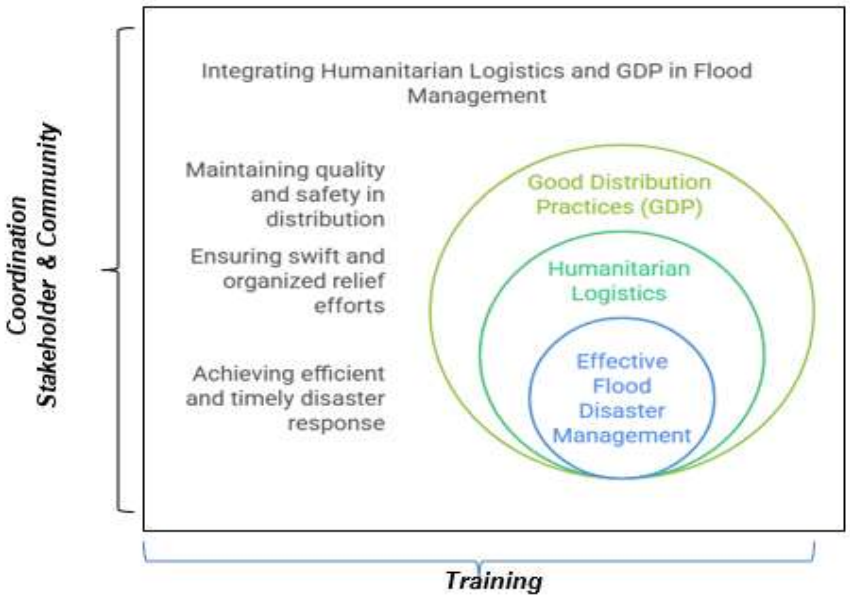

Figure 1. Conceptual Framework for the Integration of Humanitarian Logistics and Good Distribution Practices (GDP) in Flood Disaster Management in Malaysia

This approach is supported by Kovacs & & Falagara Sigala, (2020), who emphasized that community engagement and public awareness significantly enhance the efficiency of disaster response systems. Similarly, Zain et al., (2023) highlighted the importance of inter-agency coordination in reducing aid delays and improving the distribution of humanitarian assistance during large-scale disasters. However, in Malaysia, the lack of a structured framework incorporating Good Distribution Practices (GDP) significantly hinders the quality and accountability of aid distribution. This deficiency is particularly evident during crises such as the COVID-19 pandemic, where vulnerable populations face increased challenges due to inadequate support systems (Zainuddin et al., 2022).

Therefore, this study underscores that community engagement and public understanding, facilitated through continuous training, can greatly enhance the efficiency of disaster response systems during floods. In line with these findings, the proposed framework offers a comprehensive and systematic approach to integrating humanitarian logistics with GDP principles in flood disaster management in Malaysia, emphasizing the importance of thorough training. This framework highlights coordination among government agencies, non-governmental organizations, and communities, ensuring that flood response efforts are not only effective but also that aid is delivered efficiently, promptly, and ethically. While existing literature provides valuable insights into various components of this framework, the connections between humanitarian logistics and Good Distribution Practices remain largely unexplored. Most research on GDP has focused on its application in commercial supply chains, revealing a significant gap in its implementation within the humanitarian aid context (Kapoor, 2018; WHO, 2019). This study addresses this critical gap by investigating how GDP principles, such as inventory management and quality assurance, can be effectively adapted to meet the challenges of humanitarian logistics during floods in Malaysia. Furthermore, the proposed framework aligns with

the Malaysian National Security Council Directive No. 20, which outlines disaster management coordination efforts but lacks comprehensive guidelines for integrating GDP. By addressing this gap, the framework supports policy development and enhances practical disaster response systems, ultimately leading to more efficient and effective humanitarian responses.

4. Methodology

To address this gap, the study assessed the applicability of the conceptual model using quantitative methodology. This approach provides a comprehensive understanding of the dynamics involved in humanitarian logistics and Good Distribution Practices (GDP) during flood disasters in Malaysia, thereby enhancing the practical applicability of the model. By using quantitative methods together with descriptive and inferential research designs to examine flood victims' perceptions and experiences of humanitarian logistics, this study involved collecting numerical data for statistical analysis, enabling the identification of patterns, relationships, and factors influencing the effectiveness of humanitarian assistance. Target population included individuals affected by floods in five flood-prone states in Malaysia: Kedah, Perak, Selangor, Johor, and Melaka. These states were selected based on their history of large and frequent flood events over three years (2021 to 2023). A sample size of 430 respondents was determined using the Krejcie & Morgan, (1970) sampling formula and based on the G*power software as shown in Figure 2 to ensure adequate representation across multiple perspectives, a stratified random sampling method was used, taking into account demographic and geographical factors.

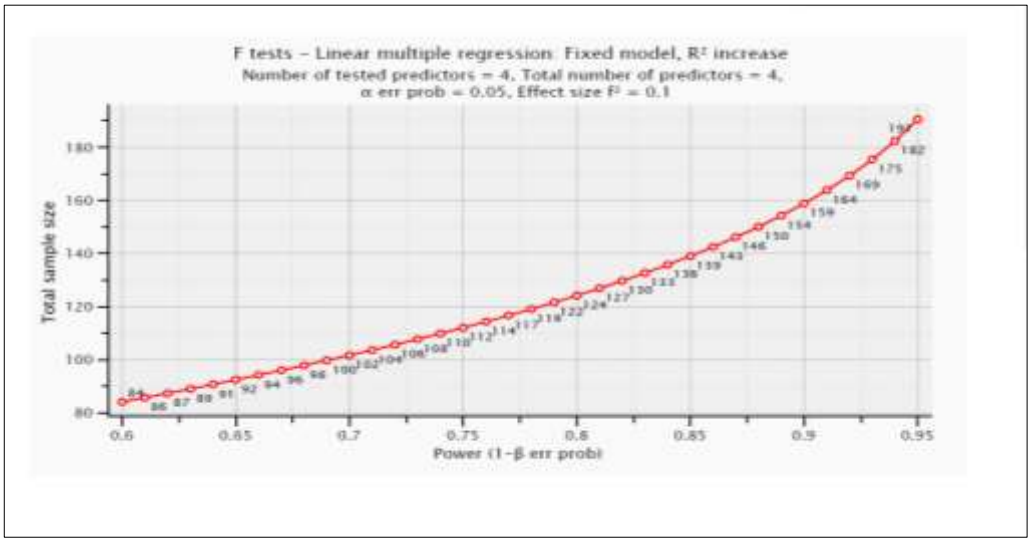

Figure 2. Determination of sample size

Source: *Verma, (2020)*

A structured questionnaire was developed based on existing literature and adapted to the Malaysian context to collect primary data. The questionnaire was divided into four sections: (1) demographic information, capturing details such as age, gender, location, and occupation; (2) public understanding, assessing respondents' knowledge and perceptions of humanitarian logistics during flood disasters; (3) coordination effectiveness, assessing the perceived effectiveness of coordination among government agencies, NGOs, and local communities; and (4) aid delivery, measuring satisfaction with the timeliness, accuracy, and fairness of aid distribution. Responses were recorded using a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree).

The questionnaire was distributed through multiple channels, including face-to-face surveys, email, and Google Forms, to ensure accessibility to a wide range of respondents. In addition to primary data, secondary data were collected from government reports and peer-reviewed articles to provide contextual background and validate key findings. Important sources included statistics from the Department of Statistics Malaysia and scholarly research on flood disaster management. This

comprehensive approach ensured a robust analysis of humanitarian logistics in the context of flood disasters.

4.1 Method

To ensure the reliability and validity of the data collection instrument, Cronbach's alpha reliability test was performed using SPSS software version 20. This confirmed the internal consistency of the construct after expert review and pilot testing, ensuring that the questionnaire was both accurate and comprehensive in measuring the intended construct. For data analysis, descriptive analysis was conducted to summarize demographic data and overall response trends through frequency distribution and percentages, providing an overview of the respondents' characteristics. Inferential analysis was conducted to assess the level of community understanding of humanitarian logistics. This included correlation analysis to examine the relationship between the coordination of government agencies, non-governmental organizations (NGOs), and communities with the effectiveness of humanitarian logistics, as well as regression analysis to determine whether an integrated approach to humanitarian logistics and Good Distribution Practices (GDP) influences the effectiveness of humanitarian logistics in flood disaster management in Malaysia.

4.2 Case Study

This analysis focuses on the factors contributing to the vulnerability of the study areas, which include the states of Kedah, Perak, Selangor, Johor, and Melaka, to the impacts of flooding. These states were significantly affected by major flood events between 2021 and 2023, facing various environmental, social, and infrastructural challenges. The unique geographical, social, and economic conditions of each state influence the severity of flood impacts and the effectiveness of recovery efforts (Anua et al., 2021; Noor et al., 2022; Rahmat et al., 2023).

Kedah, known for its vast agricultural areas, has been severely impacted by heavy rainfall and river overflows, particularly from the Muda and Kedah rivers. These flood events disrupted agricultural activities, displaced rural populations, and underscored the need for improved flood mitigation strategies to protect livelihoods and minimize displacement (Shukri et al., 2023). Similarly, challenges in Perak are closely linked to its river systems, such as the Perak and Kampar rivers, which frequently overflow during the monsoon season. The state has experienced repeated damage to infrastructure and residential areas, highlighting the importance of resilient construction and effective flood response plans (Rosmadi et al., 2023).

Selangor, one of the most urbanized states in Malaysia, faces significant challenges due to rapid urbanization and inadequate drainage systems. Recurrent flooding, particularly in areas such as Shah Alam and Klang, exposes systemic issues in urban planning, leading to widespread disruptions in transportation, emergency services, and daily activities (Muhammad Wafiy et al., 2021; Ramli et al., 2023). In Johor, located at the southern tip of Malaysia, seasonal monsoons bring heavy rainfall, often resulting in severe flooding. These floods affect both residential and agricultural areas, emphasizing the need for better water management systems and more efficient coordination in relief efforts (Hashim et al., 2023).

Melaka's unique location along the Straits of Malacca makes it particularly vulnerable to serious risks such as flooding and storm surges. These environmental threats endanger the region's cultural heritage and local economy. As a result, Melaka is grappling with the challenges posed by severe flooding and storm surges, which have caused considerable damage. To effectively address these issues, a customized flood management strategy is needed (Jamaliidin & Sulaiman, 2018; Tasnim et al., 2023).

Population growth in these states, coupled with urbanization, has increased exposure to flood risks. The concentration of people in flood-prone areas increases the demand for emergency services, shelter, and humanitarian assistance during disasters. Economic activities, including agriculture,

manufacturing, and tourism, are also severely affected during floods, leading to financial losses and prolonged recovery periods. In addition, inadequate drainage infrastructure and the proliferation of unplanned low-rise housing exacerbate the physical challenges faced by communities, making them more vulnerable to the effects of floods (Abdullah et al., 2019; A. Noor et al., 2021). Thus, these factors exacerbate the situation in these states. Coordination gaps among government agencies, NGOs, and communities delay effective disaster response, while limited public awareness of disaster preparedness and humanitarian logistics reduces community resilience.

Addressing these issues requires targeted interventions, including enhanced coordination, public education, and investment in resilient infrastructure (Wu et al., 2023). Therefore, this comprehensive analysis provides a basis for understanding the challenges faced by flood-affected states and offers insights to improve the effectiveness of humanitarian logistics, strengthen stakeholder coordination, and build community resilience. By addressing these factors, this study aims to contribute to more effective flood disaster management, particularly towards efficient, rapid, and effective humanitarian responses.
According to the Department of Statistics 2023 report, Johor recorded the highest losses among the states, amounting to RM275 million, followed by Kelantan RMRM139.7 million, Terengganu RM77.7 million, Pahang RM74.8 million and Perak RM46.9 million (Diana Azis, 2024). In 2022, almost all states, except the Federal Territories of Labuan and Putrajaya, experienced floods, resulting in total losses of RM622.4 million. This figure is much lower than the RM6.1 billion recorded in 2021; however, the impact of the floods is still significant, especially in terms of damage to public infrastructure, housing, and various economic sectors. The decrease in the total losses in 2022 may indicate that the government has made improvements in its disaster mitigation efforts. However, challenges persist, especially in coordinating humanitarian aid and logistics, which continue to hinder the effectiveness of disaster response and recovery initiatives.

4.3 Study Area

The study focuses on five key states in Malaysia: Kedah, Perak, Selangor, Johor, and Melaka. These states have been significantly affected by major flood events between 2021 and 2023. Located in the northern and central parts of Peninsular Malaysia, these regions are particularly vulnerable to seasonal flooding, which has been exacerbated by climate change and urbanization.

- Kedah: Renowned for its agricultural landscape, Kedah has experienced frequent flooding due to heavy rainfall and the overflow of rivers, such as the Muda and Kedah Rivers. In 2021, floods severely impacted communities in the northern part of the state, displacing thousands of residents (National Disaster Management Agency, 2021).

- Perak: Perak, home to rivers like the Perak and Kampar Rivers, frequently faces flooding. The state was particularly hard hit by floods in December 2021, which submerged homes and public infrastructure, leaving many residents stranded (National Disaster Management Agency, 2021).

- Selangor: As one of the most urbanized states, Selangor, including the Klang Valley, has experienced recurrent flooding. Floods in 2021 and 2022, especially in Shah Alam and Klang, highlighted significant urban drainage issues and caused widespread disruption (National Disaster Management Agency, 2021).

- Johor: Located at the southern tip of Malaysia, Johor has faced severe flooding, especially during the monsoon season. In 2022 and 2023, heavy rains triggered floods in several districts, displacing thousands of people and damaging infrastructure (National Disaster Management Agency, 2022).

- Melaka: Melaka, a historic state along the Straits of Malacca, has experienced destructive floods, particularly in 2021 and 2023. These floods caused significant damage to property, crops, and local businesses (National Disaster Management Center, 2024).

The five states selected for this study were chosen due to their significant vulnerability to flood risk, which stems from various environmental, social, and infrastructural factors. These states have faced considerable challenges in managing flood disasters, underscoring the importance of understanding the effectiveness of humanitarian logistics in delivering relief during such events. Over the years, population growth has been accompanied by increasing urbanization and infrastructure development in these areas. Therefore, it is essential to understand how flood events impact these states, particularly in terms of logistical responses, community awareness of humanitarian logistics, and coordination among government agencies, non-governmental organizations (NGOs), and local communities. This knowledge is crucial for enhancing flood disaster management in the future.

5. Analysis and results

This section presents the analysis of the survey data collected from 430 flood-affected respondents across five Malaysian states Kedah, Perak, Selangor, Johor, and Melaka. The analysis aims to provide insights into the effectiveness of humanitarian logistics, inter-agency coordination, and the integration of Good Distribution Practices (GDP) in flood disaster management.

Table 1. Number of Respondents

State	Number of Respondents	Percentage (%)
Kedah	90	20.9
Perak	85	19.8
Selangor	100	23.3
Johor	85	19.8
Melaka	70	16.2
Total	**430**	**100.0**

Source: *By author, 2024*

The survey responses provide valuable insights into the experiences and perceptions of flood victims concerning the effectiveness of humanitarian logistics and the coordination of flood disaster relief. The distribution of respondents across five states reflects the varying levels of flood impact, offering a comprehensive view of the challenges faced by affected communities. This data is essential for understanding the role of humanitarian logistics in flood management and highlights areas that could be improved. **Table 2** presents details on the demographic characteristics of the respondents, including gender, age group, occupation, type of residence, prior flood experience, and knowledge of humanitarian logistics. This demographic breakdown offers an important context for understanding the diverse perspectives and needs of different groups.

Table 2. Respondent Demographics

	Category/Description	Frequency (n)	Percentage (%)
Gender	Male	233	54.2
	Female	197	45.8
Age Group	18-20	68	15.8
	21-30	103	24
	31-40	160	37.2
	41-50	81	18.8
	51-60 and above	18	4.2
Occupation	Government Employee	50	11.6
	Private Sector Employee	75	17.4
	NGO/Volunteer Worker	166	38.6
	Unemployed/Housewife	96	22.3
	Student	43	10.0
Residence Type	Urban	176	40.9
	Rural	254	59.1
Experience with Floods	Yes	316	73.5
	No	114	26.5
Knowledge of Humanitarian Logistics	High	116	27.1
	Moderate	139	32.3
	Low	175	40.6

Source: *By author, 2024*

The demographic characteristics of the respondents, as shown in Table 2, provide significant insight into the contextual factors influencing their experiences and perceptions regarding flood disaster management and the integration of humanitarian logistics and Good Distribution Practices (GDP) in Malaysia. This section examines how these demographic variables may affect the understanding, effectiveness, and coordination of humanitarian aid during flood events.

Gender Distribution and Its Influence on Humanitarian Logistics

The sample consists of 54.2% male respondents and 45.8% female respondents. Given the significant proportion of male participants, their responses may reflect a particular understanding or involvement in flood management activities, which could be influenced by gender-specific roles in disaster preparedness and response. Previous studies have suggested that gender disparities may exist in the access to resources, roles in community-based disaster response, and the reception of aid. Therefore, it is crucial to consider how gender dynamics shape the perceptions of humanitarian logistics and coordination during flood disasters.

Age Group and its Role in Disaster Management Perceptions

The largest age group among the respondents is 31-40 years, accounting for 37.2% of the sample, followed by 21-30 years (24%) and 41-50 years (18.8%). The significant representation of individuals in the 31-40 age group may indicate a strong involvement in active community and family roles during disasters, which could affect their views on the efficiency of disaster relief operations and logistical challenges. Younger age groups, such as those between 18-30 years, may exhibit more familiarity with modern technologies, which could influence their expectations for the integration of digital tools in humanitarian logistics. On the other hand, older age groups might emphasize traditional forms of community support and resource distribution.

Occupational Background and Its Impact on Knowledge of Humanitarian Logistics

Respondents from diverse occupational backgrounds were surveyed, with the highest proportion of participants (38.6%) working as NGO/volunteer workers, followed by unemployed/housewives (22.3%). This distribution suggests a strong connection between humanitarian work and the respondents' professional roles, which may directly influence their understanding of humanitarian logistics and its integration with GDP in disaster response. NGO and volunteer workers likely have more exposure to disaster relief operations, making them key stakeholders in assessing the effectiveness of humanitarian logistics practices. Conversely, unemployed individuals or housewives may have limited direct involvement in flood management but could provide valuable insights based on their experiences as recipients of aid and services.

Residential Area and Flood Response

A notable 59.1% of respondents reside in rural areas, where the impact of floods may differ in terms of accessibility, infrastructure, and community resilience compared to urban areas (40.9%). Rural communities often face greater challenges in receiving timely aid due to geographical isolation, lack of infrastructure, and limited access to emergency services. The experiences of respondents from rural areas could shed light on the logistical challenges faced by humanitarian agencies in reaching affected populations and delivering relief goods efficiently. Additionally, rural residents might highlight the role of local knowledge in navigating flood response and logistical coordination, especially in areas with limited infrastructure.

Prior Flood Experience and Its Influence on Humanitarian Logistics Awareness

A significant proportion (73.5%) of respondents had prior experience with floods, indicating a high level of familiarity with the challenges associated with flood disasters. This experience is likely to influence their expectations regarding the efficiency of logistical responses and the effectiveness of humanitarian aid distribution. Respondents with prior flood experience may provide insights into areas where current humanitarian logistics systems are perceived to be lacking, especially in terms of response speed, resource allocation, and coordination between different stakeholders. In contrast, respondents with no prior experience may offer a more theoretical perspective on what they expect from flood disaster management systems.

Issue 1: Knowledge of Humanitarian Logistics

Humanitarian logistics is essential for the timely and efficient delivery of aid to communities impacted by flood disasters. However, this study reveals significant gaps in public awareness regarding the logistics processes involved in flood disaster management. The data shows that 40.6% of respondents have low awareness of humanitarian logistics, 32.3% demonstrate moderate awareness, and 27.1% have high awareness. This indicates an urgent need for targeted education and training initiatives to enhance public understanding of humanitarian logistics, especially in the context of flood disasters. A lack of awareness can seriously undermine the effectiveness of community-based disaster responses, where local knowledge and coordination are crucial (Bali, 2022). Improving public comprehension of disaster management processes is vital for strengthening community resilience and coordination during emergencies. By implementing effective communication and educational strategies, we can empower citizens to respond swiftly and appropriately to disasters. Initiatives designed specifically for different disaster contexts will enhance this essential understanding (Ahmadi et al., 2024; Yuksel & Akbel, 2023).

A comprehensive analysis of demographic data reveals key factors that shape perceptions of flood disaster management and the integration of humanitarian logistics and Good Distribution Practices (GDP) in Malaysia. Variations in knowledge, occupational backgrounds, previous flood experiences, and types of residences create a complex environment that affects both the effectiveness and challenges of disaster relief systems.

To optimize the integration of humanitarian logistics and GDP, it is crucial to address these demographic differences through targeted interventions. Enhancing public awareness, improving coordination among stakeholders, and ensuring equitable distribution of resources especially in rural and marginalized communities are essential steps forward. By aligning disaster management strategies with the specific demographic realities of affected populations, Malaysia can significantly improve the resilience and responsiveness of its flood disaster relief efforts.

Issue 2: Coordination Between Government Agencies, Non-Governmental Organizations (NGOs) and Communities

The findings of the study on flood disaster response and the involvement of various stakeholders, such as government agencies, NGOs, volunteers, and communities, provide valuable insights into the coordination and effectiveness of humanitarian assistance. This study examines that the role of humanitarian agencies and organizations during the flood event, underscores the significance of coordinating efforts among multiple stakeholders for effective humanitarian assistance. A frequency and percentage analysis reveals that non-governmental organizations (NGOs) and volunteers were the primary contributors, accounting for 38.6% of the assistance provided. This emphasizes the crucial role that NGOs played in delivering immediate support during the flood. Government agencies played a significant role in the contributions to disaster response efforts. The Malaysian Civil Defence Force (APM) accounted for 20.7% of the contributions, while the Malaysian Fire and Rescue Department (JBPM) contributed 14.7%. Other entities included the police, which represented 9.1%, and the Social Welfare Department (JKM), contributing 7.0%. Community contributions were at 2.3%, and the military provided 1.4%. Additionally, the National Disaster Management Agency (NADMA) contributed 6.3%.

These findings emphasize the need for strategic coordination to ensure efficient and effective humanitarian logistics responses, particularly in hard-to-reach areas, for the rapid and accurate distribution of humanitarian aid. According to the study by Xavier et al.,(2021), the military plays a crucial role in providing logistical support during disasters, even if it is not heavily involved in the initial response. This support is particularly vital in areas that are hard to reach, highlighting how strategic military interventions can enhance the efficient distribution of humanitarian aid.

Table 3 Comparative Analysis Between States

Frequency (%)	NGO	Malaysian Fire And Rescue Department	APM	POLICE	Social Welfare Department	ARMY	NADMA	OTHERS
Kedah	50.0	11.8	8.8	5.9	2.9	0.0	14.7	5.9
Perak	27.3	4.5	34.1	9.1	13.6	4.5	4.5	2.3
Selangor	41.2	13.1	21.2	8.8	7.5	0.6	5.6	1.9
Melaka	27.5	25.0	20.0	15.0	5.0	2.5	2.5	2.5
Johor	39.5	17.1	19.1	8.6	5.9	1.3	6.6	2.0

Source: *By author, 2024*

The comparative analysis across various states highlights notable differences in the participation of agencies, organizations, and communities in assisting during floods. According to Table 3, in the states of Kedah and Johor, non-governmental organizations (NGOs) emerged as the most prominent first responders, accounting for 50% and 39.5% of the responses, respectively. This finding underscores the critical role of NGOs in swiftly mobilizing resources and delivering aid to affected communities. Conversely, in states like Melaka and Perak, government agencies such as the Malaysian Fire and Rescue Department and the Civil Defence Force (APM) were more engaged, although their contributions remained lower than those of the NGOs. For instance, in Kedah, the fire brigade was involved in 11.8% of response efforts, while the APM accounted for 8.8%. This suggests that although NGOs were central to the response, there was some degree of collaboration with

government agencies, albeit limited. Additionally, family and community members contributed 2.3% of the efforts, underscoring the significance of grassroots support in facilitating timely relief following a disaster (Chong & Kamarudin, 2023).

These results highlight the vital need for effective cooperation and coordination among government agencies, NGOs, and communities in managing flood disasters. Such collaboration not only accelerates response times but also enhances the accuracy and efficiency of disaster relief efforts (Peng et al., 2018). Moreover, this teamwork can streamline logistics operations and supply chain management during floods. By adopting a coordinated approach, immediate actions can be taken to address the urgent needs of victims, ultimately fortifying community resilience in the face of future disasters (Harrison, 2023; Musdah et al., 2022).

Issue 3: Respondents' Level of Satisfaction with Relief Response During Floods

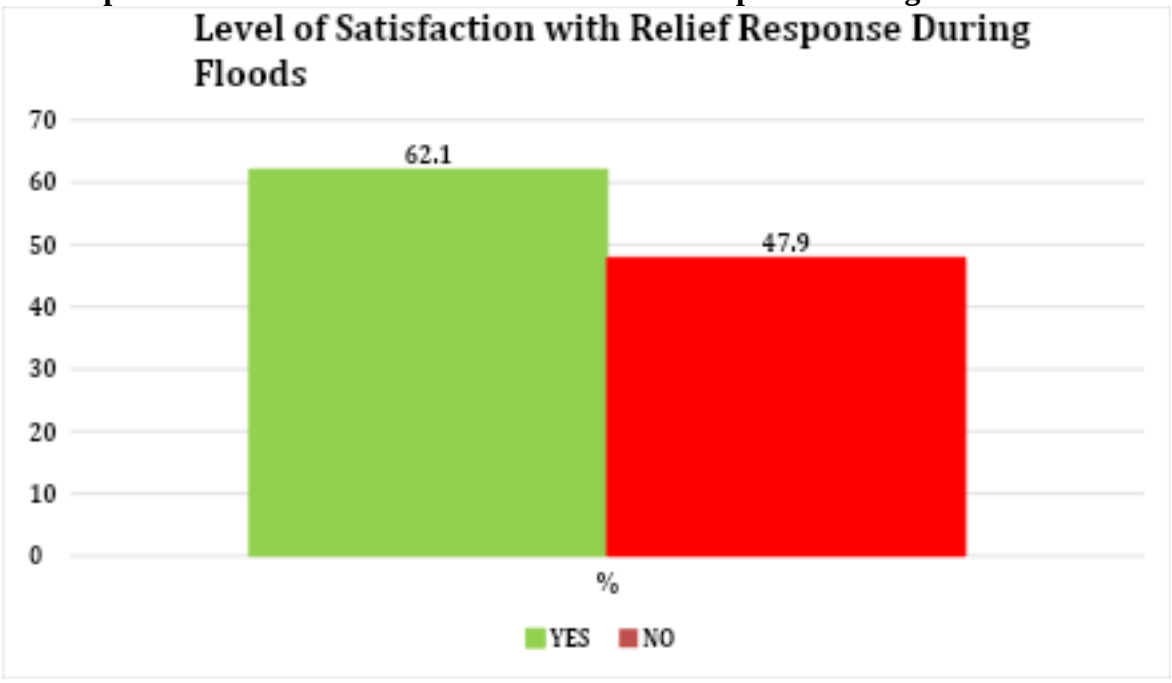

Figure 3. Level of Satisfaction with Response During Floods

Source: *By author, 2024*

Figure 3 indicates that, although a significant number of respondents expressed satisfaction with the flood relief provided in their state or district, a concerning 47.9% reported dissatisfaction with these efforts. This points to critical shortcomings in the current flood disaster management system, especially in the delivery of relief services. Key issues contributing to this dissatisfaction may include delays in aid distribution, poor coordination among agencies, and inadequate access to essential resources during critical times. These findings highlight the urgent need to address these systemic weaknesses through a more integrated and efficient approach. An effective strategy should prioritize improved coordination between government agencies, NGOs, and communities to ensure the timely and accurate delivery of aid. Additionally, adopting Good Distribution Practices (GDP) and utilizing technology for real-time tracking and communication can significantly enhance the overall efficiency of humanitarian assistance in flood disaster management in Malaysia.

In-depth data analysis reveals significant gaps in public understanding of humanitarian logistics and the coordination among key stakeholders, including government agencies, non-governmental organizations (NGOs), and communities. By incorporating Good Distribution Practices (GDP) and implementing effective flood disaster management strategies, this study offers actionable insights aimed at improving the timeliness, accuracy, and efficacy of humanitarian aid delivery. This approach

not only enhances Malaysia's flood disaster relief efforts but also contributes to the wider dialogue on disaster management.

6. Discussion

This study highlights the critical need to integrate humanitarian logistics with Good Distribution Practices (GDP) to enhance flood disaster management in Malaysia, particularly in mitigating the public health risks associated with flooding. The findings indicate that combining these frameworks effectively addresses major challenges, including inefficient resource allocation, miscommunication among stakeholders, and delays in aid distribution factors that can exacerbate health crises in disaster-affected areas.

By aligning humanitarian logistics with GDP principles, the distribution of essential medical supplies, clean water, and food aid can be optimized, ensuring timely and safe delivery to affected populations. Additionally, this integration strengthens collaboration among government agencies, non-governmental organizations (NGOs), and local communities, which is crucial in minimizing health hazards such as waterborne diseases, malnutrition, and mental health distress in flood-stricken regions.

Moreover, the study underscores the significance of training and capacity building for all stakeholders involved in disaster response. Strengthening the skills of personnel in both humanitarian logistics and GDP ensures the efficient handling, storage, and distribution of medical supplies and other critical aid items, reducing the risk of contamination and wastage. Investment in human capital not only enhances logistical efficiency but also fosters greater community resilience by equipping local responders with the necessary knowledge to manage health-related challenges during flood disasters. A well-prepared response system can significantly reduce the burden on healthcare facilities and improve overall health outcomes in affected communities.

As Malaysia continues to adapt to the increasing frequency and intensity of floods, the country has the potential to serve as a model for other flood-prone regions globally. The integration of humanitarian logistics with GDP principles can strengthen emergency preparedness and response strategies, ensuring that affected populations receive timely, safe, and adequate assistance. Beyond immediate disaster relief, this approach contributes to long-term public health resilience by promoting sustainable distribution frameworks that enhance disaster risk reduction efforts. By emphasizing preparedness, coordination, and systematic aid distribution, this study provides a structured framework to support health security and community well-being in the face of recurrent flood disasters.

Public Understanding of Humanitarian Logistics

The study reveals a significant gap in public understanding of humanitarian logistics, with a large portion of the affected population lacking a comprehensive grasp of the logistics process during flood events. This knowledge deficiency impedes the overall effectiveness of disaster response, as the active involvement of government agencies, NGOs, and local communities is essential for the timely and efficient distribution of aid. Previous research underscores the importance of training in enhancing resilience and improving disaster preparedness (Khaledi et al., 2022). Therefore, it is crucial to develop targeted training and awareness programs aimed at bridging this knowledge gap, ensuring communities are better equipped to engage in and support effective flood disaster management efforts.

Inter-agency coordination

Coordination between government agencies, NGOs, and communities continues to be a major challenge in flood disaster management in Malaysia. The findings show that NGOs play a dominant role in relief efforts, followed by government agencies such as the Malaysian Civil Defence Force (APM) and the Fire and Rescue Department (JBPM). Despite these contributions, lack of smooth collaboration often leads to delays and inefficiencies in aid distribution, as indicated by respondents'

dissatisfaction with relief efforts (Musdah et al., 2022). These results highlight the urgent need for a more integrated and systematic approach to coordination. Strengthening inter-agency cooperation, supported by clear standard operating procedures, can significantly improve disaster response efficiency. Furthermore, real-time training and enhanced coordination will address logistical inefficiencies, ensuring equitable distribution of resources in flood-affected areas.

The Role of Good Distribution Practices (GDP)

The integration of Good Distribution Practices (GDP) into humanitarian logistics offers a promising solution for improving disaster response outcomes. This study highlights that GDP principles can improve resource tracking, minimize waste, and ensure the quality and transparency of aid distribution. Such principles align with the intention to build community trust and foster sustainable disaster management practices (Gazi, 2020). However, the lack of a structured framework for implementing GDP in the Malaysian disaster response system remains a significant obstacle (Lambin et al., 2023; Zainab et al., 2022).

Adopting GDP principles can standardize processes, increase accountability, and reduce inefficiencies in disaster management. The findings of this study support the development of a conceptual framework that incorporates GDP into humanitarian logistics to tackle challenges such as resource misallocation and poor coordination.

Additionally, training programs focused on the practical application of GDP can further enhance the capabilities of government agencies, NGOs, and local communities, ensuring a more cohesive and effective response during flood disasters (Cvetanovski et al., 2020; Salgar et al., 2023).

Conclusion

This research makes a significant contribution to flood disaster management discourse by proposing actionable solutions to address identified logistical and coordination challenges, particularly in ensuring the timely and efficient delivery of medical supplies, clean water, and essential aid. The findings emphasize the need to prioritize public awareness initiatives to enhance understanding of humanitarian logistics and its critical role in effective flood response. Public education is essential in mitigating health risks associated with floods, such as disease outbreaks, malnutrition, and mental health challenges, by ensuring that communities are better prepared to manage logistical constraints and actively participate in disaster response efforts. Furthermore, strengthening inter-agency coordination through the establishment of a centralized command system, supported by technology-driven solutions, is crucial for enhancing the efficiency of flood relief efforts. Integrated communication platforms and real-time data sharing among government agencies, non-governmental organizations (NGOs), and healthcare providers can improve resource allocation, minimize duplication of aid, and expedite medical and humanitarian assistance to affected populations.

Incorporating Good Distribution Practices (GDP) into disaster management policies, along with the implementation of extensive training programs, is vital to enhancing operational effectiveness and ensuring adherence to standardized distribution protocols. By aligning GDP principles with humanitarian logistics, a robust framework can be established to improve the handling, storage, and distribution of essential supplies, reducing wastage and ensuring equitable access to aid. This integration is particularly relevant in maintaining the quality and safety of pharmaceuticals, food aid, and medical equipment, which are crucial in preventing secondary health crises following flood disasters. This study outlines a pathway towards a more efficient, equitable, and sustainable disaster response system by addressing gaps in public awareness, enhancing inter-agency coordination, and institutionalizing GDP principles. Future research should empirically validate the proposed framework and explore its scalability across other disaster-prone regions, thereby supporting global adaptation and the implementation of best practices in flood disaster management.

In conclusion, the increasing frequency and severity of floods in Malaysia, exacerbated by climate change, rapid urbanization, and population growth, necessitate a comprehensive and long-term

approach to disaster risk reduction. Adopting a multidimensional framework that integrates community engagement, stakeholder coordination, and continuous capacity-building initiatives will enhance adaptive capacity, ensuring that flood management systems not only respond to immediate needs but also build long-term resilience. Strengthening institutional frameworks and fostering interagency collaboration will be key to improving the overall effectiveness of disaster response. Ultimately, these strategic advancements will contribute to more sustainable outcomes in flood disaster management, fostering resilient, proactive systems that can better protect vulnerable communities from the health and humanitarian challenges posed by recurrent flooding.

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