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COMMUNITY PARTICIPATION IN LANDSLIDE DISASTER MITIGATION: EXAMINING IMPLEMENTATION AND BENEFIT DISTRIBUTION IN MAKALE SUBDISTRICT, TANA TORAJA REGENCY, INDONESIA

PARTICIPAÇÃO DA COMUNIDADE NA MITIGAÇÃO DE DESASTRES CAUSADOS POR DESLIZAMENTOS DE TERRA: UMA ANÁLISE DA IMPLEMENTAÇÃO E DA DISTRIBUIÇÃO DE BENEFÍCIOS NO SUBDISTRITO DE MAKALE, REGIÃO DE TANA TORAJA, INDONÉSIA

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Abstract
This study examines community participation in landslide disaster mitigation in mountainous areas, focusing on two key dimensions: participation in implementation and participation in benefits. Using a qualitative case study approach, data were collected through in-depth interviews with seven purposively selected informants, including disaster management agency officials, village leaders, and community members residing in landslide-prone areas, supplemented by field observations and document analysis. The research applies Cohen and Uphoff's (1980) participation framework, specifically analyzing participation in implementation through resource contribution, administrative and coordination involvement, and program enrollment, as well as participation in benefits through material, social, and personal dimensions. Findings reveal that communities demonstrate high levels of resource mobilization rooted in indigenous mutual cooperation values, engaging actively in emergency response, infrastructure rehabilitation, and environmental maintenance activities. Administrative and coordination mechanisms function through tiered reporting systems utilizing both digital and conventional communication channels, though constrained by infrastructure limitations and predominantly reactive rather than proactive approaches. Program enrollment remains largely top-down, with limited formal mechanisms for bottom-up community-initiated proposals. Communities receive comprehensive material benefits including emergency aid and housing

Resumo
Este estudo examina a participação da comunidade na mitigação de desastres de deslizamentos de terra em áreas montanhosas, com foco em duas dimensões principais: participação na implementação e participação nos benefícios. Utilizando uma abordagem qualitativa de estudo de caso, os dados foram coletados por meio de entrevistas em profundidade com sete informantes selecionados intencionalmente, incluindo funcionários de agências de gestão de desastres, líderes comunitários e membros da comunidade residentes em áreas propensas a deslizamentos de terra, complementadas por observações de campo e análise documental. A pesquisa aplica a estrutura de participação de Cohen e Uphoff (1980), analisando especificamente a participação na implementação por meio da contribuição de recursos, envolvimento administrativo e de coordenação e adesão a programas, bem como a participação nos benefícios por meio das dimensões material, social e pessoal. Os resultados revelam que as comunidades demonstram altos níveis de mobilização de recursos enraizados em valores indígenas de cooperação mútua, engajando-se ativamente em atividades de resposta a emergências, reabilitação de infraestrutura e manutenção ambiental. Os mecanismos administrativos e de coordenação funcionam por meio de sistemas de relatórios hierárquicos, utilizando canais de comunicação digitais e convencionais, embora limitados por restrições de infraestrutura e abordagens

relocation, substantial social benefits manifested through strengthened cohesion and collective action capacity, and personal benefits encompassing basic knowledge and improved well-being, though technical capacity remains limited due to absence of practical training. The study identifies critical gaps between responsive-curative interventions and preventive-educational programs, underscoring the necessity for transitioning toward community-driven disaster risk reduction through institutionalized participatory mechanisms, hybrid communication systems, experiential capacity building, and supportive regulatory frameworks to build sustainable disaster resilience in vulnerable communities.

Keywords: Community Participation. Landslide Disaster Mitigation. Disaster Risk Reduction. Community-Based Disaster Management. Disaster Resilience.

predominantemente reativas em vez de proativas. A adesão a programas permanece em grande parte de cima para baixo, com mecanismos formais limitados para propostas iniciadas pela comunidade de baixo para cima. As comunidades recebem benefícios materiais abrangentes, incluindo ajuda emergencial e realocação de moradias, benefícios sociais substanciais manifestados por meio do fortalecimento da coesão e da capacidade de ação coletiva, e benefícios pessoais que abrangem conhecimento básico e melhoria do bem-estar, embora a capacidade técnica permaneça limitada devido à ausência de treinamento prático. O estudo identifica lacunas críticas entre intervenções responsivas-curativas e programas preventivos-educacionais, ressaltando a necessidade de transição para a redução do risco de desastres liderada pela comunidade por meio de mecanismos participativos institucionalizados, sistemas de comunicação híbridos, capacitação experiencial e estruturas regulatórias de apoio para construir resiliência sustentável a desastres em comunidades vulneráveis.

Palavras-chave: *Participação Comunitária. Mitigação de Desastres por Deslizamentos de Terra. Redução do Risco de Desastres. Gestão de Desastres Baseada na Comunidade. Resiliência a Desastres.*

1 INTRODUCTION

Landslide disasters represent one of the most devastating natural hazards affecting mountainous regions globally, causing substantial loss of life, infrastructure damage, and economic disruption. Indonesia, positioned within the Pacific Ring of Fire and characterized by complex topography, faces exceptionally high landslide risk, with approximately 194 million people exposed to landslide hazards and potential economic losses estimated at USD 13 billion (Miyamoto International, 2025). Recent catastrophic events in Sumatra during November 2025, which triggered over 4,000 documented landslides and resulted in 442 fatalities across North Sumatra, West Sumatra, and Aceh provinces, underscore the urgent need for effective disaster risk reduction strategies (Al Jazeera, 2025). The increasing frequency and severity of landslide events, exacerbated by climate change, intensive rainfall patterns, and unsustainable land use practices,

necessitate comprehensive approaches that integrate scientific knowledge with community-based disaster management frameworks.

Contemporary disaster risk reduction paradigms emphasize the critical role of community participation in building resilience and reducing vulnerability to natural hazards. The Sendai Framework for Disaster Risk Reduction 2015-2030 explicitly advocates for inclusive, accessible, and non-discriminatory participation of all stakeholders, particularly vulnerable populations, in disaster management processes (Alcántara-Ayala & Sassa, 2023). Participatory approaches have demonstrated effectiveness in enhancing disaster preparedness, improving early warning system responsiveness, and fostering sustainable mitigation practices across diverse geographical contexts (Zhang et al., 2021). However, significant implementation challenges persist, including limited community engagement in decision-making processes, insufficient integration of indigenous knowledge systems, inequitable distribution of mitigation benefits, and weak evaluation mechanisms that fail to capture grassroots experiences (Scolobig et al., 2024).

Community participation in disaster management extends beyond passive involvement to encompass active engagement across multiple dimensions of the disaster risk reduction cycle. Cohen and Uphoff's (1980) seminal framework identifies four distinct yet interconnected forms of participation: participation in decision-making, participation in implementation, participation in benefits, and participation in evaluation. While comprehensive participation across all dimensions represents the ideal approach, practical constraints often necessitate prioritization of specific participatory forms based on local contexts, resource availability, and immediate community needs. Research from geological disaster-prone areas in Southwest China demonstrates that model disaster mitigation communities achieve higher participation rates in evacuation drills and self-help skills training compared to non-model communities, though challenges remain in facilitating meaningful feedback mechanisms (Liu et al., 2021). Similarly, studies from landslide-affected regions in South Asia highlight that effective coordination between government agencies, community organizations, and local residents constitutes an essential prerequisite for implementing sustainable risk reduction measures (Thirugnanam et al., 2023).

The implementation dimension of community participation represents a critical juncture where disaster mitigation strategies transition from planning to action.

Participation in implementation involves direct community engagement in executing mitigation activities, including infrastructure development, early warning system installation, evacuation drill conduct, and capacity-building initiatives (Witvorapong et al., 2015). Effective implementation participation requires adequate resource mobilization, technical support provision, and institutional coordination mechanisms that enable communities to translate mitigation plans into tangible actions. Research from disaster-resilient villages in Indonesia demonstrates that active community participation in mutual cooperation activities, coordinated through local disaster management agencies, significantly enhances non-structural mitigation effectiveness (Santoso et al., 2020). However, barriers to implementation participation persist, including limited technical knowledge, inadequate financial resources, insufficient heavy equipment availability, and weak coordination between government agencies and community stakeholders (Anderson & Holcombe, 2023).

The benefits dimension of community participation addresses the equitable distribution and accessibility of disaster mitigation advantages across diverse population segments. Participation in benefits encompasses both tangible outcomes, such as improved infrastructure, enhanced livelihood security, and reduced economic losses, and intangible outcomes, including increased disaster awareness, strengthened social cohesion, and enhanced community resilience (Maes et al., 2019). Equitable benefit distribution is essential for sustaining long-term community engagement, preventing elite capture of mitigation resources, and addressing vulnerabilities of marginalized groups who often bear disproportionate disaster impacts (Platteau, 2004). Studies examining community-based disaster risk reduction programs reveal that benefit distribution patterns significantly influence community resilience scores, with communities demonstrating higher resilience when mitigation activities generate broad-based participation and inclusive access to program advantages (Chen et al., 2020). Nevertheless, benefit distribution inequities frequently emerge, particularly when certain groups—such as traditional leaders, government-connected individuals, or economically advantaged households—receive preferential access to training opportunities, early warning information, or post-disaster assistance (Mohan, 2006).

Makale Subdistrict, serving as the capital of Tana Toraja Regency in South Sulawesi Province, exemplifies the complex challenges confronting mountainous communities exposed to recurrent landslide hazards. The subdistrict's geographical

characteristics—encompassing elevations ranging from less than 300 meters to over 2,500 meters above sea level, steep slopes averaging above 25% gradient, and annual rainfall exceeding 3,500 millimeters—create highly susceptible conditions for landslide occurrence (Provincial Government of South Sulawesi, 2019). Historical data from the South Sulawesi Disaster Event Analysis and Reporting System (Siandalan) documents persistent landslide activity across multiple villages in Makale Subdistrict during 2021-2025, with particularly devastating consequences in 2024 when a single landslide event in Manggau village resulted in 14 fatalities and six destroyed residential structures. These recurring disasters impose substantial human casualties, property losses, and socioeconomic disruptions while simultaneously constraining emergency response capabilities due to limited access roads, insufficient heavy equipment, and communication infrastructure damage.

The complexity of landslide risk management in Tana Toraja is further compounded by socio-cultural factors that influence community responses to disaster threats. Many residents maintain strong attachments to ancestral lands and traditional settlement patterns, choosing to remain in high-risk zones despite evident hazards due to cultural heritage preservation concerns, agricultural livelihood dependencies, and limited relocation alternatives. Moreover, existing disaster mitigation initiatives often reflect top-down planning approaches that inadequately incorporate local knowledge, traditional risk coping mechanisms, and community-specific needs. The Regional Regulation of Tana Toraja Regency No. 62 of 2016 establishes policy frameworks for disaster mitigation encompassing physical infrastructure development and awareness enhancement, yet implementation gaps persist regarding meaningful community participation mechanisms, benefit distribution equity, and sustained engagement beyond project cycles.

Table 1 presents the spatial and temporal distribution of landslide events recorded in Makale Subdistrict from 2021 to 2025, demonstrating the widespread and recurrent nature of this hazard across the administrative area:

Table 1

Landslide Events in Makale Subdistrict, Tana Toraja Regency (2021-2025)

Year	Number of Affected Villages	Village Names	Fatalities	Houses Destroyed
2021	7	Tondon Mamullu, Kamali Pentalluan, Tarongko, Lamunan, Bombongan, Tampo Makale, Ariang	-	-
2022	1	Bombongan	-	-
2023	2	Tampo Makale, Pantan	-	-
2024	1	Manggau	14	6
2025	3	Tondon Mamullu, Batupapan, Manggau	-	-

Source: South Sulawesi Disaster Event Analysis and Reporting System (Siandalan)

Despite substantial research examining community participation in various disaster management contexts, significant knowledge gaps remain regarding how implementation and benefit dimensions of participation function in landslide-prone mountainous communities characterized by strong cultural traditions, limited resource availability, and challenging geographical access. Previous studies have explored community participation in diverse development contexts, including waste management initiatives (Safitri, 2022) and health service delivery (Sintiawati, 2021), yet these investigations primarily address urban or peri-urban settings with fundamentally different socio-ecological dynamics compared to remote mountainous areas facing recurrent landslide threats. Research on ecotourism community participation in Sabah, Malaysia (Chan, 2021) identified barriers including limited financial capital and insufficient tourism knowledge, but these findings reflect economic development rather than disaster mitigation contexts. Consequently, there exists a pressing need for empirical research that systematically examines how communities in landslide-vulnerable mountainous regions engage in mitigation implementation activities and experience benefit distribution outcomes.

The present study addresses these knowledge gaps by investigating community participation in landslide disaster mitigation in Makale Subdistrict, Tana Toraja Regency, with specific focus on two critical dimensions of Cohen and Uphoff's (1980) participation framework: participation in implementation and participation in benefits. This research aims to: (1) assess the extent and nature of community involvement in implementing landslide mitigation activities, including infrastructure development, early warning systems, evacuation procedures, and capacity-building programs; (2) evaluate patterns of benefit distribution arising from mitigation initiatives, examining equity considerations,

accessibility factors, and differential impacts across community segments; and (3) identify barriers and facilitating factors influencing implementation participation effectiveness and benefit distribution equity in this specific geographical and socio-cultural context. By concentrating analytical attention on implementation and benefits dimensions rather than attempting comprehensive coverage of all participatory forms, this study provides nuanced insights into the practical realities of community-based disaster risk reduction in resource-constrained mountainous settings where participatory ideals often confront significant implementation challenges.

2 METHODS

This study employs a qualitative approach with a descriptive case study design to explore community participation in landslide disaster mitigation in Makale Subdistrict, Tana Toraja Regency. Data were collected through in-depth interviews with seven purposively selected informants, including the Head of BPBD (Regional Disaster Management Agency) Tana Toraja, the Head of Prevention and Preparedness Division of BPBD, the village head of Manggau Village, and three community members residing in landslide-prone areas. Primary data were obtained through semi-structured interviews and direct field observations in selected landslide-affected locations, while secondary data were gathered from official documents, disaster management reports, and relevant government publications. The research focuses specifically on two dimensions of community participation based on Cohen and Uphoff's (1980) framework: participation in implementation and participation in benefits distribution.

Data analysis followed Miles and Huberman's interactive model, consisting of data reduction, data display, and conclusion drawing. The data reduction process involved careful selection and categorization of interview transcripts and field notes according to the two dimensions of participation being examined. Data validity was ensured through triangulation of data sources, member checking with key informants to verify findings, rich and detailed descriptions of the phenomena observed, and explicit acknowledgment of researcher bias. Reliability was maintained through systematic documentation of all research procedures, careful review of findings to prevent errors, and consistent verification of data interpretations to avoid meaning shifts. This methodological approach enabled comprehensive understanding of how communities engage in landslide

mitigation activities and how benefits from such programs are distributed among vulnerable populations.

3 RESULT AND DISCUSSION

3.1 Participation in implementation

Community participation in the implementation of landslide disaster mitigation programs in Makale Subdistrict demonstrates diverse dynamics of involvement at each stage of execution. Implementation, as the actualization phase of program planning, requires active community contribution to ensure the effectiveness and sustainability of disaster risk reduction efforts. In the context of Manggau Village, which serves as the research locus, the manifestation of implementation participation is realized through three main dimensions that are interrelated and form a comprehensive disaster management ecosystem.

3.2 Resource contribution

Community resource contribution in landslide disaster mitigation in Manggau Village demonstrates high participation patterns rooted in local wisdom values. The mobilization of community labor manifests through institutionalized mutual cooperation (gotong royong) implemented weekly every Friday for environmental cleaning and drainage infrastructure maintenance. During disaster emergencies, communities spontaneously form local rapid response teams that conduct victim evacuation, clear landslide materials to open road access, and provide temporary shelter in residents' homes before emergency tents are erected. Material contributions are also realized through the provision of simple equipment such as hoes, shovels, and ropes used in search and rescue operations. The community-based information system functions effectively, with residents serving as the first eyes and ears in detecting early signs of landslides such as ground cracks, changes in water flow, and rumbling sounds from hillsides, which are then reported through established communication channels.

This pattern of resource contribution aligns with Cohen and Uphoff's (1980) concept of participation in implementation, which emphasizes the importance of

mobilizing various forms of local resources to support program implementation. Their theoretical framework identifies that contributions can take the form of labor, cash, materials (in kind), and information, which in the context of Manggau Village manifests through the mutual cooperation system that has been deeply rooted as social capital. However, the limitations in technical capacity and modern equipment in disaster response operations indicate the need for strengthening through training and provision of standard Search and Rescue (SAR) equipment at the community level. This finding confirms Sakurai et al.'s (2022) argument that the effectiveness of local resource contributions in disaster mitigation increases significantly when complemented with adequate technical capacity and equipment, necessitating capacity building programs that integrate local wisdom with modern standard operating procedures in disaster management.

3.3 Involvement in administration and coordination

Community involvement in administration and coordination aspects demonstrates responsive participation patterns toward landslide disaster threats. A tiered reporting system has been established where communities report landslide indications to the Neighborhood Head, which is then forwarded to the Village level and subsequently to the Regional Disaster Management Agency (BPBD) of Tana Toraja Regency. The coordination mechanism utilizes modern communication technology through WhatsApp groups that directly connect communities, village officials, and BPBD, although its effectiveness is hampered by limited internet network infrastructure in mountainous areas. During the emergency response phase, intensive coordination occurs between communities and various stakeholders including BPBD, police, and the National Search and Rescue Agency (BASARNAS) to determine evacuation routes, handling priorities, and aid distribution. Early warning information dissemination is conducted through multi-channels via the Regent's Circular distributed through WhatsApp and Facebook, demonstrating the adaptation of the early warning system to local contexts that still face digital accessibility challenges.

Table 2 presents the institutionalized administration and coordination mechanisms in the disaster management system in Manggau Village:

Table 2

Administration and Coordination Mechanisms for Landslide Disaster Management

Phase	Administrative Activities	Stakeholders Involved	Coordination Media	Challenges Encountered
Pre-Disaster	- Reporting early warning signs - Receiving preparedness circulars - Documentation of weather and soil conditions	- Community-Neighborhood Head - Village Head-BPBD	- WhatsApp Group - Facebook - Direct communication	- Unstable internet network- Not all residents active on social media
Emergency Response	- Reporting incidents and casualties - Emergency aid requests - Evacuation route coordination-Refugee registration	- Community-Neighborhood Head - Village Head - BPBD - Police - BASARNAS	- Emergency telephone - WhatsApp Group - Direct communication at command post	- Road access cut off - Communication hampered by extreme weather - Complex multi -party coordination
Post-Disaster	- Damage and loss assessment - Aid distribution - Recovery needs reporting - Response evaluation	- Community - Neighborhood Head - Village Head - BPBD - Volunteers	- Data collection forms - WhatsApp Group - Coordination meetings	- Non-standardized data collection - Weak data verification mechanism

Source: Primary data processed, 2025

The administrative and coordination practices that have developed in Manggau Village reflect the participation in implementation dimension in Cohen and Uphoff's (1980) framework, which emphasizes the importance of community involvement in organizational structures and program management mechanisms. However, the participation pattern that remains responsive-reactive indicates that a proactive-anticipatory administration and coordination system has not yet been established, as idealized in the concept of full participation. The dependence on modern communication technology without backup systems when infrastructure fails also indicates vulnerability in existing coordination mechanisms. Based on Rusdianto and Setiawan's (2023) findings, which identify that coordination effectiveness in disaster management increases significantly with clear Standard Operating Procedures (SOPs) and hybrid communication systems combining modern technology with conventional methods, there is a need to develop multi-level coordination protocols that include alternative communication procedures when digital systems are non-functional, as well as

strengthening community administrative capacity through training in incident command systems adapted to local contexts.

3.4 Program enrollment

The dynamics of disaster mitigation program enrollment in Manggau Village demonstrate a unique pattern where program initiatives originate more from the village level and spontaneous community responses rather than through formal bottom-up participation mechanisms. The tree planting program for slope conservation in landslide-prone areas was initiated by the Village Head, who assessed vegetation degradation due to illegal logging as a contributory factor to landslide incidents, then socialized to communities who responded with high enthusiasm. The routine community service activities every Friday to clean drainage channels and monitor slope conditions emerged as collective community initiatives post-disaster without formal enrollment processes or establishment of village regulations. The disaster mitigation socialization program implemented by BPBD also did not go through enrollment mechanisms where communities identify their capacity building needs; instead, it was conducted simultaneously when BPBD teams performed emergency response operations at incident locations. This pattern indicates that participation in identifying program needs and articulating community aspirations has not been institutionalized in formal systems that enable communities to actively enroll mitigation programs they require.

This condition reveals a gap between field practices and the ideal concept of participation in implementation from Cohen and Uphoff (1980), which positions program enrollment as a manifestation of bottom-up participation where communities are not merely program recipients but also active subjects who identify needs and enroll programs relevant to their local contexts. The absence of formal mechanisms for communities to propose mitigation program proposals based on their local risk assessments may potentially cause mismatches between implemented programs and actual community needs. Nevertheless, the responsiveness and enthusiasm of communities in responding to government-initiated programs demonstrate strong social capital as a foundation for developing more structured participation systems. Referring to Wijaya and Putra's (2024) study, which shows that community-based disaster risk management becomes more effective when formal mechanisms exist for communities to

propose and manage mitigation programs according to local risk characteristics, there is a need to develop participatory systems that enable communities to identify, enroll, and manage disaster mitigation programs through institutionalized village deliberation forums, ensuring that implemented programs are truly responsive to local community needs and capacities.

3.5 Participation in benefits

Participation in benefits represents a crucial dimension in measuring the effectiveness and equity of disaster mitigation programs, where program success is measured not only from implementation aspects but also from the distribution and accessibility of benefits received by target communities. In the context of landslide disaster mitigation in Manggau Village, the distribution of program benefits demonstrates multidimensional patterns, encompassing material, social, and personal aspects that interact to form comprehensive outcomes for the sustainability of community life in disaster-prone areas.

3.6 Material benefits

The distribution of material benefits in landslide disaster management in Manggau Village demonstrates comprehensive and multi-source patterns, involving local government, BPBD, volunteers, university students, and the community itself as contributors. Material assistance received by disaster-affected communities includes basic needs such as food supplies, blankets, clothing, sanitation equipment, and raincoats adapted to extreme post-disaster weather conditions. Aid infrastructure includes evacuation tents equipped with communal kitchens and sanitation facilities, as well as health posts providing emergency medical services and medicines for treating minor illnesses and preventing outbreaks in evacuation centers. The distribution mechanism is conducted through a registration system at command posts coordinated by the Neighborhood Head to ensure equitable distribution and prevent duplication of aid recipients. A significant material aspect is housing evacuation and relocation assistance, where wooden houses with structurally sound conditions but located in landslide paths are relocated through mutual cooperation to safer locations, while houses with severe

damage receive repair or permanent relocation assistance. Public infrastructure rehabilitation, especially main roads severed by landslides, is conducted collaboratively between communities, village government, and BPBD, which although the final result has not been fully asphalted like initial conditions, has restored community accessibility for economic and social activities.

This material benefit distribution pattern confirms the material benefits dimension in Cohen and Uphoff's (1980) framework, which identifies that participation in benefits includes receiving program outcomes that are tangible such as infrastructure, direct assistance, and improvements in physical environmental conditions. Distribution effectiveness is demonstrated through relatively accurate targeting mechanisms with community-based registration systems, although not yet using standard instruments such as comprehensive damage and loss assessments. However, the sustainability of these material benefits still faces challenges, particularly regarding the maintenance of repaired infrastructure and land status certainty for permanent relocation programs. Nugroho et al.'s (2023) research shows that material benefit sustainability in disaster management programs highly depends on clarity of property rights and local government's long-term commitment to infrastructure maintenance, necessitating regional regulation establishment governing community participation-based disaster mitigation infrastructure maintenance mechanisms and legal certainty over relocation land to prevent future agrarian conflicts.

3.7 Social benefits

Social benefits from landslide disaster mitigation and management programs manifest in the form of strengthened social cohesion and increased social capital in Manggau Village community. The intensity of social interaction among residents experienced significant increases post-disaster; whereas previously communities only gathered during traditional ceremonies, regular meetings now occur through weekly mutual cooperation activities every Friday, environmental cleaning community service, and disaster mitigation infrastructure maintenance. Social solidarity manifests in more intense forms of mutual assistance, where communities are more responsive in providing help when neighbors face difficulties, not limited to disaster situations but also in daily life. Participatory infrastructure development, especially main road repairs, cultivates

strong sense of ownership among communities, reflected in their commitment to voluntarily maintain the development results. The presence of security posts and landslide hazard warning signs erected by BPBD functions not only as an early warning system but also as collective symbols reminding communities of shared vulnerability and the need for communal vigilance. However, social benefits in the community capacity enhancement dimension remain limited; although socialization has been conducted by BPBD, the absence of practical training and evacuation simulations causes communities to not yet fully possess technical knowledge about identifying early signs of land movement and correct independent evacuation procedures. Table 3 presents the comparison of community social capital conditions before and after disaster mitigation programs:

Table 3

Changes in Community Social Capital Pre and Post Disaster Mitigation Programs

Social Capital Dimension	Pre-Disaster Condition	Post-Disaster Condition	Change Indicators
Social Interaction Frequency	- Meetings only during traditional ceremonies (average 2-3 times/year)- Minimal inter-resident communication- No regular forums	- Weekly regular meetings (Friday mutual cooperation)- Intensive communication through WhatsApp groups- Active disaster coordination forums	Increase in interaction frequency from 2-3 times/year to minimum 4 times/month
Solidarity and Mutual Support	- Assistance limited to close family- Incidental mutual cooperation- Informal coordination	- Mutual assistance system extended to all residents- Institutionalized mutual cooperation- Structured coordination mechanisms	Expansion of solidarity networks from kinship-based to territorial-based
Social Trust	- Trust limited to primordial groups- Skepticism toward government programs	- Increased trust among residents- Constructive collaboration with government- Transparent aid distribution	Increase in horizontal and vertical trust levels
Collective Norms and Values	- High individualism- Low environmental awareness- Minimal disaster risk awareness	- Strengthened togetherness values- Increased environmental maintenance awareness- Growing disaster preparedness awareness	Internalization of collective values in daily behavior
Collective Action Capacity	- Weak community mobilization- Dependence on local elite initiatives- No community early warning system	- Rapid mobilization capability formed- Participation extended to various segments- Active community-based early warning system	Increased collective response capacity to disaster threats
Sense of Community	- Weak community identity- Low territorial attachment	- Identity as "disaster-resilient community" formed- High sense of ownership toward public infrastructure	Strengthened collective identity as resilient community

Source: Primary data processed, 2025

The social capital transformation occurring in Manggau Village confirms Cohen and Uphoff's (1980) proposition that social benefits from participation in development programs include increased social cohesion, strengthened cooperation networks, and development of community collective capacity. Their theory identifies that social benefits are intangible but have significant long-term impacts on community resilience in facing challenges. In the disaster mitigation context, this social capital strengthening becomes a critical asset enabling communities not only to survive but also to adapt and transform (thrive) in facing persistent disaster risks. However, limitations in the knowledge capital aspect, demonstrated by low community technical understanding of disaster mitigation, indicate the need for programs that systematically convert social capital into community technical capacity. Rahayu and Setiawan's (2024) study confirms that strong social capital will produce sustainable disaster resilience only when accompanied by technical capacity building through regular training and simulations; therefore, community-based disaster mitigation training programs are needed that utilize established social capital as a platform for technical knowledge transfer, involving community leaders as community disaster champions who have received intensive training from BPBD and related institutions.

3.8 Personal benefits

Personal benefits received by communities from landslide disaster mitigation and management programs encompass dimensions of knowledge, skills, life comfort, and psychological well-being. In the knowledge aspect, communities gain basic understanding of disaster management through socialization conducted by BPBD, although still theoretical and not yet accompanied by hands-on practice that enables internalization of knowledge into concrete skills. Understanding of evacuation procedures is fairly well comprehended by some residents, but the ability to identify early signs of ground movement, which constitutes crucial early warning, remains very limited. From the comfort and personal safety aspect, road infrastructure repairs have restored community accessibility for economic activities, social interactions, and accessing public services, although road quality that has not been fully asphalted still causes discomfort, especially during the rainy season. Housing relocation and repair programs provide benefits in the form of increased safety for families whose homes were moved from red

zones, while simultaneously reducing the financial burden they should have borne themselves for repairs or new house construction. Psychological benefits are also significant; through participation in mutual cooperation activities and routine community service, individuals feel more connected to their community, reducing social isolation and increasing sense of belonging, which in turn contributes to mental health, especially for those who experienced trauma from losing property or family members in disasters.

The personal benefits received by communities affirm the personal benefits dimension in Cohen and Uphoff's (1980) framework, which includes improvements in knowledge, skills, self-confidence, and attitude changes experienced by individuals as results of program participation. However, the asymmetry between personal benefits that are material-physical in nature and those that are knowledge-capacity based indicates that disaster mitigation programs still emphasize responsive-curative aspects rather than preventive-educational aspects that should be the foundation of sustainable disaster risk reduction. The absence of structured training and simulation programs causes personal benefits in the dimensions of self-efficacy and disaster preparedness knowledge to remain suboptimal, which in turn maintains community dependence on external actors (BPBD, government) in disaster emergency situations. This condition contradicts the principle of community empowerment in disaster risk reduction, which idealizes communities as capable and confident first responders. Referring to Wibowo et al.'s (2025) findings, which show that personal empowerment in disaster mitigation contexts increases significantly through experiential learning that combines socialization, practical training, and periodic simulations involving all community segments including women, children, and the elderly, there is a need to develop comprehensive and contextual disaster mitigation training curricula encompassing local geomorphology recognition, early warning sign identification, independent evacuation techniques, first aid, and psychological first aid, with methodologies emphasizing learning by doing and implemented periodically to ensure retention of knowledge and skills acquired by communities.

4 CONCLUSION

Community participation in landslide disaster mitigation in Manggau Village, Makale Subdistrict, Tana Toraja Regency demonstrates significant manifestations across

two main dimensions: participation in implementation and participation in benefits. In the implementation dimension, communities actively contribute resources through institutionalized mutual cooperation systems, engage in administrative and coordination processes through tiered reporting mechanisms and multi-stakeholder collaboration, though program enrollment remains predominantly top-down rather than community-initiated. The participation pattern reflects strong social capital rooted in local wisdom values, yet reveals gaps in technical capacity and formal mechanisms for bottom-up program articulation. In the benefits dimension, communities receive comprehensive material benefits including emergency aid, infrastructure rehabilitation, and housing relocation assistance; substantial social benefits manifested through strengthened cohesion, enhanced solidarity networks, and increased collective action capacity; and personal benefits encompassing basic disaster knowledge, improved life comfort, and psychological well-being, though limited by the absence of practical training and simulations. The asymmetry between responsive-curative interventions and preventive-educational programs indicates that while immediate disaster response has been effective, long-term community empowerment for disaster preparedness remains suboptimal. The findings underscore the necessity for transitioning from government-led interventions to community-driven initiatives through institutionalized participatory mechanisms, development of hybrid communication systems combining digital and conventional approaches, comprehensive capacity building programs integrating experiential learning methodologies, and establishment of regulatory frameworks ensuring sustainability of mitigation infrastructure and clarity of land rights for relocated communities. Strengthening community participation in both implementation and benefit distribution is essential for building sustainable disaster resilience in landslide-prone areas, transforming vulnerable communities into empowered, capable, and confident first responders who can not only survive but also thrive in the face of persistent disaster risks.

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Authors' Contribution

All authors contributed equally to the development of this article.

Data availability

All datasets relevant to this study's findings are fully available within the article.

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