



## Exploring Agricultural Resilience in Volcano-Prone Regions: A Case Study from Mount Merapi, Indonesia

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### Abstract

Mount Merapi, one of Indonesia's most active and dangerous volcanoes, experienced a devastating eruption in 2010, causing numerous fatalities and widespread damage to homes and land, especially in areas vulnerable to the volcano's activity. Despite the inherent risks, many farmers continue to cultivate the region's land. This study examines the resilience of farmers in the Mount Merapi area in light of the persistent volcanic activity. Employing a qualitative methodology, including in-depth interviews and field observations, the research reveals that farmers' resilience is shaped by their individual experiences and the contributions of government, private sector, and community actors. Long-term residence in the area has equipped farmers with the knowledge and confidence required to navigate the risks and hazards associated with the volcano. Farmers prioritize their safety but also focus on safeguarding their livestock and other essential resources, which are integral to their livelihoods. The local community is instrumental in supporting farmers and residents in disaster-prone zones, while external organizations offer additional advantages to farmers' lives. The study proposes that a collaborative effort among all stakeholders is essential for maintaining farmers' livelihoods in areas susceptible to volcanic activity.

**Keywords:** agriculture; farmers' lives; resilience; volcano

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### INTRODUCTION

Mount Merapi, one of the most active volcanoes in Indonesia, has a rich history of eruptions, with one of the most devastating events occurring in 2010 (Budiyanto, 2021). The eruption claimed many lives and left a trail of destruction in its wake, devastating homes and lands in the surrounding areas. The volcano has a towering height of 2,930 m above sea level as of 2010 and is located within two provinces: Central Java, which includes Boyolali, Klaten and Magelang regencies, and the D.I. Yogyakarta,

which includes Sleman Regency (Marfai et al., 2008). Mount Merapi poses several types of hazards when it erupts, including bombs, hot ash, hot clouds, erosion, and lava flows. It remains an active volcano, with frequent eruptions occurring at various levels.

Despite the inherent hazards and risks of residing near the volcano, numerous individuals have opted to live in the surrounding areas, pursuing livelihoods and a sense of community. Although major eruptions, like the 2010 event, compelled some to relocate, others persisted in their homes, enduring the effects of heavy ash

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(Fiantis et al., 2019). Local residents and authorities maintain vigilance and closely observe the volcano's activities to ensure public safety (Inan et al., 2018). Individuals living in areas prone to Merapi volcanic activity maintain a profound ancestral connection to the land, and their principal means of sustenance are derived from agricultural practices (Napsiah et al., 2017; Muir et al., 2019). The fertile soil and favorable climate have sustained the agricultural practices in the area for generations, and natural resources remain a crucial source of sustenance for the people living in the volcano's vicinity (Bachri et al., 2015). Farmers in the region continue to persevere and adapt to the volcano's changing conditions (Muzayyanah et al., 2014).

Despite the considerable hazards and risks associated with residing in a volcano-prone area, farmers near Mount Merapi have opted to stay and persist with their agricultural activities (Utami et al., 2018; Widodo and Hastuti, 2019). Examining how these farmers survive and adapt to changing conditions presents an intriguing and vital research topic. People living in disaster-prone areas often employ mitigation and adaptation strategies to cope with the associated hazards and risks, regardless of the disaster type. This study seeks to investigate the resilience of farmers in Mount Merapi, acknowledging that their resilience may be influenced by both internal and external factors. Farmers' resilience in the face of disaster is an important aspect to consider the strategies to overcome threats and challenges (Le Goff et al., 2022). Slijper et al. (2022) state that farmers' resilience includes mitigation and adaptation to disaster risks and hazards. Farmers possess individual and community capital to survive in disaster-prone areas, and these capitals form part of their resilience aspects (Ackerl et al., 2023). The term 'resilience' is often used to describe the ability of

people to withstand and recover from various challenges or threats while maintaining their performance or productivity (Mousavi, 2006). The results of this research could enhance our understanding of how farmers in volcano-prone areas can foster resilience and adapt to the risks and hazards they confront. By comprehending these factors, policymakers and community leaders may devise more effective strategies to support the resilience of farmers and other individuals in disaster-prone areas.

## MATERIALS AND METHOD

Indonesia, located in the ring of fire, is home to 127 active volcanoes. This makes it one of the top countries in the world with the most active volcanoes. Mount Merapi, located in Central Java and the D.I. Yogyakarta, is among the 127 active volcanoes and is known to have frequent eruptions (Ratdomopurbo et al., 2013). The 2010 eruption was the deadliest in the past two decades, resulting in almost 400 deaths and the destruction of homes, land, and other properties (Andryato, 2021). Other eruptions have occurred with varying degrees of hazards. The eruptions of this volcano from 2015 to 2021 can be seen in Figure 1, where an eruption occurs every year (Peng et al., 2018). Despite the presence of a government agency that monitors Mount Merapi's activity, eruptions often occur abruptly.

This study explores the resilience of farmers in a volcano-prone area by focusing on a ten-kilometer radius from the summit of Mount Merapi. As an active volcano with frequent eruptions, Mount Merapi impacts the surrounding region, including the agricultural community. The study area was selected to ensure that the research focused on farmers facing the most significant risks and hazards due to their proximity to the volcano (Figure 2). This

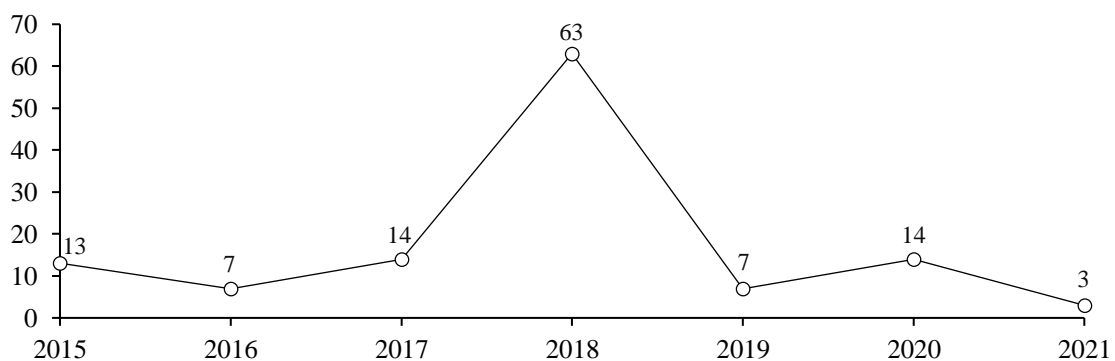


Figure 1. Number of Mount Merapi eruptions in 2015 to 2021 (Rizaty, 2022)

approach enables the study to provide valuable insights into how farmers in areas with high volcanic activity can build resilience and adapt to the associated risks and hazards.

This study employs a qualitative approach, aiming to understand the deep and diverse condition of the farmers resilience. To ensure data accuracy and reliability, the researcher conducted in-depth interviews with key informants, such as community leaders and local public figures in the Mount Merapi area. Key respondents in the in-depth interviews can be seen in Table 1.

Focus group discussion was conducted three times with local leaders and farmers in the study area, where the discussion was about the agriculture condition, challenge, and opportunities in Mount Merapi prone area. The study aimed to examine the resilience of farmers in the volcanic area across multiple dimensions, including social factors such as community involvement, economic factors including farming and non-farming activities, cultural factors, and external entities such as any relevant stakeholders. The gathered data underwent reduction techniques to eliminate irrelevant or redundant information, retaining only pertinent data for analysis. Data triangulation was also utilized to ensure accuracy and validity, and interviews were continued until data saturation was reached. The data collection process transpired between 2020 and 2022. The insights gained from this study contribute to our understanding of the factors influencing the resilience of farmers in volcanic regions and their capacity to adapt and manage the risks and hazards inherent to living in such areas. The study area covers social, economy, culture and external entities.

## RESULTS AND DISCUSSION

### Agriculture in volcanic area

The surrounding area of Mount Merapi is home to a diverse range of crops, including chili, corn, tobacco, cabbage, scallion, mustard green, cucumber, banana, taro, and sweet potato. These crops provide a sustainable source of income for the farmers, who typically sell their products in local auction markets or intermediaries. In addition to selling their crops, some farmers produce seedlings sold to customers, including neighboring farmers and buyers from farther away. Seedling nurseries are prevalent in the area, having evolved into a hub for a burgeoning seedling industry. This is largely attributed to their competitive pricing compared to other locations.

Farmers in the Mount Merapi volcano-prone area, much like their ancestors, continue to practice agriculture using traditional methods. These methods primarily involve manual labor and equipment rather than machinery (Fajarwati et al., 2016). However, a wave of innovation has been introduced by younger farmers, either through their own experiences or via education provided by government entities and other stakeholders. Given the necessity for sustainable and effective agricultural practices, these innovations are critical for supporting farmers in the long term. For instance, to prevent landslides, farmers in sloping areas have adopted terracing, a practice bolstered by planting trees along the borders. In addition to growing crops, farmers cultivate a variety of trees such as clove (*Syzygium aromaticum*), jackfruit (*Artocarpus heterophyllus*), mahogany (*Swietenia mahagoni*), coconut (*Cocos nucifera*), sengon (*Albizia chinensis*), acacia, bamboo, coffee, durian

Table 1. Key respondents

Code	Position
R1	Head of Jemowo Hamlet, Jemowo Village, Tamansari Sub-district, Boyolali Regency, Central Java
R2	Village secretary, Tlogolele Village, Selo Sub-district, Boyolali Regency, Central Java
R3	Head of farmers group association in Glagaharjo, Cangkringan Sub-district, Sleman Regency, D.I. Yogyakarta
R4	Community empowerment activists in Glagaharjo, Cangkringan Sub-district, Sleman Regency, D.I. Yogyakarta
R5	Head of Krinjing Hamlet, Dukun Sub-district, Boyolali Regency, Central Java
R6	Local young public figure in Jombong Hamlet, Paten Village, Dukun Sub-district, Magelang Regency, Central Java
R7	Regional Disaster Management Agency (BPBD) of Yogyakarta
R8	Extension officer in Selo Sub-district

(*Durio*), avocado, *petai* (*Parkia speciosa*), *jengkol* (*Archidendron pauciflorum*), and orange. These trees serve multiple purposes: they provide timber and fruits, enhance farming practices, and improve productivity through the implementation of agroforestry. Some farmers have adopted intercropping, a method that allows for the sustainable generation of income from a variety of crops with different harvest periods. This practice is also beneficial for soil and water conservation (Gashure and Wana, 2023).

*“I believe that intercropping is essential for generating regular income throughout the year. If we were to rely on a single crop, we would only earn income once the crop was harvested, which could take several months. This approach is not sustainable or practical for us. By planting a mix of crops with varying harvest times, we can ensure that we have a steady stream of income every month. This is critical to our survival and ability to support our families.” R6*

Livestock farming is an integral component of the livelihoods of many farmers residing in the Mount Merapi area. The majority of these farmers own cows, which are typically housed in sheds, though some farmers also allow them to graze in their fields. Chickens and goats are also commonly raised by these farmers. During volcanic eruptions, farmers make concerted efforts to safeguard their livestock. They ensure the animals have sufficient feed to prevent starvation. Given that farming and livestock constitute their primary income sources, farmers are often willing to take substantial risks to protect their livelihoods and assets. This commitment can sometimes extend to jeopardizing their own safety (Rozaki et al., 2021).

*“I know that during times of high volcanic activity, we need to evacuate our homes during the night for our own safety. However, during the daytime, we often return to our houses and farms to check on our livestock and feed them. We only do this if we believe that it is safe to do so based on the current conditions. We have done that to ensure that our livelihoods are not completely destroyed due to lost of agriculture and livestock. It is a difficult situation, but as farmers, we are used to facing challenges and finding ways to adapt.” R1*

Farmers in the Mount Merapi area have access to support from various entities. However, the impact of this assistance on their livelihoods is somewhat constrained. This limitation stems from the geographical coverage of the support and its primary focus on local organizations, rather than directly on individual farmers (Sullivan and Sagala, 2020). Despite these challenges, the farmers exhibit remarkable resilience and determination. They are committed to maintaining their livelihoods through agriculture, demonstrating adaptability in the face of the unique challenges posed by their environment. Over time, they have continually worked to refine and improve their farming practices, showcasing their ability to learn and innovate (Muzayyanah et al., 2014). This resilience and determination, coupled with their innovative approaches to farming and livestock rearing, underscore the farmers' ability to navigate the unique challenges of farming in the Mount Merapi area. Their efforts to protect their livelihoods, even in the face of potential personal risk, highlight their commitment to their work and community.

### **Farmers' resilience**

Farmers residing near the active Mount Merapi volcano have crafted unique strategies to cope with the inherent dangers of their location. These strategies have become an intrinsic part of their lifestyle, forming a resilience framework that is deeply rooted in their experiences. The degree of resilience may differ from one area to the other area, but this the resilience is crucial element in farmers' life. As depicted in Figure 2, various factors and resources contribute to their adaptability and recovery capabilities in the face of challenges. The resilience of these farmers is multifaceted, encompassing social, economic, and cultural aspects, as well as the influence of external entities. Understanding this resilience framework is crucial for providing effective support to these farmers. It offers insights into their needs and the strategies they employ, which can guide the development of initiatives aimed at enhancing their resilience. By doing so, we can help these farmers build a more sustainable and secure future for themselves and their families. This approach ensures that support efforts are not only well-targeted but also respect and reinforce the farmers' own resilience strategies.

### *Social*

In this study, researcher explore the social aspect of resilience, focusing on the engagement

and involvement of farmers with their peers and wider communities in the Mount Merapi volcano-prone area. In Indonesia, and indeed in many Asian countries, social engagement is highly valued, particularly in rural areas. Farmers in the Mount Merapi area demonstrate robust social engagement, as seen in their daily interactions with each other, especially among neighbors (Mutiarni et al., 2022). The social dynamics of these farmers present an intriguing facet of agricultural studies, given their potential influence on the development of the agricultural sector. As the key players in this sector, farmers' social interactions can significantly shape their approach to farming. Observing the success of peers who have embraced new innovations can serve as a powerful motivator for farmers to experiment with novel practices. This is particularly relevant in the Mount Merapi area, where many farmers are of older age and exhibit lower adoption rates for new innovations. Many farmers participate in farmers' groups, which provide a platform for various agriculturally-related activities such as training, meetings, discussions, government program transfers, and learning. These groups can significantly influence farmers' lives and agricultural practices. However, the support provided by these groups may be limited in scope, often focusing on those who are part of the local organization rather than individual farmers (Maryati et al., 2020). This limitation underscores the need for a more inclusive approach to supporting farmers in their efforts to adapt and innovate in the face of the challenges posed by farming in a volcano-prone area.

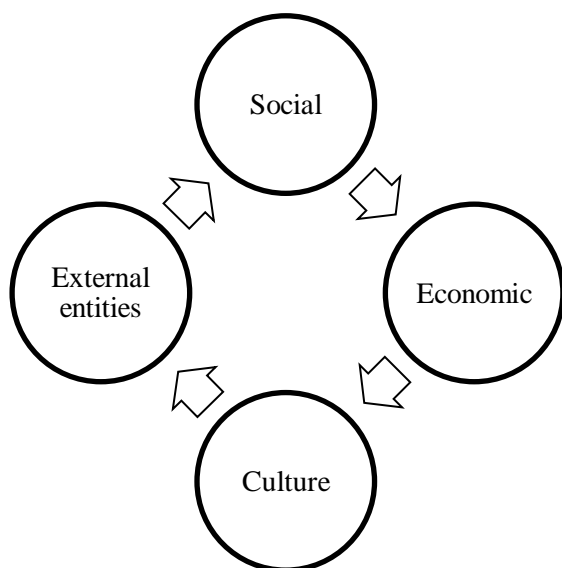


Figure 2. Farmers' resilience

As depicted in Figure 3, the farmers' group "Kepengen Maju" has taken proactive steps to promote the practice of the agroforestry system among its members. They have established an educational board to highlight the numerous benefits of this system, which include biodiversity protection, landslide and erosion prevention, and water conservation. Farmers are found practicing agroforestry with combining crops and jackfruit trees. In a similar vein, this farmers' group has created another educational board, shown in Figure 4, to advocate for organic farming. This environmentally-friendly agricultural system aligns with the group's commitment to sustainable farming practices. Organic farming is being practiced mostly regarding their fertilizer using livestock manure and jackfruit trees' leaves. The involvement of farmers' groups in the lives of farmers is a critical aspect of agricultural practices in the Mount Merapi volcano-prone area (Andreastuti et al., 2019; Sina et al., 2019; Partelow, 2021).

Information, particularly regarding government programs, often circulates more quickly within these groups. For instance, access to fertilizer subsidies is primarily facilitated through the farmers' group (Baga et al., 2023). In addition to farmers' groups, other community associations, such as the *rukun tetangga* (RT) or neighborhood, provide support to farmers in this volcano-prone area. Often referred to as the "pillar of neighbors," these communities play a crucial role in hamlet's administration. At both the hamlet and RT levels, community involvement significantly contributes to farmers' survival amidst the hazards and risks associated with living near an active volcano. These communities collaborate on risk and hazard mitigation and adaptation efforts, further reinforcing the resilience of farmers in the face of these challenges.

Living in close proximity to an active volcano like Mount Merapi necessitates a thorough understanding of the four levels of volcano hazards. These levels are *Normal* (Level 1), *Waspada* (Alert-Level 2), *Siaga* (Standby-Level 3), and *Awas* (Beware-Level 4) (National Agency for Disaster Management/BNPB, 2021). When Level 3 is declared, farmers and other residents are required to evacuate, taking with them only essential documents and belongings. Information about hazards or warning signs can be accessed through various channels, including social media platforms like WhatsApp, YouTube, and Facebook, as well as television. Recently,

WhatsApp has become the preferred channel for farmers due to its real-time updates and rapid dissemination of information. However, to avoid misinformation or hoaxes, farmers must exercise caution and engage in self-monitoring regarding the situation surrounding Mount Merapi's eruption. In some areas, traditional methods of announcing volcanic activity persist, such as using tall speakers installed at the hamlet chief's house. Local knowledge about signs of an impending eruption, such as a rumbling sound resembling a helicopter or the presence of clouds above the volcano's peak, also plays a crucial role. Recognizing these signs can help

farmers evacuate in time or inform their fellow farmers and neighbors to take necessary precautions.

In Javanese culture, the practice of "gotong royong" is common in social activities. This term refers to mutual assistance, where individuals work together with the community to achieve a common goal for the benefit of the neighborhood (Lukiyanto and Wijayaningtyas, 2020). This practice is still prevalent in Mount Merapi's society, particularly in agricultural activities, reinforcing the community's resilience and adaptability in the face of the unique challenges posed by their environment.



Figure 3. Farmers' group education board regarding agroforestry



Figure 4. Farmers' group education board regarding organic farming

*“The farmers in this neighborhood have a strong sense of community and mutual assistance, especially when it comes to agricultural activities that require more physical strength. They work together with their neighbors to help each other with various tasks, such as the tillage process. Typically, 10 to 15 farmers in the same neighborhood will take turns tilling each other’s land. They alternate their work schedule, so each farmer receives help from their neighbors in the morning to noon and then moves on to help another member in the next day, continuing the cycle. This kind of community support is crucial to ensure the success and productivity of their agricultural practices, especially in a challenging environment of Mount Merapi volcano-prone area.” R6*

The practice of “gotong royong” is a cornerstone of community life for farmers in the Mount Merapi area, offering both economic and social benefits. In the realm of agriculture, this practice allows farmers to save on the cost of hiring workers, a significant expense for smallholder farmers. However, the spirit of “gotong royong” extends beyond farming activities. It encompasses community-benefit activities such as clearing tree branches from evacuation roads during the rainy season to prevent blockages that could hinder the evacuation process. Farmers also demonstrate their solidarity and social engagement by participating in their neighbors’ celebrations, such as weddings or other events, known locally as “hajatan”. Even if they are unable to contribute financially, their presence is a token of support and a testament to the strong bonds within the community. The spirit of “gotong royong” is deeply ingrained in Indonesian culture. It prompts individuals to help each other spontaneously, often without any formal instruction. This mutual assistance can be coordinated among local stakeholders, but it often occurs naturally. This practice becomes particularly valuable during times of disaster. Fundraising or disaster relief agencies can collect substantial donations from individuals practicing “gotong royong”, contributing to Indonesia’s reputation as one of the most generous countries in the world. This spirit of mutual aid and community support is a testament to the resilience and solidarity of the farmers in the Mount Merapi area (Nugraha, 2022).

Community activities in the Mount Merapi volcano-prone area are diverse and have profound impacts on farmers’ daily lives and long-term resilience. As inherently social beings, humans rely on their communities for support and survival. In the context of Mount Merapi, the community plays a crucial role in easing the challenges of living near an active volcano by providing mutual aid and sharing the burden of the impacts of volcanic disasters. The community’s ability and preparedness to handle volcano hazards and risks are testament to its resilience (Rakib et al., 2017). This resilience manifests in various forms, including the practice of “gotong royong”, disaster mitigation awareness, and preparedness to protect themselves from the hazards and risks associated with the volcano. Community resilience is particularly vital in disaster-prone areas. It creates a supportive network that can provide immediate aid and assistance during all phases of a disaster – before, during, and after. This resilience also establishes a form of social capital, arising from the strong bonds within the community. These bonds enable community members to work together and care for each other, fostering a sense of solidarity and mutual support (Zaki et al., 2020). In essence, the resilience of the Mount Merapi community, underpinned by social engagement, mutual aid, and preparedness, is a powerful testament to their strength and adaptability in the face of the unique challenges posed by their environment.

*“The strong community bond in this area is crucial for the safety and well-being of all residents, particularly in the face of the constant threat posed by Mount Merapi. The farmers here are fortunate to have such a supportive and cooperative community, which allows them to face the challenges and risks associated with living in a disaster-prone area. Through their understanding of each other’s needs and the willingness to work together, the community is able to prepare for and respond to any potential disasters in a more effective manner. This close-knit community is a prime example of the importance of social capital in building resilience and mitigating the impacts of natural disasters.” R2*

Educational and training programs focused on volcano disaster mitigation can undoubtedly equip farmers with the knowledge and skills necessary to navigate the challenges of residing

in a volcano-prone area. However, the true strength in this context lies in the resilience of the community, which magnifies the individual efforts of each farmer (Elavarasan and Pugazhendhi, 2020). A robust sense of community fosters collective action among farmers. Despite the high risks associated with volcanic disasters, the community remains the primary focus. Farmers hold a firm belief that working together is essential to anticipate and minimize the impact of these disasters, and that such collaboration will ultimately benefit the entire community. By fostering strong bonds within the community, farmers can establish a support network capable of withstanding the challenges of living in the shadow of Mount Merapi. This network, underpinned by the practice of “*gotong royong*” and a shared commitment to mutual aid and preparedness, forms a resilient social infrastructure that enhances the community’s capacity to cope with and recover from volcanic disasters (Muir et al., 2020). This resilience is a testament to the strength and adaptability of the farmers and their community in the face of the unique challenges posed by their environment.

#### *Economy*

Economic activities play a pivotal role in the livelihoods of farmers in the Mount Merapi area (Udmale et al., 2014). Despite the inherent risks associated with residing in a volcanic hazard zone, farmers choose to stay due to the crucial income and food supply that agriculture provides for the local and surrounding areas. The region offers various economic opportunities, including agriculture, tourism, and trade (Umaya et al., 2020). However, agriculture remains the primary income source for the majority of the local population.

Farming practices in this area are typically characterized by semi-subsistence farming, where farmers consume a portion of their produce and sell the remainder to meet other needs (Achmad et al., 2022). Small land holdings, a common feature in Indonesia, pose a significant challenge to income generation for farmers (Basith, 2017). However, land size is not the only factor influencing farmers’ income. Some farmers in Mount Merapi take up additional side jobs to supplement their earnings and support their families. Despite these challenges, agriculture remains a significant economic activity in the region, playing a crucial role in the local economy. Farmers in the area obtain their capital from personal savings and bank loans. Banks

such as Bank Rakyat Indonesia (BRI) offer People’s Business Credit (KUR) to support farmers (Gunawan et al., 2021). During eruption periods, BRI offers flexible repayment terms, providing farmers with more time to repay their loans. Within farmer groups, there are no cash contributions, but they do have savings and loans with a maximum nominal value of around 1,500,000 IDR and installments every 35 days. As a result, the economic activities of farmers in the Mount Merapi area are closely tied to their livelihoods, making the economic activities essential to support and enhance these activities. Some farmers are receiving financial support from middlemen who provide them with capital to initiate their farming operations. These middlemen also commit to purchasing the farmers’ produce once the harvest is ready. By understanding and addressing the unique challenges these farmers face, we can help them build a more sustainable and resilient future.

*“Many farmers often take on additional side jobs to meet their financial needs, as relying solely on agriculture can be challenging. For instance, in this region, sand mining is a common side job. As a result, during the day, you’ll often find that women are the ones working in the fields, as their husbands are occupied with sand mining.”*  
R3

In addition to agriculture, residents in the Mount Merapi area engage in a variety of economic activities, including trading, tourism, sand mining, and public or private employment. Trading activities are a common practice among local farmers and residents, with businesses ranging from grocery shops to vegetable sellers in traditional markets. The tourism sector also provides livelihood opportunities, with locals participating in strawberry picking parks, jeep car tours, and the Merapi Volcano Museum (Suryanto et al., 2011). Many individuals seeking additional income choose to work as migrant employees in nearby cities, exploring various business and industry sectors. This diversification of income sources contributes to the economic resilience of the community. Given the importance of these economic activities for farmers and local communities in the Mount Merapi hazard zone, it is crucial for the government to provide more substantial support. In this region, a community-based economy is prevalent, where community members collaborate to facilitate economic activities (Musa et al.,



2020). Farmers cooperate in agricultural endeavors, and locals support small businesses by purchasing products from each other. This creates strong social capital, fostering a unified and resilient community (Partelow, 2021).

Following the 2010 eruption, the local farming community had to start anew by cultivating their land. The government provided assistance of 100,000,000 IDR to help rebuild the local economy, which was used to purchase cows through a group system. However, only two farmer groups - the "Maju Tani" farmers group and the "Sidosari" farmer group-were able to receive this assistance.

While there is currently no established tourist village in Tlogolele Village, plans are underway to submit a proposal to POKDARWIS (*Kelompok Sadar Wisata*: a local group focusing on tourism development). The proposal aims to declare Tlogolele as a tourist village, centered around a ground camp within a 2 km radius from the top of Mount Merapi. This initiative is expected to boost the local economy and benefit the community (Mihardja et al., 2023). In summary, the economic activities of the Mount Merapi community are diverse and interconnected, contributing to the resilience and sustainability of the local economy. Government support and community-based initiatives are crucial in enhancing these activities and fostering a resilient and prosperous community.

### Culture

The study reveals that farmers in the Mount Merapi area possess a range of cultural attitudes and beliefs that influence their actions and lifestyle. Some farmers are more conscious of these beliefs and practices than others. Understanding these cultural attitudes and beliefs is crucial for effectively supporting farmers and addressing their needs in the face of natural disasters such as volcanic eruptions (Andreastuti et al., 2019). The study underscores that culture in this context extends beyond traditional beliefs and practices to include the daily activities and lifestyles of farmers.

Research by Hendro (2018) sheds light on the fact that some farmers and locals in the Mount Merapi area still hold beliefs in mystical and supernatural factors related to volcanic eruptions. However, this belief system is gradually fading as more people turn to religion, particularly Islam, and adopt a more logical and scientifically-driven perspective. This shift towards accepting scientific information about Mount Merapi is facilitating the education and awareness of

farmers and locals by the government and other stakeholders. The study also highlights the significance of cultural practices such as "gotong royong" in the social aspects of the findings. This practice of mutual assistance and community cooperation is deeply ingrained in the local culture and plays a crucial role in fostering community resilience and solidarity.

*"Farmers are not only steeped in tradition and belief, but also their way of life and social customs. Cultivating crops goes beyond just their beliefs and encompasses their lifestyle and community interactions."*

R2

### External entities

External entities invariably influence farming practices and the lives of farmers in all agricultural regions. This is no different for those living and farming in the vicinity of the Mount Merapi volcano. These farmers are not isolated; they rely on various external entities for support, as depicted in Figure 5. These entities, encompassing organizations, institutions, and individuals, may exist outside the farming community, but they play a pivotal role in the farmers' lives and livelihoods. Despite being external, their influence and support are integral to the resilience and sustainability of the farming community in the Mount Merapi region.

The government plays a crucial role in the lives of farmers residing in volcanic regions, especially around Mount Merapi. Its policies and regulations can either facilitate or impede the farmers' efforts to sustain their livelihoods in this challenging environment (Marfai et al., 2008; Yulianto et al., 2020). The government provides tangible support in various forms, including the construction of evacuation roads, subsidies for agricultural inputs like fertilizers, provision of agricultural advisors, financial access support, and the implementation

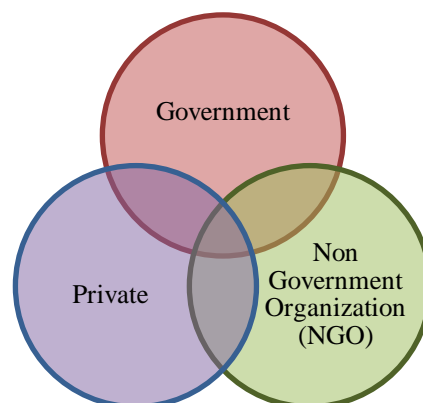


Figure 5. External entities

of agricultural development programs and training. While farmers are somewhat dependent on this support, they acknowledge the substantial assistance the government has provided in the past and continue to hope for additional measures to enhance their resilience against volcanic activities and further develop their livelihoods.

To monitor Mount Merapi's activity, the government established the Center of Volcanology and Geological Hazard Mitigation (PVMBG/*Pusat Vulkanologi dan Mitigasi Bencana Geologi*), which disseminates information about the volcano during periods of heightened activity. In times of disaster, the BNPB operates at the national level, and the BPBD operates at the local or regional level. These agencies provide assistance to all residents in Mount Merapi during dangerous situations arising from the volcano's activity. However, the government's efforts to support farmers in the Mount Merapi volcano-prone area are limited by resources, emphasizing the importance of non-government organizations (NGOs) in providing much-needed assistance (Yulianto et al., 2020). These independent organizations can generate funds and distribute them to farmers in the form of education, infrastructure, and economic resources. The support provided by NGOs complements the government's efforts and can enhance farmers' resilience in the face of the volatile volcanic environment. National and international NGOs actively participate in community empowerment programs benefiting farmers in the Mount Merapi region. Private entities refer to companies operating in the area and engaging in related activities (Umaya et al., 2020; Yusrifa and Danugroho, 2022). While these entities often prioritize their own interests, Indonesian regulation mandates companies to fulfill their corporate social responsibility (CSR) in society, which includes supporting the development of farmers in the Mount Merapi region. Private entities, with their resources and capabilities, can contribute to improving farmers' resilience in the volcano-prone area by providing financial support and professional assistance. Both NGOs and private entities can play a crucial role in supporting farmers before, during, and after volcanic activities occur.

## CONCLUSIONS

Living in the shadow of Mount Merapi, one of Indonesia's most active volcanoes, the local farming community has demonstrated remarkable

resilience and adaptability. The study illuminates the resilience of the farming community in the Mount Merapi region, their adaptive strategies, and the crucial role of external entities in supporting them. The study also highlights the need for more targeted and comprehensive support from external entities, particularly in terms of expanding the coverage area and focusing more on individual farmers. Moreover, the importance of education and training programs in enhancing farmers' knowledge and skills to cope with volcanic disasters is underscored. It underscores the need for a collaborative approach among all stakeholders to further enhance the farmers' resilience, ensuring the sustainability of their livelihoods, and securing a safer future for them and their families.

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