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Understanding the Behavioral Drivers of Landslide Mitigation: A Quantitative Assessment

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A B S T R A C T

This study aims to assess the levels of knowledge, attitude, and preparedness related to disaster mitigation and to analyze their influence on community readiness for landslides. A total of 180 residents of Lamkleng Village were selected using a simple random sampling technique. Data was collected through questionnaires and analyzed using multiple linear regression. The results showed significant positive effects of knowledge (B = 0.273, p = 0.000), attitude (B = 0.320, p = 0.001), and preparedness (B = 0.256, p = 0.001) on disaster mitigation. The regression model explained 50.7% of the variance in mitigation outcomes (Adjusted R^2 = 0.507). These findings suggest that behavioral factors are critical to improving disaster resilience and should be prioritized in community-based disaster risk reduction programs.

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INTRODUCTION

Indonesia's geographical configuration as an archipelago and its tropical climate renders the country highly prone to natural disasters, particularly landslides. The frequent occurrence of extreme weather due to climate variability exacerbates this vulnerability. In January 2021, a significant landslide event in Lamkleng Village, Aceh Besar, Indonesia, led to the displacement of 14 families. The area's geophysical characteristics—marked by alluvial, unconsolidated deposits—contribute to high susceptibility to land movement (Amalia et al., 2023). These incidents are not isolated, as similar events are frequently reported in various provinces, highlighting the persistent threat that landslides pose to human life, infrastructure, and socio-economic stability.

Globally, landslides are considered among the most destructive geological hazards, second only to earthquakes and floods in terms of casualties and economic loss (UNDRR, 2020). In Southeast Asia, and particularly in Indonesia, the combination of high rainfall intensity, mountainous topography, and land-use change creates a dangerous mix of natural and anthropogenic drivers of slope instability. Climate change further intensifies this risk by increasing rainfall variability and extreme weather patterns (IPCC, 2021). As a result, understanding community responses and developing effective mitigation strategies has become a national and regional priority.

Disaster mitigation, especially in high-risk zones, relies heavily on community-level behavioral responses. Previous studies have shown that public knowledge (Pertiwi et al., 2021), attitudes (Ajzen, 1991; Adiwijaya, 2017), and preparedness (Marlyono et al., 2016) significantly influence how communities respond to potential disasters. This study evaluates the extent to which these behavioral drivers affect landslide mitigation. The integration of behavioral science into disaster management research reflects a paradigm shift from purely structural interventions to approaches that also emphasize human and social dimensions.

Landslides are geological hazards characterized by the downward movement of soil, rocks, or debris. They are triggered by natural processes such as intense rainfall and earthquakes, but human interventions like deforestation, slope excavation, and poor land management practices can worsen their frequency and impact (Faizana et al., 2015). This dual nature—natural and anthropogenic—means that mitigation efforts must be comprehensive, addressing both environmental management and human behavior.

Knowledge is foundational in shaping people's behavior during disasters. Individuals who understand risk factors, early warnings, and evacuation routes are more likely to engage in timely and effective response behaviors (Pertiwi et al., 2021). Community education initiatives and public information campaigns have been recognized as effective ways to improve knowledge. Attitudes, as internal dispositions to respond favorably or unfavorably toward an object or event, significantly shape disaster-related behavior. According to the Theory of Planned Behavior (Ajzen, 1991), attitudes influence intentions, which in turn predict behavior. In disaster contexts, positive attitudes toward preparedness

measures have been shown to enhance participation in mitigation programs (Adiwijaya, 2017).

Preparedness refers to the measures undertaken before a disaster to ensure an effective response. It includes actions such as preparing emergency supplies, creating evacuation plans, and participating in disaster simulations. Communities with higher preparedness levels are consistently found to be more resilient during disasters (Marlyono et al., 2016). However, despite various government-led and non-governmental initiatives, gaps in preparedness remain, particularly in rural and underdeveloped regions. This highlights the importance of continuous capacity building and strengthening local disaster risk reduction mechanisms.

Disaster mitigation involves both structural measures, such as engineering interventions, and non-structural measures, like community training and risk communication. Research has emphasized that combining infrastructure development with education and community engagement yields the most effective results in reducing disaster risk (Suwaryo & Yuwono, 2017). In this regard, fostering disaster-resilient communities requires not only technical solutions but also behavioral change at the individual and collective levels.

Problem Statement and Research Gap

Although previous studies have confirmed that knowledge, attitudes, and preparedness influence disaster response behavior, limited research has specifically examined their combined effect on landslide mitigation in Indonesia, particularly in high-risk rural areas such as Aceh Besar. Most existing studies tend to focus on general disaster preparedness or single behavioral aspects, leaving a gap in understanding how these three variables interact holistically in the context of landslide-prone communities. Moreover, empirical evidence linking behavioral drivers with practical mitigation outcomes remains scarce. Therefore, this study seeks to address this gap by investigating the influence of knowledge, attitudes, and preparedness on landslide disaster mitigation at the community level, providing insights that can inform more effective and sustainable disaster risk reduction strategies.

LITERATUR REVIEW

Knowledge is the main foundation of any mitigation action. In the context of disasters, knowledge refers to individuals' understanding of the causes, signs, risks, and ways to reduce the impact of disasters. Risk knowledge requires that communities living in landslide-prone areas understand various triggering factors, such as heavy rain, erosion, earthquake tremors, and human activities such as cutting slopes for development. Understanding early warning signs, such as the appearance of ground cracks, cloudy well water, or leaning trees, is also vital to enable early evacuation (Fell et al., 2008). Furthermore, knowledge is not limited to “what” and ‘why’ but also includes “how,” which encompasses knowledge about structural mitigation measures such as gabion construction and erosion-control vegetation planting, as well as non-structural measures such as evacuation procedures and temporary shelter locations. A study by García and

Fearnley (2012) shows that effective education programs can significantly increase the level of public knowledge about landslide hazards. Additionally, the sources of knowledge whether from the government, non-governmental organizations, the media, or personal experience also influence the quality and accuracy of the knowledge possessed by individuals.

Knowledge is the main foundation of every mitigation action, which refers to an individual's understanding of the causes, signs, risks, and ways to reduce the impact of disasters. This knowledge covers two main aspects, namely risk knowledge to understand the triggering factors and early warning signs, and mitigation knowledge about concrete steps that can be taken, both structurally, such as making gabions, and non-structurally, such as evacuation procedures. The accuracy and quality of this knowledge are greatly influenced by the source of the information, whether it comes from the government, non-governmental organizations, the media, or personal experience. A study by García and Fearnley (2012) demonstrated that effective education programs can significantly improve the public's understanding of landslide hazards, which ultimately forms the basis for better action.

Attitudes, which are an individual's evaluation or feelings toward risk and mitigation programs, act as drivers or inhibitors of behavior. These attitudes are often manifested through risk perception; communities that underestimate the threat of landslides (optimism bias) or adopt a fatalistic attitude tend to have low motivation to participate in mitigation efforts (Slovic, 2000). Conversely, realistic risk perceptions encourage more positive attitudes. Additionally, attitudes are shaped by trust in institutions and, most importantly, by individuals' belief in their own ability (self-efficacy) to take mitigation actions, as emphasized in the Theory of Planned Behavior (Ajzen, 1991). Without this trust and belief, community attitudes tend to be negative and passive.

Disaster mitigation is an umbrella concept that encompasses all efforts to reduce the impact of disasters, which are generally divided into two approaches. First, structural mitigation, which involves engineering techniques such as installing safety nets, retaining walls, and drainage systems. Second, non-structural mitigation, which includes spatial planning policies, early warning systems, insurance, and—most relevant to this study—strengthening community behavior (UNISDR, 2009). In the context of this research, mitigation behavior is an outcome variable measured through participation in training, application of soil conservation techniques, compliance with evacuation warnings, and advocacy for policies at the community level.

METHODOLOGY

This cross-sectional was conducted among 180 residents of Lamkleng Village in Aceh Besar, Indonesia, selected from a population of 317 using Slovin's formula at a 10% margin of error. A simple random sampling technique ensured equal participation opportunities. Data were collected via structured questionnaires assessing knowledge, attitude, preparedness, and disaster mitigation.

To determine the influence of the three independent variables—knowledge, attitude, and preparedness—on the dependent variable (disaster mitigation),

multiple linear regression analysis was employed. Significance was tested using t-tests and F-tests, with a 95% confidence level.

RESEARCH RESULTS

The descriptive analysis revealed that most respondents were categorized as having "good" or "very good" levels across the studied variables. 57 respondents scored "very good" in both attitude and preparedness, 46 in knowledge, and 44 in disaster mitigation. The "good" category had the highest count in disaster mitigation (74), preparedness (67), attitude (66), and knowledge (63). The "fair" category had notable representation in mitigation (56) and knowledge (54), suggesting moderate community competence in those areas.

A multiple linear regression analysis showed that knowledge (B = 0.273, p = 0.001), attitude (B = 0.320, p = 0.001), and preparedness (B = 0.256, p = 0.001) significantly influenced disaster mitigation. The regression equation was:

Y = 3.978 + 0.273(Knowledge) + 0.320(Attitude) + 0.256(Preparedness)

Attitude had the strongest standardized coefficient (β = 0.368), indicating its primary role in enhancing mitigation behaviors. Knowledge (β = 0.299) and preparedness (β = 0.253) also contributed significantly. The detailed regression output is shown in Table 1.

Table 1. Results of Analysis of Knowledge, Attitudes, Preparedness for Disaster Mitigation

Coefficients[a]						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	3.978	1.768		2.249	.026
	Knowledge Category	.273	.053	.299	5.110	.001
	Attitude Category	.320	.053	.368	6.006	.001
	Category of Preparedness	.256	.065	.253	3.920	.001
a. Dependent Variable: Disaster Mitigation Category						

To determine the overall significance of the regression model, an ANOVA test was conducted. As shown in Table 2, the F-value of 62.300 with a significance level of p = 0.000 indicates that the model is statistically significant, confirming that the combined predictors explain a substantial portion of the variance in disaster mitigation.

Table 2. ANOVA for Disaster Mitigation

ANOVA[a]						
Model		**Sum of Squares**	**Df**	**Mean Square**	**F**	**Sig.**
1	Regression	2360.745	3	786.915	62.300	.000[b]
	Residual	2223.055	176	12.631		
	Total	4583.800	179			
a. Dependent Variable: Disaster Mitigation Category						
b. Predictors: (Constant), Preparedness Category, Knowledge Category, Attitude Category						

Furthermore, Table 3 shows the model summary including the coefficient of determination. The adjusted R^2 value of 0.507 suggests that approximately 50.7% of the variability in disaster mitigation is accounted for by the combined influence of knowledge, attitude, and preparedness.

Table 3. Correlation Analysis and Determination Correlation

Model Summary				
Model	**R**	**R Square**	**Adjusted R Square**	**Std. Error of the Estimate**
1	.718[a]	.515	.507	3.55401
a. Predictors: (Constant), Preparedness Category, Knowledge Category, Attitude Category				
a. Dependent Variabel: Disaster Mitigation Category				

Source: Primary data, processed (2025)

DISCUSSION

The results of this study confirm the significant influence of knowledge, attitude, and preparedness on disaster mitigation in the context of landslides. Among the three independent variables, attitude emerged as the most influential factor (B = 0.320, β = 0.368, p = 0.000). This finding aligns with Ajzen's (1991) Theory of Planned Behavior, which emphasizes the importance of personal attitudes in shaping behavioral intentions and actions. A positive attitude toward mitigation efforts likely fosters a greater sense of responsibility and motivation to participate in disaster preparedness and response activities.

Knowledge also showed a statistically significant effect (B = 0.273, β = 0.299, p = 0.000), highlighting the importance of information and education in risk reduction. Respondents who possessed a better understanding of landslide risks

and mitigation measures were more likely to engage in appropriate behaviors. This supports prior research by Pertiwi et al. (2021) and Suwaryo & Yuwono (2017), which found that knowledge is a crucial determinant in shaping community readiness.

Preparedness, while having the lowest regression coefficient among the three (B = 0.256, β = 0.253, p = 0.000), still demonstrated a strong influence on mitigation outcomes. This suggests that even when knowledge and attitude are favorable, practical readiness in the form of emergency plans, supplies, and training plays a vital role. The relevance of preparedness in reducing vulnerability is consistent with findings by Marlyono et al. (2016) and resonates with the Protection Motivation Theory (Rogers, 1975), which posits that preparedness is driven by perceived threat and efficacy.

The high F-value (F = 62.300, p = 0.001) and adjusted R^2 value of 0.507 reflect a robust regression model, explaining over half of the variance in disaster mitigation behavior. This underscores the collective impact of cognitive (knowledge), affective (attitude), and behavioral (preparedness) components on community resilience.

These findings have practical implications for disaster management programs. Effective interventions should not only focus on knowledge dissemination but also target attitude change through community engagement and simulations. Moreover, efforts to improve preparedness such as regular drills, community-based early warning systems, and household-level planning should be prioritized.

In conclusion, enhancing disaster mitigation in landslide-prone communities requires a multidimensional approach that integrates educational, motivational, and practical strategies. This behavioral model provides a strong foundation for policymakers and practitioners seeking to strengthen local capacity and reduce disaster risk.

CONCLUSIONS AND RECOMMENDATIONS

This study concludes that knowledge, attitude, and preparedness are significant behavioral drivers of landslide disaster mitigation. Among these variables, attitude exerted the most substantial influence on mitigation behavior, followed closely by knowledge and preparedness. This outcome highlights the pivotal role of mental and emotional readiness, which can motivate individuals and communities to take proactive steps in reducing disaster risks.

The integration of cognitive understanding, emotional commitment, and practical preparedness offers a comprehensive framework for enhancing community resilience. While individuals may possess adequate knowledge about disaster risks and necessary precautions, the willingness to act—shaped by attitude—serves as a crucial link between awareness and behavior. Moreover, preparedness transforms this awareness and willingness into tangible readiness, ensuring that individuals and households are equipped to respond effectively during a disaster.

Given these findings, disaster risk reduction programs should adopt a holistic approach that goes beyond mere information dissemination. Public education campaigns should be designed to foster not only knowledge but also positive attitudes toward risk mitigation. Active community engagement, participatory simulations, and storytelling can be used to influence perception and behavior at the grassroots level. Furthermore, investments in preparedness infrastructure, such as emergency kits, evacuation route planning, and community-based early warning systems, are essential to translate awareness into action.

ADVANCED RESEARCH

Future research could explore the interplay between behavioral variables and external factors such as access to resources, institutional support, and local governance. Understanding these dynamics could further strengthen disaster management strategies, especially in high-risk and underserved communities. Ultimately, reinforcing behavioral dimensions—knowledge, attitude, and preparedness can form the backbone of effective and sustainable disaster mitigation efforts.

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