Sister village-based volcano disaster response communities in Indonesia

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Abstract

This study aims to examine the efficacy of the Sister Village Program in enhancing community resilience to the consequences of volcanic eruptions in Magelang Regency. The research method is qualitative, with data analysis derived from interviews, observations, and a literature review. The research findings indicate that collaboration between government entities, non-governmental organizations (NGOs), the private sector, and academic institutions is essential for developing effective disaster mitigation strategies. While progress has been made in village preparedness and logistics management, the primary challenge remains the low level of community involvement in evacuation management, particularly in Taman Agung village. Furthermore, social, economic, and emotional factors contribute to residents' reluctance to relocate from high-risk areas. The findings of this research indicate a necessity for the enhancement of mitigation programs, emphasizing the expansion of community involvement and the provision of comprehensive economic solutions. Furthermore, the research underscores the significance of inter-institutional collaboration in formulating responsive and inclusive policies. However, the study's scope is constrained by its exclusive focus on Magelang Regency, limiting the generalizability of its findings to other regions. Additionally, the absence of individual psychological data in disaster mitigation decisions may impede the depth of analysis. Future research should delve more profoundly into the psychological aspects and encompass a broader range of locations to gain a more comprehensive understanding.

Keywords: Community resilience, Disaster management, Sister village Program, Volcanic eruption, Volcano.

1. Introduction

Natural disasters are undesirable events caused by nature, often exacerbated [1] (Satija & Kar, 2020), which are difficult to prevent due to their unpredictable nature [2]. These events can result in loss of life, damage to property and infrastructure, and disruption of economic and social systems. Due to its geographical location at the confluence of four tectonic plates - the

Australian, Asian, Indian, and Pacific - Indonesia is prone to natural disasters, particularly volcanic eruptions [3]. Among the many active volcanoes in Indonesia, Gunung Berapi is one of the most active and dangerous, having erupted repeatedly since 1900, threatening thousands of residents [4]. In response, the Indonesian government has initiated a disaster management policy by implementing the Sister Village program in the Magelang Regency. This program encourages cooperation between disaster-prone villages and safer areas to improve community preparedness, resilience, and collaboration during disaster emergencies. Despite these efforts, many residents are still reluctant to move, posing a challenge to the effectiveness of disaster mitigation efforts. This research examines the political community's role in volcanic disaster response, focusing on the collaborative mechanisms and actors involved in policy design and implementation in disaster-prone areas such as the Ngargomulyo and Tamanagung villages in the Magelang Regency.

While existing research provides a solid foundation for disaster management policies and community-based mitigation programs, there is a significant gap in understanding the role of policy communities in disaster response, particularly in volcanic areas such as volcanoes [5, 6]. The importance of advocacy coalitions and policy communities in influencing disaster-related decisions [7]. However, there is limited research exploring the specific dynamics of these communities in the context of volcanic disasters in Indonesia. In particular, applying theories such as the Advocacy Coalition Framework (ACF) and the Policy Community model to the Sister Village program has not been fully explored [8]. This research seeks to fill this gap by investigating how policy communities, consisting of local government, academics, and residents, interact and influence the development and implementation of disaster management policy in high-risk areas such as volcanoes.

Addressing the complexities of disaster management in high-risk areas such as volcanoes requires more than just emergency response; it requires active engagement of local communities and ongoing collaboration between different stakeholders. The Sister Village program, initiated by the Magelang government, is a promising solution to reduce the risks of volcanic eruptions by fostering partnerships between vulnerable and safer villages. By strengthening community ties, promoting local knowledge, and involving residents in planning and decision-making, the program aims to create a network of prepared and resilient communities. However, for this initiative to reach its full potential, the program must overcome the underlying reluctance of many villagers to relocate and better integrate scientific research into its policies [7]. This study proposes strategies to improve the program's effectiveness by strengthening the policy community's role and incorporating lessons from global disaster management practices.

The main motivation for this study stems from the urgent need to improve disaster preparedness and response in volcanic areas, particularly in the volcanic region, which continues to scare local communities. Although the Sister Village program is up and running, significant challenges remain regarding community engagement, policy coordination, and long-term resilience [9-11]. The following questions prompted this research: How does the policy community function in the Bersaudara Villages program? What are the roles of local government, academics, and communities in shaping disaster management policies? And how can these policies be improved to ensure a more effective and inclusive response to future eruptions? This research aims to contribute to a broader understanding of community disaster policies and their impact on disaster resilience by answering these questions.

This research aims to examine the role of community policies in disaster response strategies in the Sister Village program in Magelang Regency, with a particular focus on Ngargomulyo and Tamanagung Villages. The objectives of this study are to: (1) analyze the process of collaboration between local government, academics, and community members in designing and implementing disaster management strategies; (2) assess the effectiveness of the Bersaudara Village program in improving community resilience and preparedness; (3) identify key factors influencing residents' reluctance to move from high-risk areas; and (4) propose policy recommendations to improve the program's effectiveness in mitigating the effects of volcanic activity.

This research will be of significant value to policymakers, disaster management practitioners, and community leaders by providing a deeper understanding of the role of policy communities in disaster-prone areas. The research will provide practical insights into how collaborative frameworks such as the Sister Village program can be optimized to improve disaster preparedness and resilience in volcanic areas. In addition, this research will contribute to the growing literature on community-based disaster management by highlighting the importance of local knowledge, advocacy coalitions, and sustained political engagement in mitigating the impacts of natural disasters. Findings from this research can inform future disaster management policies in Indonesia and other regions facing similar challenges, ultimately benefiting vulnerable communities by improving their safety and resilience.

2. Research Methodology

This research employs a descriptive qualitative approach [12] to explain and analyze the public policy process, particularly the volcano management policy community in the sister villages of Ngargomulyo and Tamanagung, Magelang Regency, Central Java Province. The descriptive qualitative approach was chosen because this research focuses on an in-depth understanding of existing phenomena and identifying factors that support and hinder the policy community. The type of research used is a descriptive case study because case studies allow generalization to theoretical premises [13], not to count frequencies or produce statistical generalizations, but rather to develop and generalize theories through analytical generalizations. This research is also expected to provide a detailed description of the dynamics in the policy community in areas vulnerable to natural disasters.

Data for this study were obtained from two main sources, namely primary data and secondary data. Primary data were collected through in-depth interviews with key informants [14], including village officials, village leaders, and residents of the villages of Ngargomulyo and Tamanagung. In addition to the interviews, field observations were conducted to gain a direct understanding of the conditions on the ground, capture the actual situation, and identify elements relevant to disaster

response policy. Secondary data were obtained from relevant documents [15], including local government reports, related policies, and previous studies that supported the analysis.

The data analysis technique used in this research is the interactive model method developed by Miles et al. [16]. In this model, data analysis involves three main activities: first, data reduction, which is the process of reducing and simplifying data obtained from interviews and observations; second, data display, which is the presentation of data in the form of matrices, graphs, or tables to facilitate understanding and interpretation; and third, inference/verification, which is the drawing of conclusions based on patterns that emerge from the data and the verification of these conclusions by double-checking or triangulating existing data [16]. This analysis process is carried out continuously throughout the research to ensure that the data generated is relevant and valid.

3. Findings and Discussion

3.1. Collaboration in Developing and Implementing Volcano Disaster Management Policies

Developing and implementing disaster management strategies in Magelang Regency requires close cooperation between various parties, including the local government, non-governmental organizations, the private sector, the community, and academia. Each party has a specific role in ensuring the community is prepared to face potential disasters, especially volcanic disasters around the volcano [17]. This collaboration increases community resilience and strengthens disaster mitigation and response mechanisms. The table below summarizes the forms of cooperation and support each party provides based on data from the Central Bureau of Statistics.

Table 1.
Forms of Cooperation and Support Provided by Stakeholders.

Stakeholders	Forms of Collaboration	Forms of Support
Local Government	Magelang Regional Disaster Management Agency as the main coordinator, with Regional Regulation No. 3/2014 as the legal basis.	Improving the effectiveness of disaster management by strengthening cross-sector coordination and community training.
Non-Governmental Organizations	The Indonesian Red Cross provided medical and logistical assistance; community organizations such as Muhammadiyah and Nahdlatul Ulama were involved in socialization and training.	Increased community capacity in responding to emergency situations through medical training and information dissemination.
Private Sector	Local companies, through CSR, provided material and logistical assistance; local industries helped with the provision of heavy equipment during the emergency response.	Significant contribution of companies in providing logistics and heavy equipment for evacuation, based on private participation data.
Community	Volunteers and disaster response task forces are involved; regular training and socialization are required to improve preparedness.	Increased community participation in task forces and regular preparedness training.
Academics and Researchers	Universities and research institutions cooperate with Magelang Regional Disaster Management; Central Bureau of Statistics data is used to map risks and develop data-driven policies.	Use of academic research results for more effective mitigation policies, and risk mapping based on Central Bureau of Statistics data.

Table 1 shows how different parties are working together to support disaster management in Magelang Regency. The local government, through the Regional Disaster Management Agency, acts as the main coordinator, strengthening cross-sectoral coordination and community training. NGOs such as the Indonesian Red Cross focus on logistical and medical support, while the private sector provides logistics and heavy equipment through CSR programs. Communities are actively involved as volunteers and emergency response trainees, and academics contribute to data-driven research and policy development. This collaboration helps improve the effectiveness of disaster preparedness and risk reduction in Magelang Regency.

The results of this study show that multi-stakeholder collaboration in Magelang Regency has made a significant contribution to disaster management. Collaboration involves all key sectors, including government, non-government organizations, the private sector, the community, and academia. Each sector has a role to play in ensuring community preparedness, providing logistics, and building local capacity to deal with volcanic disasters that may occur. In addition, the use of Central Bureau of Statistics data in policymaking has enabled the development of more targeted and evidence-based policies.

This study aligns with previous research highlighting the importance of cross-sectoral collaboration in disaster management and the role of advocacy coalitions in disaster mitigation policy [18]. However, the results of this study also highlight the importance of more intensive participation and direct involvement of local communities in the disaster management process, which is often overlooked in previous studies. The results of this study emphasize that local community-based collaboration, supported by government, the private sector, and academia, is the key to success in volcanic disaster mitigation in vulnerable areas such as Magelang Regency.

3.2. Evaluation of the Effectiveness of the Sister Village Programme in Improving Community Resilience to Volcanoes

The Sister Village program, implemented in Magelang Regency, aims to enhance community resilience in the face of volcanic eruption threats. An evaluation of the program's efficacy was conducted by examining several key aspects [19]

including the preparedness of buffer villages, logistics management, community involvement, and the implementation of disaster simulations. The following table summarizes the primary findings of the program evaluation based on research and field reports.

Table 2.
Key Aspects Evaluated in the Sister Village Program Implementation.

Aspects	Description
Peyangga Village Readiness	Peyangga Village is ready to evacuate refugees; evacuation sites have been prepared.
Logistics Management	Initially, logistics management was not optimal, but after one week, management was good and transparent.
Program Implementation	Implementation of the Sister Village policy went well, especially in communication, resources and disposition.
Community Involvement	Community involvement in evacuation management is low, especially in Tamanagung Village.
Contingency Evaluation	Contingency plans are appropriate, but the livestock and economic sectors need further preparation.
Simulation and Training	Disaster training and simulations have been conducted to improve community preparedness.

Table 2 shows the evaluated aspects of the Sister Village program. Peyangga Village, as one of the buffer villages, was ready to receive evacuees with a prepared evacuation site. Initially, the logistical management was not optimal, but within a week, it improved to be good and transparent. The program's implementation was considered effective, especially in terms of communication and resource utilization. However, community involvement in evacuation management in Tamanagung Village remains relatively low. The contingency plan is deemed adequate but requires improvement in the livestock and economic sectors. Disaster drills and simulations were also conducted to enhance community preparedness.

The results of this study show that the Sister Village Program in Magelang Regency has increased the preparedness of buffer villages and improved logistics management during disasters. Although program implementation is going well, challenges remain regarding community engagement, particularly in Tamanagung Village, and the preparedness of the economic and livestock sectors, which require further attention. Regular disaster preparedness training has helped to increase community awareness and preparedness for Mount Merapi eruptions.

The findings of this study are consistent with those of previous research, which emphasizss the crucial role of logistics preparedness and contingency plans in volcano disaster management. In particular, although initial challenges were encountered in the logistics management of the situation [20] improvements were made over time, highlighting the importance of efficient resource allocation [21]. Similarly, Peyangga Village has effectively prepared evacuation sites, paramount for disaster preparedness. Moreover, the Sister Village policy implementation has been successful, particularly regarding communication and resource management. However, a significant finding of this study is that community engagement at the village level, particularly in evacuation management [22] remains a considerable challenge. This concern is corroborated [11, 23], who observed low community participation in evacuation efforts in Taman Agung Village. Therefore, the findings of this study highlight the necessity for ongoing improvement in the level of active community participation in the implementation of disaster management policies. This is crucial for enhancing resilience in disaster-prone regions, emphasizing the necessity for targeted strategies to effectively engage and empower local communities.

3.3. Factors Influencing Residents' Reluctance to Relocate from High-Risk Areas

Relocation from high-risk areas, such as the volcanic disaster zones around volcanoes, is a key disaster mitigation strategy often proposed by the government [24]. Despite the significant risks of volcanic eruptions, efforts to relocate residents from these hazardous areas are usually met with considerable resistance [25]. Various interwoven factors shape this reluctance, including social, economic, and emotional elements. On the social front, communities in these regions are often tightly knit, with strong family and community ties that span generations. Moving away from their homes would mean not only leaving behind physical assets but also severing the deep-rooted social relations that have been built up over time [26]. These relationships, which serve as an important source of social support, are difficult to replicate in new locations, adding to the reluctance to move. The cultural significance of the land, particularly in areas where families have lived for decades, reinforces this reluctance, as the land is often seen as an inseparable part of their identity and heritage.

Economically, many people living in these high-risk areas rely heavily on agriculture. The fertile soils around volcanoes, enriched by previous volcanic eruptions, provide a significant economic advantage to those who farm the land. This creates a dilemma for the residents, as relocation would mean not only moving away from their homes but also giving up their main source of income. The fear of losing economic security and facing uncertainty in new areas, where the land may not be as fertile or suitable for farming, plays a major role in their decision to stay. In addition, resettlement policies often fail to offer viable long-term economic solutions that adequately compensate for the loss of agricultural opportunities. Emotional ties compound these financial considerations, as people feel a deep sense of belonging and purpose tied to their land. These social, economic, and emotional factors create strong resistance to relocation, even in the face of imminent disaster, and highlight the need for more comprehensive and sensitive approaches to disaster mitigation and resettlement strategies.

This study shows that people are reluctant to leave high-risk areas like Ngargomulyo and Tamanagung Village. This is for several reasons. People are unwilling to move because they have strong emotional ties to their homeland. This strong attachment is often linked to their family, culture, and community, making leaving difficult and emotional. Additionally,

money is a significant reason they don't want to move. Many people depend on the land on the hills for their farming. Relocation could mean losing their main source of income, which is important for their families and quality of life. Furthermore, the residents believe they are prepared for disasters, and the Village Disaster Management Agency makes them feel safer. They believe that they can manage potential disasters without leaving their homes. This illustrates many reasons why people in these communities don't want to move. To help them, we must ensure that new policies address their concerns.

This study is consistent with previous studies on the psychological and social factors that influence residents' reluctance to relocate. Previous studies have demonstrated that emotional and economic ties constitute significant impediments to the implementation of relocation policies in disaster-prone regions [27]. However, this study introduces a novel dimension to the assessment of local preparedness, frequently engendering a misperception of security among individuals residing in hazardous areas. The findings of this study underscore the necessity for an effective relocation policy to consider social and emotional factors and to provide commensurate economic solutions for the affected population, thereby encouraging them to relocate to safer areas.

3.4. Policy Recommendations to Increase Program Capacity in Volcano Impact Mitigation

In light of the findings from this study, a series of comprehensive policy recommendations have been proposed to enhance the efficacy of the Sister Village program in mitigating the impacts of volcanic eruptions from Mount Merapi. The program's scope must be expanded to encompass additional villages in areas prone to disasters. By extending its scope, the program can facilitate the involvement and protection of more communities, thereby ensuring that more residents benefit from the resources and support provided. Such an expansion will enhance collective preparedness and facilitate the creation of a unified approach to disaster management encompassing multiple villages. This will foster a sense of solidarity and shared responsibility among the communities involved. Furthermore, the involvement of neighboring villages will facilitate the sharing of best practices and experiences, thereby reinforcing the region's overall resilience against volcanic threats.

Secondly, it is imperative to allocate greater resources, including financial and infrastructural support, to guarantee the long-term viability of village disaster management institutions. As highlighted by the third interviewee, the reliance on village funds as a primary source of revenue may prove inadequate to meet the growing needs of disaster management. Therefore, local governments should seek to augment these funds through grants, partnerships, and contributions from the private sector, which can provide essential support for training programs, equipment acquisition, and the development of critical infrastructure. Such investments will enable village disaster management agencies to operate effectively, enhancing their capacity to respond to and recover from volcanic events. Furthermore, the establishment of community self-help initiatives can supplement these resources, enabling residents to contribute actively to their preparedness efforts and fostering a culture of resilience.

Furthermore, additional measures must be implemented to enhance community awareness of disaster risks and the necessity of relocating from high-risk zones. In collaboration with scientists and disaster management experts, local governments can play a pivotal role in disseminating information to the general public regarding the long-term impacts of volcanic eruptions. It would be beneficial for public education campaigns to emphasize the importance of prioritizing life safety over emotional ties to the homeland to effectively address the psychological barriers that hinder relocation. It is recommended that workshops, community meetings, and informational materials be developed to facilitate open discussions about the realities of living in high-risk areas and the benefits of proactive risk management strategies. By fostering a well-informed community, residents will be better equipped to make informed decisions regarding their safety and well-being in a disaster.

Therefore, there must be closer collaboration between governmental bodies, scientific institutions, and local communities to develop inclusive policies responsive to local needs. Such a collaborative endeavor could be further reinforced by establishing a more comprehensive Memorandum of Understanding (MoU) between all relevant parties involved in disaster management. Such an MoU will establish a transparent legal foundation for implementing local disaster management policies, delineating each stakeholder's roles and responsibilities. Formalizing these partnerships facilitates coordinating efforts, pooling resources, and leveraging expertise from various sectors, thereby engendering a more effective and unified approach to disaster risk reduction. The strengthening of these collaborative frameworks will not only enhance the overall resilience of communities at risk but also ensure that disaster management policies are equitable, effective, and tailored to the unique challenges faced by each community.

4. Conclusions

This research investigates the potential for the Sister Village Program to mitigate the impact of volcanic eruptions in Magelang Regency. The findings indicate that collaboration between the government, non-governmental organizations, the private sector, communities, and academia is crucial for developing and implementing effective disaster management policies. The initial inquiry into collaboration indicates that multiple entities possess distinct yet complementary roles in ensuring community preparedness. The second question regarding the evaluation of program effectiveness demonstrated that, despite advancements in logistics management and village preparedness, challenges persist, particularly in community engagement. Furthermore, the third question, which explored the factors influencing residents' reluctance to relocate, indicated that social, economic, and emotional factors play an important role in their decision to remain in high-risk areas. Ultimately, the policy recommendations emphasize enhancing the program's capacity and fostering greater community involvement in disaster mitigation. The implications of these findings are significant for both the development of disaster mitigation theory and the practical implementation of strategies to enhance community resilience to disasters.

It is important to acknowledge the limitations of this research. Firstly, it should be noted that the results of this study may not be fully generalizable to other regions facing similar threats, as the study focused on a single area, namely Magelang Regency. Secondly, the limitations of the data obtained from respondents may also affect the depth of analysis, particularly in terms of community involvement in mitigation programs. Furthermore, this study focuses more on the quantitative and qualitative aspects of policy and management and less on individual psychological perspectives that may influence decisions in disaster mitigation. Consequently, future research is recommended to explore the influence of psychological and social factors on relocation decisions in greater depth and involve more regions for comparison to gain a more comprehensive understanding of disaster mitigation in Indonesia.

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