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Community-Based Landslide Disaster Mitigation: Integrating Local Knowledge for Strengthening Community Resilience

Dwiki Hermawan[1]
[1]Universitas Pertahanan Republik Indonesia, Indonesia
Dr. Mohammad Ikhwan Syahtaria, S.T., S.E., M.M[2]
[2]Universitas Pertahanan Republik, Indonesia
Dr. Dody Ruswandi, MSCE[3]
[3]Universitas Pertahanan Republik, Indonesia

Corresponding Author: *Dwikihermawannn22@gmail.com*

Abstract

Landslides represent a significant natural hazard, particularly in areas characterized by steep topography and high rainfall intensity. Conventional disaster mitigation approaches, which are often top-down in nature, have not been fully effective in enhancing community resilience. This study aims to analyze the role of community-based approaches in landslide disaster mitigation through the integration of local knowledge and capacity strengthening. This research employs a qualitative approach using literature review and descriptive analysis. The findings indicate that local knowledge plays a crucial role in identifying early warning signs of landslides, managing the environment, and developing community-based early warning systems. The integration of local knowledge with scientific approaches enhances the effectiveness of mitigation strategies and strengthens community resilience. Therefore, a collaborative strategy involving government, communities, and other stakeholders is essential to develop sustainable community-based disaster mitigation models.

Keywords: Disaster Mitigation, Landslides, Community-Based Approach, Local Knowledge, Community Resilience

INTRODUCTION

Indonesia is widely recognized as one of the most disaster-prone countries in the world due to its geographical, geological, and climatic characteristics. Located along the Pacific Ring of

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Fire, Indonesia experiences a wide range of natural hazards, including earthquakes, volcanic eruptions, floods, and landslides (UNDRR, 2015). Among these hazards, landslides represent a significant and recurring threat, particularly in mountainous and hilly regions where steep slopes, unstable soil conditions, and high rainfall intensity converge. Seasonal rainfall patterns, which are often intensified by climate variability, further increase the likelihood of landslide occurrences (BNPB, 2020).

The occurrence of landslides is influenced by both natural and anthropogenic factors. Natural factors include soil composition, slope gradient, vegetation cover, and prolonged rainfall, while human activities such as deforestation, land conversion, mining, and unplanned infrastructure development significantly exacerbate the risk (Mileti, 1999). These combined factors not only trigger landslides but also amplify their impacts on vulnerable communities. The consequences of landslides extend beyond physical damage, including loss of life, displacement, disruption of livelihoods, and long-term socio-economic instability (Cannon, 2008). In many cases, the most affected populations are those with limited access to resources, information, and disaster preparedness systems.

Despite continuous efforts by the government to reduce disaster risks, disaster mitigation strategies in Indonesia have largely relied on top-down approaches. These approaches are typically characterized by centralized planning and policy-driven interventions that may not fully consider local contexts and community-specific needs (Chambers, 1994). While such strategies are important for establishing national frameworks and technical standards, they often fail to capture the socio-cultural dimensions of disaster risk. As a result, there is frequently a mismatch between formal policies and their effectiveness at the community level (Mercer et al., 2010).

In contrast, local communities have developed adaptive capacities and indigenous knowledge systems through long-term interaction with their surrounding environment. This local knowledge includes the ability to identify early warning signs of landslides, such as soil cracks, unusual water seepage, and changes in vegetation patterns. Furthermore, traditional practices, such as terracing and maintaining specific vegetation types, contribute to environmental sustainability and slope stability (Hiwasaki et al., 2014). Such knowledge is often context-specific, practical, and deeply embedded in local culture, making it highly relevant for disaster mitigation. However, despite its importance, local knowledge is often overlooked or undervalued in formal disaster management systems (Gaillard & Mercer, 2013).

The growing recognition of the limitations of top-down approaches has led to increased interest in community-based disaster risk reduction (CBDRR). This approach emphasizes the active

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participation of communities in all stages of disaster management, including risk assessment, planning, implementation, and evaluation (IFRC, 2014). By involving local communities as key actors, CBDRR enhances local ownership, improves the relevance of mitigation strategies, and strengthens community capacity to respond to disasters effectively. Moreover, participatory approaches have been shown to increase the sustainability of disaster risk reduction programs (Allen, 2006).

The integration of local knowledge with scientific and technological approaches offers a promising pathway for improving disaster mitigation outcomes. Scientific methods, such as geospatial analysis, hazard mapping, and early warning systems, provide systematic and data-driven insights into disaster risks (UNDRR, 2015). Meanwhile, local knowledge contributes contextual understanding and practical experience that enhance the applicability and acceptance of these scientific interventions at the community level (Mercer et al., 2010). Several studies have emphasized that combining these two knowledge systems can lead to more comprehensive and adaptive disaster mitigation strategies (Hiwasaki et al., 2014; Gaillard & Mercer, 2013).

However, despite the acknowledged importance of integrating local knowledge into disaster management, there remains a gap in understanding how such integration can be effectively operationalized within community-based frameworks, particularly in the context of landslide mitigation. Many existing studies tend to focus either on technical aspects of disaster mitigation or on community participation independently, with limited exploration of how these elements interact in practice (Mercer et al., 2010). This gap highlights the need for a more holistic approach that bridges scientific knowledge and local practices.

Therefore, this study aims to examine how community-based landslide disaster mitigation can be optimized through the integration of local knowledge to strengthen community resilience. Specifically, this research seeks to analyze the role of local knowledge in identifying risks and mitigation practices, evaluate the effectiveness of community participation, and explore strategies for integrating local and scientific knowledge into a cohesive and sustainable disaster mitigation framework.

LITERATURE REVIEW

1. Disaster Mitigation

Disaster mitigation refers to a series of efforts aimed at reducing disaster risks and impacts through both structural and non-structural measures, including physical development and community capacity building. According to the United Nations Office for Disaster Risk Reduction,

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mitigation encompasses all actions taken to minimize the adverse impacts of hazards before they occur, including risk assessment, land-use planning, and infrastructure reinforcement (UNDRR, 2015). Structural mitigation measures include the construction of retaining walls, slope stabilization, drainage systems, and reforestation, while non-structural measures involve policy formulation, public awareness campaigns, and disaster education.

In the context of landslide disasters, mitigation plays a crucial role in reducing vulnerability and exposure, particularly in high-risk areas. Effective mitigation strategies require a comprehensive understanding of hazard characteristics, environmental conditions, and socio-economic factors that influence risk (Mileti, 1999). However, traditional mitigation approaches often prioritize technical solutions while underestimating the importance of social dimensions, such as community behavior, local practices, and cultural values. As a result, mitigation efforts may fail to achieve optimal outcomes if they are not aligned with local contexts (Mercer et al., 2010).

2. Community-Based Disaster Risk Reduction (CBDRR)

Community-Based Disaster Risk Reduction (CBDRR) is an approach that emphasizes the active involvement of local communities in all stages of disaster management, from risk identification and planning to implementation and recovery. This approach recognizes that local communities are the first responders in disaster situations and possess valuable knowledge and resources that can enhance disaster preparedness and response (IFRC, 2014).

CBDRR shifts the paradigm from a top-down to a bottom-up approach by empowering communities to take ownership of disaster risk reduction initiatives. Participation in decision-making processes allows communities to identify their own vulnerabilities, capacities, and priorities, leading to more context-specific and sustainable solutions (Allen, 2006). Moreover, CBDRR fosters social cohesion, strengthens local institutions, and enhances collective action, which are essential components of effective disaster management.

Studies have shown that community participation significantly improves the effectiveness of disaster risk reduction programs by increasing awareness, preparedness, and adaptive capacity (Chambers, 1994). However, the success of CBDRR depends on the level of community engagement, the availability of resources, and the support of external stakeholders, including government agencies and non-governmental organizations (Mercer et al., 2010).

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3. Local Knowledge

Local knowledge, also referred to as indigenous or traditional knowledge, is a body of knowledge developed by communities through long-term interaction with their environment and transmitted across generations. This knowledge is deeply rooted in cultural practices, beliefs, and experiences, making it highly context-specific and adaptive to local conditions (Hiwasaki et al., 2014).

In the context of disaster risk reduction, local knowledge plays a critical role in understanding environmental changes, identifying hazard indicators, and implementing traditional mitigation practices. For example, communities in landslide-prone areas often rely on observable signs such as soil cracks, changes in water flow, and vegetation patterns to anticipate potential hazards. Additionally, traditional land management practices, such as terracing and agroforestry, contribute to slope stability and reduce the risk of landslides (Gaillard & Mercer, 2013).

Despite its relevance, local knowledge is often marginalized in formal disaster management frameworks, which tend to prioritize scientific and technical approaches. However, recent studies emphasize the importance of integrating local knowledge with scientific knowledge to enhance the effectiveness and sustainability of disaster mitigation strategies (Mercer et al., 2010). Such integration not only improves risk assessment but also increases community acceptance and participation in mitigation programs.

4. Community Resilience

Community resilience refers to the ability of a community to anticipate, cope with, adapt to, and recover from disaster impacts effectively and efficiently. It is a multidimensional concept that encompasses social, economic, institutional, and environmental capacities (UNDRR, 2015). Resilient communities are characterized by strong social networks, effective communication systems, access to resources, and adaptive governance structures.

The concept of resilience has gained significant attention in disaster studies as it shifts the focus from vulnerability to the capacity of communities to manage risks and recover from shocks (Cutter et al., 2008). Community resilience is not only about bouncing back to pre-disaster conditions but also about “bouncing forward” by improving systems and reducing future risks.

Several factors influence community resilience, including education, local leadership, institutional support, and access to information. Community-based approaches, such as CBDRR, play a vital role in strengthening resilience by enhancing local capacities and promoting collective

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action (IFRC, 2014). Furthermore, the integration of local knowledge into disaster risk reduction strategies contributes to resilience by ensuring that interventions are culturally appropriate and locally relevant (Hiwasaki et al., 2014).

In the context of landslide mitigation, strengthening community resilience involves improving early warning systems, enhancing preparedness, promoting sustainable land management practices, and fostering collaboration among stakeholders. Therefore, resilience should be viewed as a dynamic process that requires continuous learning, adaptation, and innovation.

RESEARCH METHODOLOGY

This study employs a qualitative research approach with a descriptive design to explore the role of community-based approaches and local knowledge in landslide disaster mitigation. A qualitative approach is considered appropriate as it allows for an in-depth understanding of social phenomena, particularly the interaction between community participation, local knowledge systems, and resilience in disaster contexts (Creswell, 2014). The descriptive method is used to systematically describe and interpret existing knowledge and practices related to disaster mitigation without manipulating variables.

The data utilized in this study are secondary data obtained through an extensive literature review. Sources include peer-reviewed academic journals, books, policy documents, and official reports published by national and international organizations related to disaster risk reduction, such as government agencies and global institutions. The literature review method enables the researcher to synthesize existing theories, empirical findings, and best practices regarding community-based disaster risk reduction (CBDRR), local knowledge, and community resilience (Snyder, 2019).

The data collection process involves identifying relevant literature through academic databases, screening sources based on relevance and credibility, and organizing the selected materials according to key themes. The inclusion criteria focus on publications that discuss disaster mitigation, landslides, community participation, and local or indigenous knowledge systems. This systematic approach ensures that the data used in the study are valid, reliable, and relevant to the research objectives.

Data analysis in this study follows an interactive model, consisting of three main stages: data reduction, data display, and conclusion drawing/verification (Miles et al., 2014). Data reduction involves selecting, simplifying, and categorizing relevant information from the collected

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literature to focus on key concepts and findings. Data display refers to the process of organizing the reduced data into structured forms, such as thematic narratives or conceptual groupings, to facilitate interpretation. Finally, conclusion drawing involves synthesizing the findings to identify patterns, relationships, and insights regarding the integration of local knowledge and community-based approaches in strengthening resilience.

To enhance the rigor and credibility of the study, the researcher applies a triangulation strategy by comparing findings from multiple sources and perspectives. This process helps to validate the consistency of the information and reduce potential bias (Patton, 1999). Additionally, the study adopts a thematic analysis approach to identify recurring themes and relationships across the literature, particularly those related to mitigation strategies, community engagement, and resilience outcomes.

Through this methodological framework, the study aims to provide a comprehensive and nuanced understanding of how local knowledge can be effectively integrated into community-based landslide disaster mitigation efforts. The approach also allows for the identification of key factors, challenges, and opportunities in strengthening community resilience within disaster-prone areas.

DISCUSSION

1. The Role of Local Knowledge in Landslide Mitigation

Local knowledge plays a vital role in identifying early warning signs of landslides, such as soil cracks, unusual water seepage, changes in vegetation patterns, and subtle shifts in land structure. This knowledge is developed through long-term interaction between communities and their surrounding environment, allowing them to recognize environmental cues that may not be immediately visible through conventional scientific instruments (Hiwasaki et al., 2014). In many rural and mountainous areas, local communities rely on experiential knowledge to anticipate hazards and take preventive actions.

In addition to early warning identification, traditional practices such as vegetation management, terracing, and maintaining natural drainage systems contribute significantly to slope stability. These practices not only reduce soil erosion but also enhance water absorption, thereby minimizing the risk of landslides (Gaillard & Mercer, 2013). Furthermore, local knowledge often includes customary rules or informal regulations governing land use, which can serve as an effective mechanism for environmental conservation.

However, despite its importance, local knowledge is often undervalued in formal disaster

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mitigation frameworks, which tend to prioritize technical and scientific approaches. This marginalization may lead to the loss of valuable indigenous practices and reduce the effectiveness of mitigation strategies. Therefore, recognizing and incorporating local knowledge into formal systems is essential for developing more context-specific and sustainable disaster mitigation approaches (Mercer et al., 2010).

2. Community-Based Approach in Disaster Mitigation

The community-based approach emphasizes active participation of local communities in all stages of disaster management, including risk assessment, planning, implementation, and evaluation. This approach shifts the paradigm from a centralized, top-down model to a more inclusive, bottom-up framework that recognizes communities as key actors in disaster risk reduction (IFRC, 2014).

Active participation fosters a sense of ownership and responsibility among community members, which in turn increases the sustainability and effectiveness of mitigation initiatives. When communities are directly involved in identifying risks and designing solutions, the resulting strategies are more likely to be relevant to local conditions and needs (Allen, 2006). Moreover, community engagement strengthens social cohesion and collective action, which are critical in emergency response situations.

In practice, community-based approaches can take various forms, such as participatory risk mapping, community training programs, and the establishment of local disaster management groups. These initiatives not only improve preparedness but also enhance communication and coordination at the local level. However, the success of this approach depends on several factors, including the level of community awareness, access to resources, and institutional support from government and external stakeholders (Chambers, 1994).

3. Integration of Local Knowledge and Scientific Approaches

The integration of local knowledge with scientific approaches represents a critical step toward developing comprehensive and effective disaster mitigation strategies. Scientific methods, such as geographic information systems (GIS), remote sensing, and early warning technologies, provide accurate and systematic data for hazard assessment and monitoring (UNDRR, 2015). However, these methods may lack contextual sensitivity if implemented without considering local conditions.

Local knowledge, on the other hand, offers context-specific insights and practical

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experience that can enhance the applicability of scientific interventions. For instance, traditional observations regarding rainfall patterns or soil conditions can complement technological tools to improve the accuracy and responsiveness of early warning systems. The combination of these two knowledge systems can create a more holistic approach that leverages both empirical data and lived experiences (Mercer et al., 2010).

Despite its potential, the integration process faces several challenges, including differences in epistemological perspectives, limited documentation of local knowledge, and institutional barriers. Therefore, effective integration requires collaborative mechanisms, mutual recognition, and continuous dialogue between scientists, policymakers, and local communities (Gaillard & Mercer, 2013). Such collaboration ensures that mitigation strategies are not only scientifically sound but also socially acceptable and sustainable.

4. Strengthening Community Resilience

Community resilience is a key outcome of effective disaster mitigation strategies. It refers to the capacity of a community to anticipate, cope with, adapt to, and recover from disaster impacts while maintaining essential functions (UNDRR, 2015). Strengthening resilience involves enhancing both individual and collective capacities through education, training, and institutional development.

Education and awareness programs play a crucial role in improving community understanding of disaster risks and appropriate response measures. Training initiatives, such as simulation exercises and emergency drills, help build practical skills and preparedness. Additionally, strengthening local institutions, including community-based organizations and disaster management committees, enhances coordination and resource mobilization during emergencies (IFRC, 2014).

Collaboration among stakeholders is another critical factor in building resilience. Effective disaster mitigation requires the involvement of multiple actors, including government agencies, non-governmental organizations, the private sector, and local communities. This collaborative approach aligns with the concept of multi-stakeholder governance, which emphasizes shared responsibility and coordinated action in addressing complex challenges (Cutter et al., 2008).

Furthermore, resilience should be viewed as a dynamic and continuous process rather than a static outcome. Communities must continuously adapt to changing environmental conditions, socio-economic factors, and emerging risks. In this context, the integration of local knowledge and community-based approaches provides a strong foundation for building adaptive and sustainable

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resilience in landslide-prone areas.

CONCLUSION

Community-based landslide disaster mitigation has proven to be an effective and relevant approach in reducing disaster risks, particularly in areas characterized by high vulnerability and complex environmental conditions. By positioning communities as active participants rather than passive beneficiaries, this approach enhances local ownership, strengthens adaptive capacity, and ensures that mitigation strategies are grounded in real community needs and experiences. As highlighted in this study, the active involvement of communities in disaster risk reduction processes contributes significantly to improving preparedness, responsiveness, and long-term sustainability.

The findings of this study underscore the critical role of integrating local knowledge with scientific and technological approaches. Local knowledge, which is deeply rooted in community experience and environmental interaction, provides valuable insights into early warning indicators and context-specific mitigation practices. When combined with scientific methods such as hazard mapping, monitoring systems, and risk analysis, it creates a more comprehensive and effective disaster mitigation framework. This integration not only improves the accuracy and relevance of mitigation strategies but also increases community acceptance and participation.

Furthermore, strengthening community resilience emerges as a key outcome of effective mitigation efforts. Resilient communities are better equipped to anticipate, respond to, and recover from disaster events while maintaining essential social and economic functions. This resilience is built through continuous processes, including education, capacity building, institutional strengthening, and the development of local leadership. In this context, community-based approaches and the incorporation of local knowledge serve as fundamental pillars in fostering adaptive and sustainable resilience.

However, the study also highlights the need for stronger collaboration and coordination among various stakeholders. Effective disaster mitigation cannot be achieved in isolation; it requires the collective efforts of governments, local communities, non-governmental organizations, and the private sector. Collaborative governance plays a crucial role in bridging the gap between policy and practice, ensuring that mitigation strategies are inclusive, context-sensitive, and well-coordinated across different levels.

In conclusion, optimizing community-based landslide disaster mitigation through the integration of local knowledge represents a strategic pathway toward enhancing community

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resilience and reducing disaster risks. Future efforts should focus on institutionalizing this integration within formal disaster management frameworks, promoting participatory approaches, and fostering multi-stakeholder collaboration. By doing so, disaster mitigation strategies can become more adaptive, sustainable, and responsive to the dynamic challenges posed by landslide hazards.

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