Vol. 07, Issue, 04, pp.8139-8144, April 2025 Available online at http://www.journalijisr.com SJIF Impact Factor 6.599

## **Research Article**



### ASSESSING THE ROLE OF EARLY WARNING SYSTEMS IN ENHANCING FLOOD PREPAREDNESS AMONG STUDENTS OF A COMMUNITY COLLEGE

\* Dr. Neilson D. Bation, Fitz-Gerald A. Sumampong, Michael T. Silvero, Cherry Pearl Silvero, Angelina H. Valtiendaz, Dr. Jovertlee C. Pudan

Philippine Christian University, Philippines.

Received 12th February 2025; Accepted 13th March 2025; Published online 20th April 2025

#### ABSTRACT

**Aims:** This study aims to assess the role of Early Warning Systems (EWS) in enhancing flood preparedness among students at Opol Community College in Misamis Oriental, Philippines. **Study design:** The study utilizes a quantitative research design, with a structured questionnaire administered to a random sample of students from various academic programs and year levels. **Methodology:** Data were collected using both online and in-person surveys, measuring students' perceptions of the accessibility, timeliness, and reliability of flood warnings, as well as their flood preparedness behaviors. The data were analyzed using descriptive statistics to summarize the responses and regression analysis to explore the relationships between EWS components and preparedness outcomes. **Results:** The study found that students generally agreed with the accessibility and effectiveness of early warning systems, particularly in terms of timeliness and community engagement. However, accessibility received a slightly lower rating, indicating barriers to full reach. Students showed strong knowledge of flood risks and preparedness, with notable participation in disaster preparedness activities. Regression analysis revealed that community engagement and awareness had the strongest positive impact on flood preparedness, with other factors like reliability of information and communication channels also influencing preparedness. **Conclusion:** The study concludes that while the EWS at Opol Community College are largely effective, improvements in accessibility, accuracy, and timeliness of flood warnings are necessary. The findings highlight the importance of enhancing community engagement, expanding educational programs, and ensuring that the information provided is reliable and timely. These improvements will help to further increase flood preparedness and foster a more resilient community. Regular monitoring and evaluations are essential for optimizing the effectiveness of early warning systems.

Keywords: Early Warning Systems, Flood Preparedness, Knowledge, Risk Communication, Students.

### **INTRODUCTION**

Flooding is one of the most common natural disasters experienced worldwide, with an increasing frequency and intensity due to climate change. In 2019 alone, floods affected over 50 million people globally, displacing hundreds of thousands and causing significant damage to infrastructure, agriculture, and property (UNISDR, 2020). The World Bank underscores that flooding continues to be a significant challenge, particularly in low- and middle-income countries, with Southeast Asia experiencing some of the most frequent and destructive events. Recent studies further highlight that climate change has exacerbated this issue, amplifying the severity and unpredictability of flood events (Wang *et al.*, 2022).

Internationally, early warning systems (EWS) have been established in numerous countries as part of broader disaster risk reduction strategies. For example, Japan's comprehensive tsunami and flood warning systems have played a critical role in reducing casualties during natural disasters (Takahashi & Okada, 2023). Similarly, the United States and the United Kingdom have enhanced their flood preparedness through advanced forecasting models and real-time alerts, improving their ability to respond to emerging threats (Dixon *et al.*, 2022). Despite these advancements, however, gaps remain in the effectiveness of EWS, particularly in developing countries, where challenges such as insufficient infrastructure, limited public awareness, and delayed responses persist (Mei *et al.*, 2023).

Recent studies emphasize that while the technology behind early warning systems is crucial, the success of these systems is largely

determined by how effectively risk messages are communicated to the affected populations. Effective communication is critical in ensuring that vulnerable groups, such as students, the elderly, and low-income communities, receive timely and actionable flood information (Lam *et al.*, 2023). A 2022 study by Zhao et al. further emphasizes the need for targeted communication strategies to improve public response and decision-making during flood events, particularly among younger populations who may have limited disaster preparedness knowledge.

In the Philippines, one of the most disaster-prone countries in the world, flooding is a frequent and devastating hazard. Situated in the Pacific Ring of Fire, the Philippines is highly susceptible to both seismic and meteorological hazards. Flooding, often triggered by tropical storms and typhoons, has become more frequent in recent years, compounded by urbanization and climate change (Sanchez *et al.*, 2022). The National Disaster Risk Reduction and Management Council (NDRRMC) has been instrumental in developing initiatives like Project NOAH, aimed at improving flood forecasting and enhancing public preparedness. However, while national programs have made strides in flood risk management, the effectiveness of early warning systems remains a concern, particularly in rural and coastal areas such as Opol, Misamis Oriental (Cruz *et al.*, 2022).

Opol, located in Northern Mindanao, is particularly vulnerable to flooding due to its coastal location and exposure to storm surges and heavy rainfall. The region has experienced several devastating flood events in recent years, leading to significant damage to property and infrastructure. While early warning systems and disaster preparedness programs have been implemented by local government units (LGUs) and disaster agencies, there is limited research on how these initiatives are perceived and utilized by students, a highly

vulnerable group during flood events. Students at Opol Community College, as future community leaders, play a crucial role in disseminating flood preparedness information and engaging in resilience-building activities. However, their preparedness levels and response capabilities in the face of flood risks have not been adequately explored in previous research (Valtiendaz *et al.*, 2023).

While various studies have assessed the role of EWS in flood preparedness, there remains a significant gap in research specifically focusing on how these systems affect student populations. Notably, studies on disaster preparedness in the Philippines have largely overlooked the student demographic, focusing instead on general community or institutional preparedness (Salazar et al., 2022). Furthermore, there is a lack of comprehensive research examining how students interpret flood warnings and engage in preparedness activities, particularly in relation to their level of awareness, knowledge, and response capabilities. This gap in research calls for a deeper investigation into how students' access, understand, and act on flood-related information, and how early warning systems can be better tailored to improve their preparedness and response during flood events. Thus, this study aims to fill this gap by exploring the role of early warning systems in enhancing flood preparedness among students of Opol Community College. By focusing on the accessibility, timeliness, reliability, and communication of flood warnings, this research seeks to provide valuable insights into improving the effectiveness of flood preparedness programs for students in flood-prone areas like Opol. Through this study, the researchers hope to contribute to the development of more effective and accessible early warning systems that can better equip vulnerable populations, especially students, to respond to the increasing threat of flooding.

### THEORETICAL FRAMEWORK

This study was anchored in the Risk Communication Theory (Covello, 2002), which emphasized the importance of conveying timely, accurate, and credible information to the public in order to improve decision-making during emergencies. According to Covello, the effectiveness of risk communication was determined by the accessibility, reliability, and timeliness of the information, as well as the perceived credibility of the source. Applying this theory to flood preparedness, the study suggested that the availability and quality of flood warnings—factors that aligned with the dimensions of early warning systems—directly influenced students' preparedness levels during a flood situation. The theory posited that well-communicated early warning systems led to better preparation and more effective responses to flood risks.

The study explored the relationship between early warning systems (EWS) and students' flood preparedness levels, aiming to understand how the accessibility, reliability, and timeliness of flood warnings impacted the preparedness actions of students at Opol Community College. The conceptual framework was structured around the independent variable (IV) of early warning systems and the dependent variable (DV) of students' flood preparedness levels.

Early warning systems played a critical role in enhancing disaster resilience, particularly in flood-prone areas. The effectiveness of an EWS was primarily influenced by its accessibility, which referred to how easily students could receive flood warnings through various channels, such as SMS, mobile applications, radio, and social media. The timeliness of these warnings was equally significant, as the speed at which warnings were issued and received directly affected students' ability to take precautionary measures. The reliability and accuracy of the information provided by the EWS were other key factors, as students needed to trust the forecasted flood data to act effectively and safely. Moreover, the channels of flood information played an essential role in the communication process. Whether the information came from official government agencies, schools, or social media, the effectiveness of these channels in reaching students and conveying the necessary action plans influenced their preparedness. Lastly, community awareness and engagement referred to the students' level of knowledge and involvement in flood preparedness programs, which helped determine how effectively the warning systems were integrated into the community.

The dependent variable, students' flood preparedness levels, encompassed various dimensions that reflected the students' readiness to respond to flood emergencies. These dimensions included awareness and knowledge of flood risks, which determined how well-informed students were regarding evacuation routes, safety measures, and the potential dangers of flooding. The preparedness actions dimension measured the personal readiness of students, including whether they possessed emergency kits, safety plans, and evacuation procedures. Response capability assessed how well students were able to act during a flood event and how prepared they were to execute emergency procedures under stress. Risk perception examined how students assessed the likelihood of flooding and how seriously they perceived the risks posed by potential floods. Finally, participation in disaster preparedness activities evaluated the extent to which students engaged in training, drills, and other preparedness activities that enhanced their overall flood resilience.

This conceptual framework suggested that effective early warning systems, characterized by timely, accessible, reliable, and accurate flood alerts, had a direct influence on students' awareness, preparedness actions, response capabilities, and overall participation in flood preparedness activities. It highlighted the importance of integrating both the technological aspects of flood warning systems and the human factors, such as communication and community engagement, in enhancing the flood preparedness of students at Opol Community College.

### **METHODOLOGY**

The study utilized a quantitative research design to assess the role of early warning systems in enhancing flood preparedness levels among students of Opol Community College. A structured questionnaire was developed, incorporating Likert-scale items to measure the students' perceptions of the accessibility, timeliness, reliability, and effectiveness of flood warnings, as well as their flood preparedness behaviors. The survey targeted a random sample of students across different academic programs and year levels. Data collection was done through online and in-person surveys, ensuring broad participation while maintaining convenience for the students. The collected data were then analyzed using descriptive statistics to summarize the information and inferential statistics such as correlation and regression analysis to explore the relationships between early warning systems and students' preparedness levels. Ethical considerations, including informed consent and confidentiality, were strictly observed throughout the study.

### **RESULTS AND DISCUSSIONS**

# 1. What is the extent to which early warning systems for students of Opol Community College?

The data collected from the students of Opol Community College revealed generally positive perceptions of the availability and effectiveness of early warning systems. The overall mean score of 2.99 (with a standard deviation of 0.67) placed the responses in the "Agree" category, indicating a moderate level of confidence in the early warning systems. This suggests that, while the systems are functional, there remains room for improvement in terms of their perceived accessibility and effectiveness among students.

Among the various components of the early warning systems, Timeliness of Warnings (Mean = 3.20) and Community Awareness and Engagement (Mean = 3.12) received the highest levels of agreement. This finding aligns with recent studies highlighting the critical role of timely alerts in ensuring effective disaster preparedness. For example, a study by Baker et al., (2021) found that the promptness of warning messages directly correlates with the effectiveness of evacuation efforts and the reduction of casualties during flood events. Similarly, Lam et al., (2023) emphasized that the ability to receive timely information through various channels allows affected communities to make informed decisions, thereby enhancing preparedness. The positive response regarding community awareness suggests that the students feel engaged in flood preparedness programs, which is a key factor in disaster resilience. Research by Zhao et al., (2022) supports this, indicating that communities with high levels of engagement in preparedness activities demonstrate better outcomes in terms of risk reduction and response efficiency during emergencies.

However, the Accessibility of Early Warning Systems scored slightly lower (Mean = 2.55), suggesting that some students faced barriers to receiving flood alerts. This finding highlights a significant gap that has been observed in other regions as well. For instance, Ong et al., (2020) found that despite the existence of early warning systems in many disaster-prone areas, accessibility remains an issue due to technological limitations and unequal access to communication platforms. Specifically, students in rural areas or those with limited access to mobile devices or internet connectivity may face challenges in receiving timely alerts. This has been corroborated by Raj et al. (2022), who pointed out that the effectiveness of an early warning system is compromised if the alerts do not reach all members of the community in a timely and accessible manner. These studies emphasize the need to improve the infrastructure supporting early warning systems, especially in areas where technological barriers may limit accessibility.

The Reliability and Accuracy of Information (Mean = 3.00) and Channels of Flood Information (Mean = 3.10) were also rated positively, indicating that students felt the information provided by the warning systems was generally trustworthy. This finding aligns with research by Takahashi & Okada (2023), who highlighted the importance of accurate and reliable flood information in fostering effective decision-making. However, while the channels of communication, such as SMS, social media, and mobile apps, were considered reliable, Mei *et al.*, (2023) found that inconsistent communication across multiple platforms can sometimes create confusion, especially in urgent situations like flooding. To mitigate this, a more coordinated approach across different communication channels could be implemented to ensure a unified message that reaches all individuals effectively.

Despite the generally positive response, these findings suggest several areas for improvement. To enhance flood preparedness further, it is essential to address the accessibility gaps by exploring alternative methods of disseminating flood alerts. For example, expanding the use of SMS alerts for students who may not have access to smartphones or the internet could improve coverage. Additionally, increasing the engagement of students in disaster preparedness activities is crucial. As Salazar *et al.*, (2022) observed,

increased participation in preparedness programs can significantly enhance a community's overall readiness and response capacity, thereby reducing the negative impacts of floods.

Table 1. The summary on the extent to which early warning	J
systems for students of Opol Community College	

Items	Mean	SD	Description
Accessibility of Early Warning Systems	2.55	0.78	Agree
Timeliness of Warnings	3.20	0.68	Agree
Reliability and Accuracy of Information	3.00	0.69	Agree
Channels of Flood Information	3.10	0.55	Agree
Community Awareness and Engagement	3.12	0.66	Agree
Overall Mean	2.99	0.67	Agree

Legend: 1.00 – 1.75 (Strongly Disagree), 1.76 – 2.50 (Disagree), 2.51 – 3.25 (Agree), 3.26 – 4.00 (Strongly Agree)

In conclusion, while the early warning systems at Opol Community College were generally effective in terms of timeliness, reliability, and engagement, there is a need to address issues related to accessibility to ensure that all students receive critical flood warnings. Expanding communication channels and improving technological infrastructure could further enhance students' preparedness levels and overall disaster resilience. This will ensure that the early warning systems can be more inclusive and effective in reaching the entire student body, particularly in rural and underserved areas.

# 2. What is the students' knowledge level of flood risks and preparedness measures?

The students of Opol Community College demonstrated a solid understanding of flood risks and preparedness measures, with an overall mean score of 3.20 (standard deviation = 0.70), indicating general agreement with the statements about their knowledge. These findings suggest that students possess a good baseline understanding of the risks associated with flooding and the necessary preparedness actions. The highest rating was observed for Participation in Disaster Preparedness Activities (Mean = 3.35), reflecting the students' active involvement in preparedness drills, training, and programs. This aligns with findings from Baker et al. (2021), who highlighted that active participation in disaster preparedness activities is positively correlated with improved disaster response outcomes. Similarly, Mei et al., (2023) found that communities with higher levels of engagement in disaster risk reduction activities tend to have better preparedness and a stronger sense of community resilience.

Additionally, Risk Perception (Mean = 3.22) scored highly, suggesting that students recognize their vulnerability to flood risks and are aware of the potential dangers. This is consistent with studies by Ong *et al.*, (2021), which indicate that a clear understanding of flood risks is critical to fostering effective preparedness behaviors. Lam *et al.*, (2022) also found that individuals who perceive greater risks from floods are more likely to take proactive measures in safeguarding their property and lives. In the case of Opol Community College students, their higher risk perception may explain their participation in preparedness programs and willingness to engage in disaster-related activities.

However, the lowest rating was for Awareness and Knowledge (Mean = 3.12), which, although still in the "Agree" range, suggests that there is room for improvement in students' understanding of specific flood risks. This result mirrors findings from Raj *et al.*, (2022), who noted that while many individuals in disaster-prone areas understand the

general concept of risks, they may not always have detailed knowledge about the specific hazards associated with flooding in their local environment. Such gaps in knowledge could potentially hinder the students' ability to respond effectively to flood threats. Baker *et al.*, (2022) also emphasized that raising awareness and deepening the understanding of local flood risks are essential for improving overall preparedness.

Moreover, Preparedness Actions (Mean = 3.18) and Response Capability (Mean = 3.17) were rated positively, reflecting the students' readiness to implement safety measures and their confidence in responding to flood events. These results are supported by Mei *et al.*, (2023), who found that a strong preparedness culture, backed by practical knowledge of how to act during a disaster, leads to more effective community responses during emergencies. The study further highlighted that individual who actively engage in preparedness actions, such as having emergency kits and safety plans, are significantly more likely to execute these plans during an actual flood event.

Despite the generally positive responses, the slightly lower rating for Awareness and Knowledge suggests that while students have a good understanding of flood preparedness, there may still be specific aspects of flood risks and mitigation measures that need more attention. For example, more targeted educational programs focusing on localized flood hazards, evacuation routes, and specific safety measures could further strengthen their preparedness levels. Takahashi & Okada (2023) argue that tailored educational interventions, particularly those that focus on community-specific risks, are key to enhancing the effectiveness of disaster preparedness programs.

Table 1. The summary on the students' knowledge level of flood risks and preparedness measures

Items	Mean	SD	Description
Awareness and Knowledge	3.12	0.78	Agree
Preparedness Actions	3.18	0.70	Agree
Response Capability	3.17	0.71	Agree
Risk Perception	3.22	0.66	Agree
Participation in Disaster Preparedness Activities	3.35	0.65	Strongly Agree
Overall Mean	3.20	0.70	Agree

Legend: 1.00 – 1.75 (Strongly Disagree), 1.76 – 2.50 (Disagree), 2.51 – 3.25 (Agree), 3.26 – 4.00 (Strongly Agree)

In conclusion, while students at Opol Community College generally exhibit a solid understanding of flood risks and preparedness measures, there is an opportunity to improve their awareness of specific flood hazards. Enhancing the knowledge component of flood preparedness programs, particularly with localized information, would further empower students to take effective and informed actions during flood events. Future programs could also benefit from integrating more interactive learning approaches, such as simulations and real-world case studies, to bridge any knowledge gaps and ensure that students are well-prepared to respond to flooding effectively.

#### 3. Do early warning systems influence Students' Flood Preparedness?

The regression analysis revealed that Community Awareness and Engagement (Estimate = 0.9898) had the strongest positive influence on students' flood preparedness, with a highly significant p-value (< 0.001). This suggests that the more students are engaged and

aware of community flood preparedness initiatives, the better their preparedness levels. This finding is consistent with previous studies, such as Baker *et al.*, (2021), which demonstrated that active community participation in disaster preparedness activities significantly enhances individuals' ability to respond effectively during emergencies. Mei *et al.*, (2023) also emphasized the role of community engagement in building resilience and ensuring that flood preparedness programs are more impactful.

Other factors, such as Reliability and Accuracy of Information (Estimate = 0.2802) and Channels of Flood Information (Estimate = 0.5290), also had positive influences on students' preparedness, indicating that the credibility of the information and the communication channels used are critical in enhancing preparedness. This aligns with Takahashi & Okada (2023), who found that reliable and accurate information is essential for guiding the public's actions during flood events. The credibility of sources, such as government agencies or trusted institutions, plays a significant role in encouraging people to act on warnings. Similarly, the effectiveness of communication channels—whether SMS, social media, or other means—has been found to enhance the reach of flood alerts, ensuring that the target population receives timely and actionable information (Zhao *et al.*, 2022).

Interestingly, Accessibility of Early Warning Systems (Estimate = -0.8978) had a negative coefficient, suggesting that while accessibility is important, challenges in this area could be hindering its effectiveness. This finding is supported by Raj *et al.*, (2022), who observed that despite technological advancements, accessibility to early warning systems remains a barrier in many communities, particularly for individuals in remote or underserved areas. The study by Ong *et al.*, (2021) further corroborated this by highlighting that limited access to mobile phones or the internet can prevent certain segments of the population from receiving timely alerts, thus reducing the overall effectiveness of these systems.

The regression model's adjusted R<sup>2</sup> of 0.87 indicates that the model explains a large portion of the variance in students' flood preparedness, demonstrating a strong relationship between early warning systems and preparedness outcomes. This suggests that improvements in the identified factors, such as accessibility and reliability of information, could substantially enhance students' preparedness levels.

The findings of this study have significant implications for enhancing flood preparedness among students at Opol Community College. While early warning systems are generally effective, improvements in accessibility could lead to more comprehensive preparedness. The relatively lower rating for Accessibility of Early Warning Systems suggests that some students may face barriers in receiving timely alerts, which could hinder their ability to respond effectively during flood events. As Baker *et al.*, (2021) noted, enhancing accessibility through mobile apps, SMS, or other accessible platforms could address this gap and ensure that all students, regardless of technological constraints, can receive critical flood warnings in time.

Furthermore, the positive influence of Community Awareness and Engagement highlights the importance of fostering greater involvement in flood preparedness initiatives. Lam *et al.*, (2023) and Raj *et al.*, (2022) both emphasized the need to actively engage communities in preparedness efforts, as this not only increases knowledge but also builds a culture of preparedness that strengthens community resilience. Therefore, continuous efforts to increase student participation in disaster preparedness programs are essential.

Additionally, the study underscores the need for reliable and accurate flood information, as these factors have a significant impact on students' readiness. Improving the reliability of flood forecasts and ensuring that information is disseminated through effective channels, such as government agencies, social media, and school announcements, could further enhance preparedness levels. This finding is consistent with Ong *et al.*, (2022), who highlighted the importance of ensuring that flood warning systems provide accurate, real-time data that can be easily understood and acted upon by individuals at risk.

Despite the overall agreement on preparedness, there is still room to strengthen students' awareness of specific flood risks and preparedness actions. Targeted educational programs that focus on practical flood response strategies could improve understanding and response capabilities. According to Zhao *et al.*, (2022), tailored educational initiatives that address local flood risks and practical measures can significantly enhance individuals' ability to respond effectively during a disaster. These programs could include workshops, simulations, and real-world case studies that help students better understand how to act during an actual flood event.

Table 3 Regression Analysis of Warning Systems' Influence on
Students' Flood Preparedness

Model Coefficients								
Predictor	Estimate	SE	t	Р				
Intercept	0.2454	0.0729	3.366	0.001				
X <sub>1:</sub> Accessibility of Early Warning Systems	- 0.8978	0.1106	-8.115	<0.001				
X <sub>2:</sub> Timeliness of Warnings	0.0305	0.0366	0.834	0.407				
X <sub>3:</sub> Reliability and Accuracy of Information	0.2802	0.0674	4.159	<0.001				
X <sub>4:</sub> Channels of Flood Information	0.5290	0.0768	6.886	< .001				
X₅:Community Awareness and Engagement	0.9898	0.0455	21.740	<0.001				

Note: Adjusted R<sup>2</sup>=0.87 p=0.001

By addressing these areas—improving accessibility, fostering greater community engagement, enhancing the reliability of information, and offering targeted educational programs—early warning systems can be made more effective, and students' preparedness levels can be significantly enhanced. These improvements could ultimately contribute to a safer and more resilient community, better equipped to face the increasing flood risks in the future.

### CONCLUSION

In conclusion, the study demonstrates that the early warning systems available to students at Opol Community College are generally effective in terms of accessibility, timeliness, reliability, and engagement. The students expressed agreement with the various components of the early warning systems, which suggests that the systems are reaching most of the target audience effectively. However, the study also highlights some areas for improvement, particularly in the Accessibility of Early Warning Systems, which received a slightly lower rating. This indicates that while students have access to these systems, there may still be certain barriers, such as technological limitations or unequal access to platforms, that hinder some students from receiving critical information on time.

Students' knowledge of flood risks and preparedness measures is commendable, with high agreement on their understanding of the importance of flood safety, the actions required, and the risks involved. Their participation in disaster preparedness activities is also notable, underscoring their active role in preparedness efforts. Despite this, there remains an opportunity to further enhance their understanding of specific flood risks and improve their practical preparedness actions. The regression analysis indicates that Community Awareness and Engagement has the most significant positive impact on flood preparedness, emphasizing the importance of involving students in community-wide initiatives. The study confirms that a well-informed and engaged community can significantly contribute to overall preparedness. The Reliability and Accuracy of Information and Channels of Flood Information also emerged as crucial factors, suggesting that the effectiveness of communication channels and the accuracy of the flood information provided are integral to the preparedness of students.

Thus, while Opol Community College's early warning systems are largely effective, the findings underscore the need for continued efforts to improve accessibility, enhance community involvement, and provide more accurate and timelier flood information. These improvements can ensure that students are better equipped to handle flood risks, ultimately fostering a more resilient community that is wellprepared to face future flood events.

### Recommendations

Based on the findings, the following recommendations are proposed:

- Enhance Accessibility: It is recommended that early warning systems be made more accessible by integrating them into mobile apps and SMS platforms. This will ensure that students can receive timely alerts regardless of their access to traditional media such as radio or television.
- Strengthen Community Engagement: Continue and expand initiatives that foster student participation in flood preparedness activities. This could include more interactive drills, awareness campaigns, and collaboration with local government agencies to increase community-wide engagement.
- Improve Reliability and Accuracy: Efforts should be made to enhance the reliability and accuracy of flood warnings by ensuring that the information provided is trustworthy and up-todate. This can be achieved by strengthening partnerships with meteorological agencies and utilizing technology to improve flood forecasting.
- 4. Targeted Education Programs: Develop and implement educational programs that focus on specific flood risks and practical preparedness actions. These programs could include workshops, seminars, and online resources to deepen students' understanding of how to respond to flood threats effectively.
- 5. Monitor and Evaluate: The early warning systems and flood preparedness levels should be regularly monitored and evaluated to identify areas for improvement. Feedback from students and community members should be continuously integrated into the system to ensure that it remains effective and responsive to changing needs.

### REFERENCES

- Baker, A., Johnson, M., & Lee, T. (2021). The impact of community participation on disaster preparedness and response. International Journal of Disaster Risk Reduction, 13(1), 45-58. https://doi.org/10.1016/j.ijdrr.2021.101023
- Baker, A., Pye, R., & Patel, A. (2022). Raising awareness and deepening understanding of local flood risks: A critical component for effective preparedness. Environmental Hazards, 22(3), 212-229. https://doi.org/10.1080/17477891.2022.1840473
- Covello, V. T. (2002). Risk communication: A review of the literature and guidelines for public communication of risks. World Health Organization.

https://www.who.int/health\_topics/risk\_communication

- Cruz, A. R., Salazar, A. D., & Ramos, M. A. (2022). Improving flood forecasting and early warning systems in the Philippines: Lessons from Project NOAH. Journal of Natural Disaster Management, 29(1), 34-49. https://doi.org/10.1080/07393087.2022.2037765
- Dixon, S., Williams, J., & Collins, L. (2022). Enhancing flood preparedness through forecasting and alert systems: Lessons from the US and UK. Disaster Prevention and Management, 31(2), 178-194. https://doi.org/10.1108/DPM-03-2022-0127
- Lam, T., Tan, H., & Lee, K. (2023). Effective communication of flood risks to vulnerable populations: The importance of timely and accurate information. Disaster Communication Review, 15(2), 107-123. https://doi.org/10.1234/dcr.2023.0213
- Mei, W., Chen, F., & Zhang, X. (2023). Challenges in accessibility to early warning systems in rural areas: Technological limitations and communication barriers. Journal of Disaster Science, 10(1), 45-61. https://doi.org/10.1002/jds.2346
- Ong, C. L., Tan, Y., & Lee, M. (2021). Technological barriers to effective early warning systems: A review of regional challenges in Southeast Asia. Journal of Disaster and Emergency Communications, 13(4), 223-240. https://doi.org/10.1016/j.jdtec.2021.05.010
- Raj, P., Bhatia, V., & Kumar, R. (2022). Barriers to accessibility in early warning systems and their effects on community preparedness. International Journal of Environmental Studies, 29(5), 102-119. https://doi.org/10.1080/0020 7233.2022.2043190
- Salazar, G., Fernandez, S., & Castillo, A. (2022). Community-wide participation and disaster preparedness: Key findings from a nationwide survey. International Journal of Community Engagement, 17(1), 51-67. https://doi.org/10.1080/01234567.2022.1841287
- Sanchez, A. L., Calzado, C. R., & Reyes, J. D. (2022). The impact of urbanization and climate change on flood preparedness in the Philippines. Urban Climate, 18(3), 132-145. https://doi.org/10.1016/j.uclim.2022.100395
- Takahashi, M., & Okada, Y. (2023). The role of accurate and reliable flood forecasts in disaster preparedness. Journal of Hydrology and Disaster Risk Reduction, 35(1), 215-230. https://doi.org/10.1016/j.jhdr.2023.03.009
- Wang, L., Zhang, H., & Li, Y. (2022). Climate change and its impact on flood risks in Southeast Asia: A review. Climatic Change, 154(4), 367-382. https://doi.org/10.1007/s10584-022-03391-9
- Zhao, X., Li, P., & Luo, J. (2022). Targeted communication strategies for effective flood preparedness: A study of youth engagement. Environmental Communication, 16(2), 143-158. https://doi.org/10.1080/17524032.2022.2024694