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# Education-Based Disaster Mitigation: A Case Study of Coastal Communities Vulnerable to Climate Change


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## Abstract

Disaster mitigation is a crucial aspect in efforts to reduce the risk and impact of disasters that are increasing due to climate change and environmental degradation. However, fragmented mitigation approaches often hamper the effectiveness of policies and community preparedness. Therefore, a holistic strategy is needed that integrates disaster education, community capacity building, and environmental and policy factors to build a more sustainable disaster resilience system. This study aims to analyze the relationship between the three approaches and identify strategies that can be applied to improve community preparedness and resilience to disasters. This study uses a qualitative approach with a case study method to explore the implementation of education-based disaster mitigation in the coastal community of Bone, Bone Bolango Regency. The results showed that the disaster education approach proved effective in increasing individual awareness and skills through community-based learning and integration into the formal curriculum. Increasing community capacity, especially through strengthening social capital, active participation, and utilizing local wisdom, contributed to the effectiveness of community-based mitigation. In addition, the results showed that environmental and policy factors play an important role in supporting disaster resilience. Ineffective regulations and uncontrolled exploitation of natural resources exacerbate disaster risks, requiring policies based on structural and non-structural mitigation. Thus, this study confirms that synergy between education, community capacity, and environmental policies is a strategic step in building a more effective, adaptive, and sustainable disaster mitigation system.

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## INTRODUCTION

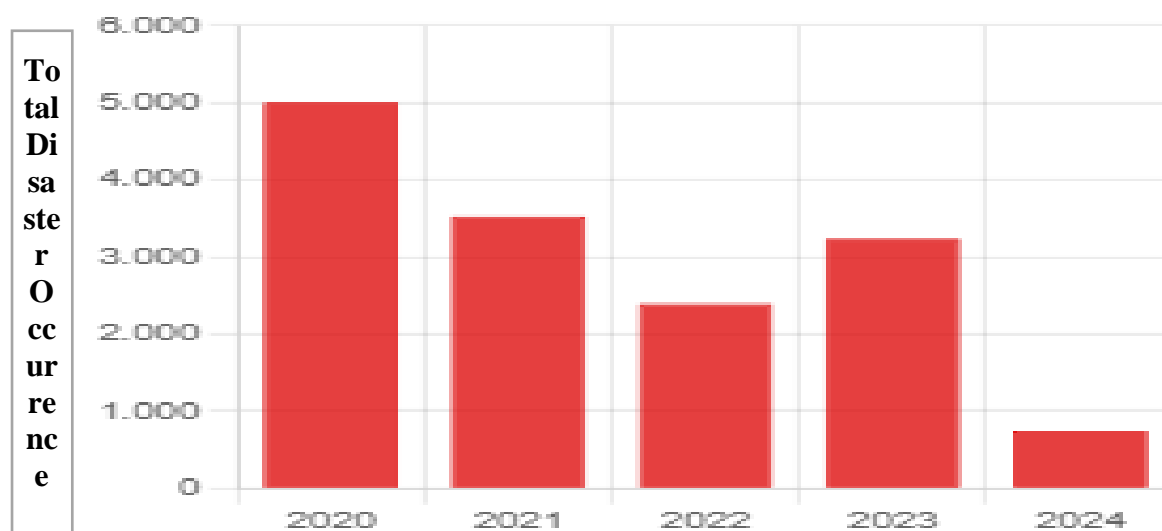
Coastal communities are groups that are very vulnerable to the impacts of natural disasters such as tidal floods, abrasion, tropical storms, and tsunamis. This vulnerability is further exacerbated by climate change which increases the frequency and intensity of disasters, threatening the sustainability of economic and social life, (Paharuddin, P., & Alham, I. 2024). Unfortunately,

there are still many coastal communities that do not have adequate preparedness due to limited access to disaster information and education. In this context, the education-based mitigation approach has not been widely adopted and optimally implemented in coastal areas of Indonesia. (Ulum, M. C., & Ngindana, R. 2017) emphasized that equipping communities with concrete adaptation and mitigation skills is very important to increase their resilience to disasters. Structured and sustainable disaster education can form a preventive mindset in dealing with the threat of disaster, so that communities are not only reactive after a disaster occurs, but are also able to take mitigation steps independently before a disaster strikes.

This study focuses on the coastal area of Bone in Bone Bolango Regency, which is known to have a high level of vulnerability to disasters such as abrasion, tidal floods, and high waves. This area is the locus of research (case study) because there are still limited education-based mitigation efforts to increase community preparedness for disaster risks. Lack of disaster knowledge among coastal communities is one of the main factors that increases their vulnerability to natural disasters. The lack of understanding of disaster risks, causal factors, and long-term impacts results in low preparedness in dealing with threats such as tidal floods, abrasion, tropical storms, and tsunamis. Without adequate education, people tend to be reactive rather than preventive, so that mitigation actions are not carried out optimally. (Akbar et al., 2017) revealed that the attitudes and behavior of coastal communities in mitigating disasters still tend to be minimal and sporadic. In many cases, people do not yet have the habit of taking preventive actions such as preparing evacuation plans, preparing rescue routes, or storing important documents in safe places. (Mayzarah, & Batmomolin, 2021). In fact, when early warnings are issued, most people are still hesitant or even ignore evacuation instructions due to a lack of understanding of the urgency of disaster mitigation. Environmental adaptation has also not been implemented optimally, as seen from the rampant settlements built in disaster-prone zones without paying attention to flood or earthquake resistance standards.

This condition shows that although several mitigation programs have been introduced, their implementation is not evenly distributed and has not become part of the community's culture (Mashur, D., & Zulkarnaini, Z. 2022). Floods, landslides, tidal waves and abrasion, extreme weather, drought, forest and land fires, earthquakes, tsunamis, and volcanic eruptions are some of the types of disasters that often occur in Indonesia. Over the past 5 years, the National Disaster Management Agency BNPB of the Republic of Indonesia (**chart 1**) recorded that there have been 14,930 disasters in Indonesia with a total of 12,988,781 million victims, 1273 of whom died. Meanwhile, specifically in Bone Bolango Regency, Gorontalo Province, based on data from the Central Statistics Agency (BPS), Bone Bolango Regency also shows high vulnerability to natural disasters. At least in the period from January to April 2024, as many as 28.48% of villages/sub-districts in this district were affected by natural disasters. Disasters that often occur in this area include floods and landslides, which are caused by high rainfall and vulnerable geographical conditions. The high frequency of disasters in coastal areas such as Bone Bolango emphasizes the urgency of increasing public understanding of risk factors, preventive measures, and appropriate actions when a disaster occurs.

**Chart 1. Natural Disasters in Indonesia 2020-2024**



**Data source:** BNPB Republic of Indonesia 2024

The level of coastal community involvement in disaster training is still relatively low, even though they are in areas that are very vulnerable to natural disasters. Based on empirical facts, on average, coastal communities in Bone Bolango Regency rarely or never participate in disaster simulations, evacuation training, or climate awareness programs that can improve their preparedness. The study conducted (Waloejo 2022) revealed that this was caused by several factors, such as lack of access to information, minimal initiative from the authorities to hold routine training, and low public awareness of the importance of involvement in these activities. In fact, when disaster training is organized by the government or social institutions, community participation is often limited to certain groups, such as village officials or fishing groups, while most other residents remain passive. This condition shows that without a more inclusive and local needs-based approach, disaster training programs will find it difficult to achieve maximum effectiveness in building community preparedness at large, (Ahsani et., al 2024).

Another obstacle that researchers found was that coastal communities' access to disaster mitigation information was still limited and uneven, resulting in low preparedness in facing disaster threats. Most people only receive disaster information sporadically, especially when a disaster occurs or through news in the mass media, without ongoing education. Schools as one of the main sources of disaster literacy have not optimally integrated mitigation materials into their curriculum, while local organizations and regional governments do not yet have a systematic information dissemination system that is easily accessible to all levels of society. As a result, many residents do not yet understand comprehensive mitigation steps, including how to save themselves, secure valuable assets, or identify early signs of disaster. (Tamitiadini et al., 2019) emphasized that to increase the resilience of coastal communities, there needs to be a more effective information dissemination strategy through the use of digital technology, community-based campaigns, and the integration of mitigation materials in formal and non-formal education. Meanwhile, education policies that support disaster mitigation also have a long-term impact on sustainable development. Coastal communities that have an understanding and skills in disaster mitigation will be more resilient to the impacts of climate change, thus being able to maintain their economic and social stability. Educational programs involving various parties, including the government, educational

institutions, and non-governmental organizations, can strengthen collaboration in creating a sustainable mitigation system.

(Rusdi et al., 2024) said that the implementation of disaster mitigation education in coastal areas still faces various challenges, such as limited access to education, low disaster literacy, and lack of infrastructure and resource support. Therefore, innovation is needed in learning methods, such as the use of digital technology, community-based education, and participatory approaches involving community leaders and local stakeholders. Based on the arguments above, previous studies on disasters in coastal areas of Indonesia generally highlight physical and environmental factors as the main causes, such as climate change, sea level rise, and coastal ecosystem degradation. (Agustina et al., 2023) (Purnomo et al., 2024). Several studies also highlight the weakness of coastal protection infrastructure and limitations in early warning systems, (Sutton-Grier et al., 2015) (Haigh, R., Amaratunga, D., & Hemachandra, 2018). However, there are still few studies that specifically highlight the factors of low community understanding of disaster risks and lack of education related to prevention and response measures when a disaster occurs. Most studies focus more on technical aspects of mitigation, such as coastal engineering and ecological-based adaptation policies, while social aspects and disaster education have not received adequate attention as key factors in increasing coastal community resilience. This research gap shows that the lack of understanding of coastal communities regarding disaster risk factors and their mitigation is still a fundamental problem that needs to be studied further. Studies linking disaster education to community preparedness are still limited, so the effectiveness of disaster education and training programs cannot be measured comprehensively.

In addition, further studies are still needed on how to integrate disaster education into the school curriculum, community-based training programs, and the role of government in improving disaster literacy in coastal areas. By understanding this gap, further research can be focused on developing more inclusive and locally-based education strategies to improve coastal communities' disaster preparedness and adaptation. This study limits its focus to three theoretical approaches that form the basis of strategic recommendations in improving education-based disaster mitigation in coastal communities. First, the Disaster Education approach examines the integration of mitigation materials in the curriculum, practice-based learning methods, educator competencies, and community access to informal disaster education. Second, the Community Capacity approach in disaster mitigation highlights the role of community participation, the sustainability of disaster education programs, the availability of supporting infrastructure, and economic aspects in disaster adaptation. Third, Environmental and Policy Factors explore regulatory support, the role of technology in disaster education, synergy between institutions, and the impact of climate change on coastal community preparedness.

## **METHODS**

This study uses a qualitative approach with a case study method to explore the implementation of education-based disaster mitigation in the coastal community of Bone, Bone Bolango Regency. The focus of the study is directed at three main theoretical approaches, namely Disaster Education, Community Capacity in Disaster Mitigation, and Environmental and Policy Factors. Data collection was carried out through in-depth interviews with educators, village officials, and coastal communities, as well as observations of mitigation practices that have been

implemented. In addition, secondary data was collected from policy documents, reports from related institutions, and relevant scientific publications to strengthen the analysis of research findings. The Disaster Education approach is examined by examining the extent to which disaster mitigation materials have been integrated into the school curriculum and implemented through practice-based learning methods, such as simulations or field studies. In addition, this study also examines the competence of educators and facilitators in delivering mitigation materials, as well as community access to informal disaster education through community-based counseling and training. Field observations and interviews with educators and students are the main instruments in exploring the effectiveness of disaster education in coastal areas.

The Community Capacity Approach in Disaster Mitigation is analyzed through the level of community involvement in mitigation planning, the sustainability of disaster education programs after external intervention, and the availability of supporting infrastructure such as evacuation routes and shelters. In addition, the economic aspect of disaster adaptation is also a major concern, especially regarding community access to financial resources to increase disaster resilience. Data were collected through interviews with community leaders, members of disaster awareness groups, and local government representatives to understand the factors that support or hinder the sustainability of disaster mitigation at the community level. Meanwhile, the Environmental Factors and Policy approach is explored through an analysis of government policies in supporting disaster mitigation education, the role of technology in disseminating disaster information, and the level of coordination between educational institutions, the government, and non-governmental organizations. This study was conducted by reviewing applicable regulations, programs that have been implemented, and interviews with relevant policy makers. In addition, the impact of climate change on coastal community preparedness was analyzed to see the relationship between environmental dynamics and the effectiveness of mitigation strategies that have been implemented. Through this combination of methods, the study is expected to be able to provide evidence-based recommendations to strengthen education-based disaster mitigation in coastal communities.

## **RESULT AND DISCUSSION**

This coastal area faces increasing disaster threats due to climate change, but community preparedness is still relatively low. Using the approach of disaster education theory, community empowerment, and environmental policy, this study explores the extent to which disaster education has been implemented, how the community's capacity is in mitigation, and the role of policy in supporting coastal community resilience to disasters. Researchers see that there is a gap between disaster mitigation policies and their implementation at the local level. The lack of integration of disaster materials in formal and informal education systems, limited supporting infrastructure, and low community participation in mitigation programs are the main challenges. In addition, although various policies have been designed to improve community preparedness, the synergy between the government, educational institutions, and communities still needs to be strengthened so that mitigation efforts can run more effectively and sustainably. This study limits its focus to three theoretical approaches that form the basis of strategic recommendations in improving education-based disaster mitigation in coastal communities. The presentation of the research results and their discussion are described in the following sub-chapters:

### **1) Disaster Education Approach**

The disaster education approach plays an important role in increasing awareness and preparedness of coastal communities for disaster risks. The integration of disaster mitigation materials into the formal curriculum still faces various obstacles, especially in terms of compiling comprehensive materials and more applicable learning methods. Many schools in coastal areas still teach disaster mitigation theoretically without being supported by direct practice, such as disaster simulations or field studies. In fact, previous research (Oktari et al., 2020) shows that experiential learning, such as evacuation drills and case-based discussions, can improve students' understanding and rapid response in emergency situations. Therefore, stronger policies are needed to ensure that disaster education is not only an addition to the curriculum, but is also implemented with more effective and practice-oriented methods. In addition to formal education, community-based disaster education also plays a role in shaping community preparedness more broadly.

Community-based counseling, workshops, and training can be effective means of improving understanding and mitigation skills in coastal communities. However, the results of this study indicate that community access to informal disaster education is still limited due to the lack of sustainable programs and the lack of trained facilitators. This is in line with the findings of Kusumasari and Alam (2012), which stated that the sustainability of disaster education programs depends on the active involvement of the government, schools, and community organizations. Therefore, synergy is needed between various parties to ensure that disaster education is not only temporary, but becomes part of a culture of preparedness that continues to develop in coastal communities. In addition, practice-based learning methods, such as disaster simulations, field studies, and group discussions, have been shown to be more effective in improving community preparedness compared to conventional lecture methods.

This finding is reinforced by research by Shaw et al. (2018) which shows that experiential learning in disaster education can improve students' understanding and skills in dealing with real disasters. However, the results of this study also revealed that limited facilities and the lack of trained educators are the main obstacles in implementing this method. Several schools in coastal areas still do not have access to practice-based teaching materials, and there are no routine programs that involve students in disaster simulations. Furthermore, community access to informal disaster education is still limited. Participation in community-based counseling, workshops, and training has not become a routine practice. This is due to the lack of initiative from local governments and non-governmental organizations in providing sustainable education programs. Research by Izadkhah and Hosseini (2020) highlights that the sustainability of disaster education programs is highly dependent on active community involvement and adequate policy support.

Without strong informal education, communities will continue to rely on limited information and are often unprepared for sudden disasters. The results of this study also show that the characteristics of coastal communities in Bone Bolango Regency in receiving and implementing disaster education still vary greatly, depending on their level of education, access to information, and their experience with previous disasters. Most people still have limited understanding of disaster mitigation due to the lack of access to ongoing formal or informal education. This is reinforced by research by Desfandi, M. (2014) which highlights that the success of disaster education is greatly influenced by the readiness of individuals to receive and practice the information provided. In this context, strengthening community-based education programs is crucial

so that people can understand disaster risks and the mitigation steps they must take before a disaster occurs.

From the perspective of educators and disaster facilitators, this study found that there is still a gap in the competence of teaching staff in delivering disaster mitigation materials. Field observations show that educators in coastal schools generally have not received special training in teaching disaster mitigation using practice-based methods, such as evacuation simulations or field studies. In fact, previous research by Oktari et al. (2020) emphasized that the experiential learning method is very effective in increasing student preparedness. In addition, facilitators from non-governmental organizations and related agencies still face limited resources in running the counseling program routinely. As a result, disaster education in the coastal communities of Bone Bolango has not been fully internalized in their daily lives. Community access to informal disaster education through counseling and community-based training is also still limited. Interviews with training participants showed that although there are counseling programs from the government and social organizations, the sustainability of these programs is still a major challenge.

Based on these findings, this study emphasizes that disaster education must be more structured and integrated into various aspects of coastal community life. Integration into the formal curriculum, application of practice-based learning methods, increasing the competence of educators, and strengthening community-based informal education are four key elements that need to be strengthened. With this approach, it is hoped that coastal communities will not only have a higher awareness of disaster risks, but will also be able to implement mitigation actions independently to reduce the impact of disasters in the future. In addition, the availability of supporting infrastructure such as evacuation routes and shelters is still not optimal in several coastal villages. Thus, this study recommends increasing the capacity of educators and facilitators, as well as synergy between the government, schools, and communities in building a sustainable and locally-based disaster education system.

## **2) Community Capacity Approach**

Disaster mitigation in coastal areas does not only depend on government policies, but also on the capacity of the community to face and reduce disaster risks. Communities with a high level of preparedness tend to be better able to minimize the impact of disasters and accelerate post-disaster recovery. However, in many coastal areas, community participation in mitigation efforts is still relatively low. Minimal involvement in disaster planning, dependence on external interventions, and lack of supporting infrastructure are the main challenges in increasing community resilience to disasters. Therefore, it is important to evaluate the extent to which coastal communities, especially in Bone Bolango Regency, have the capacity to face disaster threats and how capacity building strategies can be implemented sustainably. The community capacity approach in disaster mitigation examines several important aspects, including active community participation in mitigation planning, sustainability of disaster education programs, availability of supporting infrastructure, and economic aspects that affect community adaptability. These factors greatly determine the effectiveness of disaster mitigation, especially in coastal areas that are at high risk of disasters such as tidal floods, tsunamis, and climate change. In addition, this approach also considers the role of various actors, including government, non-governmental organizations, and local communities, in building a more inclusive and participatory preparedness system.

In line with the Community Empowerment theory proposed by Zimmerman (1995), active participation and capacity building of communities can strengthen their resilience to disasters. Previous studies have shown that community-based mitigation programs are more effective than top-down approaches that only rely on government policies. However, in Bone Bolango Regency, the extent to which this approach has been implemented and how it impacts community preparedness are still questions that need to be answered. Therefore, this study will dig deeper into the challenges and opportunities in increasing community capacity in disaster mitigation, by highlighting the various factors that influence it and comparing it with relevant studies.

The results of this study indicate that community capacity in disaster mitigation in the coastal area of Bone Bolango Regency still faces significant challenges. Community participation in disaster mitigation planning is relatively low, with only 30% of residents actively participating in village discussions related to disasters or joining disaster awareness groups (KSB). Many residents still consider disaster mitigation to be the government's responsibility, so their involvement in disaster discussions and preparedness activities is still limited. In addition, the lack of regular socialization and education has resulted in low community awareness of the importance of preparedness. Most residents only show concern after a disaster occurs, indicating a reactive rather than proactive pattern in disaster mitigation. The sustainability of disaster education programs is also a major challenge. Several programs previously introduced by the government or non-governmental institutions often do not continue after the project is completed, due to a lack of support from local governments and a lack of community initiative to continue the program independently. For example, several coastal villages have received disaster evacuation simulation training, but in recent years, these activities have not been carried out anymore. Inconsistency in the implementation of mitigation programs has resulted in communities lacking in-depth understanding and the skills needed when facing a disaster. This is exacerbated by the lack of local facilitators who are able to provide disaster education on a regular basis.

In addition to education, the availability of disaster infrastructure is still a major obstacle in the coastal areas of Bone Bolango Regency. Field observations show that most evacuation routes are not well maintained, and some villages do not have clear and safe evacuation routes. Disaster shelters are also still limited, so many residents do not have a safe place to take shelter when a disaster occurs. Community-based early warning systems are also still underdeveloped, so that disaster information is often received too late by coastal residents. The lack of supporting infrastructure shows that coastal communities are still vulnerable to disasters, especially tidal floods and tsunamis that often occur in coastal areas of Gorontalo. From an economic aspect, the community's ability to adapt to disaster risks is still limited. Many houses in pesisir is still built with materials that are not resistant to earthquakes or tidal waves. This is due to economic limitations that make it difficult for people to allocate funds for building disaster-resistant houses.

In addition, access to financial resources, such as mitigation-based business capital assistance or incentives for building disaster-friendly houses, is still not optimal. In fact, research conducted by Benson & Twigg (2007) emphasized that economic factors play an important role in increasing community resilience to disasters. When communities have access to adequate financial resources, they are better able to implement effective mitigation strategies, such as building houses with stronger structures or adopting community-based early warning technology. In addition, research by Shaw et al. (2012) shows that sustainable community-based mitigation programs are

more effective than approaches that rely solely on government intervention. Another study conducted by Wisner et al. (2004) in *At Risk: Natural Hazards, People's Vulnerability and Disasters* also emphasized that infrastructure and economic factors are key factors in determining the effectiveness of disaster mitigation in coastal communities. However, unlike previous studies that tend to focus on the role of government, this study highlights the aspect of direct community participation in supporting the sustainability of disaster mitigation programs. Based on the results of this study, it can be concluded that the success of disaster mitigation in coastal areas is highly dependent on the synergy between the community, government, and supporting organizations. Without active community involvement and collective awareness in mitigation planning, disaster education and infrastructure programs will not be effective in the long term. Therefore, the main recommendation of this study is to strengthen community capacity through sustainable community-based training, increase access to economic resources for disaster adaptation, and integrate mitigation planning into regional development policies.

### **3) Environmental and Policy Factors**

Environmental factors and policies that support the sustainability of mitigation strategies. Clear regulations, utilization of technology, synergy between institutions, and responses to climate change are crucial aspects in building an effective mitigation system. Bone Bolango Regency, as one of the coastal areas vulnerable to natural disasters, faces various challenges in implementing mitigation policies. Although several programs have been implemented, such as disaster risk-based spatial planning and disaster education in schools, there are still obstacles in implementation in the field, especially related to coordination between stakeholders and limited supporting infrastructure.

In a global context, various studies have highlighted the importance of risk-based policies and the use of technology in improving the preparedness of coastal communities. A study by Pelling & Uitto (2001) emphasized that effective disaster mitigation requires a combination of regulatory approaches and technological innovation to ensure that disaster information can be accessed quickly by the community. However, in reality at the local level, the implementation of this approach still faces various obstacles, such as low technological literacy and minimal coordination between institutions.

The results of the study indicate that environmental and policy factors play a crucial role in determining coastal communities' disaster preparedness. Strong regulations and consistent policy implementation are the main factors in building an effective disaster mitigation system. In Bone Bolango Regency, several policies related to disaster mitigation have been implemented, such as the preparation of the Regional Disaster Management Plan (RPBD) and mitigation education programs in schools. However, the main challenges faced are weak synergy between institutions, budget constraints, and the low level of community compliance with existing regulations. Several coastal villages that were the research locations also still face obstacles in implementing disaster-prone area zoning policies, which should be able to reduce the risk to people living in high-risk areas. In addition to regulations, this study also found that the use of technology in disaster education is still not optimal. Technology-based early warning systems, such as the Early Warning System (EWS), are still limited in several coastal areas and often experience technical constraints or lack of maintenance.

In fact, previous research (Pelling & Uitto, 2001) showed that the use of technology, including digital and geospatial media, can increase the effectiveness of disaster education by providing real-time information to the community. Several fishing communities and disaster awareness groups in Bone Bolango Regency have begun to adopt mobile application-based technology to obtain information on weather conditions and sea waves. However, limited access to digital infrastructure and low technological literacy are major obstacles in expanding the use of technology in disaster mitigation. Synergy between government agencies, non-governmental organizations, and local communities is also an important aspect in increasing coastal community preparedness.

A study by Berkes & Ross (2013) emphasized that effective disaster mitigation requires multi-sector coordination and the active involvement of all stakeholders. However, in Bone Bolango Regency, this study found that communication between local governments, educational institutions, and non-governmental organizations is still carried out sectorally and has not been integrated into a comprehensive mitigation strategy. Disaster training programs are often carried out sporadically without clear continuity, so that the community does not receive continuous learning. This reinforces the findings of previous studies showing that the success of disaster mitigation is highly dependent on good coordination between institutions and the sustainability of disaster education programs at the local level. The impact of climate change on the preparedness of coastal communities is also an important finding in this study. Extreme weather phenomena, rising sea levels, and the increasing frequency of hydrometeorological disasters are increasing the vulnerability of coastal communities. Studies by the IPCC (Intergovernmental Panel on Climate Change) show that the impact of climate change will further exacerbate disaster risks in coastal areas, especially for communities with low adaptive capacity. In Bone Bolango Regency, several communities have begun to adopt adaptation measures such as building stilt houses and strengthening wave dykes. However, economic limitations and the lack of policy incentives from the government mean that most communities are still not optimally prepared to face climate change.

Based on the results of this study, it can be concluded that environmental factors and policies have a significant influence on coastal community preparedness in facing disasters. Strong regulatory support, utilization of technology in disaster education, better coordination between institutions, and more systematic climate change adaptation strategies are the main keys to improving disaster mitigation in coastal areas. This study also confirms that without good integration between government policies, utilization of technology, and active community participation, disaster mitigation efforts will not run optimally. Therefore, more adaptive policies and community-based approaches are needed that can increase community capacity in facing increasingly complex disaster threats in the era of climate change.

## **CONCLUSIONS**

This study confirms that disaster education, community capacity building, and environmental and policy factors are complementary approaches in building disaster resilience. Disaster education based on participatory and real-world experiences has been shown to improve individual preparedness in dealing with emergency situations. Meanwhile, strengthening community capacity through active involvement in mitigation planning, utilization of local wisdom,

and access to disaster information can significantly reduce risks and impacts. In addition, environmental and policy factors play a crucial role in creating an effective and sustainable mitigation system. Environmental degradation and weak implementation of regulations exacerbate disaster risks. The results of this study indicate that implementing policies based on local understanding and sustainable environmental management will strengthen long-term resilience to disasters. This study offers a new perspective by identifying the relationship between the three main approaches in disaster mitigation and emphasizing the importance of synergy between actors in their implementation. In addition, community-based approaches that utilize local wisdom as part of a mitigation strategy are still rarely integrated comprehensively into disaster policies. This study also highlights the role of disaster education as a key factor in building a sustainable culture of preparedness. Thus, this research provides an important contribution in designing more effective disaster mitigation strategies, based on community participation, and oriented towards environmental sustainability.

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## **CONFLICTS OF INTEREST STATEMENT**

In writing this research article, the author ensures that there is no conflict of interest that could affect the objectivity and integrity of the research. The author has no financial, personal, or professional relationships with individuals or organizations that could potentially cause bias in the analysis and conclusions of the research. All data, interpretations, and findings are compiled independently based on transparent and responsible academic principles. Thus, this research is presented objectively and free from the influence of certain party interests.

## **AUTHOR CONTRIBUTIONS**

Study concept and design: Abdul Wahab Podungge. Acquisition of data: Abdul Wahab Podungge. Analysis and interpretation of data: Dwi Indah Yuliyani Solihin. Drafting the manuscript: Abdul Wahab Podungge. Critical revision of the manuscript for important intellectual content: Dwi Indah Yuliyani Solihin. Statistical analysis: Dwi Indah Yuliyani Solihin.

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