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Empowering Indigenous Papuan Communities for Early Flood Emergency Response: A Quasi-Experimental Study in Entrop, Indonesia

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ABSTRACT

Floods are one of the most frequent disasters in Indonesia and have a significant impact on the safety, health, and livelihoods of communities, including in Papua Province. The unique geographic and climatic conditions make this region vulnerable to flooding, necessitating a rapid and appropriate emergency response. Indigenous Papuans possess local wisdom, such as knowledge of natural signs, the value of mutual cooperation, and the role of traditional leaders, which offer significant potential in disaster management. However, this initial response capacity needs to be continuously strengthened to ensure more effective flood emergency management. This study aims to evaluate the effectiveness of empowering indigenous Papuans in improving the initial emergency response to floods in Entrop Village, South Jayapura District. The study used a quasi-experimental design with a one-group pretest-posttest approach. The sample consisted of 41 indigenous Papuans who had experienced flooding, selected using the Slovin formula from a total population of 69. The intervention was conducted through outreach and digital simulations in the form of flood disaster videos. The results showed that the average emergency response score increased from 0.51 in the pretest to 0.73 in the posttest, a difference of 0.22. This increase indicates a significant improvement in the community's ability to recognize flood risks, determine priority actions, and carry out a more appropriate initial response. These findings confirm that empowerment based on the integration of modern disaster knowledge and local wisdom is effective in strengthening the preparedness of indigenous communities as the frontline in handling initial flood disasters in Papua.

INTRODUCTION

On Earth, due to accelerating climate change, the frequency and intensity of climate-related hazards have increased over the past few decades and often result in disasters, especially when events occur with high intensity (Murshed et al. 2023). how the negative impacts of “natural” disasters can be substantial at the local level, even though their impact is negligible at the country level: Consequently, an exclusive focus on the national level prevents a proper assessment of disasters and their impact on local economies, making country-level analyses almost useless. A second important limitation relates to disaster severity: The existing

literature largely addresses this issue by simply dividing events into two distinct groups, namely major and minor events, without explicitly considering the role of graded disaster severity, thus neglecting an important explanatory variable (Marcoberardino and Cucculelli 2024). The major problem is that they occur suddenly and unexpectedly, resulting in loss of life and physical injury, as well as extensive damage and losses in various social, economic, environmental, and infrastructure sectors (Nindy, Ca, and Aeni 2022), thus threatening and disrupting the survival of society due to natural, non-natural, and human-related factors, as well as impacting the safety of life, health, the environment, and the social order (Al et al. 2022) so that the impact can be multidimensional, including death, environmental damage, material losses, and psychological stress, so that etiologically classified into natural and non-natural disasters (Erita, Donny Mahendra 2019) Natural disasters are generated by the dynamics of natural processes, while non-natural disasters are triggered by non-natural factors such as epidemics, disease outbreaks, technological failures, and social conflicts, both of which have a significant impact on people's lives (Danil 2021) Many coastal and riverine communities worldwide are experiencing significant increases in the frequency and severity of flooding (Fanama and Bang 2025).

In July 2021, several European countries were affected by severe flooding affecting several river basins across Europe, causing 221 deaths and widespread damage as the Meuse River reached its highest summer level in over 100 years. The VieCuri Medical Center (VCMC) is located right next to the river, in the city of Venlo, which has a population of 85,000. The rising water levels of the Meuse River led to the decision to evacuate the entire hospital on July 16, 2021 (Barten et al. 2025), and parts of Western Europe, including Germany, Belgium, and the Netherlands, have witnessed the worst flooding in Europe in recorded history, after record-breaking rainfall caused rivers to overflow their banks starting July 13, 2021. With over 200 deaths by July 22 (over 170 in Germany and 32 in Belgium), hundreds of people injured, and many more still unaccounted for, Germany was the country hardest hit by this once-in-a-century flood event. The German states of Rhineland-Palatinate and North Rhine-Westphalia, as well as the Belgian city of Liège, suffered the highest death toll. Fast-moving floodwaters swept away and swept away vehicles, submerged villages, triggered landslides, destroyed water supply and sewerage lines, and left more than 200,000 homes without electricity. Members of the German military were deployed to assist in rescue efforts, assisted by flood rescue teams from France, Italy, and Austria. The European Union activated its Civil Protection Mechanism to support local flood rescue teams, and the German government has announced more than €300 million in aid, although damage is estimated to be in the billions of euros (Chatzistratis et al. 2021). In recent decades, the United States has experienced frequent coastal flooding due to extreme marine events, which have had an increasing impact on natural ecosystems and humans. These floods have caused shoreline changes, biodiversity loss and human mortality, increased health risks and poverty, damage to coastal infrastructure/assets, disruption of key services, and economic losses in New York and New Jersey. Coastal flooding has claimed more lives than flash floods and river floods, damaging coastal cities. Coastal flooding can have significant socioeconomic impacts even on populations not directly affected by flooding, due to the loss of access to essential services such as health, education, transportation, and energy supplies (Chatzistratis et al. 2025). The global climate and the

increasing frequency of extreme weather events have made flooding a significant challenge facing countries worldwide. In the first half of 2024 alone, heavy rainfall and flooding, along with associated geological hazards, affected 14.34 million people in southern China, resulting in 230 deaths or missing persons (Guo et al. 2025). Over the past decade, Indonesia has faced more than 1000 flood events annually, impacting more than 3 million people annually. This alarming frequency is projected to worsen due to the undeniable impacts of climate change (Suwarman et al. 2025) with floods accounting for 43.1% of the total national disaster events by 2022. Mitigation efforts have primarily focused on structural protection, such as the construction of embankments, aimed at reducing the likelihood of flood hazards (Farid et al. 2025). Data from the National Disaster Management Agency in 2025 showed that the number of incidents was 1,116, resulting in 1,498 deaths, 264 missing, 7,751 injured, 10,275,745 people suffering/displaced and the disasters were 15 earthquakes, 8 volcanic eruptions, 1,420 floods, 733 extreme weather events, 207 landslides, 89 droughts, 27 tidal waves/abrasion events throughout Indonesia based on data from January 1 to December 17, 2025. The Indonesian government has taken mitigation measures and flood mitigation studies in several areas have also been carried out, which include the normalization of natural channels, water gates, reservoirs, groundwater storage, and rainwater harvesting systems. However, several previous studies concluded that mitigation cannot reduce the threat of flooding. This is because the influence of flood-causing phenomena has not been included in determining the design parameters used. Similarly, reservoirs are becoming increasingly difficult to select due to the threat of increased flooding due to dam failures and the threat of earthquakes (Isma et al. 2024).

Papua Province, with its geographical conditions consisting of mountains, valleys, and coastal areas, is not immune to the threat of disasters. (Sri Haryani, M Salim 2023). Floods in the Papua region often have serious impacts on the health, safety, and social life of the local community. This condition demands a quick and appropriate response, especially in the early phases of an emergency, to minimize morbidity and mortality (Nur Alzair 2022). Based on disaster data, Papua Province has experienced 14 incidents, namely 10 floods, 3 earthquakes, and 1 landslide. According to (Ariyanti, Azka, and Nur 2025), however, the Indigenous Papuan community has local wisdom that has been passed down from generation to generation in dealing with disaster situations. This local wisdom includes traditional knowledge about natural signs, self-rescue strategies, to the mechanism of mutual cooperation in evacuating and caring for victims (Wandik and Sitorus 2024) The values of solidarity, traditional leadership, and harmonious relationships with nature are important social capital that influences community resilience to disasters. In disaster management, understanding this local wisdom is crucial so that nursing interventions can be adapted to the values, culture, and social systems of the local community. This study focuses on exploring local wisdom regarding flood disaster situations (Hagar Wandik, Yannice L M Sitorus 2024) By understanding these local practices, it is hoped that relevant adaptation patterns and initial handling strategies can be found to be used as a basis for developing a local culture-based disaster response model through empowering the Papuan indigenous community in Entrop Village, South Jayapura District.

METHODS

This study uses a Paired Sample T-Test to assess the response of the Papuan indigenous community when floods come in Entrop. The assessment was conducted twice, namely before and after counseling and videos on how to handle floods were given. The counseling focused on increasing the understanding of the Papuan community in recognizing quick and appropriate responses to flood disasters. Meanwhile, digital simulations in the form of short videos about flood events were used to provide an overview of the priority responses that need to be carried out by indigenous communities in facing flood disasters. The formulation of the hypothesis is as follows: H_0: There is no significant difference in the level of flood emergency response in the Papuan indigenous community in Entrop before and after being given interventions in the form of counseling and digital simulations. H_1: There is a significant difference in the level of flood emergency response in the Papuan indigenous community in Entrop before and after being given interventions in the form of counseling and digital simulations. Calculate the difference in value (d), average, and standard deviation. Determine the calculated t-value, then compare it with the t-table at a significance level of 0.05. If t-count > t-table, then H_0 is rejected (there is a significant difference). If the data is not normally distributed, the Wilcoxon Signed Rank Test is used as a non-parametric alternative. The research location is in Entrop Village, South Jayapura District. This research was conducted for 3 months starting from May 5 to July 5, 2025. The population of the Entrop Village community is 69 people. The sample is indigenous Papuan people who have been affected by flooding for 3 years with ages 20 to 60 years. ever carried out flood evacuation. the calculation until: d = 0.1 (10%). This study examines the response of indigenous Papuans to the flood emergency in Entrop. The population of indigenous Papuans in Entrop is 69 people. The sampling technique used the Slovin Formula, which is used to determine the sample size from a relatively small population with a certain level of error.

The margin of error used in this study is 10% (0.1). Based on the calculations, the sample obtained was 41 people, representing the indigenous Papuan population. Data Collection Technique with Questionnaire in the form of a statement to find out the response of the Papuan indigenous community to the flood emergency in Entrop measurement using a Likert scale: 1-5 (Strongly Disagree, Less Agree, Agree, Strongly Agree).

Pretest conducted measurements first before counseling and exposure to flood disaster videos to the Papuan community in Entrop and Posttest was conducted again after counseling and exposure to flood videos to the indigenous community in Entrop so that the community already knows how to take priority actions when floods in Entrop come suddenly. All data were analyzed using Statistical Package for the Social Sciences (SPSS) software. Specifically, SPSS version 27.0 for Windows (SPSS Inc., Chicago, Illinois, USA) was used for data analysis. Descriptive statistics, including frequencies, percentages, measures of central tendency, measures of dispersion, means, and standard deviations, were used to summarize the data analysis of the pre-test and post-test on indigenous community empowerment related to flooding in Entrop.

RESULTS

Based on respondent characteristics, this study involved 41 indigenous Papuans in the Entrop region. Of these, the majority were male, 24 (54.8%), while 17 were female (41.5%). This composition indicates a slightly greater male participation than female participation in the

study. The question of male respondents can be attributed to their social and cultural roles in indigenous Papuan communities, where men are often directly involved in community decision-making, outdoor activities, and emergency response such as flooding. Meanwhile, women's involvement remains significant and crucial, given their roles in household management, protecting family members, and maintaining health during and after emergencies.

Table 1. Gender of Papuan Indigenous Community Empowerment in the Flood Emergency in Entrop

Gender	n	%
Man	24	58.5
Woman	17	41.5
Total	**41**	**100**

Source: Primary Data, 2025

Table 2. Pre-community empowerment regarding flood emergencies in Entrop (Pre-test)

Readiness of Papuan Indigenous People	n	%
Safety Procedures	11	48.8
Making Decisions During a Flood Emergency	30	51.2
Total	**41**	**100**

Source: Primary Data, 2025

This table illustrates the readiness of indigenous Papuans to face flood emergencies, as measured by 41 respondents. This readiness focused on two main aspects: understanding safety procedures and decision-making skills during flooding. The results show that in terms of safety procedures, 11 respondents (48.8%) demonstrated readiness to understand and implement safety measures during flooding. This reflects that nearly half of indigenous Papuans possess basic knowledge regarding self-rescue and family safety measures when facing flood emergencies. Meanwhile, in terms of decision-making during flood emergencies, 30 respondents (51.2%) demonstrated good preparedness.

Table 3. Community Empowerment Regarding Flood Emergencies in Entrop (Post-Test)

Readiness of Papuan Indigenous People	n	%
Safety Procedures	20	26.8
Making Decisions During A Flood Emergency	21	73.2
Total	**41**	**100**

Source: Primary Data, 2025

Table 3 illustrates the preparedness of indigenous Papuan communities for flood emergencies in Entrop during the post-test phase, following community empowerment interventions. The preparedness assessment focused on two main aspects: understanding safety procedures and decision-making skills during flood emergencies. The results show that, regarding safety procedures, 20 respondents (26.8%) demonstrated readiness to understand and implement flood safety measures. This finding indicates an increase in community

understanding of self-rescue measures after the community empowerment activities, although the percentage is still relatively low compared to other aspects. Meanwhile, regarding decision-making during flood emergencies, 21 respondents (73.2%) demonstrated good preparedness. This percentage is the most dominant, indicating that community empowerment has had a positive impact on the ability of indigenous Papuans to make quick and accurate decisions, such as determining evacuation times, selecting safe locations, and coordinating with family and community members during floods.

Tabel 4. Empowering Papuan Indigenous Communities for Early Flood Emergency Response Improvement Score

Readiness of Papuan Indigenous People	Pre-test	Post-test	*p-Value*
	Mean	Mean	
Safety Procedures	11 (48.8)	20 (26.8)	0,048
Making Decisions During a Flood Emergency	30 (51.2)	21 (73.2)	

*p≤0.05 was considered to be statistically significant
Source: Primary Data (Processed), 2025

Table 4. Empowering Papuan Indigenous Communities for Early Flood Emergency Response Improvement Score shows changes in the level of preparedness of Papuan indigenous communities in responding to flood emergencies in the pre-test and post-test phases of empowerment, with the same number of respondents (n = 41). In the aspect of safety procedures, the average readiness score increased from 11 respondents (48.8%) in the pre-test to 20 respondents (26.8%) in the post-test. This increase reflects an improvement in the understanding and ability of Papuan indigenous communities in implementing early safety procedures when facing flood threats. The mean difference value of 220 and p-value = 0.048 indicate that the change is statistically significant ($p < 0.05$), so it can be concluded that the empowerment program provided has a significant effect on improving community preparedness in the aspect of safety procedures. Meanwhile, in terms of decision-making during a flood emergency, there was an increase in the proportion of preparedness, from 30 respondents (51.2%) in the pre-test to 21 respondents (73.2%) in the post-test. This indicates that after the intervention, Papuan indigenous people became more prepared and more capable of making appropriate and rapid decisions in the early stages of a flood emergency, although the table does not show the mean difference and p-value.

DISCUSSION

We conducted an ITS analysis to determine if there was an improvement after the intervention, which included counseling and video simulations of flood disasters, resulting in a significant increase in responses regarding safety among the Papuan indigenous community in Entrop Village. With a score of 0.51 in the pretest to 0.73 in the posttest, this indicates a change in knowledge and decision-making during flood emergencies. An average difference of 0.22 points indicates that the interventions provided were able to increase community capacity in facing flood disasters. These interventions played a dominant role in shaping improved emergency response, regardless of variations in community initial capabilities. This condition

indicates that community-based education is effective when applied evenly to communities with diverse knowledge backgrounds. The importance of local knowledge and independent preparedness lies in the ability of communities to develop emergency response strategies that are appropriate to their own conditions and experiences. In line with research (Toyoda and Tanwattana 2023) which indicates that the increasing risks and impacts of climate hazards require communities living in disaster-prone areas to collect, document, and systematically compile their Local Disaster Knowledge (LDK). This local knowledge then needs to be integrated with scientific knowledge so that disaster risk management can be carried out more effectively and contextually. By implementing Local Disaster Knowledge, which will generate knowledge about the terrain, natural patterns, and collective memory of previous disaster events, communities can create more contextual and effective emergency plans compared to formal plans that are often general or do not take local conditions into account. (Wight et al. 2025). Local knowledge enables communities to recognize early signs of danger, determine safe evacuation routes, and utilize available resources around them.

Thus, self-preparedness is a strong form of community resilience, born from direct experience and time-tested wisdom (Firman Dwi Cahyo, Farly Ihsan, Roulita, Nunik Wijayanti 2023). Local wisdom is not only a cultural heritage but also an effective and sustainable disaster mitigation strategy. Community-based approaches, such as those implemented in Tempur Village, have been proven to reduce the impact of disasters through a combination of ecological knowledge, social values, and adaptive practices integrated into daily life. However, preserving and integrating local wisdom into broader policies requires a systematic effort from various stakeholders (Ariyanti et al. 2025). In the context of preparedness, this integration must encompass all stages of disaster management—from prevention and mitigation, through emergency response, including the acute and sub-acute phases, to recovery and rehabilitation/reconstruction. Thus, local wisdom can serve as an important foundation in building a sustainable disaster management system based on community strengths (Akbar, Dwiningtias, and Rahmat 2024). One concrete example of implementing these principles is disaster mitigation education activities using a participatory learning approach that emphasizes active participant involvement through interactive methods such as questions and answers and quizzes. This approach makes the learning process more enjoyable, easier to understand, and relevant to the participants' experiences. Evaluation through simple quizzes is used to reinforce understanding, while documentation of the activities demonstrates their enthusiasm and active participation. Overall, these activities reflect the principles of community-based disaster risk reduction (CBDRR), where increasing local capacity through continuous education is an essential foundation for strengthening community preparedness and resilience to disasters.

CONCLUSION

This study shows that empowering Papuan indigenous communities through the integration of local wisdom and modern disaster education significantly improved early flood emergency response in Entrop Village, South Jayapura Regency. The study's objective to evaluate the effectiveness of community empowerment in strengthening early flood response capacity was successfully achieved, as evidenced by a significant improvement in emergency

response scores from the pre-test to the post-test phase. This improvement was particularly evident in decision-making skills during flood emergencies and in understanding safety procedures, indicating that counseling and digital video simulations effectively enhanced community preparedness. These findings contribute to public health and disaster management by reinforcing the importance of culturally rooted, community-based interventions as a key strategy for reducing disaster-related health risks, morbidity, and potential mortality. From a practical perspective, this study provides empirical support for incorporating indigenous knowledge systems into health-oriented disaster preparedness programs. Based on these findings, it is recommended that local governments and health authorities institutionalize a community empowerment model that combines local wisdom with participatory education and digital simulation methods as part of their disaster risk reduction policies. Furthermore, public health practitioners should strengthen collaboration with traditional leaders to increase community trust and the sustainability of interventions. Future research is recommended to use controlled or longitudinal designs, include larger and more diverse Indigenous populations, and examine long-term behavioral and health outcomes to further refine community-based flood response models in disaster-prone areas

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