

The resilience of local population in the tourist area of Le Thuy, Quang Binh, Vietnam: Insights from the 2024 Trami tropical storm

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ABSTRACT

This paper focuses on the community resilience dimension and the potential of information and communication technology (ICT) in enhancing crisis communication in the tourist area of Le Thuy district, Quang Binh province (Vietnam) based on their experience of the Trami storm in October 2024. A case study has been conducted and relies on two five-day-field-trips (including observation and interviews) before (July) and after the storm (December) and an online ethnography. We aimed to understand how ICT has supported crisis managers, local authorities and people (including tourists) to spread and get relevant information, communicate and organize at the time of the storm. Preliminary results indicate that the community of the Province demonstrated an accurate risk acculturation based on the 2020 historical floods and relevantly combined both traditional and digital channels to prepare and respond to the floods. Lastly, the results question the relevance of mobile applications in enhancing flood prevention for remote areas.

Keywords

Resilience community, crisis communication, Trami storm, mobile app.

INTRODUCTION

Floods are one of the natural disasters that cause heavy damage to coastal countries. With the current unusual natural disaster situation, natural hazard management and the application of science and technology in early warning play an important role in minimizing risks of natural disasters, losses and casualties.

In Vietnam, natural disasters have become increasingly severe and complex in terms of scale, frequency, and intensity. Over the past 20 years, the central provinces of Vietnam have suffered seventy percent of the damage caused by storms and floods (Tùng & Quang, 2022). In the period 1986-2020, recent floods occurred in the year 1995, 1999, 2007, 2008, 2010 and 2020. The historic flood in October 2020, with a 100-year frequency, resulted in 57,000 flooded properties and many other damages and casualties (Luu et al., 2021).

Le Thuy district, located in Quang Binh province, is a low-lying area prone to frequent and severe flooding. As part of the Nhat Le River Basin, Le Thuy is traversed by the Kien Giang River, which experiences significant

water level fluctuations, particularly from September to December - the region's peak flood season (Minh et al., 2024). The district's vulnerability to flooding is attributed to several key factors, i.e., i) geographical and topographical factors, ii) hydrological and meteorological conditions, iii) sedimentation and river blockages, and iv) infrastructure and human activities (Minh et al., 2024; Tùng & Quang, 2022). The catastrophic flood of October 2020 and October 2024 underscored the severity of Le Thuy's flood risk, with water levels exceeding historical records and inundating vast areas for an extended period. Given these challenges, improving flood management strategies based on the resilience of the area, seems essential to mitigate future flood impacts in the district.

STRAP - Transdisciplinary research strategy on crisis management and resilience of population - is a one-year project funded and supported by the French embassies in Indonesia and Vietnam. It aims to foster a transdisciplinary approach based on collaboration between practitioners and researchers from Indonesia, France and Vietnam, and to conduct two pilot surveys in areas with high tourism potential. This work in progress presents the preliminary results of the field survey carried out in Le Thuy district, in the Vietnamese province of Quang Binh, a few weeks after the passage of tropical storm Trami.

More specifically, the pilot survey took the opportunity of the design and development of the mobile app. "FloodGuard Quang Binh" by Thuyloi University, which is already being used by some local authorities in Quang Binh, to both i) further investigate how such a mobile app. could benefit civil society (i.e. the local population and tourists) and ii) deepen understanding of the resilience of the area, with a particular focus on how communication and information technologies are mobilized to face the event.

THE TRAMI TROPICAL STORM

On October 24th, typhoon Trami entered the eastern sea of the North East Sea, becoming the 6th typhoon to affect Vietnam in 2024. Meteorologists predicted the typhoon's path and intensity while preparing response measures. The typhoon got the intensity of level 11 by October 26th and reached Vietnam on the afternoon of the 27th making landfall in the central localities of Thua Thien Hue, Quang Nam and Da Nang. The following table presents its evolution through Vietnam to the Quang Binh Province.

Table 1. Evolution of the Trami storm before heading the Quang Binh Province

Date	Description	Impact
27/10/2024	On the afternoon, Trami storm made landfall in the provinces of Thua Thien Hue, Quang Nam to Da Nang. After moving deep into the mainland, the storm weakened into a tropical depression (Công Thông tin điện tử Chính phủ, 2024).	On the day and night, the area from Ha Tinh to Quang Nam had heavy to very heavy rain (Cục Khí tượng Thủy văn, 2024). In Le Thuy, Quang Binh, one person was missing. The water level in KienGiang river was rising very quickly (Ngọc Hải, 2024a).
28/10/2024	The total rainfall from 7am on Oct. 27 to 4am on Oct. 28 was generally 100-300mm, with some places over 500mm (Cục Khí tượng Thủy văn, 2024). Early morning, the tropical depression weakened into a low pressure area on the mainland along the coast of Quang Nam to Da Nang (Nguyễn & Trương, 2024).	Continuous heavy rain, flood in Kien Giang river exceeded alarm level 3 (Ngọc Hải, 2024b). Nearly 17,700 houses were flooded, including 12,361 in Le Thuy district, 4,897 in Quang Ninh district, and 370 in Dong Hoi city (Phúc Châu, 2024).
29/10/2024	Tropical depression continues to cause heavy rain in Central region (Lan Chi, 2024).	The water level on the Kien Giang River continued to slowly decrease (Ngọc Hải, 2024a). The water level remained above alert level 3 and people still had to endure prolonged flooding (Nguyễn & Trương, 2024).

29/10/2024

According to the Vietnam Disaster and Dyke Management Authority, as of the morning of October 29, in Quang Binh province had more than 32,700 flooded houses, 58 villages and hamlets were isolated. Roads were submerged at 76 locations, landslides occurred at 13 locations. Additionally, 3 fishing boats sank, and 1.5km of embankment and dyke erosion (Hoàng Phúc, 2024).

Major television channels like VTV and social media platforms such as Facebook provided regular updates with live footage from affected areas, warning nearby residents about the risk of flooding and hazardous locations. Local authorities have instructed people to evacuate to safe places. Information about floods was regularly updated on the media, and people also shared information, images and videos of deeply flooded areas on social networks. Local authorities have mobilized rescue boats for people in the flood center area of Le Thuy¹

This paper focuses on the period from October 27th to 29th, when the typhoon made landfall and its subsequent impacts in the Quang Binh province. While floodwaters in the rivers continued to rise, leading to prolonged flooding, residents organized efforts to cope with the flood warnings caused by heavy rains.

STATE OF THE ART

The concept of resilience comes from Holling (1973) who describes it as the capacity of an ecological system to absorb an external shock. Moatty & Reghezza-Zitt (2018) present two conceptions of resilience, depending on whether it is the antonym of vulnerability - improving the resistance of a system mechanically reduces its vulnerability, or whether it is more encompassing by focusing on both the territorial system and its (infrastructure) network - resilience becomes a capacity to maintain activity during a crisis and to recover post-crisis according to a mechanical link between the resilience of technical networks and the resilience of the territorial system. The authors emphasise that territorial resilience makes it possible to broaden the technical approach to network vulnerability by considering 'the importance of organisational vulnerabilities at all scales'.

Dufty (2012, 2013) highlights the multitude of definitions of 'disaster resilience' and clarifies the two meanings of the term: while the original notion of resilience, from the Latin word *resilio*, means 'jumping back' or 'bouncing back' (i.e. resuming normal functioning), a second meaning encourages consideration of the new post-disaster reality and its possibilities. Thus, the definition of community resilience emphasises the human aspect of the system. It can be defined as 'the existence, development and commitment of community resources to manage change and uncertainty' (Bec et al., 2019) and can be measured by 'the success of civil protection authorities and communities in improving their capabilities and adapting to cope with possible adverse events in the future' (Eklund et al., 2023). For Dufty (2012), community resilience involves three dimensions that digital communication tools, and more specifically in his case social media, can improve: risk reduction (by providing new media for information, discussion, coordination and feedback); emergency management (by enabling non-professional communities to contribute to the resolution of a crisis); and community development and collaboration.

Risk culture is an essential element in understanding the resilience of a community in a given area. (Courant et al., 2021) define it as an awareness of risk and of all the knowledge that enables actors and citizens to anticipate the impact of a situation and to adopt adaptive behavior in the event of a disaster. More specifically, the knowledge they mention covers the interactions between nature and land-use planning choices, as well as past or even actual experience of the hazard in the area, which enables them to make their own progress. This knowledge becomes culture, in the sense that it is inscribed geographically and temporally through its transmission over time. In this way, the culture of risk(s) is territorially specific.

Social media are Web 2.0 platforms or applications that allow their users to create content online, exchange it, consume it and interact with other users or their environment in real time (Kaplan & Haenlein, 2010; Luna & Pennock, 2018; Reuter et al., 2020). In recent years, the use of social media has increased considerably and its nature has changed, becoming more collaborative, particularly during crises (Reuter et al., 2020). Through social

¹ Source : Lê Thủy: *Huy Động Thuyền Của Ngư Dân Chờ Hàng Cứu Trợ Cho Người Dân - Báo Quảng Bình Điện Tử*, - <https://www.baoquangbinh.vn/thoi-su/202410/le-thuy-huy-dong-thuyen-cua-ngu-dan-cho-hang-cuu-tro-cho-nguoi-dan-2221971/>

media, citizens can gather information, disseminate it, solve problems collaboratively and participate in the adaptation and recovery of the territory (Jurgens & Helsloot, 2018). In this way, they can actively participate in crisis management, initiating processes ‘parallel’ to those carried out by public institutions (Batard et al., 2018; Rizza & Bubendorff, 2022). Rizza & Pereira (2014) found that the 2011 Genoa floods exemplify how social media empowered citizens and local authorities to respond effectively to a crisis, fostering community resilience. A Facebook page, initially created by a citizen, became a central communication hub connecting local authorities, emergency agencies, and citizens. This platform facilitated online and offline coordination of rescue and reconstruction activities. Also, in a research in one heavily flooded community in the greater Houston, Texas area, Stephens et al. (2018) found that during flood disasters, citizens raised health concerns, categorized into existing conditions and water-related issues such as contaminated water and immediate dangers. Social media became a key tool for sharing health information.

Lastly, the increasing use of smartphones highlights the potential of mobile applications in crisis management. Mobile apps can integrate multiple features, allowing users to quickly and accurately receive critical information during emergencies. However, for mobile applications to be widely adopted and effectively accessed by the public during crisis situations, usability is a key factor that requires attention from researchers (Ahmed Al-Sadi et al., 2023; Tan et al., 2017). Ahmed Al-Sadi et al. (2023) explored the development of a disaster mobile application capable of operating in both online and offline modes, emphasizing the importance of offline communication during disaster response to ensure continuous communication even when networks are unreliable or interrupted. Usability criteria for such applications were identified through a comprehensive literature review and expert discussions, highlighting that enhanced usability can save lives and reduce disaster response costs. Furthermore, users have expressed a preference for a minimalist interface that focuses on essential communication features, which is crucial in high-pressure crisis situations. The ability to operate offline becomes particularly vital when communication networks are interrupted or unavailable, ensuring that users can still access and exchange critical information when it is most needed. They also emphasize the importance of user experience and the public evaluation of usefulness, so further usability tests are needed before application publication.

METHODOLOGY

The research is based on two 5-day-field studies conducted in the Province of Quang Binh in July and December 2024. The first field study consisted of a visit to the three main flooded areas of the province along the river (KienGiang River) to its mouth and their monitoring, warning and safety infrastructures, accompanied by the director of the meteorological center. The second field trip, consisted to conducted exploratory interviews with four types of actors: local authorities, crisis managers, tourist guide and local people (see table 2 presenting the profile of the people interviewed). We completed 12 interviews and collected 31 images. Each interview lasted up to 60 minutes. We can classify the participants in four categories: Three from local authorities, two crisis managers, six citizens and one tourist guide. Institutional participants (*i.e.* local authorities, crisis managers and tourist guide) were selected based on their relevance to disaster management and practical experience in the field. We randomly selected citizens in different areas of Le Thuy district to ensure a comprehensive perspective.

Table 2. Sociodemographic description of the persons interviewed

Name of institution	Job/ Position	Age	Gender	Location	ID
Local authority	A member of the Disaster Prevention, Search, and Rescue Committee of Hong Thuy Commune	DN	Male	Hong Thuy commune	D8
	An executive actor of Hong Thuy Commune People's Committee	DN	Male	Hong Thuy commune	D9
	An executive actor of Hong Thuy Cooperative in Moc Thuong village	DN	Male	Hong Thuy commune	D10
Crisis manager	An executive actor of the Quang Binh Provincial Hydrometeorological Center	DN	Male	Quang Binh Provincial Hydrometeorological Center	D5

	A member of Duty Office of the Provincial Disaster Prevention Command, Department of Water Resources	DN	Male	Quang Binh Provincial Hydrometeorological Center	D6
Citizen	Manager of gas station, Hong Thuy commune	46	Male	Gas Station	D1
	Street Vendor	50	Female	Dai Phong Village	D2
	Farmer	62	Female	My Loc Thuong Village, Trong Dai village	D3
	Farmer	74	Female	Hong Thuy commune	D4
	Farmer	61	Male	Kien Giang Town	D11
	Farmer	55	Female	Hong Thuy commune	D12
Tour guide	Freelance Tour Guide, Front office supervisor at Vinh Hoang Nhat Le Hotel	32	Male	Dong Hoi city	D7

Our objective was to get a picture or understanding of the resilience community of the Province of Quang Binh based on their experience of the Trami storm. The interviews were structures through four axes: the profile of the people; their Trami storm experience (preparation, information and its channels, communication et organization); the ICT they mobilized (if relevant); a last set of questions was dedicated to the mobile app. “FloodGuard Quang Binh”. Indeed, we also wanted to understand how information and communication technology (ICT) may support resilience building community. To do so, the data collected on the field has been completed by an online ethnography aiming at understanding which types of information have been published at the time of the Trami typhoon (see table 3).

Table 3. Presentation of the online platforms analyzed for the online ethnography

Name of institution/ Organization	Platform	Type of information
Vietnam Meteorological and Hydrological Administration	Institutional Website	Typhoon and tropical depression forecasts, storm impact warnings, disaster preparedness warnings
Ministry of Natural Resources and Environment		
Voice of Vietnam (VOV)		Typhoon forecasts, emergency response and support information
VTV online		Disaster response and preparedness, flood impact and damage reports, emergency incidents and casualties, Government and Disaster Management Authority Updates
Government news		Government directive and response measures, weather and typhoon updates
Quang Binh news		Disaster response and preparedness, emergency incidents and casualties, flood impact and damage reports, rescue and relief operations
VNExpress		Flood impact and damage reports

Labor newspaper		Flood impact and damage reports, emergency incidents and casualties
Easia Travel		Weather and travel conditions, transport update, activity about tourist sites update, tourist site suspensions
Weather forecast – Hydrometeorological Information Quang Binh	Social Media 1	Weather forecasts, typhoon forecasts, disaster warnings, flood impact reports, misinformation alerts
Weather Center – News Department, Vietnam Television		Weather forecasts, emergency flood warning, contact for flood relief support
Personal expert page		Disaster warnings and extreme weather events, flood and typhoon updates
Weather forecast - VTcab weather	Social Media 2	Weather forecasts, typhoon forecasts, disaster warnings
VTV Weather Forecast (VTVWDB)		
Private account	Social Media 3	Evacuation decision, transportation, travel advisory and safety information
Weather forecast information in Quang Binh	Social Media 4	Weather forecasts, disaster risk level warnings, forecast of heavy rain impacts, and flood water level on the river.

The interviews were recorded, translated into English and transcribed. All the data collected (online ethnography, photos and interviews) was coded using thematic coding in Atlas.ti software. Drawing from the theoretical foundations, we constructed a coding framework to guide the thematic analysis of our qualitative data. This framework reflects key conceptual dimensions identified in previous research on disaster resilience, community response, and the role of digital communication tools. The main coding categories include:

- Information (*i.e.* type of information, information channels, transmission, reception information);
- Crisis communication (*i.e.* devices, topics, actors);
- Organisation (*i.e.* crisis management process);
- Mobile application (*i.e.* use of digital device and mobile application used by the interviewees, reviews of FloodGuard Quang Binh app by interviewees).

Each main code was divided into subcodes to further specify the key components that contribute to a more detailed understanding of the data. These subcodes support a granular analysis of the corpus, highlighting specific aspects of the resilience process, the community response, the role of digital communication devices and the effectiveness of mobile application. The same main codes and subcodes have been used to analyse and answer the research questions allowing us to present the results according to 3 topics: information and channels; communication and resilience community; the relevance of the use of a mobile app. such as “FloodGuard Quang Binh”.

RESULTS AND DISCUSSION

Following the state of the art, in this WiP paper, we have decided to mainly focus on the community resilience dimension and the potential of ICT to foster it (Dufty, 2012, 2013), letting willingly apart the infrastructure aspects of the territory (Moatty & Reghezza-Zitt, 2018). Since the Province of Quang Binh is a famous tourist destination (UNESCO site), we also paid attention to the way tourists are included in the information and communication flows.

Combining traditional and social media to face the typhoon

Based on the interviews and online ethnography, we got a clearer understanding of the information channels to prepare and face the Trami storm.

Before Typhoon Trami made landfall, the National Meteorological Center issued early warnings on major media channels and through their website, alerting people to prepare for the approaching storm. From their side, local authorities received telegrams from the government to prepare to respond to the storm and quickly organized press conferences, spread warning information through loudspeakers (localized in the streets of the villages) and posted information on social media to encourage residents to take precautions. Media (including social media) provided information and updated the situation about the storm.

More specifically, crisis managers typically forecast the path of storm and flood through prediction models and issue warnings to local authorities and the public. As soon as they received information about the storm, local authorities and agencies, prepared to respond to the storm and to promptly inform people to prevent storms and floods. Currently, to make decisions or officially communicate information to the public, local authorities require directive documents from higher authorities. In emergency situations, however, they take the initiative to help residents respond promptly.

Not only can digital channels quickly reach the public, but crisis managers also use them to rapidly share information with local authorities to facilitate timely decision-making. Smartphones were widely used by crisis managers and residents to access updates and social media reports on weather updates, flood warnings, evacuation instructions. Additionally, depending on the severity of the flood, SMS alerts are automatically dispatched to phone numbers across the province in the Quang Binh region in collaboration with Vietnamese mobile telephony service providers (e.g. Viettel and MobiFone). One crisis manager explained once the impact of the storm was assessed, they would work with the network providers to send warning messages to residents across the province.

“Each year, SMS messages are sent [...]. However, this depends on the severity of the flood each year. In years with severe floods, these messages will be sent.” In Interview D5

In that respect, a Zalo² group, named “Thông tin thời tiết Quảng Bình”³ has been created. It counts 198 members, mainly from disaster prevention office at local level, department heads, specialists and advisory staff. All information about forecasting and warning is posted here. Based on this information, its members report and communicate to other different groups at local levels ensuring they receive information and make decisions, proactively prepare and spread official information to local residents.

“[...] the agency will edit the forecast bulletin on storms, floods, rain, wind and attach the necessary information. I will send the information to the Provincial People's Committee, the District People's Committees, the Provincial Disaster Prevention and Control Command, and post it on Quang Binh Television Station, Quang Binh Newspaper. In addition, I will also post it on the Zalo group of the Hydrometeorological Information community established by the Station, as well as the Disaster Prevention group and fanpage.” In Interview D5.

However, traditional channels remain familiar sources of information and provide official, reliable information that the public keep trusting: when interviewed, residents immediately cited loudspeakers as the first source of information issued by the authorities on the storm and its preparation.

Lastly, travel agencies when they receive information about the storm are able to inform tourists when they have booked through their services. Most of the time they do so through social media platforms such WhatsApp, Instagram or Facebook. If not, tourists would carry on or postpone or cancel their journey. When they are on the territory, they are locally alerted and managed by local tourist institutions as hotels.

“Tourists communicate with the travel agency, either directly or by contacting their executive.” In Interview D7

While digital channels, such as smartphones and social media, seem relevant to spread information and preparation among each category of actors, traditional channels such as news media and loudspeakers remain the main means to alert local population. The same way, while tourists are warned by national tourist agencies through social media, they are taken in charged locally by their hotels.

A resilient community built to cope with the risk of flooding

Before the flood, information was delivered to residents through various channels. Authorities made every effort to ensure the information reached the people, especially through loudspeakers. During the event, loudspeaker is as the most effective tools for urgent warnings and official announcements, particularly in rural areas – sometimes

² Zalo is a Vietnamese instant messaging multi-platform service developed by VNG Corporation. This is a free application allowing users to text, call, send photos, share files and use diverse features right in the app. In September 2024, Zalo has approximately 77.6 million active monthly users. Zalo is available in all 63 provinces of Vietnam, including islands, remote areas, and is accessible in more than 23 countries worldwide [Source: <https://en.wikipedia.org/wiki/Zalo> - visited on 17/02/2025]

³ “Weather forecast information in Quang Binh”

boats equipped with loudspeakers are sent to spread information and monitored the people.

“When the storm is closer, the loudspeakers in the commune announce updates every day and every hour.” [In Interview D2](#)

When the residents were warned about the storm, they organized their homes so that they could stay at least on the first floor of the building with enough food and water. They also share information and organize through digital media such as Facebook and Zalo. More specifically, how residents deal with the storm includes the process of preparing for, responding and recovery from flood. Most of them, explained that they got prepared based on their experience from the historic flood of 2020.

An interviewee explained: *“Now, after learning from previous floods, people are better prepared. We store essential items for flood and storm preparedness and stay updated with information more regularly.”* [In Interview D3](#)

Rescue teams and volunteer teams also act locally to support local people and answer to their needs. Rescue teams, called “commune’s disaster response committee” gathers local police, military, security teams, and members of the Civil Defense Committee and of the Community security forces.

Citizens will directly call the commune's disaster response committee. The commune will then provide direct assistance to people. Due to the area being cut off by floods, the local community is responsible for the logistics on-site, following the principle of "four at the site", using local resources for rescue efforts, as higher-level vehicles cannot be used due to high waves and the area being isolated. [...]The commune’s disaster response committee consists of local police, military, security teams, and 27 members of the Civil Defense Committee, as well as nearly 100 people from the community’s security forces. [...].” [In Interview D9](#)

Volunteer teams, composed of healthy, willing and not affected local citizens, can join the committee to support the rescue efforts. Local authority mentioned that these volunteers are chosen based on their age and health to ensure their effectiveness in disaster response.

“The volunteer rescue team operates under the leadership of the Commune Youth Union Executive Committee. In emergencies, the Chairman of the Commune People's Committee issues a formal decision to activate the team, ensuring it complies with regulations and policies. In Hong Thuy commune, there is already a civil defense team of nearly 100 members. This team is composed of young individuals from the local community, selected specifically to participate in flood and storm response efforts at the commune level. These volunteers are chosen based on their age and health to ensure their effectiveness in disaster response.” [In Interview D9](#)

“They come from areas that are not affected by the floods, like Quang Binh province, the deepest place is Le Thuy. Generally, the volunteer team consists of young members of the company's youth union, office staff, and employees from other stores that are not in the flooded area. They come to support us.” [In Interview D1](#)

“There are youth teams, soldiers, police, and youth unions helping people clean up after the flood.” [In Interview D5](#)

An elderly interviewee stated that the rescue were present to provide support during the recent flood. However, they mainly focused on areas that were deeply flooded, where the impact was most severe.

“[...] The soldiers came to assist during the recent flood, but they mostly helped in areas that were deeply flooded[...].”[In Interview D2](#)

During the event, residents would use their phones to directly call the hotline to receive timely support from the rescue teams. However, they also stated the example of the historical flood 2020 when they could not reach the support teams because of the high numbers of people requiring support.

“I have phone numbers to contact the rescue team. For example, during the 2020 flood, some families knew the contact number and called for help, but no one answered. Some families in lower-lying areas, who didn't have boats or canoes, also tried calling. Because there were so many calls for help and the rescue teams also went everywhere so maybe they did not answer the phone.” [In Interview D3](#)

The interviews conducted with local citizens highlight their competences in adapting and facing the Trami storm or more generally, flooding. They have developed their own “risk culture” (Courant et al., 2021) mainly based on the 2020 flooding and they are able to organize themselves and mobilize digital technology to communicate with each other as well as with institutions despite some issues which have been mentioned. They also take in charge tourists who may be on the field during the event.

What role can a mobile application fulfil?

Based on the previous results, the question of the usability (Ahmed Al-Sadi et al., 2023; Tan et al., 2017) of the mobile application “Flood Guard” for local citizen and tourists in the Province of Quang Binh is at stake.

We conducted seven exploratory interviews with local people. While the exploratory individual interview does not confirm or refute a research hypothesis, it does provide an opening onto the subject under study and enables research avenues to be formulated (Ragouet, 2000). Despite the ‘non-representative’ nature of the individual interview, it is a way of obtaining information and points of view on an object that cannot be physically gathered *in situ* by direct observation (Beaud, 1996). The majority of the interviewed persons were more than 46-year-old. Most of them declare rarely use mobile applications to access disaster warning information. Instead, they rely on social media platforms, TV news or announcements broadcast through local loudspeakers. Despite this, they acknowledge that such applications are quite useful for staying updated with reliable, official information sources. They also believe that these applications would be particularly beneficial for risk management officials, helping them monitor and coordinate responses effectively during crises. Some of them, do not use at all any mobile applications about natural disaster warning and mainly get updates from television, loudspeakers.

“I don't use any disaster warning apps.” In Interview D12

When we presented “FloodGuard Quang Binh” mobile app. to local people, most of them expressed that this application would help them track essential information for flood prevention. They felt however that it would be difficult for elderly to use it. They confirmed they mainly relied on their own flood prevention experience and updated information primarily through television, loudspeakers and social media. The common disadvantages they mentioned included network disruptions that hindered access to the application and difficulties for the elderly in using it. They also suggested that to make the application more accessible to the local community, its name should be changed to something easier to recognize (if a mobile app wants to be popular among the local residents).

“This app is useful as it provides essential information, especially about shelter areas. However, only young people know how to use it. For older or elderly people, it's harder to access.” In Interview D2

From their side crisis manager mainly use VNDMS application, which has been developed by the General Department of Natural Disaster Prevention and Control to enhance monitoring and respond to natural disasters.

“Mainly, I use the application from the General Department of Natural Disaster Prevention and Control or Windy application, for instance. Windy is commonly used to track the storm's movement. There is also the VNDMS app from the General Department of Natural Disasters. However, the main source of information is still the Quang Binh Hydrometeorological Station.” In Interview D6

In complement, crisis managers and local authorities also mentioned their use of mobile applications such as WindyApp. Windy application is a professional weather app, initially created for water and wind sports. In our case study it appears to be used to complement the monitoring of storms' path.

“There is no application yet to directly warn the public. The existing applications, such as Windy, are mainly for individuals to download, allowing them to check, research, and stay informed [...]. However, everything must ultimately come under the direction of higher authorities, and information must be communicated accurately, especially from these higher levels. [...]” In Interview D8

They believe “FloodGuard Quang Binh” application could provide real-time updates on the situation. However, it would require a longer period of use for evaluation and improvement before being widely adopted by the public. To effectively manage crises, the application should integrate additional features that offer solutions for timely decision-making to support residents. The local authorities also hoped that the application could be widely used, not only by residents but also by the government, to help them develop response plans to support people during floods. They also pointed out some limitations of the application for residents, including lack of technological literacy, age barriers, and areas with limited network connectivity.

Lastly, the tour guide believed that this application would be useful for local residents. However, it would be difficult for tourists to access. Also, usability for tourists is not sure since they usually check forecast before their trip and do not travel for long periods. Most of them already have prior information, and since the application only provides data for Quang Binh Province, it becomes challenging to reach tourists. For foreign visitors, the application should offer more language options.

“I believe that this app is currently difficult to access for both agency-booked and independent travelers. [...]Therefore, this app, which is currently available only in Vietnamese, is challenging for foreign tourists who do not speak the language. [...]. The more languages the app supports, the more widely it will be adopted.” In Interview D7

Usability of the mobile app. “FloodGuard Quang Binh” is at stake when it comes to foster community resilience

in the Province of Quang Binh. Despite the beliefs and projections of each category of actors interviewed, concrete barriers challenge its appropriation among which the strong community resilience itself and the existence of specific app. Developed by national authorities and already used by local crises managers and authorities.

CONCLUSION

Taking the opportunity of the Trami storm, which occurred at the time of our research, our case study has highlighted a strong resilience of the population of the province of Quang Binh acculturated to the risks of typhoons and flooding in the region – they learned from the previous flooding in 2020 and organized consequently. Also, local population demonstrates a high capacity to mobilize both traditional and digital channels to get information they need to prepare and be updated about the event as well as communicate and self-organize at the local level, including supporting local authorities through volunteer rescue teams. When they are still on the field at the time of the disaster, tourists are taken in charge by their hotels or local tourist institutions. From their side, local authorities and crisis managers also mobilize the panel of (official and non-official) channels they have at disposal to warn, follow-up and manage the crisis: for instance, they combine official channels such as loudspeakers and localized SMS to warn people as well as unofficial means such as a Zalo group and the mobile application Windapp. to get updated about the event and communicate and organize

In this context, the FloodGuard Quang Binh mobile application both demonstrates its potential as a tool for flood preparedness and crisis communication in Quang Binh province and faces usability challenges. Based on our study, we have identified key areas for further enhancement of the application to better serve the community and improve disaster resilience.

1. Multilingual Support (English Version)

To increase accessibility, the app should support multiple languages, particularly English, to cater to foreign tourists, international NGOs, and expatriates in Quang Binh. Implementing a language switch option would make critical flood-related information more widely available.

2. Evacuation Route and Shelter Information

A key addition to the app would be an interactive evacuation map, displaying real-time shelter availability, safe routes, and emergency contact numbers. Integration with Google Maps or OpenStreetMap would enhance the app's usability, ensuring that users can navigate safely during flood events.

3. Incorporating Local Knowledge and Community Feedback

Insights from community interviews suggest that residents rely heavily on local networks and traditional warning systems such as loudspeakers and in-person alerts. A citizen reporting feature should be integrated to allow users to share real-time flood updates, damage reports, and emergency needs, fostering a more collaborative disaster response system.

4. Offline Mode for Disaster Resilience

Given the frequent loss of internet connectivity during storms, the app should include an offline mode where critical information, such as evacuation maps and emergency contacts, is pre-downloaded and remains accessible without an internet connection.

5. AI-Based Flood Prediction and Early Warning System

Building on recent research into deep learning models for water level prediction in the Kien Giang River Basin, the app could integrate AI-powered flood forecasts using LSTM/GRU models. This would allow users to receive advanced warnings on rising flood levels, improving preparedness and response times.

6. Community Engagement and Social Media Integration

Social media has played a vital role in previous flood responses in Quang Binh. Enhancing the app's functionality with Zalo, Facebook, and SMS broadcasting features will enable faster dissemination of alerts and increase user engagement. Additionally, a social media sharing function will empower residents to share real-time flood conditions with their networks.

7. Strengthening Collaboration with Local Authorities

Local government agencies are key stakeholders in disaster management. The app should include a government dashboard for official agencies to issue real-time alerts, evacuation orders, and verified information. Additionally, a two-way communication system will allow residents to request rescue assistance directly through the app.

8. Usability Testing and Public Feedback Integration

To ensure the app meets the needs of its users, usability testing with local communities should be conducted, incorporating feedback from residents, emergency responders, and local authorities. A built-in feedback form will enable continuous improvements based on user experiences.

9. WebGIS Integration for Risk Awareness

Building on prior studies on flood risk visualization in Quang Binh, the app should integrate WebGIS-based real-time flood risk maps, providing users with dynamic visualizations of flood-prone areas and predicted inundation levels.

Future Directions

These enhancements will transform FloodGuard Quang Binh into a comprehensive digital flood management tool, integrating real-time alerts, predictive modeling, citizen engagement, and emergency coordination. Future research will focus on pilot testing these features, refining AI-based forecasts, and expanding the app's reach to other flood-prone regions in Vietnam.

By strengthening community resilience through technological innovation and localized insights, this study highlights the potential of ICT in enhancing disaster preparedness and response, ultimately mitigating flood impacts in Quang Binh and beyond.

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