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Flood preparedness and utilization of early warning systems among households in selected flood-prone areas in Tagum City, Davao Del Norte

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ABSTRACT

Flooding is a pervasive natural disaster posing significant threats to infrastructure, property, and lives globally. Barangay San Miguel in Tagum City, Davao Del Norte, emerges as a particularly vulnerable area with substantial repercussions for its surrounding communities. Therefore, assessing household preparedness and the efficacy of early warning systems in mitigating the community's vulnerability becomes crucial. A survey encompassed a random sample of 99 respondents derived using the Slovin formula representing the study population. The evaluation of household preparedness considered indicators such as the readiness of first aid kits, evacuation plans, food supplies, and participation in seminars and training. Additionally, the effectiveness of early warning systems was gauged through indicators, including localized floodwater warning systems, electronic floodwater warning systems, flyers and leaflets, and direct communication.The findings reveal a commendably high overall level of household preparedness for floods, as reflected by a mean value of 3.75. However, notable deficiencies were identified in seminars and training, registering a weight of 2.74, which was classified as very low. Moreover, flyers and leaflets recorded the lowest mean value at 2.06, indicating a need for improvement in this aspect of the early warning system. Given these results, policymakers and disaster management officials shall prioritize enhancing households' knowledge and skills through targeted seminars and training programs. Simultaneously, allocating sufficient funding and resources is crucial to bolster the effectiveness of early warning systems, particularly in distributing information through flyers and leaflets. This comprehensive approach aims to fortify community resilience and reduce vulnerability to flooding in Barangay San Miguel, Tagum City, Davao del Norte and similar areas.

Keywords: Davao del Norte, early warning system, flood, preparedness, quantitative research design

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INTRODUCTION

Floods, one of the most prevalent and economically burdensome natural disasters globally, significantly impact communities, economies, and ecosystems (WHO, 2017). Bangladesh faces recurring challenges with severe floods, causing extensive damage and displacing populations, exacerbating poverty, and hindering long-term development efforts (Rashid et al., 2022). The United States, as seen in events like Hurricane Harvey, experiences devastating economic losses, displacement of residents, and long-term environmental repercussions due to flooding (Smith et al., 2023). Every year, many cities in the Philippines face potential threats from floods. In December 2017, specifically in the areas of Eastern Visayas and Northern Mindanao, the Philippines experienced tropical cyclones named "Urduja" (known internationally as Kai-tak) and "Vinta" (known internationally as Tembin). These cyclones resulted in devastating flash floods and landslides, claiming the lives of over 200 individuals and forcing thousands from their homes (Lagmay and Racoma, 2019). Flooding in the Philippines has been a recurrent and impactful phenomenon, bringing about severe consequences for the country's communities and ecosystems.

The archipelagic nature of the Philippines, coupled with its susceptibility to typhoons and heavy rainfall, exacerbates the frequency and intensity of flooding events. The consequences of such flooding include widespread displacement of populations, loss of lives, destruction of homes, and disruption of critical infrastructure, particularly in low-lying and densely populated areas (Braimah, 2020). According to current literature, the damages caused by it become higher as its frequency is also rising (Takeuchi, 2002). However, Musyuki et al. (2016) suggested that flood is a normal and essential component of both agricultural and ecological systems as it provides the basis for the regeneration of crops, plants, and aquatic life.

In the Davao region of Mindanao, Philippines, flooding poses a significant threat, primarily due to the region's location and climate, leading to heavy rainfall, river overflow, and flash floods. Despite efforts by the local government in Tagum City, Davao del Norte, to implement flood control measures, flooding remains a persistent problem, particularly in coastal barangays and areas along the Liboganon River (Tagum City CLUP, 2011-2025). The vulnerability of Barangay San Miguel and other urban barangays to significant river and overland flooding is particularly high during rainfall events with a 5-year probability, posing risks to lives, property, and livelihoods (Habitat, 2010).

In recent years, Tagum City has faced multiple devastating flooding events, including those caused by Tropical Cyclones Pablo, Crising, Zoraida, and Agathon. These events have severely affected numerous barangays, leading to distress, displacement, and economic losses (Gaudiel, 2023). The recurring nature of these incidents highlights the urgent need for comprehensive disaster management and mitigationstrategies to enhance community resilience.

Furthermore, several researchers from various regions have explored the effectiveness of early warning systems and the importance of community preparedness in reducing the impacts of flooding. However, there needs to be more studies on flood preparedness and the effectiveness of early warning systems locally, specifically in Barangay San Miguel, Tagum City, Davao del Norte. There is a need for more information on factors affecting households' utilization of early warning systems and more effective strategies to encourage families to use early warning systems and improve their preparedness for flood disasters.

Flood preparedness is pivotal in safeguarding communities and minimizing flood-related impacts and, at the same time, encompasses strategies like risk

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assessment, infrastructure development, public awareness campaigns, and the establishment of early warning systems (EWS). A study by Merz et al. (2010) emphasizes the importance of an integrated approach to flood preparedness. It highlights that earlywarning systems are most effective in a comprehensive flood risk management strategy, including mitigation, response, and recovery components.

Effective flood preparedness reduces adverse effects and ensures swift recovery for affected populations. One critical component of flood preparedness is etablishing early warning systems. The Sendai Framework for Disaster Risk Reduction, a global framework adopted by United Nations member states, emphasizes the importance of early warning systems in reducing disaster mortality. These systems provide timely and accurate information about impending flood events, enabling communities to take proactive measures. Effective early warning systems rely on meteorological and hydrological monitoring, communication infrastructure, and community engagement, providing evacuation, shelter, and emergency response alerts and guidance.

A study by Jongman et al. (2015) highlights that well-implemented early warning systems can significantly decrease flood impacts, especially in low- and middle-income countries where vulnerability is often higher. These systems are most effective when integrated into a comprehensive flood risk management strategy, including mitigation, response, and recovery components. Early warning systems are crucial in reducing the loss of lives, livelihoods, and property caused by floods. According to the United Nations Office for Disaster Risk Reduction (UNDRR, 1901), early warning systems reduce the loss of lives, livelihoods, and property caused by floods by providing advance notice and information on the severity and expected impacts of the event. Also, the United Nations Food and Agriculture Organization (FAO) defines disaster occurrences as unexpected or serious tragedies that significantly affect a community's basic functioning and regular activities (Macusi et al., 2023).

Thus, this study has been conceptualized and undertaken and contributes to the literature on flood preparedness and utilization of early warning systems in specific areas in the provinces of Davao del Norte, Mindanao, and the Philippines. The main objective of this study is to evaluate flood preparedness and the utilization of early warning systems among households in Barangay San Miguel, Tagum City, Davao del Norte. Specific objectives and the scope of the study include assessing the level of flood preparedness among households, evaluating the utilization of early warning systems, and providing recommendations to improve the community's resilience to flood disasters. The results of the study will serve as a baseline for local policymakers and stakeholders to implement targeted interventions and enhance the community's adaptive capacity in the face of future flooding events, contributing to the achievement of SDG 11 (Sustainable Cities and Communities) and SDG 13 (Climate Action) at the local level. The results may only be true and applicable to the local context, specifically in the chosen study locale.

MATERIALS AND METHODS

Study site

This study was conducted in Barangay San Miguel, Tagum City, Davao del Norte. It is one of the progressive barangays in the Tagum City, Davao del Norte, Davao Region, Philippines. Barangay San Miguel is situated at approximately 7.4435, 125.7747, on the island of Mindanao.

Elevation at these coordinates is estimated at 16.3 meters or 53.5 feet above mean sea level (Figure 1).

Research instrument and informed consent

This study employed a quantitative research design. A cross-sectional survey was conducted among households in Barangay San Miguel, Tagum City, and Davao del Norte using a researcher-made questionnaire. The survey was done in January 2023. The researchers designed the questionnaire and employed a closed-ended format, allowing respondents to select their preferred answer from a predetermined list of choices. The survey questionnaire is composed of two parts. The first part is the sociodemographic profile of the respondents, and the second part consists of questions about their preparedness and early warning implementations, constructed on a 5-point

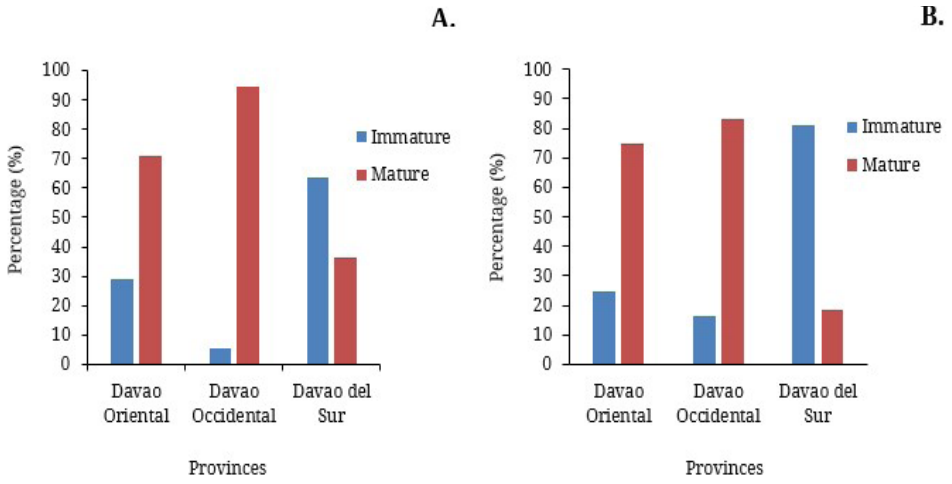

Figure 1. Map of Tagum City, Davao del Norte, Philippines.

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Likert scale. The validation process encompassed various steps, including pilot testing, assessing reliability and validity, and making necessary revisions. Pilot testing involved administering the questionnaire to a small group of participants to identify design or administration issues.

Reliability was evaluated through test-retest reliability by administering the questionnaire to a sample of respondents on two separate occasions with a time interval in between. Validity was assessed by determining if the questionnaire adequately covers the content domain it intends to measure. Faculty and researchers in the field were invited to review the questionnaire and provide feedback on its relevance and representativeness of the measured construct. Based on the results of the validation process, revisions were made to ensure the questionnaire's clarity, coherence, and relevance.

Before conducting the survey, informed consent procedures were thoroughly explained to the respondents, ensuring they were fully aware of their roles, rights, and the purpose of the study. It confirmed voluntary participation and safeguarded the privacy and confidentiality of the respondents. The researchers adhered to ethical guidelines and ensured the survey was conducted anonymously and respectfully.

Data collection

Before the study's commencement, the researchers made comprehensive procedures to establish a foundation of transparency and collaboration. A courtesy call was conducted, during which permission was sought from the barangay officials, underscoring the commitment to ethical research practices. This preliminary step aimed to foster a positive relationship with the local community, laying the groundwork for the forth coming data collection. Data was gathered by a team of trained research personnel equipped with the necessary skills to ensure the accuracy and reliability of the information obtained.

The chosen approach involved house-to-house surveys, where these proficient individuals visited selected households and administered a structured questionnaire. This hands-on method allowed for direct and personal interaction with the respondents, fostering an environment of openness and cooperation. Ninety-nine respondents participated in the study, contributing valable insights through the interview process. The house-to-house survey method not only facilitated comprehensive data collection but also demonstrated a commitment to engaging with the community respectfully and conservatively.

The sample size was determined using the Slovin formula. Slovin's formula is given as follows: n = N/(1+Ne2), where n is the sample size, N is the population size, and e is the margin of error. In this study, the margin of error used is 10%. Based on secondary data gathered from the barangay officials, Barangay San Miguel has a total household of 5,391 as of 2022. Out of this total household population, only 99 respondents were chosen using the formula.

Data analysis

Data were analyzed using descriptive statistics, and data were presented through frequencies, percentages, means, and standard deviations. Computations were mainly done through Microsoft Excel.

RESULTS AND DISCUSSIONS

Sociodemographic profile of respondents

The figures below depict the sociodemographic profile of respondents. The chart reveals that the level of education (Figure 2. a) has a crucial impact on preparedness for floods.

Individuals with higher education levels tend to have more knowledge and resources to mitigate the effects of floods. Along with education, experience also plays a vital role in flood preparedness. The graph indicates that 47.22% of the respondents are on high school level, 13.89% are high school graduates, and only 16.67% and 2.78% are elementary graduate and elementary level education, respectively.

Moreover, 2.78% have completed a college degree, and 16.67% have reached college-level courses. It is imperative to n ote that education and experience are significant contributors to enhancing flood preparedness. People with a higher level of education can access better information and resources to deal with floods. However, those who lack formal education can also acquire knowledge and experience through various means, such as community-based programs and training (Onuma et al. 2017).

Furthermore, Figure 2. b also displays the age distribution of the respondents in Barangay San Miguel, Tagum City. The results suggest that older individuals may be better equipped to handle floods since they have more experience and knowledge. Vladimir et al. (2016) conducted a study that found a significant correlation between the age of respondents and their preparedness to respond to natural disasters. It is likely because older individuals have lived through more natural disasters and have developed skills to handle them effectively. Out of the total respondents, 29.29% were aged 51 and above. These respondents will likely have more experience dealing with floods and may be more knowledgeable about the risks involved.

Additionally, 26.26% of respondents aged 31-40 have some experience dealing with floods and may better understand their associated risks. There were 19.19% of respondents aged 21-30 and 13.13% aged 18-20 and below. These younger respondents may have less experience with floods but can still contribute valuable information on their household preparedness.

Lastly, the monthly income of respondents demonstrated in Figure 2. c reveals that most respondents' income is just enough to meet their daily needs, and they can only afford the necessary preparations for floods. It is a significant concern since some flood preparedness actions may require costly resources. Hallegatte et al. (2016) found that lower-income people invest less in preventing and mitigating the adverse effects of natural hazards and environmental changes.

Similarly, Al-Rousan et al. (2014) conducted a study that showed individuals with lower income levels were significantly less prepared for natural disasters. The graph shows that 32.32% of respondents have a monthly income of 2,000-4,000, 47.47% have a monthly income of 5,000–8,000, and only 20.21% have a monthly income of 10,000 and above. These results suggest that many households in Barangay San Miguel may struggle to afford the necessary resources and preparations for floods. It is vital to ensure that low-income individuals have access to resources and information to help them prepare for floods. It can include community-based programs, training, and government assistance. Additionally, raising awareness about the importance of flood preparedness and encouraging individuals to take necessary precautions to protect themselves and their property is crucial.

Household preparedness to flood

In this study, household preparedness for flooding was measured in terms of the identified indicators: the presence of a first aid kit, evacuation plan, food supply, and acquired training and seminars. Each of the indicators was presented and discussed below.

(b) Age bracket

(c) Monthly income

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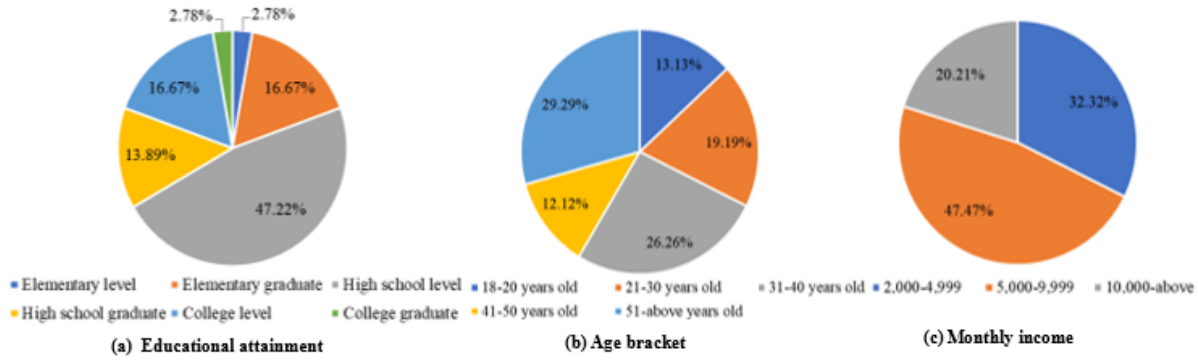

Figure 2. Sociodemographic profile of the respondents showing educational attainment, age bracket, and monthly income.

First aid kit. Table 1 presents data on the mean level of preparedness among household members concerning the presence of a first aid kit in their homes to mitigate the impact of floods. The mean preparedness level is reported as 3.57, with a standard deviation of 1.18. This figure suggests a relatively high level of preparedness among households, emphasizing the importance of having a pre-arranged first aid kit as a crucial component for survival in flood situations. The significance of this preparedness is underscored by the fact that, despite facing resource constraints, families prioritize safety and emergency response, recognizing the necessity of a first aid kit for coping with the challenges posed by floods.

The data also emphasizes that even though more than half of the respondents did not currently possess a first aid kit, the overall preparedness level of households for flood events remains high. This paradoxical situation is attributed to families' demonstrated interest in contributing to a first aid kit despite financial limitations that prevent them from acquiring all the essential items independently. The community's commitment to safety and emergency preparedness is evident in its collective efforts to address the challenges posed by flood events.

Furthermore, the study underscores the additional support provided by the local community in enhancing the overall preparedness level of households. This collaborative approach suggests a community-oriented strategy, wherein resources and assistance from the local government or community organizations complement individual efforts, creating a more resilient and collectively prepared environment.

The result draws on the research of Cvetkovic (2019), which suggests that during flood events, emergency responders may face challenges in reaching everyone promptly. The survival rate, therefore, becomes highly dependent on the presence of a well-equipped first aid kit and other disaster and emergency supplies readily available within the households. The study emphasizes the need for proactive measures and reinforces the critical role of individual and community preparedness in ensuring the well-being and survival of residents during flood events when external assistance may be limited or delayed.

Evacuation Plan. The findings from Table 1 reveal a noteworthy level of preparedness among households in Barangay San Miguel, Tagum City, specifically in terms of lessening the impact of floods through evacuation plans. The mean preparedness score of 4.73, coupled with a relatively low standard deviation of 0.59, indicates a consistently high level of readiness within the community. This high level of preparedness is a positive sign, suggesting that households in the area are well-equipped to assess and navigate evacuation

routes during flood events.

The robust preparedness observed can be attributed to the awareness and knowledge possessed by families regarding appropriate actions to take in the face of a flood. The community's understanding of evacuation procedures contributes significantly to their overall readiness, aligning with the findings of previous research by Lindell (2010). He emphasizes the critical nature of effective evacuation planning, particularly in scenarios involving large-scale evacuations and short warning periods. The success of such plans hinges on seamless coordination and collaboration among various agencies at different levels of government, as well as engagement with non-governmental organizations such as the Red Cross.

The elevated level of preparedness among households in Barangay San Miguel, Tagum City, serves as a valuable asset in mitigating the impact of floods and ensuring the safety of residents during disasters. This preparedness is indicative of a community that recognizes the importance of proactive measures in the face of natural hazards. As highlighted by Lindell's research, effective evacuation planning is a multifaceted process that necessitates a joint effort from governmental and non-governmental entities. The positive outcomes observed in this study reflect the success of such collaborative efforts, ultimately contributing to the resilience of the community in the face of potential flood-related challenges.

Food supply. The result shows the mean level of preparedness among household members in terms of storing food supplies to mitigate the impact of floods. According to the data presented in Table 1, the mean preparedness level is 3.95, indicating a high level of readiness. This is a positive sign, suggesting that households are taking proactive measures to ensure they have sufficient food supplies during flood events. The standard deviation of 0.89 provides insight into the variability of preparedness levels among households.

However, this also highlights a potential limitation to this high level of preparedness. While the mean indicates overall readiness, it is noted that this preparedness may only be sustainable for a short period. Some households may have enough food supply for only a few days, while others can sustain for weeks. Additionally, there may be families who are unable to stockpile food due to various reasons, such as financial c onstraints or lack of storage facilities.

Lassa et al. (2019) emphasize that disasters and extreme climate events can have a profound impact on food systems. In response to these challenges, governments have been actively working on developing more robust and resilient food systems. One of the strategies mentioned is the implementation of stockpiling emergency food reserves. This measure is considered essential for both food security and disaster preparedness.

Seminar and training. The mean value of households' preparedness level in lessening the flood impact, as indicated by a score of 2.04 with a standard deviation of 1.50 (Table 1), underscores a concerning lack of readiness among the residents of Barangay San Miguel, Tagum City. This low mean value suggests a significant gap in the community's capacity to effectively mitigate the impact of floods, primarily attributed to insufficient access to seminars and training programs. The dearth of both equipment and human resources in the barangay compounds this issue, exacerbating the vulnerability of households to flood-related risks.

This situation highlights the urgent need for increased efforts in providing households with access to educational opportunities, particularly through seminars and training programs related to flood preparedness. The findings align with the research conducted by Reid et

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al. in 2020, which emphasizes the positive impact of knowledge acquisition and skill development on flood preparedness and management in affected communities. The study indicates that communities benefit from training and seminars, as they play a pivotal role in enhancing residents' abilities and knowledge, ultimately reducing vulnerability to floods.

Education through these activities is crucial, as it equips households with the necessary knowledge and skills to effectively prepare for and respond to floods. Survival techniques, a fundamental aspect covered in these educational opportunities, are essential for families in flood-prone areas. The study underscores that when provided with the proper training, families can develop a basic understanding of survival techniques crucial for navigating and surviving floods.

Thus, it becomes imperative for local government units and relevant stakeholders to prioritize and invest in educational initiatives to improve flood preparedness in the area. Addressing the lack of access to seminars and training can empower households with the tools needed to withstand and manage flood events better. This proactive approach aligns with current research and best practices in disaster management, emphasizing the role of education in building resilient communities (Cost, 2015).

Overall, the mean value of households' preparedness level for the flood was high at 3.75, with a standard deviation of 0.67 (Table 1). It indicates that families have a greater capacity to reduce the impact or damage caused by floods. Being prepared helps reduce fear,anxiety, and losses accompanying a disaster such as a flood. The LGU of Barangay San Miguel has emphasized the importance of disaster management to its constituents. Lindell and Perry (2012) pointed out that disaster experience indirectly and directly affects the adoption of hazard adjustment. The authors suggest that the indirect effect is through an increased perceived personal risk. People with disaster experience may be more alert to disaster risks and, therefore, better prepared to avoid possible damages from disaster events than their counterparts. Furthermore, according to Bronfman et al. (2019), having a household preparedness plan is crucial when dealing with natural disasters. This study emphasizes the importance of disaster preparedness and the need for households to be equipped with knowledge and resources to cope effectively with natural disasters such as floods.

Households' utilization of early warning systems

The utilization of households as a response to early warning systems was assessed based on the respondents' perceptions of the identified indicators: localized flood level alert systems, electronic flood warning systems, flyers and leaflets, and direct communication systems like providing announcements to the community. The results of each indicator were presented and discussed comprehensively below.

Table 1. Household preparedness according to the identified indicators.

Indicators	Mean	Standard deviation	Interpretation
First-aid kit	3.57	1.18	High
Evacuation plan	4.73	0.59	Very high
Food supply	3.95	0.89	High
Seminars and training	2.04	1.50	Very low
Weight	3.75	0.67	High

They localized floodwater warning systems. Implementing a graduated and localized floodwater warning system in Barangay San Miguel has proven to be highly effective in enabling residents to gauge the severity of flooding and take necessary precautions. This system, which includes graduated measures and corresponding marks on the base structures of a bridge, is initiated by local officials in partnership with local government offices such as the City Disaster Risk Reduction and Management Office (CDRRMO) and the City Engineering Office. This system provides a tangible and accessible method for residents to assess the flood levels, especially during rainy seasons and extreme weather events, and make informed decisions. The cornerstone of any flood monitoring system, the water level gauge provides crucial information about the water stage or floodwater height in a river, alerting authorities about imminent flooding (Athirah et al. 2020).

The community's strong response to the localized floodwater warning system is evident from the high mean value of 4.37 and the standard deviation of 0.78 recorded in Table 2. The data indicate a positive and consistent perception among the residents regarding the effectiveness and value of the system. The high mean value suggests that the community recognizes the system's importance in managing flood impacts, while the low standard deviation implies a consensus among the respondents.

Early warning systems, such as floodwater warnings, enhance community resilience and reduce flood-related risks. By providing residents with timely and accurate information about flood levels, the system empowers them to take necessary precautions and make informed decisions regarding their safety and the protection of their households. The installation of the flood level alert system by the LGU has been instrumental in enabling residents to effectively manage the impact of floods within their families and receive timely evacuation warnings. This proactive approach by the LGU demonstrates its commitment to the safety and well-being of the community. It highlights the importance of investing in early warning systems and effective communication channels to ensure that residents are adequately prepared and respond appropriately during flood events.

Electronic floodwater warning system. The installation of an electronic floodwater warning system by the Provincial Disaster Risk Reduction and Management Office (PDRMO) has been positively received by the community in Barangay San Miguel. The system's effectiveness is evidenced by the high mean value of 4.38 and a standard deviation of 0.64, indicating a consistent and favorable perception among residents (Table 2). This system provides real-time information on weather forecasts and river water levels, enabling timely preparedness measures. To ensure effective communication, the provincial government of Davao del Norte activelyshares updates from the warning system through a local T.V. channel, radio station, and their official Facebook page. Additionally, the system utilizes a color-coded system that aids in identifying the severity and risk levels of floods. This feature significantly contributes to the community's preparedness and response capabilities, allowing them to be well-prepared for potential flood events.

The effectiveness of electronic floodwater warning systems, similar to the one implemented in Barangay San Miguel, is supported by Subramaniam et al. (2010), who demonstrated the efficiency of Flood Observatory Systems (FOS) in monitoring flood-prone areas within communities. FOS implementation reduces the reliance on costly flood mitigation plans and aids flood victims effectively. The installation of this electronic flood alert warning system exemplifies the commitment of the provincial disaster risk reduction and management office to

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prioritize the safety and well-being of the community. Providing valuable real-time information empowers residents to take necessary precautions and respond appropriately to flood risks. However, it is crucial to continuously improve and maintain the system to ensure its effectiveness in adapting to changing weather patterns and other environmental challenges that may arise.

Flyer and leaflets. The use of flyers and leaflets as an early warning system for floods has a low level of response from households, as indicated by the mean value of 2.06 and a standard deviation of 1.47 in Table 2. However, it is essential to note that officials from Barangay San Miguel do not use this method due to a lack of resources. Despite the low response rate, flyers and leaflets are essential in raising awareness about the dangers of natural disasters, including floods, and providing recommended actions for the public. Flyers and leaflets are an effective way to communicate with the public and improve their preparedness for potential floods. In this regard, Glantz (2009) emphasized the importance of early warning systems in informing and motivating governments, media, social media, newspapers, and affected people to take action and respond to the warning.

These early warning systems can help to reduce the impacts of disasters, minimize loss of life and property damage, and facilitate recovery efforts. In light of this, Barangay San Miguel officials should consider using flyers and leaflets to raise awareness and improve the community's preparedness for potential floods. It may require seeking additional resources or collaborating with other organizations to ensure the necessary information reaches households effectively. Moreover, regular evaluations of the effectiveness of these materials help identify areas for improvement and ensure that they remain relevant to the community's needs.

Direct communication. The level of response of households to the local government unitn(LGU) flood announcements is very high, with a mean of 4.36 and a standard deviation of 0.63, as shown in Table 2. The proactive approach of the Barangay in providing announcements to its residents ensures that they are prepared for any flood situation. Installing early warning signs in flood-prone areas makes residents aware of the risks present while deploying personnel to disseminate information and monitor nearby rivers during heavy rain or the rainy season, further enhancing the effectiveness of the risk communication system. Tanaka (2005) emphasizes that providing education and targeted information to the community helps residents make informed decisions and take appropriate action to protect themselves and their property.

The noteworthy level of responsiveness households in Barangay San Miguel exhibited to the flood announcements made by the local government unit (LGU) signals the effectiveness of the current risk communication system. The direct communication channels have engaged the community and prompted swift action in response to flood-related information. However, the effectiveness of any communication system is contingent upon its adaptability and responsiveness to evolving circumstances. Therefore, officials should maintain a proactive stance by continuously evaluating and refining the existing system.

One improvement avenue could involve exploring and integrating new technologies and approaches in risk communication. For instance, leveraging mobile phone alerts or implementing social media campaigns could enhance the reach and immediacy of flood-related information dissemination. These modern communication channels have the potential to rapidly inform a larger segment of the population, aiding in timely evacuation and preparedness

efforts. Additionally, incorporating resident feedback should be a fundamental aspect of the evaluation process. Soliciting input from the community enables officials to identify specific areas for enhancement, ensuring that the communication system remains pertinent and effective.

Moreover, investing in the education of communities and local officials on flood risk communication is paramount. This educational initiative should focus on imparting the necessary knowledge and skills to effectively comprehend, interpret, and disseminate risk information. By enhancing the understanding of the community and local leaders, the reliability and validity of the communicated information can be assured (Feldman et al. 2016). This educational effort should also emphasize the importance of proper dissemination methods to guarantee that critical information reaches the intended audience comprehensibly.

The LGU's efforts to provide various forms of flood early warning systems have been recognized by households, as evidenced by the moderate level of response with a mean value of 3.04 and a standard deviation of 0.44 (Table 2). Early warning systems are critical in providing decision-makers and end-users with timely and essential information on specific phenomena, enabling effective responses. Basher (2006) emphasizes the importance of early warning systems in reducing the impact of disasters on affected communities. Routine monitoring and broadcast real-time updates on water level changes through various platforms, such as websites and television,can effectively disseminate information and improve preparedness.

CONCLUSION

In conclusion, the study assesses household preparedness for flooding in Barangay San Miguel, Tagum City, across various indicators such as the presence of a first aid kit, evacuation plan, food supply, and participation in training and seminars. The findings reveal commendable levels of preparedness regarding first aid kits, evacuation plans, and food supply, showcasing the community's commitment to safety despite financial constraints. However, a significant gap is identified in seminars and training, indicating the need for increased educational initiatives to effectively enhance the community's ability to mitigate flood impacts.

The study also evaluates the effectiveness of early warning systems in the barangay, including localized floodwater warning systems, electronic flood alerts, flyers and leaflets, and direct communication. The community's positive response to localized and electronic systems underscores their value in enhancing resilience and reducing flood-related risks. However, the low effectiveness of flyers and leaflets, attributed to resource limitations, suggests a potential area for improvement in raising awareness. The high responsiveness to direct communication indicates the success of the current risk communication system. Still, it emphasizes the need for continuous adaptation and incorporation of modern technologies to enhance outreach and effectiveness.

Table 2. Utilization of the community of early warning systems.

Early warning types	Mean	Standard Deviation	Interpretation
Localized floodwater warning system	4.37	0.78	Very High
Electronic floodwater warning system	4.38	0.64	Very High
Flyer and leaflets	2.06	1.47	Low
Direct communication/announcements	4.36	0.63	Very High
Weight	3.04	0.44	Moderate

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In moving forward, local government units and stakeholders must prioritize and invest in educational initiatives to improve flood preparedness. Additionally, efforts should be directed toward addressing resource limitations to enhance the effectiveness of awareness campaigns through methods like flyers and leaflets. The study emphasizes the importance of continuous evaluation and adaptation of early warning systems, incorporating resident feedback, and investing in the education of communities and local officials to ensure the reliability and effectiveness of flood risk communication. By adopting a proactive approach and fostering collaboration, Barangay San Miguel can strengthen its resilience and preparedness in the face of potential flood-related challenges.

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Competing interests

The authors declare no conflict of interest.

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