

Review

Harnessing Mobile Technology for Flood Disaster Readiness and Response: A Comprehensive Review of Mobile Applications on the Google Play Store

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Abstract: The increasing frequency and severity of disasters in urban areas demand sustainable, smart disaster management strategies to leverage technological advancements. This study provides a comprehensive review of mobile apps for disaster awareness available in the Google Play Store, with a particular emphasis on addressing flood disaster readiness and response. Mobile apps have become indispensable tools for disseminating immediate notifications, facilitating emergency communication, and coordinating response activities. A total of 77 mobile apps in the Google Play Store were identified and evaluated using a systematic search. The evaluation criteria included user ratings, download counts, and key crisis management functionalities such as real-time alerts, emergency contact directories, preparedness checklists, and user reporting capabilities. The findings emphasised the following: (a) the importance of integrating cutting-edge technologies, i.e., AI and IoT, to enhance functionality, accuracy, and capacity in mobile applications; (b) the use of crowdsourcing as a valuable mechanism for enriching inclusive and responsible data; (c) enabling timely updates and fostering community engagement; and (d) establishing agency engagements, gamified elements, and real-time reciprocal communication tools, i.e., push-to-talk features to ensure the long-term sustainability of mobile apps. By incorporating these insights, disaster management apps can significantly enhance community resilience and improve the effectiveness of responding to natural disasters in this digital age.

Keywords: mobile applications; communication; disaster readiness and reaction; Google Play Store



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1. Introduction

Disasters, whether natural or human-induced, result in significant threats to human life, property, and the environment. Recent years have witnessed a notable increase in the frequency and severity of disasters such as earthquakes, floods, hurricanes, and wildfires [1]. This escalation highlights the urgent need for robust disaster management strategies. Disaster awareness involves educating and preparing communities to face potential hazards, while disaster management focuses on coordinating resources and actions to mitigate, respond to, and recover from such events [2]. The emergence of mobile technology has significantly transformed disaster management practices. Mobile applications (apps) offer

a versatile platform for disseminating critical information, facilitating communication, and coordinating emergency responses [3]. These apps can deliver real-time alerts, provide guidance on emergency procedures, enable users to report incidents and assist in organising rescue and relief efforts. The widespread use of smartphones and the broad availability of the internet make these apps accessible to a large segment of the population, thereby enhancing community preparedness and responsiveness to disasters [4].

This study aimed to review and analyse mobile applications available on the Google Play Store, focusing on disaster readiness and response. By evaluating these apps, the study intended to understand their functionalities, effectiveness, and the strategies they employ to remain relevant and beneficial over time. This paper also discusses the mobilisation strategies these apps use to engage users and ensure long-term relevancy.

2. Scope of the Study

This review adhered to a set of specific criteria to ensure the selection of high-quality, user-favoured applications. These criteria included a minimum average user rating, a threshold for the number of downloads, essential disaster management functionalities, geographic coverage, and regular updates. These are further discussed in the methodology and data section.

The analysis exclusively focused on applications available on the Google Play Store for several reasons. Firstly, Android is the most widely used mobile operating system globally, with a significant market share compared to other platforms. This widespread use ensures that findings are relevant to most mobile users. Secondly, data extraction from the Google Play Store is clear-cut and accessible. Unlike the Apple App Store, which restricts data access and requires specialised devices for viewing app information, the Google Play Store allows for data retrieval on various devices, including Windows laptops and Mac computers [5]. This ease of access facilitates a comprehensive and efficient review process.

To be considered for this review, apps must offer functionalities pertinent to disaster awareness and management. These essential features include real-time alerts, emergency contact directories, disaster preparedness checklists, and user reporting capabilities. Real-time alerts provide notifications about ongoing or imminent disasters, keeping users informed and prepared. Emergency contact directories offer lists of important contacts for quick access during emergencies. Disaster preparedness checklists provide guidelines and checklists to help users prepare for various types of disasters. User reporting capabilities allow users to report incidents or provide updates on disaster situations in their area. These functionalities are crucial for effective disaster management, helping users stay informed, prepared, and able to respond swiftly during emergencies [6].

In the case of geographic coverage, the preference was given to applications with a global reach or those specifically designed for regions prone to certain types of disasters. This criterion ensured that the review included a diverse range of applications useful in various geographic contexts. Apps with broad geographic coverage can cater to a wider audience, while region-specific apps can offer tailored features and information relevant to particular disaster-prone areas. In the screening process, special priority was given to mobile apps focusing on flood disaster readiness and response. Flooding has been documented as the most frequent natural disaster worldwide, which accounts for 44% of all disaster occurrences between 2000 and 2019. Over 2 billion people worldwide are exposed to the risk of flooding [7]. According to Jongman, 2021 [8], from 2000 to 2015, the number of people living in flood-prone areas increased by an estimated 58 M to 86 M, a 24% increase. Considering this global need, the review focused primarily on flood disaster-related mobile applications available in the Google Play Store.

3. Data and Methodology

3.1. Search Strategy

An initial keyword screening was conducted to identify the most relevant terms before finalising the keywords used in the systematic search. The final search, conducted in January 2024 at the Google Play Store, utilised the keywords “Disaster Management”, “Disaster Awareness”, “Disaster Alert”, “Flood Apps”, and “Flood Alert Apps” to locate free mobile applications related to disaster awareness and various phases of disaster management, with a specific focus on flood events.

3.2. Selection Criteria

The inclusion and exclusion criteria for filtering the retrieved mobile applications were defined to ensure the selection of high-quality, user-favoured apps. Only applications with an average rating of 4.0 stars or higher were initially included, guaranteeing a positive user reception and reflecting a certain level of satisfaction, usability, and reliability. Additionally, apps needed to have a minimum of 10,000 downloads to be selected, indicating substantial user adoption and engagement. This threshold suggested that the app has been widely accepted and tested by a broad user base, providing a reliable sample for assessing its performance and usefulness.

However, due to the limited number of applications meeting these stringent criteria, it was necessary to revise these requirements. Consequently, applications with fewer downloads and lower average ratings were also included in the review to ensure a comprehensive analysis of available disaster awareness and management tools. This adjustment allowed for a broader range of applications to be considered, ensuring that the review remained inclusive and relevant. Functionality was a crucial factor, with only those apps offering essential features such as real-time alerts, emergency contact directories, disaster preparedness checklists, and user reporting capabilities being considered. Geographic coverage was also significant, with a preference for apps with a global reach or those specifically designed for flood-prone regions. Regular updates were a mandatory selection criterion, indicating ongoing developer support and relevance.

Further refining the selection, only English-language apps were included, and while both mobile and web apps were considered, web apps without a corresponding mobile app were excluded. Apps developed on a trial basis or solely for research purposes, including those cited in academic sources like ScienceDirect, IEEE Xplore, Springer, ACM, and Google Scholar, were excluded. To ensure the review focused on freely accessible applications, apps that required payment were also excluded. The scope was narrowed specifically to flood-related disaster management, thus excluding apps specific to other disaster types. Educational apps were only included if they were specifically related to flooding, thus ensuring relevance to the primary focus of the review.

3.3. Data

The data for this review were retrieved from various sources to ensure a comprehensive understanding of each application’s performance and usability. Primary data sources included reviews, ratings, and comments from users on the Google Play Store, which provided valuable insights into the program’s dependability, performance, and user satisfaction. In addition, self-conducted investigations of each mobile app were performed to thoroughly evaluate their features, user interfaces, and overall effectiveness. This practical approach allowed for an in-depth assessment of the applications. Secondary sources, such as internet searches, were also employed to gather additional information regarding the apps’ functionalities and updates.

4. Results

4.1. Categorisation of Apps

A total of 77 apps were selected, which were categorised into six groups, as depicted in Figure 1, based on their purpose, type, and functionality as follows: (1) crowdsourcing-based general disaster management apps (apps that do not consider any specific type but considers a number of disasters, often using real-time data but not primarily relying on crowdsourcing); (2) disaster alert apps (apps that do not rely on crowdsourcing as a source of data but issues important disaster alerts); (3) earthquake-specific apps (non-crowdsourcing); (4) flood disaster apps; (5) general weather apps; and (6) other disaster management apps. All the details about the 77 apps are given in Appendix A.

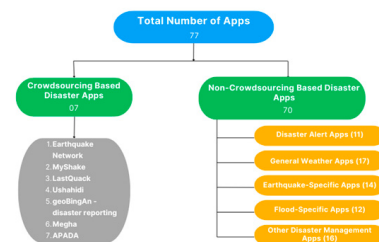


Figure 1. Classification of the apps based on utilising the crowdsourcing technique.

4.2. Geographical Coverage of the Apps

In this study, the geographical coverage of the 77 disaster management apps was analysed to understand their relevance and utility at various levels—global, regional, national, and local. A significant portion of the apps (35.1%) offer global coverage, serving a broad user base with disaster alerts, earthquake monitoring, and general disaster preparedness (e.g., My Earthquake Alerts—Map, Earthquake Network, Ushahidi). Another 13.0% of the apps provide regional coverage, such as FloodAlert Waterlevel Alerts (Europe and USA) and Flowx: Weather Map Forecast (Europe and USA), which offer more localised disaster management solutions but are still relevant to multiple countries within a region. Country-specific apps (33.8%), such as Disaster Ready AZ (Arizona, USA) and Flood Alert—Sri Lanka, cater to individual regions/nations, addressing specific local risks and government frameworks, while local-level apps (6.5%) like Floodzilla (Snoqualmie Valley, USA) are designed for communities, providing hyper-localised disaster information. While global apps have broad utility, regional and country-specific apps are more tailored and effective for addressing the unique disaster risks of particular regions. Appendix A provides a detailed list of these geographical coverages, which is essential for understanding how the apps meet the needs of users in different areas.

4.3. Detailed Analysis of the Crowdsourcing and Flood-Based Disaster Management Apps

The following section discusses these 19 selected apps in detail, categorised based on their focus. These include seven crowdsourcing-based apps and twelve flood-based apps. The crowdsourcing apps utilise real-time user-generated data to enhance disaster preparedness and response, while the flood-based apps are specifically designed to provide users with accurate, timely information on flood risks, warnings, and monitoring. Each of these apps plays a critical role in managing flood disasters and improving user engagement through innovative technology solutions. Table 1 provides a comprehensive overview of these 19 apps, outlining their key features, user engagement strategies, and sustainability efforts.

Table 1. Detailed review of the apps.

	Application Name	Developer	Location	Downloads	Description	Crowdsourcing	User Engagement	Sustainability
1	FloodAlert Waterlevel Alerts	SOBOS GmbH	SOBOS GmbH is located at Regau 14, 4550 Kremsmünster, Austria	100K+	Real-time water level updates and alerts for flood-prone areas.	No	Sends real-time notifications; maps high-risk areas.	Supports community preparedness by providing actionable alerts.
2	Flood Alert—Sri Lanka	Shalika Lahiru		100+	Provides flood alerts and disaster warnings using government and hydrological data.	No	Localised, Sri Lanka-specific alerts foster strong local adoption.	Promotes local resilience through accessible flood information.
3	My Flood Risk Accra	HKV Iijn in water	Lelystad & Delft - Netherlands	1K+	Flood risk assessment and updates in Accra, Ghana; includes vulnerability mapping.	No	Engages local users with risk assessments and visualisations.	Supports long-term planning for flood-prone communities in Accra.
4	BWDB Flood App	SoftWorks	FFWC in Bangladesh	5K+	Shares flood forecasts and emergency management guidelines.	No	Public service app; users actively check updates during flood seasons.	Government-backed app ensures continued support and reliability.
5	Sindh Flood Relief	Emergity		1K+	Focused on flood management and relief in Sindh, Pakistan.	No	Encourages user interaction through relief and reporting services.	Helps maintain community sustainability by focusing on recovery efforts.
6	Floodzilla	Snoqualmie Valley Preservation Alliance	USA	100+	Offers flood prediction and tracking based on weather and hydrological patterns.	No	Predictive capabilities engage users in preparation measures.	Supports risk reduction by encouraging preparedness activities.
7	Floods Near Me NSW	NSW Manly Hydraulics Lab	New South Wales 2093, Australia.	50K+	Real-time flood updates and warnings for New South Wales, Australia.	No	Sends alerts to users and visualises flood risks.	Enhances disaster readiness for communities in NSW.
8	Fire Alert	Plant-for-the-Planet	Tutzing, Germany	1K+	Includes flood warnings alongside fire alerts for disaster risk management.	No	Supports multiple hazard engagement, fostering awareness.	Promotes proactive disaster preparedness.
9	NBRO EW	National Building Research Organization, Sri Lanka	Sri Lanka	100+	Focused on disaster alerts, especially floods and landslides in Sri Lanka.	No	Tailored to Sri Lanka’s unique disaster landscape; highly localized user interaction.	Strengthens disaster resilience in vulnerable regions.
10	FEMA	Federal Emergency Management Agency	Washington, USA.	1M+	Offers flood alerts, preparedness tips, and recovery resources for U.S. users.	No	Comprehensive features for U.S. users keep them engaged and informed.	Continuously updated federal app ensures sustainability in disaster management.

Table 1. Cont.

Application Name		Developer	Location	Downloads	Description	Crowdsourcing	User Engagement	Sustainability
11	Flood Zone Map	Qvyshift LLC	Texas, USA	5000+	Visualises flood-prone zones, enabling users to identify risks and avoid hazards.	No	Geospatial interaction with flood zones enhances risk awareness.	Helps users make informed decisions about living or traveling in flood-prone areas.
12	Flood Maps & ZDs	Ikonetics, LLC	St.Petersburg, Florida, USA	50+	Combines flood zone mapping with meteorological updates for better situational awareness.	No	Combines live maps with user-focused warnings.	Encourages proactive mitigation strategies based on live data.
13	Earthquake Network	Futura Innovation SRL	Bergamo, Italy	10M+	Collects seismic data from user devices, improving earthquake detection and alert accuracy.	Yes	Strong user participation drives real-time seismic alerts.	User-driven data ensures scalability and adaptability over time.
14	MyShake	UC Berkeley Seismological Laboratory	University of California, Berkeley, USA.	1M+	Gathers seismic data from smartphones, contributing to a global earthquake monitoring network.	Yes	High engagement through interactive features like seismic event history.	Continuous user input makes it sustainable for global earthquake research.
15	LastQuack	EMSC-CSEM	Paris, France.	1M+	Crowd-based disaster reporting for live updates about natural disasters.	Yes	Allows live reporting of disasters, keeping engagement high.	Encourages collaborative disaster response efforts.
16	Ushahidi	Ushahidi Inc.	Nairobi, Kenya.	10K+	Enables reporting and mapping of crises, including floods and other disasters.	Yes	Users actively contribute to crisis mapping, creating a global impact.	Open-source and community-backed for long-term usability.
17	geoBingAn—disaster reporting	GeoThings	Hsinchu, Taiwan	1K+	Focused on enabling users to report disasters for real-time risk analysis.	Yes	Crowdsourced disaster updates improve situational awareness.	Involves the community in long-term disaster resilience planning.
18	Megha	Tecxal Systems	Colombo, Sri Lanka	500+	Uses crowdsourcing for weather and disaster updates, supporting disaster preparedness efforts.	Yes	Localised, user-driven data collection strengthens community engagement.	Facilitates long-term community-based disaster management solutions.
19	APADA	Disaster Management Center	Colombo, Sri Lanka	1K+	Community-focused disaster update-sharing app that encourages real-time collaboration.	Yes	Strong local interaction through community features.	Builds resilience by fostering strong community ties for disaster response.

The identified 77 apps encompass a wide range of functionalities to enhance readiness and response to various natural disasters, including floods, earthquakes, and severe weather conditions. The differences in disaster types, such as the sudden nature of earthquakes versus the gradual progression of floods, significantly influence app functionalities, integration of crowdsourcing, and mobilisation strategies. While floods tend to develop over time, the rapid onset of earthquakes and their potential to trigger secondary hazards (e.g., tsunamis and landslides) make them particularly challenging, requiring distinct approaches in app development and disaster response. For instance, earthquake-related applications, such as Earthquake Network and MyShake, use smartphone sensors to detect seismic activity and provide real-time alerts by crowdsourcing data from users' devices. These apps utilise the accelerometers in smartphones to create a dense network that detects shakes and sends out immediate alerts, making them highly effective for rapid response to sudden disasters. In contrast, flood-related applications like Flood Alert—Sri Lanka and Floodzilla rely primarily on data from physical sensors and governmental sources to forecast and monitor water levels, with a focus on long-term readiness and real-time monitoring.

The apps comprise advanced technologies such as real-time alerts, interactive maps, and crowdsourcing to provide users with timely and accurate information. For instance, many apps utilise user-generated data to improve situational awareness and community engagement. Educational resources, safety tips, and guidelines are common features that help users understand and prepare for disasters. Sustainability is often achieved through partnerships with local authorities, government funding, or innovative monetisation strategies such as app sales and advertising. By integrating these diverse features and strategies, these apps play a crucial role in disaster management, providing essential tools for both individuals and communities to enhance their resilience against natural disasters.

Mobile applications are increasingly becoming vital tools in disaster management, providing functionalities that enhance preparedness, response, and recovery. These applications generally offer real-time alerts and notifications, interactive maps, safety tips, and guidelines. Many incorporate crowdsourcing to gather real-time data from users on the ground, which significantly enhances the accuracy and timeliness of the information provided. These mobile applications share several key features that enhance their utility in disaster management. The features include (1) real-time alerts and notifications, (2) interactive maps, (3) providing safety tips and guidelines, and (4) integration of crowdsourcing. Below are screenshots (Table 2) from the selected mobile apps representing each of these features.

One of the most critical features of flood-related apps is the provision of real-time alerts and notifications. These alerts are vital for ensuring that users receive timely information about changing water levels and flood warnings, allowing them to take necessary precautions. For example, "Flood Alert Water Level Alerts excels in this area by offering immediate notifications based on real-time water level monitoring. Similarly, Flood Alert—Sri Lanka provides users with instant alerts that are particularly valuable in regions prone to sudden and severe flooding. These apps ensure that users are constantly updated with the latest information, which is crucial for effective disaster preparedness and response.

Interactive maps are another common feature in these applications, providing users with detailed visual representations of current weather conditions, flood zones, and affected areas. Applications such as Weather Radar & Weather Live and Ventusky: Weather Maps & Radar are exemplary in this regard. Weather Radar & Weather Live offers high-definition radar maps that allow users to track weather patterns and predict potential flood-prone areas. Ventusky: Weather Maps & Radar provides a comprehensive view of meteorological data, helping users understand the broader context of their local weather conditions. These

interactive maps enhance situational awareness and help users make informed decisions based on real-time data. Providing safety tips and guidelines is essential for helping users prepare for and respond to floods effectively. Apps such as First Aid: American Red Cross and Disaster Ready AZ incorporate extensive safety information into their platforms. First Aid: American Red Cross offers step-by-step instructions on how to stay safe during floods, including preparation tips and emergency response actions. Disaster Ready AZ provides similar guidance tailored to the needs of Arizona residents. By offering clear and actionable advice, these apps empower users to protect themselves and their families during flood events.

Table 2. Examples of the key features identified.

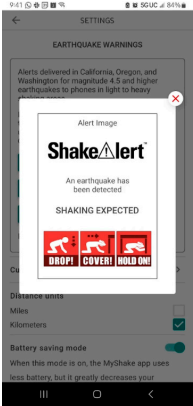
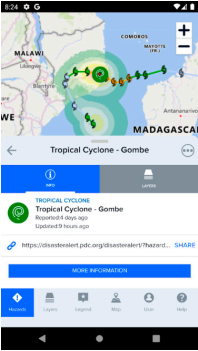
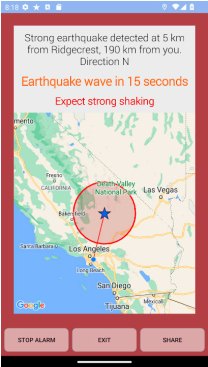
Key Feature		Real-Time Alerts and Notifications			
Name of the Mobile App	Screenshot	Rating	Downloads	Developer	Key Features
My Shake		3.7	1M+	UC Berkeley Seismological Laboratory	The early warning alerts are sent for all earthquakes of magnitude 4.5 or more in areas of light shaking or greater.
Disaster Alert		4.5	500K+	Pacific Disaster Center	Provides real-time global hazard alerts, an interactive disaster map, AI-powered risk assessments, and customisable notifications.
Earthquake Network		4.5	10M+	Futura Innovation SRL	Provides real-time earthquake detection using smartphone accelerometers, crowdsourced early warnings, instant notifications, and global seismic activity monitoring.

Table 2. Cont.

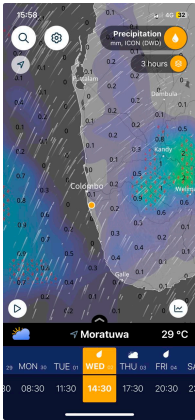
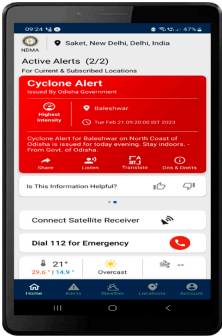
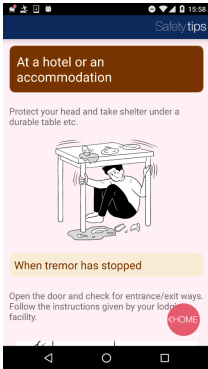
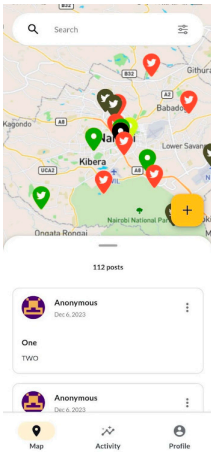
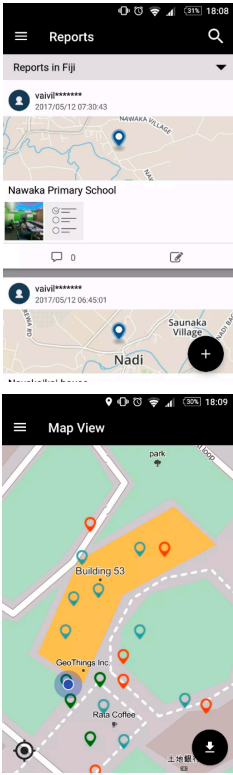
Key Feature		Real-Time Alerts and Notifications			
Name of the Mobile App	Screenshot	Rating	Downloads	Developer	Key Features
Ventusky Weather App		4.4	1M+	InMeteo	Provides real-time weather forecasting with interactive maps, advanced meteorological models, and visualisations of temperature, precipitation, wind patterns, and storm tracking.
SACHET		-	500k+	C-DOT	Provides real-time early warnings and alerts for natural disasters such as cyclones, floods, and thunderstorms, using location-based services to enhance disaster preparedness and public safety.
Safety Tips			100k+	RC Solution Co.	Provides real-time disaster alerts, emergency preparedness guidance, and safety instructions for various hazards tailored for residents and travellers.
Ushahidi			10K+	Ushahidi Inc.	Enables crowdsourced data collection, crisis mapping, and real-time incident reporting, allowing users to submit and visualise geotagged reports for disaster response, human rights monitoring, and community-driven initiatives.

Table 2. Cont.

Key Feature		Real-Time Alerts and Notifications			
Name of the Mobile App	Screenshot	Rating	Downloads	Developer	Key Features
GeoBingAn			1K+	GeoThings	Provides real-time disaster reporting, crowdsourced situational awareness, and emergency communication tools, enabling users to share geotagged incident reports.

Crowdsourcing is a powerful feature that enhances the accuracy and comprehensiveness of flood-related data by using user-generated reports. Flood Alert Water Level Alerts, Sindh Flood Relief, and PH Weather and Earthquakes are notable examples of apps that successfully integrate crowdsourcing. Flood Alert Water Level Alerts allow users to report local water levels and flood conditions, contributing to a more accurate and up-to-date picture of the situation. Sindh Flood Relief uses crowdsourced data to identify and address immediate relief needs in affected areas, demonstrating the practical utility of this approach. PH Weather and Earthquakes combines user reports with official data, enhancing the reliability and timeliness of its alerts and updates. Crowdsourcing not only improves data accuracy but also strengthens a sense of community involvement and collaboration.

The scatter plot given in Figure 2 provides a comparative analysis of app ratings versus downloads, distinguishing between apps with and without advertisements. The insight from this plot suggests that apps with advertisements (shown in red) tend to have a wider spread in ratings, with some high-rated apps also having a significant number of downloads but also several with lower ratings. In contrast, apps without advertisements (shown in blue) generally have more consistent ratings, with a few apps being highly rated despite having lower download numbers. This highlights a potential trade-off: apps with ads may generate more downloads, but they could face a decrease in user satisfaction, as reflected in the more varied ratings. Conversely, apps without ads tend to maintain a more stable user experience, though they may not achieve the same level of engagement in terms of downloads.

Table 2 presents a detailed overview of several of the most downloaded and highly rated mobile apps designed for disaster management and early warning. These apps offer

key features such as real-time alerts, crowdsourced incident reporting, interactive disaster maps, and AI-powered risk assessments.

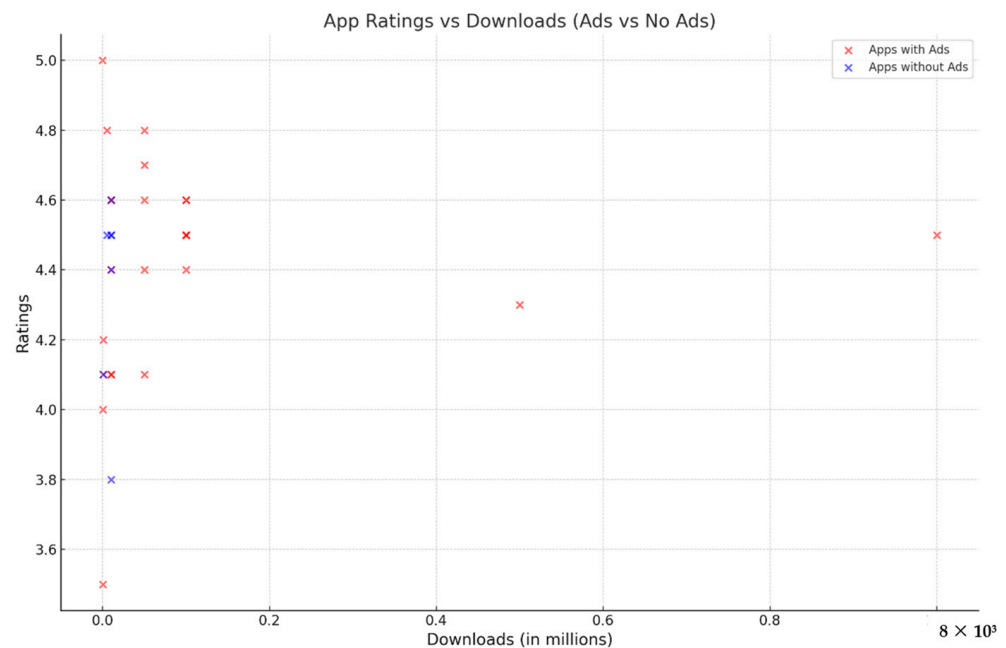


Figure 2. Relationship between the number of downloads and ratings of the apps and advertisements.

4.4. Comparative Analysis

In the comparative analysis of these mobile apps, several approaches stand out, particularly in the domains of crowdsourcing implementation, user engagement, and sustainability. Each app has tailored these elements to meet the specific needs and contexts of its target users, offering valuable insights into best practices and innovative solutions. While these approaches have been explored in various apps, there remains a need for comprehensive studies on the long-term effectiveness of these strategies in improving disaster preparedness, particularly in different regional and socio-economic contexts.

Crowdsourcing is an important feature in many flood-related apps, enhancing the richness and accuracy of the data collected. *FloodAlert Waterlevel Alerts* and *Sindh Flood Relief* stand out for their extensive use of crowdsourced data. *FloodAlert Waterlevel Alerts* allow users to report local water levels and flood conditions, creating a dynamic and real-time data stream that reflects the latest developments on the ground. These user-generated data are crucial for timely alerts and effective flood management. The effectiveness of crowdsourcing in disaster management could be further investigated, focusing on how user participation varies due to demographic factors and the impact of real-time data on emergency response effectiveness.

Similarly, *Sindh Flood Relief* utilises crowdsourcing by enabling users to contribute data on flood impacts and relief needs. This comprehensive approach ensures that emergency responses are well-informed and targeted, addressing the most urgent needs in flood-affected areas. The extensive use of crowdsourced data in these apps highlights the importance of community involvement in disaster management. Future research could investigate the challenges of data accuracy and quality in crowdsourcing platforms and how to overcome these limitations, ensuring that the information gathered is actionable for emergency response teams.

Flood Alert—Sri Lanka adopts a slightly different approach by validating user-submitted reports through local authorities. This additional layer of verification enhances the reliability of the data, ensuring that the information disseminated to users is accurate and

trustworthy. This hybrid model of crowdsourcing and official validation can serve as a benchmark for other apps aiming to balance user input with data reliability. Further exploration is needed to evaluate the operational challenges and resource requirements for verifying crowdsourced data in real-time, especially in a resource-constrained environment.

Effective user engagement is crucial for the success of disaster management apps, and different applications have adopted various strategies to keep their users actively engaged. *PH Weather And Earthquakes* and *Floodzilla* excel in maintaining high user engagement through community forums and educational resources. *PH Weather And Earthquakes* provides a platform for users to discuss weather conditions and share experiences, strengthen a sense of community and collective awareness. Regular updates and active forums ensure that users remain engaged and informed.

Floodzilla takes a similar approach, offering educational resources and community forums that encourage user participation and knowledge sharing. By educating users about flood risks and preparedness measures, *Floodzilla* not only engages users but also empowers them to take proactive steps in safeguarding their communities. *Sindh Flood Relief* enhances user engagement by integrating social media, allowing for broader community involvement. This integration facilitates real-time communication and information dissemination, making it easier for users to share updates and mobilise resources quickly. The use of social media in this app underscores the importance of utilising modern communication tools to enhance user engagement and community collaboration.

App sustainability is a critical consideration for the long-term viability of disaster management apps. *Floods Near Me NSW* and *My Flood Risk Accra* benefit from government support and international funding, ensuring their long-term viability. *Floods Near Me NSW* is supported by the New South Wales government, which provides regular funding and resources to maintain and update the app. This governmental backing ensures that the app remains a reliable tool for flood monitoring and response. *My Flood Risk Accra* similarly relies on local government support and international funding, which enables it to assess flood risks and provide timely alerts in Accra, Ghana. This combination of local and international support underscores the importance of multi-level funding for sustaining disaster management initiatives. On the other hand, apps like *Weather Radar & Weather Live* and *Weather Live: Weather Forecast* utilise in-app sales and advertising as their primary revenue generation strategies. These apps offer basic functionalities for free, with additional premium features available for purchase. This freemium model ensures a steady revenue stream, which supports ongoing development and maintenance. Advertising also contributes to their sustainability, providing a continuous source of income that helps cover operational costs.

The comparative analysis of these flood-related mobile apps reveals diverse approaches to crowdsourcing, user engagement, and sustainability. By examining the successful implementation of these elements in apps like *FloodAlert Waterlevel Alerts*, *Sindh Flood Relief*, *PH Weather And Earthquakes*, *Floodzilla*, *Floods Near Me NSW*, *My Flood Risk Accra*, *Weather Radar & Weather Live*, and *Weather Live: Weather Forecast*, it is possible to identify best practices and innovative solutions that can be applied to future disaster management tools. The above analysis highlights the importance of community involvement, effective user engagement strategies, and sustainable funding models in creating robust and reliable disaster management applications.

5. Discussion

5.1. Technological Strategies That Can Be Used to Mobilise Mobile Applications to Enhance Disaster Awareness and Preparedness

The study developed three technological strategies that could be used to mobilise mobile apps to enhance disaster awareness and preparedness in the community. These are (a) community engagement through interactive and user-friendly interfaces, (b) integration of smartphone capabilities, and (c) enhanced real-time communication.

5.1.1. Community Engagement: Interactive and User-Friendly Interfaces

The success of disaster management apps heavily relies on active community participation. Interactive and user-friendly interfaces that encourage users to report conditions, share information, and stay informed are essential [9]. Features such as gamification, where users earn rewards for contributing data, and social media integration can further enhance engagement [10]. Educational resources that inform users about flood risks and preparedness measures can also empower communities to take proactive steps in mitigating the impact of floods [9,11]. By learning from other disaster management apps such as MyShake and Zello PTT Walkie Talkie, flood-related apps can integrate advanced smartphone capabilities for better data collection, enhance real-time communication for improved coordination, and aid in community engagement through interactive and user-friendly interfaces. These strategies can significantly improve the effectiveness of flood-related apps, making them more robust tools for disaster management and response.

Both MyShake and Zello PTT Walkie Talkie excel in promoting community engagement through interactive and user-friendly interfaces. MyShake encourages users to participate in seismic data collection, making them an integral part of the earthquake detection network. This sense of involvement and contribution enhances user engagement and data reliability. Similarly, Zello's straightforward interface and ease of use make it accessible to a broad audience, encouraging widespread adoption and active participation during emergencies. Flood-related apps can benefit from adopting similar strategies to enhance community engagement. By providing interactive features such as community forums, educational resources, and real-time communication tools, these apps can encourage a collaborative environment where users feel empowered to contribute [12]. User-friendly interfaces that are easy to navigate can also enhance the overall user experience, making it more likely that people will use the app regularly and contribute valuable data in return [13].

5.1.2. Integration of Smartphone Capabilities

The integration of smartphone capabilities, such as sensors for data collection, can significantly enhance the functionality of flood-related apps [14]. Following the MyShakes example, the apps could use accelerometers to detect water movement or vibrations indicative of potential landslides triggered by heavy rainfall. GPS data can track user locations in real-time, providing valuable information on flood-prone areas and the movement of floodwaters. Additionally, utilising barometric pressure sensors can help in predicting weather changes that may lead to flooding [15,16].

5.1.3. Enhanced Real-Time Communication

Implementing push-to-talk features, such as those provided in Zello PTT Walkie Talkie, can greatly improve coordination and communication during flood emergencies. This technology allows for instant voice communication, which is crucial in rapidly changing situations where text messages may be too slow or cumbersome [17]. Real-time voice

updates can facilitate quicker decision-making and more effective coordination between emergency responders, volunteers, and affected communities [18,19].

5.2. The Key Factors That Influence the Sustainability of Disaster Management Apps and How It Is Ensured So That These Apps Remain Effective and Relevant in the Long Term

This study identified the following four factors that could directly influence the sustainability of disaster management apps: (a) user engagement and retention; (b) community and network building; (c) monetisation and funding; (d) technological innovation. These elements are essential for ensuring that apps remain effective, relevant, and continuously improve over time [9].

5.2.1. User Engagement and Retention

To keep users engaged, especially during non-disaster times, disaster management apps employ a variety of strategies. A push notification, which is a brief automated message, can be sent directly to a user's device, typically appearing on the lock screen or notification panel, to provide updates, reminders, or alerts without requiring the user to open the app. Push notifications are a fundamental tool used by many apps to deliver timely updates and alerts [20,21]. For example, apps like FloodAlert Waterlevel Alerts and Flood Alert—Sri Lanka send real-time notifications about changing water levels and flood warnings. These notifications ensure that users are constantly informed, which is crucial for maintaining engagement.

Gamification is another effective strategy to enhance user engagement. By incorporating game-like elements, such as earning points for reporting weather conditions or achieving badges for community involvement, apps can make the user experience more interactive and enjoyable [22,23]. This approach not only keeps users engaged but also encourages them to contribute valuable data regularly. PH Weather And Earthquakes and Floodzilla effectively use gamification to maintain high levels of user interaction and participation. Regular updates and new features are also crucial for keeping users engaged. Apps that frequently update their functionalities and provide fresh content tend to retain their user base more effectively. For instance, Weather Radar & Weather Live and Weather Live: Weather Forecast consistently offer updates and new features, such as enhanced radar maps and detailed weather forecasts, ensuring that users have the latest information and tools at their disposal.

5.2.2. Community and Network Building

Building and maintaining a robust community is vital for the success of disaster management [24]. Many apps promote community engagement through user forums and social media integration [25]. For example, PH Weather And Earthquakes and Floodzilla offer platforms where users can discuss weather conditions, share experiences, and provide support to each other. These forums create a sense of community and collaboration, which is essential during disaster events. Collaboration with local authorities is another critical aspect of community building. Apps like Flood Alert—Sri Lanka validate user-submitted data through local authorities, enhance the reliability of the information, and build trust among users [26]. This collaboration also ensures that the app provides accurate and authoritative information, which is crucial for disaster management.

User-generated content plays a significant role in the success of these apps. By allowing users to report conditions and share locally [27], apps like FloodAlert Waterlevel Alerts and Sindh Flood Relief harness the power of crowdsourcing to provide comprehensive and up-to-date information. Peer support, facilitated through community forums and social media, further strengthens the user network and encourages ongoing engagement.

5.2.3. Monetisation and Funding

Sustainable funding models are essential for the longevity and continuous improvement of disaster management apps. Different apps adopt various monetisation strategies, such as freemium models, advertisements, sponsorships, and crowdfunding [27,28]. The freemium model ensures that the app remains accessible to a wide audience while generating revenue from users who opt for enhanced features [29,30]. Weather Radar & Weather Live and Weather Live: Weather Forecast effectively uses this model to sustain its operations. Advertising is another common revenue stream. By displaying advertisements within the app, developers can generate income without charging users directly [31,32]. This approach is used by apps like Weather Radar & Weather Live, ensuring a steady flow of revenue to support ongoing development and maintenance.

Sponsorships and partnerships with organisations and local authorities provide additional funding and resources [33]. For example, Floods Near Me NSW and My Flood Risk Accra benefit from government support and international funding, ensuring their long-term viability. These partnerships also enhance the credibility and reach of the apps, making them effective tools for disaster management. Crowdfunding campaigns can also be an effective way to secure funding, particularly for apps developed by smaller organisations or start-ups. By appealing directly to users and the broader community for financial support, developers can raise the necessary funds to maintain and improve their apps [34–36].

5.2.4. Technological Innovation

Continuous technological advancements are crucial for ensuring that disaster management apps remain relevant and effective. The integration of cutting-edge technologies such as artificial intelligence (AI), machine learning, and blockchain can significantly enhance app functionality and sustainability [37,38]. AI and machine learning can be used to analyse large datasets and predict potential disaster events with greater accuracy. For instance, AI algorithms can process user-generated reports and sensor data to provide real-time flood forecasts and alerts. This technology can also be used to personalise notifications and recommendations to users based on their location and historical data [38,39]. Blockchain technology offers a secure and transparent way to manage data and transactions within the app. By using blockchain, developers can ensure that user data are protected and that all contributions are accurately recorded and verified [40]. This technology can also facilitate transparent funding mechanisms, ensuring that donations and sponsorships are used effectively.

The continuous integration of new technologies ensures that disaster management apps can adapt to changing circumstances and user needs. By staying at the forefront of technological innovation, apps can provide more accurate, reliable, and user-friendly services [41]. The sustainability of disaster management apps depends on a combination of effective user engagement and retention strategies, robust community and network building, diverse monetisation and funding models, and continuous technological innovation. By learning from successful examples and adopting their best practices, developers can create resilient and effective tools that significantly enhance disaster preparedness and response efforts.

6. Challenges

6.1. Common Challenges

Disaster management apps, particularly those focusing on floods, face several critical challenges that impact their effectiveness and sustainability. These challenges can be broadly categorised into technical and operational issues, user adoption and behaviour,

and policy and regulatory issues. Addressing these challenges is crucial for ensuring that these apps can provide reliable, real-time information and support during disaster events.

One of the primary technical and operational challenges is data accuracy. Ensuring the reliability of crowdsourced data is essential, as user-generated content, while valuable, can also lead to misinformation if not rigorously validated [42,43]. Apps like FloodAlert Waterlevel Alerts and Sindh Flood Relief depend on user reports, which can vary in accuracy and reliability. Another significant challenge is scalability. As the user base grows, it is crucial that the app can handle the increase in data and traffic without compromising performance. For instance, Weather Radar & Weather Live must manage large volumes of data to provide accurate weather forecasts and flood alerts. Additionally, connectivity issues during disaster events can disrupt the app's ability to provide real-time updates, making it essential for apps to function effectively offline or with intermittent connectivity. Addressing these technical and operational challenges is key to enhancing the reliability and effectiveness of disaster management apps.

6.1.1. User Adoption and Behaviour

User adoption and behaviour have been significant challenges for flood-related disaster management apps, impacting their overall effectiveness and sustainability. Sustaining user interest over time, especially during non-disaster periods, is particularly challenging. Without continuous incentives or updates, users may lose interest and stop using the app [44,45]. Apps like PH Weather And Earthquakes and Floodzilla utilise community forums and educational resources to maintain engagement. These platforms provide interactive spaces where users can share experiences, ask questions, and access valuable information, thereby strengthening a sense of community. However, maintaining these forums and resources requires ongoing effort and innovation, such as incorporating gamification elements and regular content updates to keep the users interested [46].

Many potential users may not be aware of the app or its benefits, which significantly hinders adoption rates. Effective marketing and user education are crucial to increase visibility and inform potential users about the app's features and benefits [47,48]. Strategies might include targeted advertising campaigns, partnerships with local community organisations, and educational outreach programs. For instance, collaborating with schools and community centres to conduct workshops can help spread awareness and educate people on how to use the app effectively during flood events [11,49].

Users may be reluctant to rely on crowdsourced data due to concerns about its accuracy. Building trust is essential for the success of these apps. This can be achieved through robust data validation processes and partnerships with credible organisations [50–52]. For example, Flood Alert—Sri Lanka validates user-submitted reports through local authorities, enhancing data reliability. Additionally, transparency in how data are collected, processed, and used can help build user confidence. Providing users with feedback on how their contributions are used and showing the impact of their reports can also nurture trust and encourage continuous engagement.

6.1.2. Policy and Regulatory Issues

Policy and regulatory issues significantly influence the development, deployment, and effectiveness of flood-related disaster management apps. Compliance with local and international regulations is a critical concern for app developers. These regulations cover a range of issues, including data privacy, user consent, and information security [53–55]. To ensure regulatory compliance, apps must implement robust measures to protect user data, obtain explicit consent for data collection, and maintain transparency about data usage. For instance, adhering to regulations like the General Data Protection Regulation

(GDPR) in the European Union necessitates stringent data protection protocols [56]. Failure to comply with these regulations can result in legal repercussions and loss of user trust, severely impacting the app's credibility and adoption rates.

Government collaboration can provide disaster management apps with valuable support and resources, enhancing their effectiveness and reach. Partnering with governmental agencies can facilitate access to official data, enhance credibility, and secure funding [57,58]. However, navigating bureaucratic processes poses a significant challenge. Governmental collaboration often involves lengthy approval processes, complex legal requirements, and adherence to specific standards, which can delay app deployment and updates [3,45]. Despite these challenges, successful collaboration, as seen with apps like Floods Near Me NSW, which is supported by the NSW government, can lead to improved data accuracy, better resource allocation, and increased user trust and engagement.

7. Recommendations

To address these challenges and enhance the sustainability and effectiveness of disaster management apps, several recommendations can be made.

Implementing robust data validation processes is essential to enhance the credibility of crowdsourced information. This can be achieved through algorithms that cross-check user reports with official data, ensuring that the information provided is accurate and reliable [11,59]. Additionally, establishing partnerships with local authorities to verify user-submitted data can significantly improve data validity.

Maintaining user interest over time is crucial for the sustained success of disaster management apps. Incorporating gamification elements, such as rewards and challenges, can make the app more engaging [9,60]. Regular updates and community-building features, such as forums and educational resources, also play a vital role in keeping users engaged [61,62]. For instance, PH Weather And Earthquakes effectively uses community forums and educational content to retain user interest [28,62,63].

Developing sustainable funding models is critical for the long-term viability of disaster management apps. Forming partnerships with governmental and non-governmental organisations can provide essential support and resources. Exploring subscription models and applying for grants focused on disaster management are also viable strategies [64]. These funding sources can provide the necessary financial stability to maintain and update the apps regularly.

Integrating cutting-edge technologies such as artificial intelligence (AI), machine learning, and blockchain can significantly enhance app functionality and sustainability. These technologies can improve data accuracy by providing predictive analytics and ensuring data security. For instance, AI algorithms can analyse large datasets to predict flood events more accurately, while blockchain can offer secure and transparent data transactions. Continuous technological advancements ensure that the apps remain relevant and effective in addressing emerging challenges. Investing in these technologies can lead to more sophisticated and reliable disaster management solutions [65,66].

Implementing real-time communication tools, such as push-to-talk features, can greatly improve coordination during flood emergencies. Apps like Zello PTT Walkie Talkie provide a valuable model for enhancing real-time communication. These features enable users to communicate instantly, facilitating better coordination among responders and affected individuals. Adapting such communication tools for flood-related apps can enhance their effectiveness in emergencies, ensuring that users receive timely information and can coordinate responses more efficiently. This can be particularly beneficial in areas with frequent and severe flood events, where quick communication is critical.

By adopting these recommendations, disaster management apps can overcome existing challenges and significantly improve their effectiveness, user engagement, and long-term sustainability.

7.1. Emerging Trends

One of the emerging trends in disaster management apps is the integration with Internet of Things (IoT) devices. This trend envisions a future where disaster management apps seamlessly connect with various IoT devices, such as weather stations, flood sensors, and smart home devices [20,67,68]. By integrating with these devices, disaster management apps can access more accurate and localised data, significantly enhancing their ability to predict and respond to floods effectively. For example, flood sensors installed in vulnerable areas can continuously monitor water levels and transmit real-time data to the app. These data can then be analysed to provide early warnings and alerts to users in flood-prone regions [42,69,70]. Additionally, weather stations can provide valuable meteorological data, enabling the app to forecast weather patterns and anticipate flood events with greater precision. By utilising IoT devices, disaster management apps can improve their overall functionality and provide more timely and targeted assistance to affected communities.

Another emerging trend in disaster management apps is the use of enhanced predictive analytics powered by artificial intelligence (AI) and machine learning algorithms. These advanced analytical techniques enable apps to analyse vast amounts of historical and real-time data to identify patterns and trends that can be used to predict and mitigate flood risks more effectively [38,71]. By using AI and machine learning, disaster management apps can improve their forecasting capabilities, providing more accurate and timely alerts to users. For instance, AI algorithms can analyse historical flood data, weather patterns, and terrain characteristics to predict the likelihood and severity of future flood events [38,66,72]. This information can then be used to issue early warnings and advisories to at-risk populations, allowing them to take proactive measures to protect themselves and their property. By harnessing the power of predictive analytics, disaster management apps can enhance their ability to mitigate the impacts of floods and improve overall disaster preparedness and response efforts.

7.2. Recommendations for Stakeholders

In the following recommendations, three primary stakeholders are identified: developers, policymakers, and disaster management practitioners. Each group plays a critical role in improving the effectiveness and sustainability of disaster management apps.

To address the evolving challenges faced by these apps, developers should prioritise several key strategies. Firstly, focusing on user-friendly interfaces is paramount to enhancing user experience and encouraging continued engagement. Additionally, implementing robust data validation processes is essential to uphold the credibility of crowdsourced information. By cross-checking user reports with official data and establishing partnerships with local authorities, developers can enhance data reliability. Furthermore, continuous innovation is crucial to keeping the app relevant and effective. Developers should regularly update the app with new features, functionalities, and improvements based on user feedback and emerging technological advancements. Scalability is also a critical consideration, ensuring that the app can handle increasing data volumes as the user base grows. By incorporating features that enhance user engagement and scalability, app developers can create robust and reliable tools for disaster management.

To strengthen innovation and ensure the effectiveness of these apps, policymakers should provide support through funding, regulatory frameworks, and partnerships with app developers. Various funding models can be used depending on the context, including

government funding, which supports public-serving apps; private sector funding, such as venture capital for commercially focused apps; public–private partnerships (PPP), combining government support and private innovation; and crowdfunding, which involves community-driven financial support for niche apps [73]. Financial support can help developers cover the costs associated with app development, maintenance, and updates. Regulatory frameworks should be designed to encourage innovation while ensuring compliance with data privacy and security regulations. Policymakers should strike a balance between promoting innovation and safeguarding user data, ensuring that regulations do not stifle app development. Furthermore, partnerships between policymakers and app developers can facilitate knowledge exchange and collaboration, leading to the development of more effective and sustainable solutions. By creating an enabling environment for app development, agencies can contribute to the improvement of disaster management practices and enhance community resilience.

Disaster management practitioners can utilise disaster management apps for real-time data collection and communication during emergencies. These apps provide valuable insights and enable practitioners to make informed decisions based on up-to-date information. Practitioners should encourage community participation and collaboration with app developers to ensure that the apps meet the needs of users on the ground. By actively engaging with app developers, practitioners can provide valuable feedback on app functionality, usability, and relevance to real-world scenarios. Additionally, practitioners should explore ways to integrate these apps into existing disaster management frameworks and protocols, ensuring seamless coordination and communication during emergencies. By harnessing the potential of disaster management apps, practitioners can enhance their response capabilities and better serve affected communities.

8. Conclusions

This comprehensive review underscores the pivotal role of crowdsourcing in augmenting the functionality and effectiveness of flood-related mobile apps. By harnessing real-time user-generated data, these apps serve as invaluable tools during disaster events, offering critical insights and updates to affected communities. Through an exhaustive analysis of 77 flood-related apps, this study has identified common features, challenges, and best practices that contribute to the sustainability and efficacy of these apps.

The examination of flood-related apps revealed several key findings. Firstly, real-time alerts emerged as a fundamental feature, providing users with timely notifications on changing water levels, flood warnings, and other pertinent information. Interactive maps also emerged as a crucial component, offering users detailed visualisations of current weather conditions, flood zones, and impacted areas. Additionally, community engagement features, such as crowdsourcing and user forums, were found to be instrumental in facilitating information sharing and strengthening a sense of collective resilience among users. Effective crowdsourcing mechanisms, coupled with robust data validation processes, were identified as essential for ensuring the accuracy and reliability of the information disseminated by these apps.

The insights gleaned from this review carry significant implications for both disaster management and mobile app development practices. For developers, incorporating best practices in user engagement, data validation, and technological innovation is paramount to creating more effective and sustainable disaster management apps. By prioritising user-friendly interfaces, implementing robust data validation processes, and utilising cutting-edge technologies, developers can enhance the functionality and usability of their apps, ultimately improving their efficacy in mitigating the impacts of floods.

Similarly, agencies and practitioners can incorporate these insights to bolster disaster preparedness and response efforts. Agencies play a crucial role in supporting the development and deployment of disaster management apps through funding, regulatory frameworks, and partnerships with app developers. By providing an enabling environment for innovation and collaboration, agencies can facilitate the creation of more effective and resilient disaster management solutions. Practitioners, on the other hand, can utilise these apps as valuable tools for real-time data collection, communication, and decision-making during emergencies. By actively engaging with app developers and using the capabilities of the technologies available, practitioners can enhance their response capabilities and better serve affected communities.

In conclusion, utilising mobile technology for disaster preparedness and management is imperative in today's interconnected world. The integration of crowdsourcing, real-time communication, and advanced technologies holds immense potential for improving the resilience and responsiveness of communities facing natural disasters, such as floods. Continued innovation and collaboration among developers, agencies, and disaster management practitioners are essential to harnessing the full potential of these tools and ensuring the safety and well-being of communities worldwide whilst moving forward, and it is imperative to remain cautious, flexible, and proactive in the efforts to mitigate the impacts of floods and other natural disasters.

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Appendix A													
	Name	Developer	Geographical Coverage	Disaster/s Focused	Phase of the DM Cycle	Downloads	Rating	In purchase/Not	Ads	Version	Requirements	Released on	Updated on
1	Disaster Alert	Pacific Disaster Center	All Countries	All natural disasters	Mitigation, Preparedness, Response, Recovery	500K+	4.5	No	No	7.5.5	Android 4.4 and up	2011	2023
2	Natural Disaster Monitor	dominoc925	All Countries	All natural disasters	Mitigation, Preparedness, Response	50K+	3.5	No	Yes	5.11.50	Android 4.4 and up	2012	2023
3	Earthquack Alert	Josh Clemm	All Countries	All disasters and emergency situations	Mitigation, Preparedness, Response	1M+	4.5	No	No				
4	Alertable	PEASI	Canada	All emergency situations	Preparedness, Response	50K+	4	No			Android 4.4 and up	2017	2023
5	My Earthquake Alerts—Map	jRustonApps B.V.	All Countries	Earthquake	Preparedness, Response	5M+	4.4	No	Yes	5.6.7	Android 5.0 and up	2015	2023
6	NERV Disaster Prevention	Gehirn Inc.	Japan	General disaster prevention	Preparedness, Response	1M+	4.6	Yes LKR 675.00–LKR 1300.00 per item	No	5.1.1	Android 6 and up	2021	2023
7	Earthquake + Alerts, Map & Inf	Slava Barouline	All Countries	Earthquakes	Preparedness, Response	100k+	4.1	Yes LKR 175.00–LKR 375.00 per item	Yes	3.3.3	Android 5 and up	2014	2022
8	Clime: NOAA Weather Radar Live	Clime Weather Service	USA	Weather	Preparedness, Response	10M+	4.5	Yes LKR 175.00–LKR 11,000.00 per item	Yes	1.72.0	Android 7 and up	2016	2023
9	Local Weather Alerts—Widget	Vitality App Studios	All Countries	Weather	Preparedness, Response	5M+	4.8	Yes LKR 600.00–LKR 1600.00 per item	Yes	1.6.2	Android 5 and up	2020	2023
10	Earthquake Alert	CoolApps.mobi	All Countries	Earthquake		100K+	4.2	Yes LKR 475.00 per item	Yes	2.3.1	Android 5 and up	2021	2023
11	Earthquake Alarm & Bag	Kerem Duman	All Countries	Earthquake	Preparedness, Response	50k+		No	No	1.0.5	Android 5 and up	May-23	Nov-23
12	Disaster Management BMC	Disaster Management Unit (MCGM)	India	All natural disasters (Municipal-level)	Mitigation, Preparedness, Response	10K+		No	No	2.0.10	Android 5 and up	2016	2023

	Name	Developer	Geographical Coverage	Disaster/s Focused	Phase of the DM Cycle	Downloads	Rating	In purchase/Not	Ads	Version	Requirements	Released on	Updated on
13	Disaster Management	Softecks	All Countries	General disaster management	Mitigation, Preparedness, Response	5K+		No	Yes	2.8	Android 5 and up	2016	2022
14	Emergency Alert	Government of Mauritius	Republic of Mauritius	All emergency situations	Preparedness, Response	5K+		No	No	1	Android 4.0.4 and up	2018	2020
15	Earthquake Network	Futura Innovation SRL	All Countries	Earthquake	Preparedness, Response	10M+	4.5	Yes LKR 175.00–LKR 11,500.00 per item	Yes	14.1.10	Android 6 and up	2012	2014
16	Disaster Alert for BD	MoDMR	Bangladesh	General natural disaster (Bangladesh)	Mitigation, Preparedness, Response	1K+		No	No	1.0.7	Android 4.3 and up	2020	2022
17	LastQuack	EMSC-CSEM	57 countries	Earthquake	Preparedness, Response	1M+	4.5	No	No	2.6.2	Android 7 and up	2014	2023
18	Disaster Ready AZ	Bluestone Apps	Arizona, USA	All natural disasters	Mitigation, Preparedness, Response	1K+		No	No	1.4	Android 5.1 and up	2021	2023
19	Earthquakes Tracker	Radu Resinari	All Countries	Earthquake	Preparedness, Response	500k+	4.8	Yes LKR 175.00–LKR 525.00 per item	Yes	2.7.6	Android 4.4 and up	2015	2023
20	Safety tips	RC Solution Co.	Japan	General safety information	Mitigation, Preparedness	100k+		No	No	3.9.11	Android 5 and up	2014	2024
21	PH Weather And Earthquakes	droidgox	Philippines	Earthquake and Weather	Preparedness, Response	100K+		Yes	Yes	3.62	Android 5.1 and up	2013	2024
22	Volcanoes & Earthquakes	VolcanoDiscovery	All Countries	Volcanic activity and earthquakes	Mitigation, Preparedness, Response	1M+	4.6	Yes	Yes	2.15.0	Android 5 and up	2015	2023
23	FloodAlert Waterlevel Alerts	SOBOS GmbH	Europe, USA	Floods	Preparedness, Response	100K+		Yes LKR 175.00–LKR 5650.00 per item		308	Android 7 and up	2015	2023
24	Weather Radar & Weather Live	AVN Software Inc	Worldwide (e.g., USA, UK, France, Germany, Japan, Korea, Toronto, etc.)	Weather	Preparedness, Response	1M+	4.1	Yes	Yes	1.6.4_77_20231216	Android 5 and up	2020	2024
25	Earthquake Alert Asst: Map	AppFLY & Earthquake & PackageTracker & WoodenFish	All Countries	Earthquake	Preparedness, Response	10K+		Yes LKR 375.00–LKR 4175.00 per item	Yes	.3.00	Android 5 and up	2020	2024

	Name	Developer	Geographical Coverage	Disaster/s Focused	Phase of the DM Cycle	Downloads	Rating	In purchase/Not	Ads	Version	Requirements	Released on	Updated on
26	Earthquakes	KB@	All Countries	Earthquake	Preparedness, Response	500K+		Yes LKR 999.00 per item	Yes	3.0.30	Android 5 and up	2018	2023
27	Earthquake Notifier	dardroid	All Countries	Earthquake	Preparedness, Response	50K+					Varies with the device	2014	2023
28	MyShake	UC Berkeley Seismological Laboratory	All Countries	Earthquake	Preparedness, Response	1M+		No	No	3.1.16	Varies with the device	2016	2023
29	Disaster Management Act 2005	Rachit Technology	India	Legal framework for disaster management	Mitigation	10K+		Yes	Yes	1.84	Android 4.4 and up	2015	2023
30	iFirstAid	Survival Emergency Products	All Countries	First aid for all emergencies	Mitigation, Preparedness, Response	10K+		No	No	6.1	Android 5 and above	2017	2023
31	EQInfo	gempa GmbH	All Countries	Earthquakes	Preparedness, Response	100K+		No	No	3.1	Android 5 and up	2011	2022
32	Earthquake Prediction App	Paul Cotarlea	All Countries	Earthquakes	Preparedness	10K+		Yes LKR 250.00 per item	No	1.0.2	Android 5.1 and up	Sep-21	Nov-21
33	ERG 2020 for Android	PHMSA	USA	Emergency response for hazardous materials	Response	500K+				3.3.0	Android 7 and up	2013	2023
34	Disaster Nursing	Unbound Medicine, Inc	All Countries	All disaster-related nursing practices	Response	1k+		Yes LKR 6225.00 per item	No	2.8.23	Android 7 and up	2015	2023
35	FloodAlert Waterlevel Alerts	SOBOS GmbH	Europe and USA	Floods	Response	100K+		Yes LKR 175.00–LKR 5650.00 per item	No	308	Android 7 and up	2015	2023
36	Flood Alert—Sri Lanka	Shalika Lahiru	Sri Lanka	Floods (Sri Lanka)	Preparedness, Response	100+	5 (6reviews)	No	Yes	1.0.0	Android 4 and up	2022	2023
37	Flowx: Weather Map Forecast	Flowx Weather App	Europe and USA	Weather	Preparedness, Response	500K+		Yes LKR 225.00–LKR 3725.00 per item	No	3.412	Android 6 and above	2012	2023
38	Weather Hi-Def Radar	Maple Media	All Countries	Weather	Preparedness, Response	50K+		Yes LKR 325.00–LKR 3250.00 per item	No	1.2.0	Android 5 and up	Apr-23	Aug-23

	Name	Developer	Geographical Coverage	Disaster/s Focused	Phase of the DM Cycle	Downloads	Rating	In purchase/Not	Ads	Version	Requirements	Released on	Updated on
39	Windy.app: Windy Weather Map	Windy Weather World Inc	All Countries	Weather/Wind	Preparedness, Response	5M+	4.7	Yes LKR 1600.00–LKR 44,375.00 per item	No	47.5	Android 6 and up	2016	2023
40	Windfinder: Wind & Weather map	Windfinder	All Countries	Weather/Wind	Preparedness, Response	5M+	4.1	Yes LKR 175.00–LKR 1975.00 per item	Yes	3.32.1	Android 5 and up	2010	2023
41	Ventusky: Weather Maps & Radar	InMeteo	All Countries	Weather	Preparedness, Response	1M+	4.4	Yes LKR 449.00–LKR 2999.00 per item	No	30.3	Android 5 and up	2017	2024
42	Weather data & microclimate	Weather Underground	All Countries	Weather	Preparedness, Response	10M+	4.6	Yes	Yes	6.16.0	Android 7 and up	2011	2023
43	My Flood Risk Accra	HKV Ijij in water	Accra, Ghana	Floods	Preparedness, Response	1K+		No	No	1.1.14	7.0 and up	2022	2023
44	BWDB Flood App	SoftWorks	Bnagladesh	Floods	Preparedness, Response	5K+		No	No	0.0.4-2018.09.18.17:07-pro	4.1 and up	21-Apr-18	18-Sep-18
45	Weather Live°	Apalon Apps	All Countries	Weather	Mitigation, Preparedness	50M+	4.3	Yes LKR 159.00–LKR 4175.00 per item	Yes	7.8.0	7.0 and up	2013	2023
46	Sindh Flood Relief	Emergity	Sindh, Pakistan	Floods	Preparedness, Response	1K+		No	No	1.0.6	5.0 and up	8-Sep-22	13-Sep-22
47	Floodzilla	Snoqualmie Valley Preservation Alliance	Snoqualmie Valley, USA	Floods	Preparedness, Response	100+		No	No	1.0.4	5.0 and up	6-Aug-23	5-Dec-23
48	Floods Near Me NSW	NSW Manly Hydraulics Lab	New South Wales, Australia	Floods (NSW)	Response	50K+		No	No	2.2.2	8.1 and up	2016	2021
49	Weather Forecast—Live Radar	Filog Studio	All Countries	Weather	Preparedness, Response	5M+	4.6	Yes LKR 725.00–LKR 7350.00 per item	Yes	1.4.1	5.0 and up	2022	2023
50	Weather Live: Weather Forecast	KUCO Apps	All Countries	Weather	Preparedness, Response	100+		Yes Rs.1600	No	1.8.2	6.0 and up	17-Apr-23	5-Dec-23
51	Lightning Alarm Weatherplaza	Infoplaza Network B.V.	All Countries	Lightening	Preparedness, Response	1M+	4.6	Yes	Yes	1.5.10	4.1 and up	2015	2021

	Name	Developer	Geographical Coverage	Disaster/s Focused	Phase of the DM Cycle	Downloads	Rating	In purchase/Not	Ads	Version	Requirements	Released on	Updated on
52	Weather Radar & Weather Live	AVN Software Inc	All Countries	Weather	Preparedness, Response	1M+	4.1	Yes LKR 475.00–LKR 17,750.00 per item	Yes	1.6.6_81_20230115	5.0 and up	2020	2024
53	Rain Alerts: Weather forecasts	GoNext	All Countries	Weather	Preparedness, Response	500K+		Yes LKR 3675.00 per item	Yes	1.0.5	5.0 and up	2020	2023
54	My Hurricane Tracker & Alerts	jRustonApps B.V.	USA (Hurricane-prone regions)	Hurricanes	Preparedness, Response	500K+		No	Yes	4.6.9.1	5.0 and up	2018	2024
55	Fire Alert	Plant-for-the-Planet	All Countries (Wildfire focus)	Wildfires	Preparedness, Response	1K+		No	No	1.2	5.0 and up	15 June 2023	17 July 2023
56	DEWN V2	Microimage Mobile Media	Sri Lanka	All natural disasters	Preparedness, Response	50+		No	No	1.1	5.0 and up	24 April 2023	24 April 2023
57	Megha	Tecxal Systems	Sri Lanka	Flood/Landslides	Preparedness, Response	500+		No	No	2.0.2	4.4W and up	10 September 2022	30 October 2023
58	APADA	Disaster Management Center	Sri Lanka	All natural disasters	Mitigation, Preparedness, Response	1K+		No	No	0.0.14	6.0 and up	2017	2021
59	NBRO EW	National Building Research Organisation, Sri Lanka	Sri Lanka	Landslides	Preparedness, Response	100+		No	No	1.0.8	4.4 and up	1 December 2021	1 December 2021
60	Earthquake Network	Futura Innovation SRL	All Countries	Earthquake	Preparedness, Response	10M+	4.5	Yes LKR 175.00–LKR 11,500.00 per item		14.1.11	6.0 and up	2012	2024
61	Earthquake Alert	CoolApps.mobi	All Countries	Earthquake	Preparedness, Response	100K+		LKR 475.00 per item		2.3.1	5.0 and up	2021	2023
62	ShakeNet Earthquake Monitoring	Raspberry Shake	All Countries	Earthquake	Preparedness, Response	10K+		No		1.4.13	6.0 and up	2020	2023
63	Ushahidi	Ushahidi Inc.	All Countries	All natural disasters	Mitigation, Preparedness, Response	10K+				2.202350.3	5.1 and up	2017	2024
64	GeoNet	GNS Science, Te Pū Ao	New Zealand	Earthquake	Preparedness, Response	100K+	4.1	No	No	4.3.8	6.0 and up	2012	2023

	Name	Developer	Geographical Coverage	Disaster/s Focused	Phase of the DM Cycle	Downloads	Rating	In purchase/Not	Ads	Version	Requirements	Released on	Updated on
65	Weather Underground	Weather Underground	All Countries	Weather	Preparedness, Response	10M+	4.6	Yes LKR 300.00–LKR 3625.00 per item	Yes	6.16.0	7.0 and up	2011	2023
66	MyRadar Weather Radar	ACME AtronOmatic LLC	USA	Weather	Preparedness, Response	10M+	4.4	Yes	Yes			2012	2023
67	First Aid: American Red Cross	American Red Cross	USA	First aid for emergencies	Preparedness, Response	1M+	4.4	No	No	3.2.0	8.0 and up	2012	2023
68	FEMA	FEMA Federal Emergency Management Agency (FEMA)	All Countries	Emergency management in the USA	Preparedness, Response	3.8	1M+	No	No	3.0.12	6.0 and up	2011	2023
69	Zello PTT Walkie Talkie	Zello Inc	All Countries	Communication tool for disasters	Preparedness, Response	100M+	4.5	Yes LKR 25,750.00 per item	No	5.32.5	7.0 and up	2011	2024
70	EPAs SmokeSense	US Environmental Protection Agency	USA	Wildfire	Mitigation, Preparedness, Response	10K+		No	No	3.3.6	4.1 and up		2023
71	SACHET	C-DOT	India	All disasters	Mitigation, Preparedness, Response	500K+		No	No	1.3.2	8.0 and up		2023
72	SAMHSA Disaster App	SAMHSA	USA	Behavioral health support during disasters	Preparedness, Response	10K+		No	No	5	5.1 and up	2013	2023
73	geoBingAn—disaster reporting	GeoThings	Taiwan	All natural disasters	Preparedness, Response	1K+		No	No	v7.6.8	4.2 and up	2014	2021
74	PH Weather And Earthquakes	droidgox	Philippines	Weather and Earthquakes	Preparedness, Response	100K+	4,6	Yes	Yes	3.63	5.1 and up	2013	2024
75	Hazards—Red Cross	New Zealand Red Cross	New Zealand	All disasters	Preparedness, Response	50K+	3.1	No	No	3.8.0	8.0 and up		2022
76	Flood Zone Map	Qvyshift LLC	USA	Floods	Mitigation, Preparedness, Response	5000+		Yes \$6.99 per item	Yes	1.12.0	5.0 and up	2018	2024
77	Flood Maps & ZDs	Ikonetics, LLC	USA	Floods	Preparedness, Response	50+		Yes	No	2.000	Eligible if bought after 7 February 2016	2020	2023

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