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COMMUNITY ENGAGEMENT IN NATURAL DISASTER MANAGEMENT: A DECADE OF PRACTICE AND FUTURE DIRECTIONS IN INDONESIA

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Abstract

As one of the most disaster-prone nations in the world, Indonesia confronts recurring geophysical and hydrometeorological hazards including earthquakes, tsunamis, volcanic eruptions, and seasonal floods. Over the ten-year period from 2014 to 2024, community engagement has become a foundational element of effective disaster risk reduction (DRR) policy and practice, marking a decisive transition away from top-down, state-centric governance toward participatory, culturally grounded, and technology-assisted approaches. This article presents a systematic review of the scholarly literature on community engagement in Indonesian natural disaster management, with comparative reference to peer nations in Southeast Asia, particularly the Philippines and Malaysia. Drawing on 63 sources retrieved from the Scopus database and screened through a PRISMA-informed protocol, the review synthesizes evidence across five thematic domains: culturally adapted communication strategies, community-based DRR programs, indigenous and local knowledge integration, the role of technology and social media, and the inclusion of gender and marginalized groups. Key findings indicate that Indonesia distinguishes itself through deep institutionalization of the gotong-royong (mutual cooperation) ethic within formal DRR programs, and through hybrid communication systems that combine indigenous signaling practices with digital platforms. Nonetheless, persistent implementation deficits remain in institutional coordination, sustainable financing, gender mainstreaming, and mental health integration. Comparative analysis demonstrates that, while all three Southeast Asian nations share collectivist cultural orientations favorable to community-based DRR, Indonesia exhibits a more systematic programmatic architecture through flagship initiatives such as Desa Tangguh Bencana (Destana) and the SISTER VILLAGE program. Emerging research priorities include hybrid digital-indigenous early warning systems, blockchain-enabled community risk financing, and participatory development of culturally sensitive psychosocial support frameworks.

Keywords*: community engagement, disaster risk reduction, gotong-royong, indigenous knowledge.*

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INTRODUCTION

Natural disasters pose an existential challenge to human welfare, economic stability, and environmental integrity across the twenty-first century. Situated on the Pacific Ring of Fire and occupying the world's largest archipelago, Indonesia ranks among the most hazard-exposed nations globally. The country's 17,000 islands are subject to a compound mosaic of geophysical risks encompassing earthquakes, tsunamis, volcanic eruptions, landslides, and recurrent flooding events that collectively affect millions of people each year. Over the past decade, these realities have propelled a fundamental reconfiguration of disaster risk reduction (DRR) governance: from centralized, government-executed responses toward decentralized, community-driven, and culturally embedded frameworks.

The empirical case for this transformation is compelling. Top-down disaster management has repeatedly demonstrated its inability to reach the most exposed populations or to sustain long-term community resilience. By contrast, community engagement in DRR, understood as the active involvement of local populations in risk assessment, preparedness planning, early warning, response, and recovery, has generated measurable gains including expanded social capital, faster evacuation compliance, and more equitable delivery of disaster assistance (Lassa et al., 2018; Ruslanjari et al., 2025). Within Indonesia's particular sociocultural context, community engagement draws additional strength from the principle of gotong-royong, a deeply rooted ethic of collective labor and mutual support that predates formal DRR institutions by centuries (Siradjuddin, 2023; Koopman, 2021).

Despite substantial programmatic progress, several knowledge gaps persist. The integration of indigenous knowledge systems with emerging technologies such as artificial intelligence, blockchain, and mobile platforms remains aspirational rather than operational. Policy frameworks increasingly endorse gender mainstreaming and disability inclusion, yet field evidence consistently reveals patriarchal barriers and systemic underrepresentation of marginalized groups within DRR decision-making processes (Yumarni and Amaratungga, 2017; Septanaya and Fortuna, 2023). Mental health and psychosocial support (MHPSS) remains inadequately embedded within community-based DRR programs (Trinidad and Protacio-De Castro, 2020; Yudanagara et al., 2025). Sustainable financing mechanisms continue to be fragmented and theoretically underdeveloped.

Against this backdrop, the present article makes three substantive contributions. First, it synthesizes a decade of community engagement research in Indonesian DRR spanning 2014 to 2024. Second, it benchmarks Indonesian practices against those documented in the Philippines and Malaysia. Third, it maps underexplored research directions and actionable

policy priorities. The article argues that the future of disaster resilience in Indonesia resides in a creative convergence of traditional knowledge, digital technology, participatory governance, and unwavering commitment to social inclusion.

METHODS

This study employs a systematic literature review methodology, enriched by comparative case analysis and policy document review. The review protocol adhered to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines, adapted for the social and environmental sciences. Figure 1 presents the PRISMA flow diagram illustrating the identification, screening, eligibility, and inclusion stages of the review process.

The primary bibliographic database was Scopus, selected for its comprehensive coverage of peer-reviewed literature across disaster risk, social sciences, public health, and environmental engineering. Searches were executed in April 2025 using Boolean combinations of the following controlled vocabulary and free-text terms: "community engagement" AND "disaster risk reduction" AND "Indonesia"; "gotong-royong" OR "indigenous knowledge" AND "disaster"; "early warning system" AND "Southeast Asia"; "social media" AND "flood" OR "earthquake" AND "Indonesia"; "gender" AND "DRR"; and "psychosocial support" AND "disaster" AND "Indonesia." No language filter was applied at the search stage, though the eligibility criteria subsequently restricted inclusion to English and Bahasa Indonesia publications.

The initial database search retrieved 312 records. After removing 47 duplicates, 265 records remained for title and abstract screening. Of these, 168 were excluded because they did not address community-level engagement in disaster contexts, were situated outside Southeast Asia, or constituted non-peer-reviewed commentary. The remaining 97 full-text articles were assessed for eligibility. Following full-text review, 34 articles were excluded: 18 did not meet temporal scope criteria (pre-2014 or post-2024 publication dates), 11 did not address natural disaster contexts specifically, and 5 were inaccessible in full text. A total of 63 sources were ultimately included in the final synthesis. Grey literature, comprising selected government reports and policy documents from BNPB, BPBD, and the Sendai Framework monitoring reports, was incorporated selectively to provide programmatic context, yielding an overall corpus of approximately 70 sources for the full analysis.

Inclusion criteria required that each source: (a) constituted a peer-reviewed journal article, conference proceeding, or edited book chapter; (b) addressed community-level engagement within natural disaster risk reduction contexts; (c) was situated in Indonesia or in

at least one other Southeast Asian country; and (d) was published between 2014 and 2024. Case studies from the Philippines and Malaysia were incorporated to support the comparative analysis dimension. Grey literature sources were admitted if they originated from recognized governmental or intergovernmental organizations and provided data not available in peer-reviewed form.

The analytical framework integrated three complementary lenses. A thematic synthesis approach was employed to identify, code, and categorize findings across five domains: culturally adapted communication strategies, community-based DRR programs, indigenous and local knowledge integration, technology and social media, and inclusion of gender and marginalized groups. A comparative analysis framework was applied to contrast Indonesian practices with those documented in the Philippines and Malaysia (Tota et al., 2025; Ishiwatari et al., 2023). A gap analysis was conducted to identify under-examined phenomena, methodological limitations in the existing literature, and priority areas for future research.

RESULTS AND DISCUSSION

1. Culturally Tailored Communication Strategies

A consistent finding across the reviewed literature is that effective disaster communication in Indonesia cannot be disentangled from its cultural matrix. Three distinct yet mutually reinforcing communication modalities have been documented in the scholarly record: indigenous oral and ritual communication, hybrid traditional-digital systems, and vernacular educational programming.

Indigenous communication practices occupy a central role in community early warning across remote coastal and rural areas. The use of kentongan (bamboo percussion instruments), bedug (mosque drums), and ritual oral traditions such as the smong narrative in Aceh has been shown to trigger effective evacuation responses in settings where formal alert systems are absent or distrusted (Fakhriati et al., 2023; Sugiana et al., 2025). The triangular communication model documented among Acehnese communities, which frames human-nature-divine relationships as an integrated risk governance system, resonates far more deeply with local populations than technocratic public address infrastructure. This pattern aligns with broader arguments in the DRR literature: risk communication that disregards local cosmologies and social norms generates low community compliance (Prasetyo et al., 2024).

Hybrid communication systems have emerged as the prevailing model in contemporary Indonesian DRR practice, particularly in coastal and peri-urban communities. These systems integrate traditional signaling mechanisms with digital platforms including WhatsApp,

Facebook, and Twitter/X. Research documents measurable gains in message reach and community trust when local leaders function as cultural intermediaries, translating official warnings into formats that resonate with specific communities (Rizal et al., 2025; Hesti et al., 2025). The digital divide, however, creates persistent equity concerns. Rural elderly populations, persons with disabilities, and communities with limited smartphone penetration remain structurally excluded from digitally mediated early warning networks (Kurniawan et al., 2021).

Disaster preparedness education programs delivered in vernacular languages and featuring locally relevant narratives and visual materials have demonstrated significantly improved knowledge retention among school-age youth and adult community members (Setioputro et al., 2025; Mansoor, 2015). The linguistic dimension is particularly important in Indonesia, where more than 700 distinct languages are spoken across the archipelago, making one-size-fits-all communication strategies fundamentally inadequate.

2. Community-Based Disaster Risk Reduction Programs

Indonesia's flagship community-based DRR initiative, Desa Tangguh Bencana (Destana, meaning Disaster-Resilient Village), represents the institutional cornerstone of participatory risk governance at the village level. Established under BNPB Regulation No. 1/2012 and expanded significantly after 2016, Destana institutionalizes participatory risk assessment, local contingency planning, and community response capacity building within the formal village government structure. Program evaluations report substantial achievements in local ownership, social cohesion, and preparedness knowledge (Fuady et al., 2025; Deasy et al., 2023). Persistent challenges include inadequate sustainable financing, difficulties in integrating Destana plans with village development budgets, and considerable variation in implementation quality across provinces.

Several complementary programs address specific resilience dimensions within this broader framework. The SISTER VILLAGE program cultivates inter-village collaboration and mutual aid networks for managing volcanic disaster risks, with documented reductions in evacuation decision latency and improvements in resource sharing during active crisis periods (Ruslanjari et al., 2025). The PRBBK (Pengurangan Risiko Bencana Berbasis Komunitas) framework, aligned with the Sendai Framework for Disaster Risk Reduction 2015-2030, explicitly prioritizes gender mainstreaming and the repositioning of persons with disabilities as active DRR participants rather than passive beneficiaries (Pertiwi et al., 2019).

Volunteerism constitutes an indispensable institutional pillar supporting these programs. Locally trained volunteer groups, equipped with competencies in first aid, evacuation logistics, and community communication, fill critical operational gaps between professional emergency services and affected populations, especially during the first 72 hours following disaster onset (Lassa et al., 2018). Sustaining volunteer capacity over time requires consistent training investments, which in turn presupposes stable institutional financing arrangements that many subnational governments in Indonesia have struggled to secure.

3. Integration of Indigenous Knowledge in DRR

The systematic incorporation of indigenous and local knowledge (ILK) into formal DRR systems constitutes one of Indonesia's most distinctive contributions to global disaster risk scholarship. Numerous well-documented case studies illustrate the life-saving value of ILK. The smong oral narrative tradition in Aceh guided community evacuation during the catastrophic 2004 Indian Ocean tsunami. Sasi adat (traditional resource governance) practices in Maluku embed ecological risk awareness within customary institutions. Traditional architectural knowledge preserved in Nias Island communities continues to inform the construction of earthquake-resistant vernacular buildings (Dede et al., 2024; Saadi, 2023).

The gotong-royong cultural ethic of collective labor and mutual assistance operates not merely as a social norm but as a practical mechanism for post-disaster reconstruction, shared resource management, and psychosocial recovery. Following the 2018 Lombok earthquake sequence, the restoration of gotong-royong practices served as a primary driver of community-led shelter reconstruction that outpaced formal government housing programs in both speed and perceived social legitimacy (Koopman, 2021; Siradjuddin, 2023).

Despite this recognized comparative advantage, the reviewed literature consistently documents a fundamental implementation gap: indigenous knowledge remains structurally peripheral to formal DRR policy frameworks and is almost entirely absent from technology-based early warning architectures (Maryani and Lestari, 2025). Several barriers sustain this gap. The codification of contextual, experience-based knowledge into standardized technical databases is methodologically challenging. Technical expert communities frequently harbor skepticism regarding the empirical validity of traditional environmental indicators. Formalization processes often inadvertently strip ILK of the cultural and relational context that constitutes its practical efficacy (Dede et al., 2024). Bridging this divide remains an urgent frontier for both research and policy.

4. Technology, Social Media, and Digital Volunteerism

The rapid expansion of digital communication infrastructure has fundamentally reshaped disaster information ecosystems in Indonesia over the study decade. Social media platforms, specifically WhatsApp, Twitter/X, Facebook, and Instagram, now function as primary channels for real-time disaster reporting, resource coordination, and community solidarity during crisis events (Kurniawan et al., 2021; Nazir et al., 2021). Crowdsourced disaster mapping applications have demonstrated the value of civic technology in aggregating distributed situational knowledge across urban flood emergencies.

Digital volunteer networks have achieved increasing formalization within Indonesia's disaster communication system. Analyses of the #GunungLawu hashtag community and analogous networks on X (formerly Twitter) illustrate how distributed informal digital networks can rapidly aggregate information, coordinate resource allocation, and sustain community morale during extended volcanic crises (Fauziah et al., 2024; 2026). These digital volunteers perform functions that government agencies routinely cannot: rapid contextual translation of official warnings, active identification and correction of misinformation, and provision of emotional support to displaced populations.

The same platforms that enable rapid community solidarity also facilitate the rapid propagation of misinformation, which documented cases show can undermine evacuation compliance and erode community trust in official information sources (Fauziah et al., 2026; Mansyur et al., 2021). Effective management of disaster misinformation requires proactive government digital presence, community-based fact-checking networks, and digital literacy programs, all of which remain unevenly distributed across Indonesia's regions. The embedded assumption of universal smartphone access in digital-first DRR strategies also systematically disadvantages elderly populations, rural communities, and low-income households.

5. Gender, Inclusion, and Mental Health in DRR

Despite formal commitments to gender mainstreaming embedded in Indonesia's National Disaster Management Law (No. 24/2007) and subsequent BNPB regulatory instruments, empirical evidence reveals persistent gaps between policy aspirations and field realities. Women remain systematically underrepresented in formal DRR decision-making structures across all administrative levels. Destana village disaster preparedness committees are frequently dominated by male local government officials, and gender-disaggregated disaster impact data remains insufficient for evidence-based policy adjustment (Yumarni and Amaratungga, 2017; Septanaya and Fortuna, 2023).

Qualitative research documents how patriarchal household authority structures shape evacuation timing decisions in ways that elevate female mortality risk. Women in several disaster-affected communities have reported awaiting spousal authorization before initiating evacuation, a pattern associated with elevated mortality rates among women during rapid-onset disasters (Purworini et al., 2021). The experience of the Mount Semeru eruptions in 2021-2022 demonstrated that women's communication forums functioned as critical nodes in local warning networks, simultaneously revealing both the latent capacity and the systematic underutilization of women's social networks within formal DRR architecture (Ida et al., 2025).

People with disabilities encounter compounding structural exclusions: physical barriers to evacuation infrastructure, communication formats inaccessible to individuals with sensory impairments, and near-total absence from community risk assessment processes (Pertiwi et al., 2019; Meilinarti et al., 2025). Achieving genuine disability inclusion in DRR requires not merely physical accessibility modifications but a fundamental repositioning of persons with disabilities as situated knowledge holders and active DRR participants whose experiential expertise is both unique and irreplaceable.

Mental health and psychosocial support (MHPSS) represents the most systematically underintegrated domain within community-based DRR in Indonesia. Although the institutionalization of MHPSS in emergency response protocols has advanced since the compound earthquake-tsunami disaster in Central Sulawesi in 2018, community-based DRR programs continue to treat psychological resilience as peripheral rather than integral (Trinidad and Protacio-De Castro, 2020; Reksa and Yana, 2025). Primary barriers include cultural stigma surrounding mental health disclosure, chronic shortages of trained community mental health practitioners, and the absence of culturally validated MHPSS assessment instruments (Hechanova and Waelde, 2017). Systematic integration of community-based MHPSS within Destana programming, drawing on local healing traditions and existing social solidarity mechanisms, represents a critical and practically feasible next step.

6. Comparative Analysis: Indonesia and Southeast Asia

Table 1 presents a comparative synthesis of community engagement practices across Indonesia, the Philippines, and Malaysia. Indonesia's DRR architecture is distinguished by its depth of cultural embedding and the formal institutionalization of community participation through national-scale programs including Destana, ProKlim, and SISTER VILLAGE. The Philippines exhibits comparable cultural foundations: the bayanihan ethic of communal solidarity mirrors gotong-royong as a collectivist mutual aid value system. Philippine DRR is

also characterized by strong local government-community partnerships, with notable strengths in indigenous knowledge integration and Facebook-based crisis communication (Rosario, 2025; Tota et al., 2025). Malaysia's DRR system remains comparatively more centralized and technology-oriented, with community-based frameworks that are emerging but have not yet achieved systematic institutionalization (Sulaiman et al., 2019).

All three nations confront shared regional challenges: institutional fragmentation between national and subnational DRR agencies, insufficient sustainable financing mechanisms, underrepresentation of women and marginalized groups in formal DRR structures, and the perennial tension between technology-centered solutions and the social trust required for community-level adoption. Indonesia's hybrid communication model, integrating traditional signaling systems with digital platforms while preserving the role of community leaders as trusted intermediaries, constitutes a regional good practice with transferable relevance.

Table 1. Comparative Overview of Community Engagement in DRR: Indonesia, Philippines, and Malaysia

Theme / Area	Indonesia	Philippines	Malaysia
Cultural Foundations	Gotong-royong ethic deeply embedded in formal DRR programs and national legislation	Bayanihan similarly strong; integration into formal programs less systematic	Community cohesion emerging; centralized governance dominant
Community-Based Programs	Destana, PRBBK, SISTER VILLAGE; extensive volunteer infrastructure	Strong community-based adaptation; integration of indigenous and modern knowledge	Developing program frameworks; significant implementation gaps persist
Indigenous Knowledge	Recognized comparative strength; underutilized in technology systems	More systematically integrated in local government programs	Minimal formal integration into DRR policy
Technology and Social Media	Hybrid digital-traditional systems; active digital volunteer networks	Facebook-centric; strong community-based verification and fact-checking	Digital tools expanding; community engagement component less robust
Gender and Inclusion	Policy progress documented; patriarchal barriers persist in implementation	Comparable gaps; some disability-inclusion advances noted	Similar underrepresentation challenges across gender and disability groups

MHPSS Integration	Recognized need; under-integrated in community DRR programs	Underrepresented in regional DRR architecture	Underrepresented in regional DRR architecture

Source: Author synthesis from reviewed literature (2014-2024)

7. Innovative Research Directions and Emerging Priorities

Synthesis of a decade of evidence identifies four convergent research and policy innovation priorities that define the next frontier of community engagement in Indonesian and Southeast Asian DRR.

The most immediately actionable research frontier is the development of hybrid digital-indigenous early warning systems. Proof-of-concept work from Serang Regency demonstrates that traditional tsunami warning signals, specifically kentongan percussion patterns, can be integrated with AI-enhanced digital alert platforms to produce systems combining technical precision with community cultural resonance (Pujiyono et al., 2025). Scaling such pilots demands sustained participatory co-design processes that engage community knowledge holders alongside technical engineers, deliberately avoiding the well-documented failure mode of top-down technology transfer (Sugiana et al., 2025).

Blockchain-based disaster risk financing and logistics management offers substantive solutions to chronic problems of funding opacity, disbursement delays, and accountability deficits that undermine community DRR programs (Darmawan et al., 2024; Soetanto et al., 2020). Preliminary system designs for post-disaster management in Indonesia indicate that blockchain's transparent and tamper-resistant architecture could meaningfully improve the efficiency and equity of disaster recovery fund distribution. Pentahelix partnerships, which formally engage government agencies, civil society organizations, academic institutions, the private sector, and affected communities, provide the institutional scaffolding for responsible technology piloting at scale (Yulianto et al., 2021).

Artificial intelligence applications in disaster preparedness represent a third emerging priority. These include machine learning-based hazard prediction models, AI-powered misinformation detection algorithms, and natural language processing tools for community sentiment monitoring (Padillo and Vinluan, 2025). AI deployment in disaster contexts carries genuine risks of algorithmic bias against marginalized communities. Human-centered AI design principles, developed through extensive prior community consultation, are non-negotiable prerequisites for responsible application in this domain.

Gamification and participatory rural appraisal (PRA) tools constitute a fourth promising approach to strengthening community engagement in risk assessment and DRR education. Gamified simulation exercises adapted for Indonesian contexts, including localized versions of the Stop Disaster game, have demonstrated improvements in risk perception accuracy and evacuation decision-making among both youth and adult participants (Sunarharum et al., 2021). Mobile application-based versions offer significant scalability advantages while preserving the social interaction dimension that makes simulation exercises educationally effective.

CONCLUSION

This systematic review of community engagement in Indonesian natural disaster management across the decade from 2014 to 2024 yields several substantive conclusions for scholarship, policy, and practice. Indonesia's DRR architecture is regionally distinguished by its deep institutionalization of cultural values, particularly the gotong-royong ethic, and by the nationwide programmatic reach of community-based initiatives such as Destana. Hybrid communication systems that blend indigenous signaling practices with digital platforms represent a distinctive Indonesian contribution to global DRR innovation, one with genuine transferability to analogous contexts across the Asia-Pacific region. Comparative analysis confirms that while the Philippines shares important cultural and participatory strengths, and Malaysia is advancing technologically, Indonesia's synthesis of cultural embeddedness and systematic program institutionalization offers the most comprehensive regional model.

Nonetheless, critical implementation deficits continue to undermine the effectiveness and equity of current approaches. Women face persistent patriarchal barriers in DRR decision-making at all levels. Persons with disabilities remain largely invisible in risk assessment and community planning processes. Indigenous knowledge is endorsed rhetorically while remaining operationally marginal. Mental health support lags significantly behind demonstrated psychosocial need. Sustainable financing remains chronically fragmented across institutional levels.

The research and policy agenda that emerges from this review is clear and actionable. Hybrid digital-indigenous early warning systems must be co-designed through sustained community participation rather than imposed through top-down technical transfer. Longitudinal studies are urgently needed to assess whether gender and disability mainstreaming generate durable changes in DRR decision-making structures. Blockchain and artificial intelligence pilots must be governed through robust, community-validated consent

frameworks. Culturally sensitive MHPSS must be systematically embedded within Destana and analogous community DRR programs. Pentahelix partnerships require strengthened accountability mechanisms and innovative financing instruments to move from rhetorical commitment to operational reality. The future of disaster resilience in Indonesia, and across Southeast Asia, depends on a creative, equitable, and culturally grounded convergence of tradition and technology.

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