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Strengthening Coastal Community Resilience through the Tsunami Ready Program in Padang City

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ABSTRACT

This community service program aims to strengthen the resilience of coastal communities in Purus Village, Padang City, a high-risk tsunami red zone, by implementing the UNESCO-IOC Tsunami Ready Community indicators. The project was driven by the urgent need to transform the community's fatalistic perception of disasters into a proactive and prepared mindset. The methodology employed a participatory approach through socialization, Focus Group Discussions, and community-led evacuation mapping, involving various local stakeholders such as the Disaster Preparedness Group and the Tsunami Ready Community forum. The results indicate a significant increase in disaster literacy, with participants' ability to identify early warning signs and evacuation routes rising from 35% to 85%. Furthermore, all 12 Tsunami Ready indicators were successfully addressed, including the development of participatory evacuation routes and the establishment of a localized early warning communication system. This program demonstrates that community-based disaster mitigation, supported by social capital and clear institutional coordination, is essential for building sustainable resilience in vulnerable coastal areas.

Keywords: community-based disaster management, coastal community, community resilience, disaster risk reduction, disaster mitigation, tsunami ready community

INTRODUCTION

Coastal areas, located at the meeting point between land and sea, are attractive places for people to live because they offer many benefits (Mayzarah, E. M., & Batmomolin, P. S. M, 2021). On the other hand, coastal areas also harbor the potential for disasters that can disrupt the lives and livelihoods of the people who live there. Coastal areas are always prone to significant disaster risks (Sharil et al., 2015). Disasters in coastal areas caused by natural hazards often result in serious damage to the environment, society, economy, and livelihoods of communities (Fang et al., 2017). According to Sambah & Miura (2014), coastal areas are subject to frequent changes due to the dynamic interaction between land and sea, human activities, and natural hazards such as tsunamis.

Tsunamis are a series of long waves that can be generated by undersea earthquakes, landslides, volcanic eruptions, meteorological events, and asteroids, which can have a devastating impact on coastal communities (Løvholt et al., 2015). Tsunamis can cause widespread damage to coastal areas, as illustrated by the 2004 Indian Ocean tsunami and the 2011 Tohoku tsunami (Harnantyari et al., 2020). The number of casualties and damage

caused by tsunamis can increase over time due to population growth, migration to coastal areas, and the concentration of development in coastal areas. The city of Padang, as the capital of West Sumatra Province, is one of the cities with a very high level of tsunami disaster vulnerability in Indonesia. Geographically, the coastal area of Padang is directly adjacent to the Mentawai subduction zone, which is the main source of megathrust earthquakes and tsunami threats (BMKG, 2022). History records that several major tsunamis have struck this region, such as the tsunamis of 1797 and 1833, which caused severe damage along the west coast of Sumatra (BNPB, 2023).

With a population of more than 900,000, most of the people of Padang City live in densely populated coastal areas with limited access to evacuation routes. This condition puts Padang City in a very vulnerable situation in the event of a tsunami, especially if community preparedness and disaster mitigation systems are not functioning optimally (Yulianti & Firmansyah, 2022). In response to these challenges, the Padang City Government has adopted the Tsunami Ready Community Program since 2021, in collaboration with UNESCO-IOC and the National Disaster Management Agency (BNPB). This program is implemented in several tsunami-prone villages, such as Purus, Ulak Karang, and Pasir Nan Tigo, with a focus on disaster education, the construction of evacuation routes, and the implementation of community-based evacuation simulations (BPBD Padang, 2023).

The implementation of this program still faces various challenges. Limited regional budgets, lack of cross-sector coordination, and low community participation are significant obstacles in efforts to build community resilience. Some communities still have a fatalistic perception of disasters, viewing them as inevitable fate, so mitigation programs receive little active response (Purwanto & Sulistyowati, 2020). The success of building community resilience is not only determined by the existence of formal programs from the government or international institutions, but also depends heavily on the social capital possessed by the community itself, such as trust, social networks, and norms of mutual cooperation (Aldrich & Meyer, 2015). In the context of Padang City, local wisdom values such as “badoncek” (Minangkabau tradition of mutual cooperation) can be a strategic potential in strengthening community resilience to disasters, but its utilization is still not optimal in formal policies.

However, efforts to build a tsunami-resilient community in Padang City still face various structural obstacles, such as a lack of local government funding for preparedness programs, low disaster literacy among the community, and weak political will from local policymakers (Yulianti & Firmansyah, 2022). Therefore, it is important to conduct a comprehensive study on how the Tsunami Ready Community Program is implemented, the factors that influence its success, and how multi-actor collaboration models can be optimized to strengthen the resilience of the coastal communities of Padang City, especially in Purus Village. Purus Village, located in West Padang District, is one of the coastal areas of Padang City that is highly vulnerable to tsunami disasters. Based on the tsunami hazard map issued by BNPB and BPBD West Sumatra, this area is in the red zone with the potential to be affected by waves within less than 30 minutes after a major earthquake occurs in the Mentawai-Siberut subduction zone. The geographical condition of Purus, which faces the Indian Ocean directly, makes it one of the first points to be affected if a tsunami occurs.

In addition to geographical factors, Purus Village has a fairly high population density, with most settlements located at an altitude of 0-5 meters above sea level. This density increases the risk of casualties and material losses, especially if the early warning system and evacuation routes are not yet optimal. Although Purus Village is a priority area for mitigation, supporting facilities for preparedness, such as adequate evacuation routes, clear assembly points, first aid equipment, and emergency response training for the community, are still limited. However, this area also serves as a center for economic and tourism

activities, particularly in the culinary and beach tourism sectors, which are visited daily by local and foreign tourists. In the event of a disaster, the impact will not only be felt by the local community but will also affect the city's economy more broadly.

On the other hand, Purus has social potential that can be mobilized for community resilience strengthening programs. The existence of community groups, youth organizations, and active local leaders provides a great opportunity to develop a participatory Tsunami Ready Community program. Based on considerations of risk, vulnerability, and potential support from the local community, Purus Village is considered strategic as a locus for community service in order to increase community resilience to tsunami disasters. However, the implementation of this program still faces various structural obstacles, such as limited regional budgets, weak cross-sector coordination, and a prevailing fatalistic perception among residents. While previous studies have focused on the technical aspects of tsunami modeling or top-down government policies in Padang, there is still a significant research gap regarding how community-based participation and social capital can be operationalized to meet international preparedness standards at the village level.

This is particularly critical in Purus Village, a high-density red zone where low disaster literacy and economic vulnerability hinder sustainable mitigation efforts. To address this gap, this study aims to evaluate the effectiveness of the Tsunami Ready Community program in strengthening community resilience in Purus Village by implementing the 12 UNESCO-IOC indicators through a multi-actor participatory approach. This community service aims to fill this gap by analyzing strategies to strengthen community resilience through the Tsunami Ready Community Program in Padang City, particularly in Purus Village, and evaluating the role of relevant actors in supporting the effectiveness of the program with the aim of increasing the capacity of coastal communities in facing the threat of tsunamis through strengthening community resilience, integrating the Tsunami Ready Community program into education, community activities, and local policies, and encouraging active cross-sector participation in disaster mitigation. The results of this community service are expected to provide policy recommendations based on relevant best practices for strengthening the capacity of other tsunami-prone areas in Indonesia.

METHOD

This community service activity was conducted in Purus Village, Padang Barat District, Padang City. This location was strategically selected due to its position as a high-risk tsunami red zone, directly facing the Mentawai subduction zone (Yulianti & Firmansyah, 2022). This location was strategically selected due to its position as a high-risk tsunami red zone, directly facing the Mentawai subduction zone. The program employed a participatory approach involving a purposive sample of 20 participants, comprising 4 representatives from the Purus Village Government; 10 members of the local Disaster Preparedness Group (KSB); 1 personnel from the Indonesian National Armed Forces (Babinsa) and 5 local residents. This was followed by intensive socialization and education sessions to align the community's perception with the

12 tsunami preparedness indicators established by UNESCO-IOC to foster sustainable community resilience (Bakar Sambah & Miura, 2014).

The implementation method employed a participatory approach through Focus Group Discussions (FGDs). During these sessions, community members were actively encouraged to independently identify evacuation routes and draft local contingency plans using visual aids such as regional maps and flip charts. This strategy prioritized the

strengthening of social capital and managerial capacity over a reliance on physical infrastructure, emphasizing the importance of behavioral awareness in mitigating disaster impacts (Harnantyarini et al., 2020). Through these interactions, the community was guided to transform their mindset from a fatalistic outlook to a proactive stance in facing risks (Aldrich & Meyer, 2015). To provide a clear overview of the program execution, the sequence of activities is illustrated in the following flowchart:

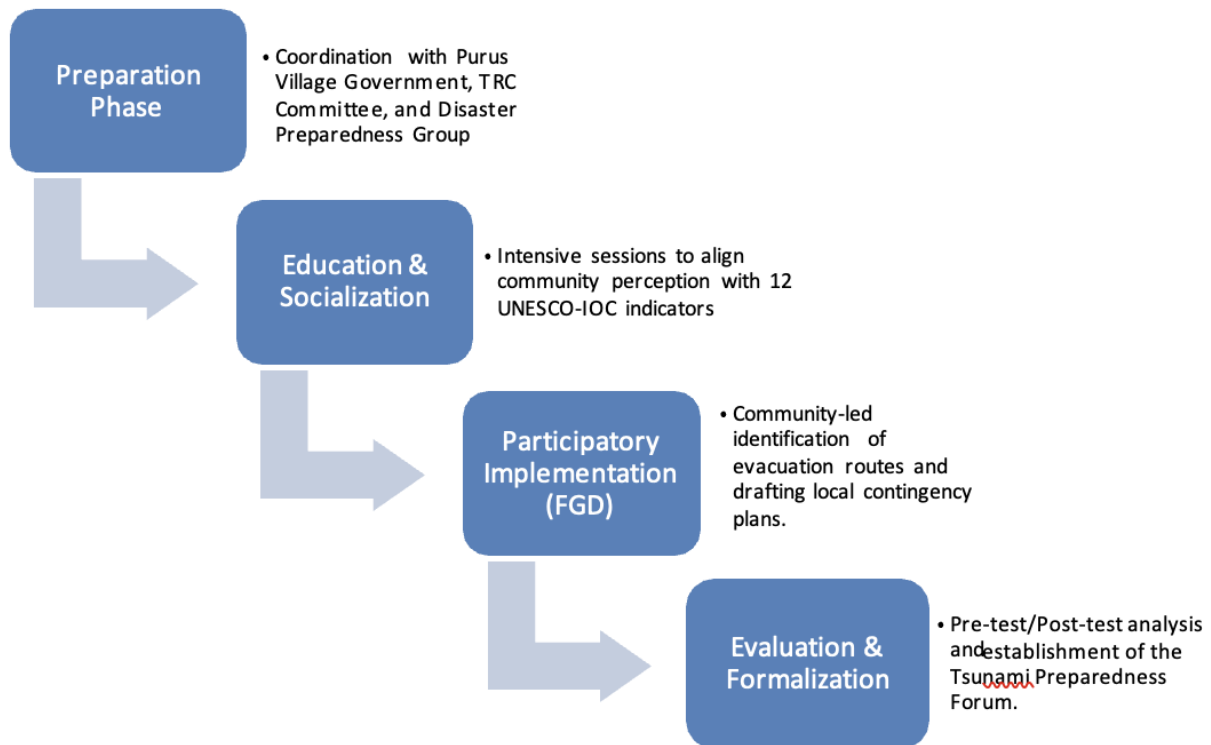


Figure 1. Flowchart of community service activities

Data collection methods included field observations, activity documentation, and the evaluation of community capacity was conducted using pre-test and post-test survey instruments. The instrument consisted of 10 closed-ended questions designed to measure two primary indicators: (1) Disaster Literacy, focusing on the recognition of official tsunami early warning signs, and (2) Evacuation Procedural Knowledge, assessing the ability to identify independent evacuation routes. Each question was measured using a binary scale (Correct/Incorrect) to determine the baseline and post-intervention literacy levels. Additionally, data were obtained through the analysis of group work outputs generated during the FGDs. The data processing and analysis techniques used were descriptive-qualitative and comparative, where the team compared the community's understanding of evacuation procedures and inter-institutional coordination to verify the enhancement of community resilience achieved during the program (Fang et al., 2017).

RESULTS AND DISCUSSION

Implementation of the Tsunami Ready Community Program The program was successfully implemented through a series of participatory activities focusing on the 12 indicators of the UNESCO-IOC Tsunami Ready standards. The initial phase revealed that the community in Purus Village possessed a high level of "fatalistic culture," where disasters were perceived as unavoidable destinies, leading to low motivation for proactive mitigation. However, through intensive education and the revitalization of social capital,

there was a significant shift in community perspective. The implementation of Focus Group Discussions (FGDs) allowed residents to collaboratively map their own vulnerabilities and resources, fostering a sense of ownership over the disaster management plan (Aldrich & Meyer, 2015).

The main achievement of this community service activity was a change in community behavior from a fatalistic attitude to a proactive one. Based on the final evaluation, residents' disaster literacy increased rapidly, particularly in understanding the early warning system and identifying independent evacuation routes. The data shows that intensive educational interventions have succeeded in changing the perception of the tsunami threat from something that was previously considered an inevitable fate to a risk that can be mitigated through planned preparedness.

The community service activities were centered at the Purus Village Office. The program involved a total of 20 participants, representing a multi-actor collaboration across different levels of the community. The participant composition consisted of 4 representatives from the Purus Village Government; 10 members of the local Disaster Preparedness Group (KSB); 1 personnel from the Indonesian National Armed Forces (Babinsa) as a security and coordination element and 5 local residents of Purus Village. To measure the effectiveness of the intervention, pre-test and post-test evaluations were administered to the participants using survey instruments before and after the socialization and Focus Group Discussion (FGD) sessions. These evaluations focused on assessing disaster literacy, specifically the community's understanding of official tsunami early warning signs and independent evacuation procedures.

Table 1 Comparison of community capacity before and after the program

Achievement Indicators	Initial Conditions (Pre-Test)	Final Conditions (Post-Test)	Description
Disaster Literacy	Low (Fatalistic)	High (Proactive)	Increased risk awareness
Understanding of Evacuation Routes	Dependent on Officials	Independent	Able to identify quick routes
Inter-agency coordination	Weak/Not harmonious	Solid and integrated	Synergy between KSB, TRC, and Kelurahan
Local Contingency Plan	Not yet available	Drafted	Ready to be formalized in SOP

The results, as summarized in Table 1, show a substantial increase in disaster literacy. Before the intervention, only 35% of participants (7 out of 20) could correctly identify official tsunami early warning signs and designated evacuation routes. Following the program, this figure rose significantly to 85% (17 out of 20). This data confirms that the participatory approach successfully transformed the participants' mindset from a fatalistic perspective to a proactive and prepared mindset. This result of test improvement reflects the transformation of the residents' mindset from a fatalistic attitude where disasters were viewed as unavoidable destinies to a proactive stance rooted in planned preparedness. Furthermore, the participatory nature of the FGDs allowed participants to not only answer surveys but also actively draft local contingency plans and identify specific evacuation routes, as shown in the independent results documented in the post-test phase.

The analysis of program effectiveness shows that focusing on strengthening human resources is more urgent than merely procuring physical infrastructure. The strategic decision to eliminate the installation of physical equipment aims to build independent governance so that the community does not become dependent on technology that requires complex maintenance. Instead, strengthening is focused on revitalizing social

capital and procedural literacy that is more sustainable for coastal zone resilience. The following is documentation of community service activities based on a group of lecturers carried out at the Purus Village Office together with the community:



Figure 2. Documentation of service activities

Figure 1 shows the active participation of multiple actors, including representatives from various elements, such as Purus Village officials, TNI/Polri personnel as security and coordination elements, and members of the Disaster Preparedness Group (KSB) wearing red and white uniforms. This synergy confirms the multi-actor collaboration in strengthening community resilience in the red zone.



Figure 3. Documentation of Community Service Activities

Based on Figure 2, it is clear that the form of service carried out by the group of lecturers was through Focus Group Discussions (FGD) and Group Work, where residents and community members did not just act as passive listeners, but were actively involved in the group discussion sessions. The participants, including women's groups and community leaders, worked together to formulate strategic points on flipcharts. This reflects the participatory process of developing community-based contingency plans and identifying Tsunami Ready Community indicators. Not only that, but the community's independent

procedural literacy through the activity of writing mitigation points directly by residents shows a transformation from a passive to a proactive attitude in understanding evacuation procedures and early warning systems. This activity supports the program's focus on managerial aspects and improving the quality of human resources without dependence on additional physical infrastructure.

Institutional Strengthening and Sustainability One of the key achievements of this service was the formalization of the Tsunami Preparedness Forum. This institution serves as a bridge between the local government and the community members, ensuring that the contingency plans developed during the program remain operational. Challenges encountered included the high turnover of local volunteers and the need for continuous simulation exercises. To address this, the program integrated disaster education into existing local social gatherings, ensuring sustainability through cultural integration rather than high-cost technology. The synergy between the Disaster Preparedness Group (KSB) and the newly formed forum has strengthened the local managerial capacity, reducing the community's dependence on external aid during the golden hours of a disaster (Yulianti & Firmansyah, 2022).

Table 2 Achievement of 12 tsunami ready indicators in Purus Village

No	Category	Tsunami Ready Indicators (UNESCO-IOC)	Status	Remarks
1	Assessment	Hazard maps approved by authorities	Achieved	Used official maps from BPBD Padang City
2		Estimated number of people in hazard zones	Achieved	Demographic data of Purus Village mapped
3		Economic and infrastructure resources identified	Achieved	Mapping of local social and economic assets
4	Preparedness	Easily understood evacuation maps	Achieved	Developed through participatory FGDs

Implementation analysis the data in Table 2 reflects a significant transition from institutional vulnerability to community-based resilience. Prior to the intervention, the community's understanding of mitigation was limited to "running during an earthquake." Through this program, there was a measurable shift in managerial capacity. Residents are now aware that tsunami resilience requires the fulfillment of both administrative and operational indicators (Indicators 1-12).

A key highlight was the participatory mapping (Indicators 4 & 5). The evacuation routes designed by the residents during the FGDs were found to be more effective than top-down government maps. Local residents were able to identify specific micro-obstacles, such as narrow alleys or frequently locked gates, which are often invisible on satellite-based maps. Furthermore, the activation of a multi-tiered communication system (Indicators 10 & 11) ensures that early warnings reach the "last mile" by utilizing local wisdom, such as traditional communication tools and religious center loudspeakers (Yulianti & Firmansyah, 2022).

Impact on Community Resilience The overall impact of the program is characterized by the transition from institutional vulnerability to community empowerment. By fulfilling the administrative and operational indicators of the Tsunami Ready program, Purus Village has moved closer to international certification. The analytical results suggest that community resilience is not merely about physical infrastructure but is deeply rooted in the strength of social networks and the clarity of coordination protocols (Fang et al., 2017).

CONCLUSION

The implementation of the Tsunami Ready Community program in Purus Village has successfully transformed the community's perspective from a fatalistic acceptance of disaster risks into a proactive and structured preparedness mindset. The significant increase in disaster literacy, from 35% to 85%, demonstrates that the participatory approach utilizing local social capital and multi-actor collaboration is an effective mechanism for operationalizing the 12 UNESCO-IOC indicators at the grassroots level. This program proves that community resilience is built not only through physical infrastructure but, more importantly, through the institutionalization of knowledge and coordinated local action. The results demonstrate that the integration of social capital, such as local communication networks and community-led evacuation planning, is more effective and sustainable than a primary reliance on physical infrastructure.

To ensure the long-term sustainability of these outcomes, several strategic actions are highly recommended. First, the Padang City Government needs to institutionalize this progress by formalizing the Tsunami Ready status through local regulations to guarantee consistent administrative support and the integration of disaster preparedness into the annual village budget. Furthermore, local stakeholders, especially the Disaster Preparedness Group (KSB), should maintain this capacity through routine evacuation drills conducted at least every six months to preserve the community's "muscle memory" and ensure that participatory maps remain updated in line with infrastructure changes. Finally, future initiatives should foster cross-sector synergy by integrating disaster education with local economic activities, such as urban farming or MSME programs, to maintain high community engagement while simultaneously reducing the social vulnerability often caused by economic instability.

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