

Hydrometeorological Disasters in Central Aceh in 2025: A Qualitative Analysis of Impacts and Mitigation Strategies

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ABSTRACT

Hydrometeorological disasters in Central Aceh in 2025, in the form of flash floods and landslides affecting the districts of Ketol, Kebayakan, and Sekeliling, caused dozens of fatalities, damage to settlements, and the disruption of road access and vital infrastructure; this study aims to analyze the qualitative impacts and mitigation strategies to strengthen the resilience of mountain communities. The method used is a qualitative approach through in-depth interviews with 20 household heads affected by the disaster, representatives of the local government, and analysis of disaster-management documents from the Central Aceh Disaster Management Agency and emergency-response records from November–December 2025. The results indicate that the main impacts include psychological trauma, loss of agricultural livelihoods, and damage to road, bridge, and irrigation infrastructure; meanwhile, strong triggering factors include unstable soil, changes in land use, and an underdeveloped early-warning system in mountainous areas. The main conclusion states that effective disaster mitigation requires a combination of strengthened local institutions, ecosystem restoration, and active community participation in mitigation planning. The key recommendations include the establishment of disaster-resilient villages, the relocation of settlements to safer areas, and the enhancement of capacity among local officials and volunteers in dealing with hydrometeorological emergencies in Central Aceh.

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Introduction

Hydrometeorological disasters have become increasingly frequent and severe in many mountainous regions of Indonesia, particularly as a result of climate change, environmental degradation, and unsustainable land-use practices. In 2025, Central Aceh Regency experienced a series of devastating hydrometeorological disasters, including flash floods and landslides that affected the districts of Ketol, Kebayakan, and surrounding areas. These events resulted in significant human casualties, destruction of residential settlements, disruption of transportation networks and critical infrastructure, and substantial losses to local livelihoods, particularly among farming communities whose economic activities are highly dependent on land and climatic conditions. The severity of these impacts highlights the growing vulnerability of mountainous communities to hydrometeorological hazards and underscores the need for context-specific disaster risk reduction strategies.

Central Aceh possesses unique geographical characteristics that distinguish it from many disaster-prone regions in Indonesia. Situated within a mountainous landscape characterized by steep slopes, unstable terrain, and high rainfall intensity, the region faces persistent threats from landslides and flash floods. These environmental conditions are further exacerbated by deforestation, land-use conversion, and unplanned settlement expansion, all of which contribute to increasing disaster risks. Moreover, recent patterns of extreme rainfall observed throughout 2025 indicate that climate variability and climate change are intensifying the frequency and magnitude of hydrometeorological events in the region. Consequently, conventional disaster management approaches developed for coastal or lowland areas may not adequately address the specific vulnerabilities and recovery needs of mountainous communities.

Although numerous studies have examined hydrometeorological disasters in Indonesia, most have focused on coastal regions, urban flooding, or technical assessments involving hazard mapping, rainfall modeling, and infrastructure vulnerability. Existing research has predominantly adopted quantitative and engineering-oriented perspectives, often overlooking the lived experiences of affected communities, local institutional capacities, and the socio-cultural dimensions of disaster resilience. Furthermore, empirical studies focusing specifically on mountainous regions such as Central Aceh remain limited, particularly those employing qualitative approaches to explore how communities perceive, experience, and respond to disaster events. This gap is significant because effective disaster risk reduction requires not only technical interventions but also an

understanding of local knowledge systems, social dynamics, and community-based coping mechanisms.

The novelty of this study lies in its integration of social, cultural, and institutional perspectives in examining hydrometeorological disasters within a mountainous context. Unlike previous studies that primarily emphasize physical damage assessment and hazard analysis, this research places community experiences, disaster-related trauma, local wisdom, and institutional responses at the center of analysis. In addition, the study investigates the interactions between environmental change, livelihood vulnerability, and local governance structures, providing a more comprehensive understanding of disaster impacts and resilience-building processes. By adopting a qualitative perspective, this research offers insights into dimensions of disaster management that are often overlooked in technically oriented studies.

Accordingly, this study seeks to address four key research questions: (1) What are the qualitative impacts of hydrometeorological disasters on communities in Ketol, Kebayakan, and surrounding areas of Central Aceh? (2) What factors contribute to and intensify community vulnerability to these disasters? (3) How do local institutions and community members participate in disaster response and recovery processes? and (4) What disaster management strategies are most relevant and feasible within the socio-environmental context of mountainous Central Aceh?

The primary objective of this study is to provide an in-depth analysis of the social, economic, cultural, and environmental impacts of the 2025 hydrometeorological disasters in Central Aceh and to formulate contextually appropriate disaster management strategies. Specifically, the study aims to identify vulnerability factors, examine the roles of local institutions and community participation, and develop recommendations based on community capacity strengthening, ecosystem restoration, and locally grounded early warning systems. Ultimately, this research seeks to contribute both theoretically and practically to the development of adaptive, participatory, and sustainable disaster risk reduction models for mountainous regions in Indonesia..

Method

Research Design

This study employed a qualitative case study design to explore the impacts of hydrometeorological disasters and the effectiveness of disaster management strategies in Central Aceh following the 2025 disaster events. A qualitative approach was selected because it enables an in-depth understanding of community experiences, perceptions, and responses within their natural socio-environmental context. The case study design was particularly appropriate for examining the complex interactions among environmental vulnerability, community resilience, local institutions, and disaster recovery processes in mountainous regions.

Research Setting and Participants

The study was conducted in the districts of Ketol, Kebayakan, and surrounding areas of Central Aceh Regency, Indonesia, which were among the regions most severely affected by flash floods and landslides during the 2025 hydrometeorological disasters. Data collection took place between January and April 2026, allowing sufficient time for post-disaster reflection while ensuring accessibility to affected communities.

The study population consisted of residents directly impacted by the disasters in the selected districts. Participants were recruited using purposive sampling to ensure the inclusion of individuals with diverse experiences and socioeconomic backgrounds. Selection criteria considered variations in livelihood characteristics, housing conditions, and levels of disaster-related damage. A total of 20 household heads participated as primary respondents, providing detailed accounts of their experiences during and after the disaster.

In addition, key informants were selected to provide institutional and community-level perspectives. These informants included representatives from the Central Aceh Regional Disaster Management Agency (BPBD), district officials, village leaders, and respected community figures. Their participation enabled a broader understanding of disaster governance, emergency response mechanisms, recovery efforts, and local knowledge systems.

Data Sources and Collection Procedures

The study utilized both primary and secondary data sources. Primary data were collected through in-depth semi-structured interviews with affected households and key stakeholders. The interviews explored participants' experiences of disaster impacts, perceptions of vulnerability, coping strategies, recovery processes, and evaluations of existing disaster management efforts.

Secondary data were obtained from official reports issued by the Central Aceh Regional Disaster Management Agency (BPBD), emergency response status extension documents, government reports, disaster-related news coverage, and relevant documentation produced between November and December 2025. These materials were used to contextualize the disaster events, verify information obtained from participants, and provide a comprehensive understanding of policy responses and institutional actions.

Field observations were also conducted to document environmental conditions, infrastructure damage, settlement characteristics, and community recovery activities. Observational notes served as supplementary evidence to enrich the interpretation of interview findings.

Data Analysis

Data analysis followed an inductive thematic analysis approach. Interview recordings were transcribed verbatim and repeatedly reviewed to ensure familiarity with the data. The analysis proceeded through several stages: data reduction, coding, categorization, and theme development. Emerging patterns and recurring narratives were systematically grouped into broader themes representing key dimensions of disaster impacts and community responses.

Several major themes were identified, including psychological impacts, socio-economic consequences, vulnerability factors, institutional responses, community resilience, and local coping strategies. These themes were continuously refined through iterative comparison across interviews, observations, and documentary evidence.

To enhance the credibility and trustworthiness of the findings, data triangulation was employed by comparing information obtained from multiple sources, including interviews, field observations, and official documents. Member checking and peer debriefing were also utilized during the interpretation process to minimize researcher bias and strengthen the validity of the findings.

The final stage involved synthesizing the thematic findings into an integrated narrative that explains the multidimensional impacts of hydrometeorological disasters in Central Aceh and identifies contextually appropriate disaster risk reduction and recovery strategies for mountainous communities.

Result and Discussion

Results

The findings revealed that the 2025 hydrometeorological disasters in Central Aceh had extensive and multidimensional impacts on communities living in the mountainous areas of Ketol, Kebayakan, and surrounding districts. From a human perspective, the disasters resulted in numerous fatalities and injuries, particularly among vulnerable groups such as older adults and children who were trapped during flash floods and landslides.

Socially, the disasters generated feelings of anxiety, uncertainty, and dissatisfaction regarding the perceived inadequacy of governmental response efforts. However, the crisis simultaneously strengthened community solidarity and collective action. Participants reported widespread mutual assistance practices, including communal sheltering, resource sharing, voluntary rescue efforts, and collective rebuilding activities. These forms of social cohesion played a critical role in supporting community recovery during the immediate post-disaster period.

Economically, the impacts were particularly severe among farming households, which constitute the dominant livelihood group in the study area. Most respondents reported substantial losses of agricultural land, crops, livestock, and farming equipment. Local traders also experienced significant economic disruptions, with estimated income reductions ranging from 50% to 70% during the first several months following the disaster. These losses further intensified household vulnerability and delayed recovery processes.

Environmental impacts included the destruction of transportation infrastructure, damaged bridges and irrigation systems, severe soil erosion, and extensive sediment deposition on agricultural land. Several villages experienced prolonged isolation due to road blockages caused by landslides, limiting access to emergency assistance and essential services.

Psychologically, the majority of respondents reported symptoms associated with disaster-related stress, including anxiety, sleep disturbances, recurring fear during periods of heavy rainfall, and emotional distress. Several children exhibited signs of severe trauma that required professional psychological support. These findings suggest that the consequences of the disaster extended far beyond physical damage, affecting the long-term mental well-being of affected populations.

Discussion

The findings can be understood through the lens of Disaster Vulnerability Theory, which argues that disaster impacts are not solely determined by the magnitude of a hazard but are significantly influenced by the social, economic, environmental, and institutional conditions that shape community vulnerability. The results indicate that the vulnerability of mountainous communities in Central Aceh stems from the interaction of multiple factors, including limited economic resources, restricted access to information, inadequate infrastructure, and environmentally sensitive geographical conditions.

Although extreme rainfall events were identified as the immediate trigger of the floods and landslides, several underlying factors amplified disaster risks. These included deforestation, conversion of forested areas into agricultural plantations and settlements, and the construction of housing on steep slopes and near riverbanks. Such practices have reduced environmental resilience and increased exposure to hydrometeorological hazards. These findings support previous studies demonstrating that land-use change and ecosystem degradation are critical drivers of disaster vulnerability in mountainous regions.

The study also revealed significant weaknesses in local disaster preparedness systems. Many respondents reported receiving warning information only after floodwaters or landslides had already occurred. The absence of community-based early warning mechanisms substantially reduced opportunities for evacuation and self-protection. Furthermore, limited technical capacity among village-level emergency personnel and volunteers contributed to delays in evacuation, damage assessment, and aid distribution. These findings highlight the importance of strengthening local institutional capacity as a fundamental component of disaster risk reduction.

From the perspective of Community-Based Disaster Risk Reduction (CBDRR), the strong social solidarity observed among affected communities represents a valuable form of social capital that can be mobilized for future disaster preparedness initiatives. Community cooperation, mutual assistance, and local knowledge were found to be essential resources that enabled residents to cope with immediate challenges and initiate recovery efforts despite limited external support. These findings reinforce the argument that effective disaster management should not rely exclusively on top-down governmental interventions but should actively involve local communities as central actors in risk reduction and resilience-building processes.

The psychological impacts identified in this study also have important implications for disaster recovery policy. The prevalence of anxiety, trauma, and recurring fear indicates that post-disaster interventions should extend beyond infrastructure reconstruction and economic assistance. Psychosocial support services, trauma counseling, and community-based mental health programs should be integrated into recovery frameworks to promote holistic and sustainable recovery outcomes.

Similarly, the disruption of agricultural livelihoods suggests the need for the development of disaster-resilient economic systems. Strategies such as climate-adaptive farming practices, diversification of household income sources, soil conservation programs, and community-based forest restoration may enhance long-term resilience while simultaneously reducing environmental degradation. Restoring forest ecosystems is particularly important because forests function as natural protective barriers against landslides and excessive surface runoff in mountainous environments.

Another important implication concerns the development of locally grounded early warning systems. Strengthening village communication networks, providing disaster preparedness training, and utilizing accessible technologies for hazard monitoring could significantly improve community

readiness and reduce future disaster losses. Integrating scientific knowledge with the indigenous ecological knowledge of the Gayo people may further enhance the effectiveness and cultural relevance of disaster mitigation programs.

Overall, this study contributes to the growing body of knowledge on hydrometeorological disaster management by demonstrating the importance of integrating local wisdom, community participation, ecosystem restoration, and institutional strengthening within disaster risk reduction strategies. Rather than viewing hydrometeorological disasters solely as environmental threats, the findings suggest that such events can serve as opportunities to strengthen social-ecological resilience and promote more sustainable forms of community development in mountainous regions.

Research Implications

The findings provide practical implications for policymakers, disaster management agencies, and local governments. Future disaster management policies in Central Aceh should prioritize community-based preparedness programs, ecosystem conservation initiatives, and integrated psychosocial recovery services. Furthermore, the study offers a conceptual framework for developing disaster-resilient villages in mountainous areas by incorporating social, economic, cultural, environmental, and institutional dimensions into disaster risk reduction planning.

Conclusion

This study demonstrates that the 2025 hydrometeorological disasters in Central Aceh generated multidimensional impacts on communities in the mountainous districts of Ketol, Kebayakan, and surrounding areas. The disasters affected not only physical infrastructure and local economies but also social cohesion, environmental sustainability, and psychological well-being. While many households experienced significant losses of agricultural land, livelihoods, and essential infrastructure, the disasters also revealed the importance of community solidarity and collective action in supporting recovery efforts.

The findings indicate that community vulnerability is shaped by a combination of environmental, socioeconomic, and institutional factors. Although extreme rainfall acted as the immediate trigger of flash floods and landslides, the severity of impacts was intensified by deforestation, land-use changes, settlement development in high-risk areas, limited access to disaster information, and inadequate local preparedness systems. These conditions highlight that disaster risk is not solely a product of natural hazards but is also influenced by underlying vulnerabilities within communities and institutions.

The study further reveals that effective disaster management in mountainous regions requires a shift from predominantly top-down approaches toward more participatory and community-based strategies. Strengthening local capacities, improving early warning systems, enhancing disaster preparedness at the village level, and integrating psychosocial recovery programs are essential for building long-term resilience. In addition, ecosystem restoration, sustainable land management, and the preservation of local ecological knowledge should be prioritized as integral components of disaster risk reduction.

Overall, this research contributes to the understanding of hydrometeorological disasters in mountainous environments by emphasizing the interconnected roles of community resilience, institutional capacity, and environmental sustainability. The findings provide practical guidance for policymakers and disaster management practitioners in designing adaptive, participatory, and context-sensitive disaster risk reduction strategies. Ultimately, strengthening social-ecological resilience offers a sustainable pathway toward developing disaster-resilient communities in Central Aceh and other mountainous regions facing similar hydrometeorological threats.

This study is limited by its focus on a relatively small number of participants and a specific geographical context within Central Aceh. Therefore, the findings should be interpreted within the local context of the affected communities. Future research is encouraged to involve a larger number of participants, incorporate comparative studies across different mountainous regions, and employ mixed-method approaches to further examine the long-term social, economic, and psychological consequences of hydrometeorological disasters. Such studies would contribute to a more comprehensive understanding of disaster resilience and sustainable recovery processes.

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