



## **A Study of Volcanic Phenomena and Their Impacts on the Social Life of Communities**

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### **Abstract**

This study explores the multifaceted impacts of volcanic phenomena on the social life of communities in Indonesia, a country situated at the convergence of three major tectonic plates and home to numerous active volcanoes. Utilizing a narrative literature review method, 30 peer-reviewed national and international journal articles published between 2014 and 2024 were analyzed to identify recurring themes and knowledge gaps regarding the socio-economic consequences of volcanic activity. Findings indicate that volcanic eruptions in Indonesia have caused significant disruption to livelihoods, especially in agriculture and tourism, exacerbating economic vulnerability in regions reliant on single-sector economies. Social consequences include mass displacement, forced relocation, and the erosion of communal identity. Health impacts—both physical, such as respiratory illnesses, and psychological, including trauma—are prevalent. Nevertheless, the literature also highlights local resilience through adaptive strategies, strong social capital, and community-based recovery initiatives. Effective disaster mitigation is found to require a combination of scientific early warning systems and the integration of local knowledge. This review underscores the need for participatory policy approaches and continued academic engagement to strengthen disaster preparedness and recovery in vulnerable regions.

**Keywords:** Volcanism; Social impact; Disaster adaptation; Community resilience; Indonesia

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### **INTRODUCTION**

Indonesia is recognized as one of the countries with the highest number of active volcanoes in the world, due to its location at the convergence of three major tectonic plates: the Indo-Australian, Eurasian, and Pacific plates. Volcanic activity plays a significant role in shaping the Earth's surface and maintaining geological ecosystem balance. However, this natural phenomenon also presents substantial risks to human life. Volcanic eruptions can cause widespread environmental destruction, result in casualties, and damage settlements, agricultural lands, and infrastructure. The impacts extend beyond the physical realm, affecting both social and economic aspects. Globally, the economic losses from volcanic disasters—especially in agriculture and tourism sectors—are considerable (Jenkins et al., 2014; Blake et al., 2017). The dispersal of volcanic ash into the atmosphere can disrupt air transportation and severely affect public health, particularly respiratory systems (Wilson et al., 2019; Yuarsa, 2019).

From a social perspective, volcanic phenomena profoundly disrupt the lives of communities residing in disaster-prone regions. People often face existential uncertainty, forced displacement, loss of homes, and psychological trauma (Lestari & Nugroho, 2020; Bird & Gísladóttir, 2018). Social dynamics are also affected by mass evacuations and population movements, which may alter community

structures and relationships. Post-disaster social adaptation and recovery remain challenging processes that demand collaborative efforts from governments, social institutions, and community solidarity (Usamah & Handmer, 2017; Paton et al., 2019).

Despite the high level of risk, volcanic regions also offer considerable long-term benefits. Volcanic materials enrich the soil, making it highly fertile and ideal for agriculture, which encourages many residents to remain in these areas (Kelman & Mather, 2008). Additionally, volcanic landscapes serve as attractions for ecotourism, geothermal energy development, and scientific research (Anggraini & Oktaviona, 2024).

Although various studies have examined specific eruption cases in Indonesia—such as Mount Merapi, Sinabung, and Semeru—from multiple perspectives (Muta'ali & Maryono, 2019; Firmansyah & Handayani, 2022), few have systematically synthesized the socio-economic dimensions of volcanic activity in a comprehensive manner. Most existing research focuses on a single location or a singular impact, thus highlighting the need for a more holistic synthesis (Tobin & Whiteford, 2017). Scientifically, such a study is essential to map the general patterns of social impacts and community adaptation strategies across the archipelago.

Therefore, this study aims to analyze and synthesize a broad range of scholarly literature to understand the volcanic processes, their impacts on the social life of communities, and the responses and adaptation mechanisms undertaken by populations living in Indonesia's disaster-prone areas.

## **METHOD**

This study employed a qualitative research methodology using a narrative literature review approach. The narrative literature review was chosen as it allows for the synthesis and thematic interpretation of diverse research findings, with the aim of identifying recurring patterns, key themes, and knowledge gaps in the existing body of literature on the social impacts of volcanism in Indonesia. Rather than performing a meta-analysis or relying on statistical aggregation, this method emphasizes contextual understanding and interpretative depth, which are essential for exploring complex socio-environmental phenomena such as volcanic disasters.

The literature collection process was conducted systematically through digital database searches, including Google Scholar, Scopus, and the SINTA (Science and Technology Index) portal. These platforms were selected to ensure access to both national and international peer-reviewed publications relevant to the Indonesian context. The inclusion criteria applied in the selection process were as follows: (1) the article must be a full-length scholarly journal publication; (2) it must have been published within the period of 2014 to 2024 to ensure the relevance and currency of the data; (3) the article must primarily focus on the social, economic, health, or psychological impacts of volcanic activity; (4) the study must be conducted within the geographic context of Indonesia; and (5) the article must be published in a nationally accredited journal (SINTA levels 1-4) or a reputable international journal indexed in Scopus (Q1-Q4).

Conversely, several exclusion criteria were established to maintain the analytical focus and quality of the review. These included: (a) conference proceedings, (b) book reviews, (c) news articles or editorial content, and (d) studies

that solely addressed geophysical or geological aspects without incorporating social dimensions.

The initial search yielded approximately 90 potentially relevant articles. A screening process was then carried out, involving title and abstract review followed by full-text evaluation based on the predefined criteria. Ultimately, 30 journal articles were selected for in-depth analysis. These articles were analyzed using thematic content analysis. Data from each article were extracted systematically, coded based on recurring concepts, and categorized under major thematic areas that emerged from the literature.

The four dominant themes identified for synthesis were: (1) economic impacts, particularly the disruption of livelihoods in agricultural and tourism sectors; (2) social disruption, including displacement, forced relocation, and changes in social structure; (3) health impacts, both physical (e.g., respiratory illnesses due to volcanic ash) and psychological (e.g., trauma and stress); and (4) community adaptation and disaster mitigation strategies, such as the role of social capital, local knowledge, and early warning systems.

This methodological approach provided a comprehensive and contextualized understanding of how volcanic activity affects social systems in Indonesia, offering insights into both the challenges and resilience strategies observed in disaster-prone communities.

## RESULTS AND DISCUSSION

An analysis of 30 scholarly studies reveals that volcanic phenomena in Indonesia exert complex and multidimensional impacts on the social life of affected communities. A summary of these findings is presented in Table 1, which highlights the key insights from each article relevant to the social implications of volcanism.

**Table 1.** Summary of analyzed articles on volcanic phenomena and social impacts

No	Author(s)	Year	Study Theme	Key Findings Related to Volcanism and Social Impact
1	Anggraini, W., & Oktaviona, E.	2024	Potential of Lampung Volcano: Opportunities and Impacts	Identified both geologic hazards and potential benefits; emphasized the need for mitigation to reduce negative social impacts.
2	Ardi, A. S., & Sumunar, D. R. S.	2017	Disaster Risk Analysis of Mount Merapi Eruption in Dukun District	Mapped social-economic risk zones in Merapi; highlighted vulnerable areas needing prioritized disaster management.
3	Bird, D. K., & Gísladóttir, G.	2018	Residents' Perceptions of Volcanic Risk: Eyjafjallajökull, Iceland	Risk perception shapes public response; stressed the importance of effective risk communication tailored to local contexts.
4	Blake, D., Cameron, C., & Potts, J.	2017	Tourism in a Volatile World	Eruptions significantly, though temporarily, impact the tourism industry in Indonesia.

No	Author(s)	Year	Study Theme	Key Findings Related to Volcanism and Social Impact
5	Cadag, J. R. K., & Gaillard, J. C.	2012	Integrating Local and Indigenous Knowledge in DRR	Local knowledge enhances disaster risk reduction strategies and community acceptance.
6	Donovan, K., & Oppenheimer, C.	2021	Social Vulnerability and Volcanic Hazards	Social factors like poverty and age significantly affect community resilience to volcanic hazards.
7	Febriska, I., Diyanti, D. H. R., & Hasanah, N.	2025	Analysis of Mount Merapi Eruption Process	Focused on geological aspects, forming the basis for early warning and mitigation efforts.
8	Firmansyah, R., & Handayani, D.	2022	Household Economic Adaptation Post-Sinabung Eruption	Farmers applied diverse adaptation strategies post-eruption, including income diversification.
9	Gaillard, J. C.	2018	Why Indeterminate Language Matters in DRR	Unclear warnings can create confusion and reduce trust, affecting preparedness.
10	Hapsari, D. P., & Purnomo, H.	2023	Economic Impact of Mount Agung Eruption on Bali Tourism	Eruption led to substantial economic losses, especially for small-medium enterprises in tourism.
11	Hickey, J., et al.	2025	Social Sensing a Volcanic Eruption: Kīlauea	Social media data provided real-time insights into social impacts and community needs.
12	Jenkins, S. F., et al.	2014	Regional Impacts of Volcanic Eruptions	Agricultural sectors in developing countries are extremely vulnerable to volcanic ash fallout.
13	Kelman, I., & Mather, T. A.	2008	Sustainable Livelihoods and Volcanic Risks	Showed how communities can leverage volcanic resources (e.g., geothermal) while managing risks.
14	Kurniawan, A. D. S.	2022	Galunggung Eruption and Social-Economic Impact in West Java	Historical analysis showed major post-eruption impacts, including relocation and livelihood changes.
15	Lavigne, F., et al.	2018	Volcanic Hazard Analysis for Mount Merapi	Geohazard analysis supports the designation of risk zones and social evacuation strategies.
16	Lestari, P., & Nugroho, A.	2020	Psychosocial Impact of Merapi	Identified significant trauma; recommended holistic and

No	Author(s)	Year	Study Theme	Key Findings Related to Volcanism and Social Impact
			Eruption in Sleman	sustainable trauma recovery approaches.
17	Muta'ali, L., & Maryono, A.	2019	Socio-Economic Vulnerability in Merapi KRB III	Communities in Merapi's high-risk zone show high vulnerability, exacerbated by limited access and resources.
18	Nainggolan, H. L.	2019	Impact of Sinabung Eruption on Horticultural Farmers	Revealed major negative impacts on farmers' social and economic conditions; forced market and crop changes.
19	Paton, D., Johnston, D., & Houghton, R.	2019	Community Resilience and Volcanic Risk	Community resilience strongly correlates with social capital and preparedness levels.
20	Pratiwi, N. A.	2020	Resilience of Kelud Farmers Post-2014 Eruption	Farmers showed strong recovery due to social networks and locally grounded strategies.
21	Purwantiningsih, A., & Puryanto, S.	2024	Social Capital and Economic Resilience Post-Semeru Eruption	Social trust and networks played a key role in post-disaster economic recovery.
22	Setiawan, B.	2017	Resettlement Dynamics Post-Merapi 2010	Highlighted conflict between government policy and local social realities during relocation.
23	Sword-Daniels, V., et al.	2018	Communicating Volcanic Risk	Effective risk communication requires interdisciplinary approaches and public engagement.
24	Tantri, E.	2019	Socio-Environmental Impacts of Tambora 1815 Eruption	The massive eruption affected demographics, agriculture, and caused global famine.
25	Tobin, G. A., & Whiteford, L. M.	2017	Comparative Analysis of Social-Economic Consequences of Eruptions	Showed variability of impacts depending on social context, development level, and governance.
26	Usamah, M., & Handmer, J.	2017	Social Context of Recovery Post-Merapi	Informal institutions, community trust, and participation crucial in disaster recovery.
27	Wafda, R., & Hidayat, R.	2021	Social Capital in Post-Semeru Recovery	Community cooperation (e.g., mutual aid) accelerated post-disaster recovery.

No	Author(s)	Year	Study Theme	Key Findings Related to Volcanism and Social Impact
28	Wilson, G., Wilson, T. M., & Cole, J. W.	2019	Volcanic Ash Impacts on Infrastructure	Ash impacts on infrastructure have serious socio-economic implications for community survival.
29	Yuarsa, T. A.	2019	Volcanic Dust Impact on Respiratory Health in Yogyakarta	Volcanic ash increased cases of respiratory illness; underscored public health risks.
30	Yuniningsih, T., & Nugroho, S. B.	2018	Role of Local Institutions in Karangasem Disaster Management	Local institutions (customary and formal) were central to mobilization and evacuation efforts.

### Economic Impacts: Loss of Livelihoods and Agricultural Vulnerability

Key findings from multiple case studies indicate that volcanic eruptions have directly devastated the primary sources of income for local communities, particularly within the agricultural sector. The eruption of Mount Sinabung, for example, resulted in substantial economic losses for horticultural farmers due to the coverage of their farmland by volcanic ash. This environmental degradation led to complete crop failures and significant job losses (Nainggolan, 2019; Firmansyah & Handayani, 2022). A similar pattern was observed in the case of Mount Semeru, where post-eruption economic uncertainty was elevated due to widespread damage to infrastructure and farmlands (Purwantiningsih & Puryanto, 2024).

The economic impact extended beyond agriculture. Studies of the Kīlauea eruption (Hickey et al., 2025) and its parallels in Bali (Hapsari & Purnomo, 2023) showed that the tourism sector is also highly vulnerable. The closure of national parks and the mass cancellation of tourist visits led to the loss of thousands of jobs and massive economic downturns (Blake et al., 2017). These cases collectively illustrate that economic vulnerability is greatly amplified in regions with a homogeneous economic base; areas overly reliant on a single sector, whether agriculture or tourism, are the most severely affected.

### Social Disruption: Displacement, Relocation, and Changes in Social Structure

One of the most profound social consequences of volcanism is the occurrence of mass displacement and the problematic nature of the relocation process. The 1982-1983 eruption of Mount Galunggung forced hundreds of thousands of residents to evacuate under dire conditions, precipitating secondary humanitarian crises (Kurniawan, 2022). Similarly, the catastrophic Tambora eruption of 1815 led to the total destruction of local kingdoms and the decimation of surrounding populations (Tantri, 2019).

In more contemporary contexts, eruptions have displaced residents and led to the permanent loss of homes (Febriska et al., 2025). The relocation to safer areas has often disrupted existing social networks, changed settlement patterns, and, in some instances, sparked new social tensions (Setiawan, 2017). Moreover, post-

eruption environmental changes, such as the alteration of land use and the loss of cultural heritage sites, have been found to erode communal identity and cohesion (Yuniningsih & Nugroho, 2018).

### **Physical and Psychological Health Impacts**

Health-related issues are among the most frequently reported secondary effects of volcanic eruptions. Ash exposure from Mount Merapi in Yogyakarta, for instance, significantly increased cases of upper respiratory tract infections and eye irritation (Yuarsa, 2019). Long-term exposure to silica-laden volcanic dust is also associated with the risk of developing chronic respiratory conditions.

Beyond physical ailments, psychological trauma is a major concern. Studies on victims of the Semeru (Purwantiningsih & Puryanto, 2024) and Merapi (Lestari & Nugroho, 2020) eruptions have revealed marked increases in anxiety, stress, and trauma during the acute phases of disaster events. The emotional toll associated with the loss of family members and personal property remains one of the primary sources of long-term psychological impact. These findings underscore the need for sustained and well-structured psychosocial intervention programs (Bird & Gísladóttir, 2018).

### **Adaptation Patterns, Social Capital, and Disaster Mitigation**

Despite the severity of volcanic disasters, literature also highlights numerous instances of community resilience and adaptive capacity. In the aftermath of the Semeru eruption, communities adopted various strategies to cope with economic uncertainty, such as shifting to temporary occupations, relying on local social networks, or even utilizing volcanic materials as new economic resources (Purwantiningsih & Puryanto, 2024; Wafda & Hidayat, 2021).

Within this context, social capital—defined as interpersonal trust, communal ties, and local support networks—has emerged as a critical determinant of recovery. Research conducted in Semeru (Purwantiningsih & Puryanto, 2024), supported by international cases (Hickey et al., 2025; Paton et al., 2019), consistently demonstrates that communities with strong internal cohesion are more likely to recover quickly due to enhanced access to assistance and efficient resource mobilization (Pratiwi, 2020). Additionally, the strategic use of social media for "social sensing" has proven effective in disseminating early warnings and sharing real-time information during crises, as evidenced in the Kīlauea case (Hickey et al., 2025).

In terms of formal mitigation, risk mapping in the disaster-prone zones of Merapi (Ardi & Sumunar, 2017; Muta'ali & Maryono, 2019) has been identified as a fundamental step. However, Gaillard (2018) observed that the implementation of mitigation policies often falls short due to inadequate coordination and limited community engagement. The most successful mitigation strategies are those that integrate local knowledge systems (Cadag & Gaillard, 2012) with science-based early warning frameworks (Sword-Daniels et al., 2018), ensuring both technical reliability and community acceptance.

## **CONCLUSION**

Volcanic phenomena are an integral part of both the geological and social dynamics of Indonesia. This activity presents a dualistic impact: on one hand, it results in major disasters such as environmental degradation, economic loss, health

issues, and social disruption; on the other hand, it offers long-term benefits such as soil fertility and geo-economic potential.

The synthesis of literature in this study reveals that community resilience and the speed of post-disaster social recovery are highly dependent on the strength of internal social capital (networks of trust and mutual cooperation) and the effectiveness of participatory mitigation policy interventions. Recovery failures are often not solely due to the scale of physical destruction, but rather the result of weak institutional coordination and the failure to integrate indigenous knowledge.

Theoretically, this study supports the perspective that disasters are not purely natural events, but are shaped by the interaction between natural hazards and the socio-economic vulnerabilities of the affected population (Donovan & Oppenheimer, 2021). Therefore, this review forms a foundation for developing community-based social recovery policies that focus not only on physical infrastructure but also on strengthening social capacity and capital in disaster-prone regions. Further research is needed to assess the long-term effectiveness of resettlement programs and to explore the implications of climate change on the frequency and intensity of volcanic activity.

## RECOMMENDATION

The government is encouraged to strengthen volcanic disaster mitigation systems and early warning mechanisms, as well as to enhance disaster education for communities living in eruption-prone areas. Communities should also cultivate awareness and preparedness in facing potential volcanic hazards, while continuing to utilize natural resources wisely and sustainably.

Moreover, academics and researchers are advised to continue developing scientific studies on the social and economic impacts of volcanic activity as a foundation for more effective public policy formulation. Social institutions and the private sector are also expected to take an active role in post-disaster recovery efforts and economic empowerment so that disaster-prone areas can evolve into resilient and productive regions.

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