JURNAL PENELITIAN GEOGRAFI
Vol (13), No (1), (2025), pp. 37-50
Doi: http://dx.doi.org/10.23960/jpg

Original Article

Conservation Practices of Volcanic Landforms in Eruption Mitigation in the Southern Merapi Region, Klangon Hill, Daerah Istimewa Yogyakarta

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ABSTRACT
The present study focuses on the conservation of volcanic landforms in Klangon Hill, with a view to mitigating the potential for eruption disasters at Mount Merapi, in conjunction with the development of natural tourism potential in the area. The objective of this research is to ascertain the conservation strategies for eruption disaster mitigation that can be integrated with sustainable tourism development for the local community. The present study employed a qualitative-descriptive methodology. The data collection technique employed triangulation of data sources, consisting of observation, interview, and documentation. Four distinct approaches are currently being employed to ensure the conservation of Bukit Klangon: preserving it as a tourist destination, utilising traditional agricultural practices, implementating afforestation initiatives, and disseminating of knowledge regarding volcanic disaster mitigation. Research indicates that in order to ensure the cultural and economic sustainability of areas formed by volcanoes and to minimise the risk of them becoming disaster zones, such as Merapi, local communities must be engaged.

KEYWORDS
Volcanoes; Volcanic Landforms; Tourism; Environmental Conservation

Received: February 21, 2025 **Acepted:** May 13, 2025 **Published:** June 3, 2025

Citation:
Wachidatullailiya, M., Adawiyah, R., Intan, P. A., Sinaga, E. F., Wibawa, Y. P. W., Hariyanto, B., & Sitohang, L. L. (2025). Conservation practices of volcanic landforms in eruption mitigation in the southern Merapi region, Klangon Hill, Daerah Istimewa Yogyakarta. *Jurnal Penelitian Geografi, 13*(1), 37–50. http://dx.doi.org/10.23960/jpg.v13.i1.33536

INTRODUCTION

Indonesia is situated at the convergence of four tectonic plates: the Eurasian, Indo-Australian, Indian, and Pacific Plates. Indonesia also possesses a volcanic belt that extends from the island of Sumatra, through Java and Nusa Tenggara, to Sulawesi, consisting of ancient volcanic mountain ranges and lowland swamp areas (Simatupang, 2017). A volcano is a vent or fissure in the Earth's crust through which magma, gas, or other fluids emerge to the surface. Volcanoes are typically conical in shape, with a crater through which volcanic materials are expelled (Gerhana et al., 2023). An active volcano is one that has a history of erupting or releasing magma, hot lava, or cold lava flows, and may erupt at any time once it is classified as under high alert status (Permata & Putranto, 2023). Indonesia has 127 active volcanoes, accounting for 13% of the world's total. Sixty percent of these pose potential environmental hazards. Geological disasters, such as volcanic eruptions, can significantly impact human activities (Kurniawan et al., 2022). Therefore, efforts must be undertaken to anticipate and mitigate the risks associated with volcanic disasters.

Geography, being closely related to specific regions or spaces on Earth, enables the identification of locations and the natural and human-made elements present on the Earth's surface (Niasari et al., 2017). The tourism potential of a destination is a subject of geographical study, both in terms of its physical and social aspects. These geographical aspects include location, climate, accessibility, and available facilities (Juniwan et al., 2013).

One of the most active volcanoes in the world is Mount Merapi. Mount Merapi is located on the border between the Central Java Province and the Yogyakarta Special Region. Its 2010 eruption caused extensive damage and claimed many lives. The cold lava floods resulting from the eruption of Merapi flowed through three rivers—Kali Gendol, Kali Kuning, and Kali Boyong—devastating nearby settlements.

Mount Merapi is the most active volcano in the Yogyakarta–Central Java region, producing lava, pyroclastic flows, hot clouds, and lahars. In the upper area of Klangon Hill, there are volcanic deposits from the Young Merapi period, of Quaternary age, consisting of unweathered tuff, ash, breccia, agglomerate, and lava flows. These overlie the Older Merapi volcanic deposits, beneath which lie tertiary bedrock formations that serve as aquifer bases (Listyani R.A., 2020). The rocks forming the groundwater basin in the Cangkringan area are derived from the volcanic deposits of Young Merapi. These deposits consist of two formations: the Yogyakarta Formation (upper part) and the Sleman Formation (lower part). The availability of groundwater in Cangkringan is supported by these Young Merapi volcanic deposits.

Mount Merapi contributes significant economic value to the local community. Its natural beauty and abundant natural resources are utilized by local residents, particularly in the agriculture and tourism sectors. However, the land use managed by the community remains vulnerable to volcanic hazards due to its location on the mountain slopes, combined with a lack of awareness and preparedness among land managers (Hasanah et al., 2023).

Regarding land use for tourism, the Yogyakarta Special Region's Tourism Office recorded fluctuating visitor numbers to Klangon Hill in Sleman Regency during the 2018–2022 period. In 2018, the number of visitors was recorded at 111,883 and increased to 125,472 in 2019. However, in 2020, no visitors were recorded due to the COVID-19 pandemic. In 2021, tourism began to recover with 24,512 visitors, increasing again to 63,188 in 2022 (Yogyakarta Special Region Tourism Office, 2021). This increase indicates a high level of interest among tourists in visiting Klangon Hill. Local governments must strive to identify and develop the natural and socio-cultural potentials dispersed throughout their regions (Zulkarnain Sumarni, 2012).

The strategy for conserving volcanic landforms at Klangon Hill, Mount Merapi, takes into account the sustainability of local communities (Harjanti et al., 2024). One conservation initiative at Mount Merapi is the establishment of a conservation forest area known as the Mount Merapi National Park (TNGM). Mount Merapi was designated a National Park through the Minister of Forestry Decree No. 134/Kpts-II/2004 dated May 14, 2004, encompassing an area of approximately 6,410 hectares (Kuswijayanti et al., 2011). The TNGM area includes tropical rainforest, which harbors biodiversity, serves as a source of genetic resources, and has socio-economic, religious, and cultural functions (Rahmayanti, 2022).

Although various conservation efforts have been introduced, few studies have empirically identified and explained how volcanic landform conservation can be synergized with the development of tourist destinations that support the economic and social sustainability of surrounding communities. Therefore, this research fills the gap in the literature by focusing on the integration between volcanic landform conservation and sustainable

tourism development in Bukit Klangon, part of the Mount Merapi National Park, to ensure a positive impact on environmental preservation and community well-being.

Merapi conservation practices are oriented toward tourism development with the aim of maintaining community sustainability in both cultural and economic aspects. In other words, it can be stated that tourism development on the slopes of Mount Merapi requires the implementation of disaster mitigation. This is important because volcanic hazards that occur outside eruption periods will threaten the inhabitants of the slopes. Therefore, the development of the tourism sector must be based on the principle of sustainability, which means that development should generate long-term benefits for social, economic, ethical, and environmental aspects (Hasanah et al., 2023).

Based on this background, the research question in this study is: how is the implementation of volcanic landform conservation efforts in mitigating Mount Merapi eruption disasters integrated with the development of sustainable tourism that benefits the local community? Previous studies have emphasized the importance of preserving volcanic areas, particularly Mount Merapi, to reduce disaster risks and promote economic development through tourism, namely:

a. Volcanic Area Conservation. Conservation of the Mount Merapi area has been carried out through various approaches, such as the establishment of the Mount Merapi National Park (TNGM), reforestation practices, and the preservation of local wisdom among the communities on the slopes of Merapi (Kuswijayanti et al., 2011; Ernawati et al., 2018).
b. Volcanic Disaster Mitigation. Strategies for mitigating volcanic eruption disasters have been widely discussed in the literature through structural approaches (monitoring volcanic activity) and non-structural approaches (community socialization and education) (Bakkour et al., 2015; Fatima & Sudibyo, 2023).
c. Conservation-Based Tourism. Bukit Klangon has been identified as a potential site for the development of nature- and culture-based tourism, integrating conservation practices to maintain ecosystem sustainability and support the local economy (Hadi & Yulianto, 2021; Rindrasih, 2018).
d. Local Community Involvement. Studies such as Donovan et al. (2012) and Rozaki et al. (2021) demonstrate that active involvement of local communities in conservation and disaster mitigation is a key factor in the successful management of disaster-prone areas.

Although numerous studies have been conducted, there remain several research gaps that have not yet been addressed empirically and in an integrated manner. For instance, there is a lack of comprehensive and integrated studies examining the direct relationship between volcanic landform conservation, eruption mitigation, and the development of sustainable tourism at the local level in Bukit Klangon. Moreover, there is still limited research specifically focusing on the conservation of volcanic landforms.

The objective of this study is to identify various conservation efforts in volcanic eruption disaster mitigation that can be integrated with the development of sustainable tourism for local communities. Specifically, this research aims to empirically describe the synergy between continuous conservation practices and the development of tourism destinations in Bukit Klangon, as part of the broader conservation efforts within the Mount Merapi National Park.

METHOD

Research Location

The research site was selected purposively, taking into account the occurrence of volcanic disasters and the existence of active disaster mitigation efforts. The study is conducted in Cangkringan District, Sleman Regency, Special Region of Yogyakarta. Cangkringan District covers an area of 47.99 km^2 with a population of 31,117 people (BPS, 2022). Bukit Klangon is located in Kalitengah Lor Hamlet, Glagaharjo Village, Cangkringan District, Sleman Regency, Special Region of Yogyakarta. The research location is illustrated in Figure 1.

The landform in Klangon is classified as volcanic, consisting of upper, middle, and lower slopes. Bukit Klangon has a slope gradient of approximately 30° and an elevation ranging from 1,100 to 1,299 meters above sea level. Volcanic areas are landforms on the Earth's surface shaped by volcanic activity from active volcanoes. This activity includes all magma-related processes beneath the Earth's crust, such as volcanic eruptions, toxic gas emissions, volcanic earthquakes, and lava flows. Volcanic regions are also highly prone to natural disasters. Common characteristics of volcanic areas include the presence of volcanoes, fertile soil, and high disaster risk.

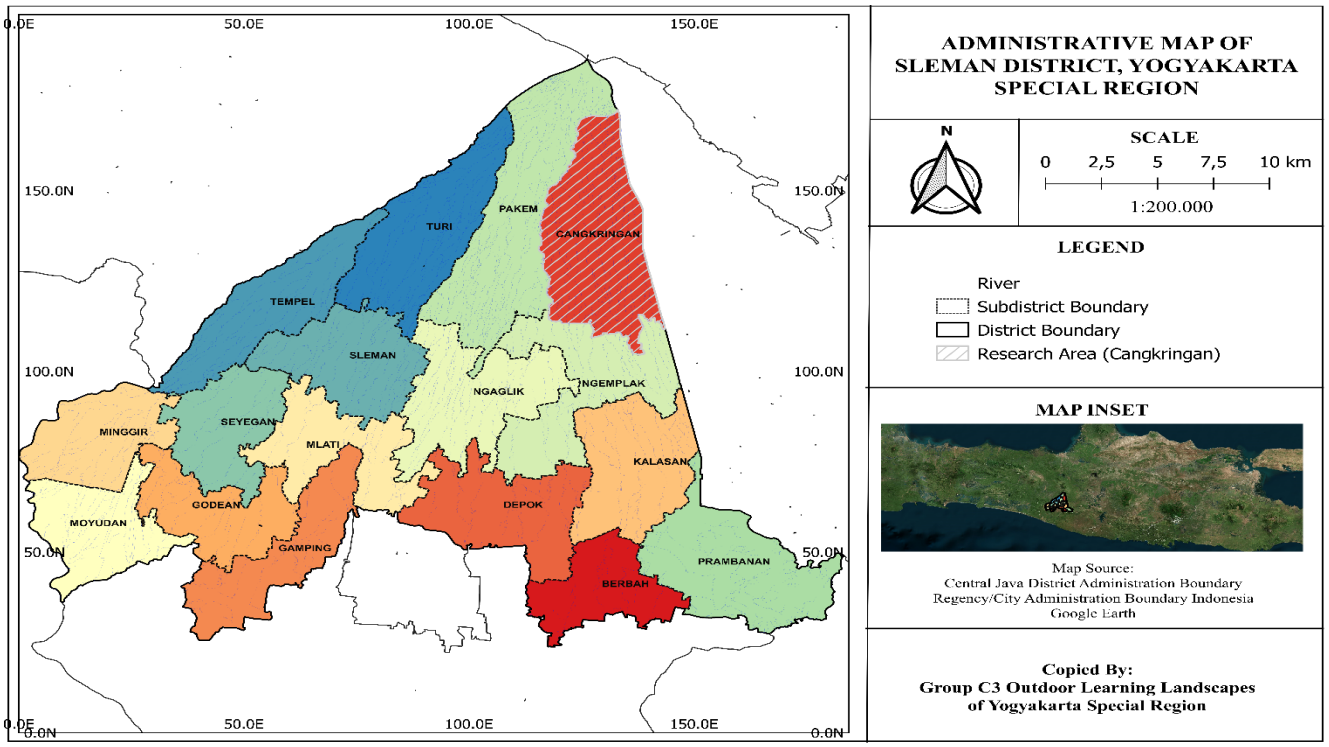

Figure 1. Administrative Map of Sleman Regency DIY

Research Approach

This study adopts a qualitative-descriptive method, developed based on the phenomenon of Merapi conservation as a strategy for volcanic eruption disaster mitigation. The descriptive method is used to illustrate conditions or phenomena and to identify factors associated with specific circumstances as they occur in the field (Febriyantri et al., 2014). Descriptive research aims to provide a detailed account of situations or events (Hakki et al., 2015).

Data collection was carried out through four main techniques: observation, interviews, questionnaires, and documentation (Pratiwi & Chotimah, 2022). Observational data were obtained through an integrated rapid survey involving collaboration among experts from physical and environmental geography, as well as human geography backgrounds (Sitohang et al., 2023).

This research approach is also oriented toward literature review. That is, the author conducted an extensive examination of various sources, including books, academic journals, news articles, and government policy documents relevant to disaster mitigation in the Mount Merapi region. In addition, information regarding the local wisdom of communities within the study area was gathered through in-depth interviews with local residents.

Research Procedure

The research was conducted in three stages. The pre-field stage involved preparations such as determining the research theme, formulating research objectives, conducting a literature review, creating field maps, selecting observation sites, and preparing research instruments. The field stage was carried out during outdoor learning activities and included observations, interviews, documentation, and field checks. The post-field stage comprised data processing, data analysis, and the writing of a scientific article. The research framework is illustrated in Figure 1.

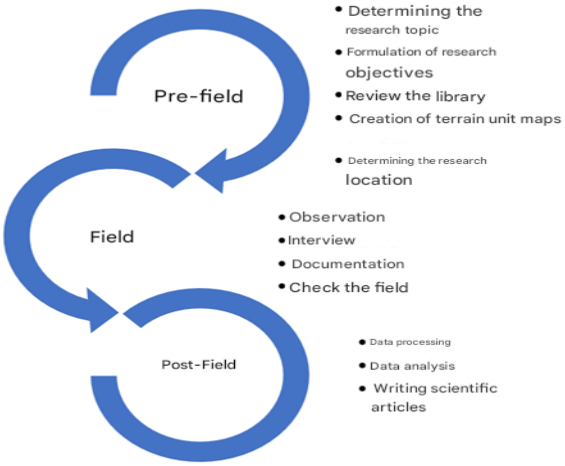

Figure 1. Research Flowchart

Data Collection Instruments

This study focuses on the empirical exploration of rapidly integrated cultural landscapes (Sitohang et al., 2024). Specifically, the cultural landscape in this study refers to conservation efforts as a form of volcanic eruption disaster mitigation implemented in Bukit Klangon.

The study conducted interviews with 10 local community members. Interviews were carried out using a semi-structured interview guide. The involvement of local residents as informants was conducted using accidental sampling.

For the integrated rapid survey, data collection through observation was carried out using the five senses, combined with in-depth note-taking regarding the research subjects commonly referred to as observational methods (Prawiyogi et al., 2021). The focus of direct observation was on the visual appearance of signs and symbols that indicate natural resources and volcanic hazards of Merapi, as well as the surrounding land use (Sitohang et al., 2025).

Furthermore, secondary data used in this study comprised geospatial and qualitative data obtained through literature review and previous studies.

Data Analysis

In the data processing stage, both geospatial and qualitative data were analyzed. The geospatial data used in this study consisted of spatial information that was processed into maps using Geographic Information System (GIS) technology. GIS refers to the combination of computer hardware and software that allows for the creation of maps, spatial analysis, and management of spatial data along with its attributes (Fahlefi et al., 2023). With the rapid advancement of information technology, GIS has become an essential tool for volcanic monitoring. GIS is expected to facilitate the analysis of regional aspects so that the tourism potential of the area can be developed into tourist attractions.

Meanwhile, the analysis of qualitative data in this study employed thematic analysis (Moleong, 2007). The qualitative data included documentation obtained from direct field observation (primary data) and literature review (secondary data). Thematic analysis was conducted by coding the data to identify conservation strategies implemented as part of Merapi eruption mitigation efforts.

RESULTS AND DISCUSSIONS

The study on the conservation practices of volcanic landforms in Bukit Klangon is an exploratory investigation encompassing physical characteristics, historical richness, and cultural uniqueness. Based on interviews and field observations, it was found that conservation efforts in the southern part of Mount Merapi, particularly in Bukit Klangon, are closely linked to tourism development. Bukit Klangon represents a combination of natural and cultural landscapes. As part of the natural landscape, Bukit Klangon is a landform resulting from volcanic processes. The cultural landscape in this area is closely tied to both the potential and hazards of Mount Merapi.

The forms of conservation practices implemented to maintain the stability of Bukit Klangon include: (1) maintaining Bukit Klangon as a site of cultural and natural tourism; (2) practicing agriculture based on local wisdom; (3) reforestation (greening efforts); and (4) conducting outreach and education on eruption disaster mitigation. In Glagaharjo Village, these four activities are known to be based on sustainable forest management. The following section outlines the conservation practices observed in the study area.

a. Natural and Cultural Tourism Sites Maintenance

Each region in Indonesia possesses diverse tourism potential due to the country's varied natural conditions (Susianti et al., 2014). Bukit Klangon holds high historical value and a diversity of preserved spiritual values, which are the result of longstanding interaction between the local population and Mount Merapi. This situation positions Bukit Klangon as a tourism site of cultural and ecological significance, contributing to the discourse on sustainable tourism studies.

Bukit Klangon, also referred to as Klangon Tourism Village, is located in Kalitengah Lor Hamlet, Glagaharjo Village, Cangkringan Subdistrict, Sleman Regency, Yogyakarta Special Region. The Bukit Klangon area lies on volcanic flow and fall deposits (Agustiarini & Permata Wijaya, 2021). With its pristine natural beauty, Bukit Klangon offers breathtaking scenery and refreshing air for nature enthusiasts (see Figure 2). On clear days, tourists can observe the summit of Mount Merapi with visible smoke emissions from its crater—an attraction that contributes to the growth of the local tourism industry.

Bukit Glagaharjo Nature Tourism, formerly known as Bukit Klangon Merapi, has become one of the most visited tourist destinations since its opening to the public in 2011. The natural allure of Bukit Klangon and the stable

condition of Mount Merapi support outdoor tourism activities, such as mountain biking, trail running, and other sporting events (Hadi & Yulianto, 2021). As one of the most active volcanoes in the world, Mount Merapi continues to attract both domestic and international tourists.

Figure 2. Tourism Site of Bukit Klangon
Source: Field Observation, 2024

Mount Merapi possesses a unique characteristic through its traditional guardian, known as "Mbah Maridjan" (Listyawati & Hakim, 2022). The story of Mbah Maridjan is an inspiring tale of dedication, courage, and devotion to nature and cultural heritage. He is remembered as the legendary *juru kunci* (guardian) of Mount Merapi. In this role, Mbah Maridjan held a vital responsibility in maintaining balance and harmony between humans and Mount Merapi. His primary duties included preserving traditions and rituals related to the mountain, such as offerings (*sesaji*) and prayers intended to seek safety and calm for the volcano (Sukma et al., 2023).

On October 26, 2010, Mount Merapi experienced a massive eruption that released deadly pyroclastic flows. At that time, Mbah Maridjan chose to remain in his home in Selo rather than evacuate. This decision stemmed from his deep conviction that he must accompany the mountain in its final moments. Tragically, Mbah Maridjan could not be saved and passed away during the eruption.

Despite his passing, Mbah Maridjan continues to be revered as a guardian figure of Mount Merapi. He left behind a profound legacy rooted in the values of environmental stewardship, cultural preservation, and local wisdom. Today, his former dwelling site, known as Petilasan Mbah Maridjan (*Figure 3*), located in Klangon, Sleman, Yogyakarta, has become a popular pilgrimage and tourism destination, attracting visitors who wish to remember and honor his legacy (Sukma et al., 2023).

Figure 3. Petilasan of Mbah Maridjan
Source: Kulampa, 2023

Through a series of interviews, field observations, and literature reviews, it has been identified that various conservation efforts in Bukit Klangon, Cangkringan have been implemented by multiple stakeholders to ensure the sustainability of the natural environment and the local economy of communities living near Mount Merapi. The involvement of local communities is a key factor in the success of conservation efforts in Bukit Klangon, located in Dusun Kalitengah Lor, Glagaharjo Village, Cangkringan Sub-district, Sleman Regency, Yogyakarta Special Region (DIY).

Communities residing around Bukit Klangon play a vital role in preserving the environment and maintaining Klangon's function as a prominent tourist destination on the slopes of Mount Merapi. Their active participation in various conservation programs not only contributes to the implementation of these initiatives but also fosters a sense of ownership and collective responsibility towards the long-term sustainability of Bukit Klangon's ecotourism landscape.

b. Agriculture Based on Local Wisdom

The results of interviews and field observations indicate that the involvement of the surrounding community in the efforts to preserve Bukit Klangon Cangkringan is closely related to agricultural activities based on local wisdom. The largest land use on Mount Merapi consists of agricultural activities, both rice and non-rice crops (Antriyandarti et al., 2013). Agriculture in

Bukit Klangon is very suitable due to geographic factors that are highly supportive of agricultural activities (Sugara et al., 2016). There are three agricultural activities based on local wisdom oriented towards the conservation of Merapi. First, *pranoto mongso*, which is guidance given to farmers to follow natural signs when planting crops. For example, during the dry season, farmers can conserve water usage. Second, *gugur gunung* (village cleaning), which is an activity of maintaining and cleaning the village from waste conducted through mutual cooperation (Rahman et al., 2016). Third is the *pohon kalitulangan*, which refers to maintaining the sacred forest. In practice, this activity involves protecting the forest ecosystem and preserving the forest's function as a water catchment area (Ernawati et al., 2018).

The community's environmental awareness is reflected in the agricultural management system used. The community still predominantly uses hoes to till the soil, and agricultural land is managed using terracing systems (Dilwan, 2023). The people of Merapi have long practiced agriculture integrated with local wisdom known as agroforestry (AF) activities. Three agroforestry activities implemented in Glagoharjo are agrisilviculture, silvopasture, and agrosilvopasture (Rozaki et al., 2021). Agrisilviculture is a conservation activity that integrates forest management with food crops and trees. Silvopasture is a conservation practice that combines trees with livestock farming. Agrosilvopasture is a conservation practice that integrates food crops, trees, and livestock (Rozaki et al., 2021). Other conservation efforts include soil conservation activities as well as ensuring that water channels and drainage systems function properly (Fitriani et al., 2021). Soil conservation activities are integrated into forest management on Mount Merapi involving various stakeholders, including the local community (Sutata et al., 2023).

The community on the slopes of Merapi employs local wisdom in water management. Traditional irrigation systems, such as *subak* or other water management systems, ensure equitable and sustainable water availability. This method is often accompanied by traditions and cultural principles that emphasize the importance of preserving water sustainability. Additionally, there is the concept of *Wanatani* or *talun*, which refers to a traditional diversified farming pattern where various types of plants grow together, helping to maintain biodiversity, prevent erosion, and improve soil fertility. Local knowledge about plant species suitable for the land and climate conditions of Merapi is also present.

c. Forest Reforestation

Based on interview results, it is known that the participation of the local community in reforestation efforts at the Bukit Klangon Cangkringan tourist site is manifested in several activities. The community participates in greening activities, tree planting, and the maintenance of vegetation around the forest area of Mount Merapi. Local residents also assist in maintaining water channels and drainage systems by helping to clear sediment and waste that block the flow.

Reforestation is the process of restoring greenery with the aim of reestablishing ecological balance, such as replanting in forest areas that have lost many trees. This restores the forest trees to their normal state and protects humans by providing air and water (Muhammad et al., 2023). Reforestation is carried out with the goal of promoting development towards industrial forests or industrial timber plantations expected to supply raw materials for the timber industry established around the forest development area. The purpose of reforestation is to create economic ventures. To improve the hydrological conditions of the region, tree planting is conducted to conserve water resources, improve and maintain soil fertility, and prevent flooding, erosion, and landslides. Forest litter products return nutrients to the soil effectively, and the evergreen canopy along with abundant litter helps prevent soil degradation due to hydrological processes (Muhammad et al., 2023).

To minimize the impacts of climate change, land use management and soil and water conservation techniques need to be enhanced. Environmentally friendly soil and water conservation technologies can increase land productivity and assist in planting management according to contour lines as a basis for constructing terraces (Naharuddin et al., 2023).

Reforestation and soil conservation are not only used as protections against dam damage but also provide ecological and economic benefits to the surrounding community. Moreover, the soil in Bukit Klangon Glagaharjo Cangkringan is volcanic soil resulting from eruptions of Mount Merapi. Volcanic soil has a high nutrient content, making it very suitable for agriculture and plantations. Around the dam area, many lands are covered with fertile grass, which local residents utilize as livestock feed.

The involvement of the community in the conservation efforts of Bukit Klangon Glagaharjo Cangkringan has a positive impact on raising their awareness about the importance of preserving the beauty of Bukit Klangon. Through direct participation, the

community gains a more efficient understanding of how citizen actions, such as maintaining vegetation preservation and preventing littering, contribute to the overall success of dam conservation. To ensure sustainable community participation, the government and related institutions have consistently conducted socialization and education programs. The Public Works and Public Housing Office (PUPR) of Sleman Regency routinely provides counseling and training for the community around Bukit Klangon, which includes information on lahar flood risks and sustainable environmental management practices.

d. Socialization and Education on Merapi Eruption Disaster

The impact of Mount Merapi's eruption is crucial to be minimized, especially in areas close to the volcano. Efforts to reduce the impact of eruptions are conducted to ensure that people can carry out activities and live safely, even though the area is considered disaster-prone. These mitigation activities are aimed at the community, authorities, and academics living in disaster-prone areas. Disaster risk mitigation for volcanic eruptions involves various methods and patterns (Kurniawan & Setyawan, 2021).

Socialization and education on disaster management are integral parts of disaster mitigation efforts, particularly in eruption-prone areas such as the slopes of Mount Merapi. Considering the high vulnerability of areas like Cangkringan District, including Bukit Klangon in Kalitengah Lor, Glagaharjo, Sleman, which is located directly below Mount Merapi and classified as a very high-risk disaster zone, this approach becomes increasingly important. Socialization and education are directed toward enhancing the preparedness and knowledge of the community, enabling them to take quick and appropriate actions when an eruption occurs.

These efforts target not only the general public but also involve authorities, academics, and students. Kurniawan and Setyawan (2021) emphasize that volcanic disaster mitigation requires a varied and comprehensive approach, involving multiple actors with methods tailored to local needs. In this context, socialization functions as the dissemination of technical and practical information regarding hazards, evacuation routes, and emergency procedures, whereas education encompasses the development of knowledge, attitudes, and skills to sustainably reduce risks.

Research by Fatima and Sudibyo (2023) demonstrates that the Regional Disaster Management Agency (BPBD) of Magelang Regency has performed its role quite effectively in socializing mitigation policies. They educate the community through activities such as evacuation simulations, volunteer training, and the dissemination of disaster information both directly and via social media. Furthermore, organizational effectiveness is measured by indicators such as cross-sector coordination, quality of human resources, accuracy of program implementation, and adaptability to changing environmental conditions.

Meanwhile, a community-based educational approach is illustrated in the study by Simanihuruk et al. (2021), which developed comic book media for socializing disaster mitigation of Mount Sinabung. The results showed a significant increase in student understanding, with a normalized gain score of 0.85. The use of creative media such as comics proved effective, especially among younger age groups. This indicates that disaster education needs to be adapted to the characteristics of the audience, so that the material is not only delivered but also understood and practiced. This approach is highly relevant to be applied in areas around Merapi, which also have the potential for educational tourism, such as Bukit Klangon, thereby making the integration of education, conservation, and tourism both possible and strategic.

Considering the characteristics of the Merapi area, which is prone to disasters yet densely populated with tourism activities and settlements, disaster education cannot be conducted conventionally alone. Innovation in material delivery, inter-sectoral collaboration, and active community involvement are required so that the implemented mitigation strategies can truly build social-ecological resilience. Socialization should not be merely informative but must also be transformative, encouraging behavioral change and enhancing collective capacity to face recurring and unpredictable disaster risks.

Bukit Klangon, Kalitengah Lor Hamlet, Glagaharjo Village, Cangkringan District, Sleman Regency, Yogyakarta Special Region, is located in a very high disaster risk zone (dark red color), indicating a very high level of vulnerability due to its position directly under Mount Merapi (Figure 4).

Regular monitoring of Mount Merapi's volcanic activity is conducted through adaptive governance to anticipate potential hazards and prepare necessary mitigation measures (Bakkour et al., 2015). The government, through the National Disaster Management

Agency (BNPB), establishes the status of the volcano to reduce volcanic disasters based on monitoring results and updates from the Meteorology, Climatology, and Geophysics Agency (BMKG). Bakkour et al. (2015) explain that within the disaster early warning system organization for Merapi's eruption, BNPB cooperates with the Ministry of Energy and Mineral Resources and BMKG for geological risks; the Ministry of Public Works, Ministry of Agriculture, Ministry of Forestry, and the National Institute of Aeronautics and Space (LAPAN) for hydrometeorological hazards; supported by studies conducted by the Ministry of Research and Technology, Indonesian Institute of Sciences (LIPI), and universities across Indonesia.

The volcano's status is determined by its activity level. Level I (normal activity) indicates no change in volcanic symptoms; Level II (alert) shows an increase in volcanic activity; Level III (standby) indicates clearer volcanic signs, often followed by eruptions; and Level IV (warning) signifies the approach of a major eruption, with the volcano considered in an eruptive disaster state at this level (Kurniawan & Setyawan, 2021).

Disaster mitigation socialization and education during the pre-disaster phase are conducted by the Sleman Regency Disaster Management Agency (BPBD) so that communities in disaster-prone areas receive clear information. This enables them to utilize the information, understand the risks, and cooperate to achieve disaster management goals. This socialization has successfully involved all community elements in the disaster-prone areas (Fatima & Sudibyo, 2023).

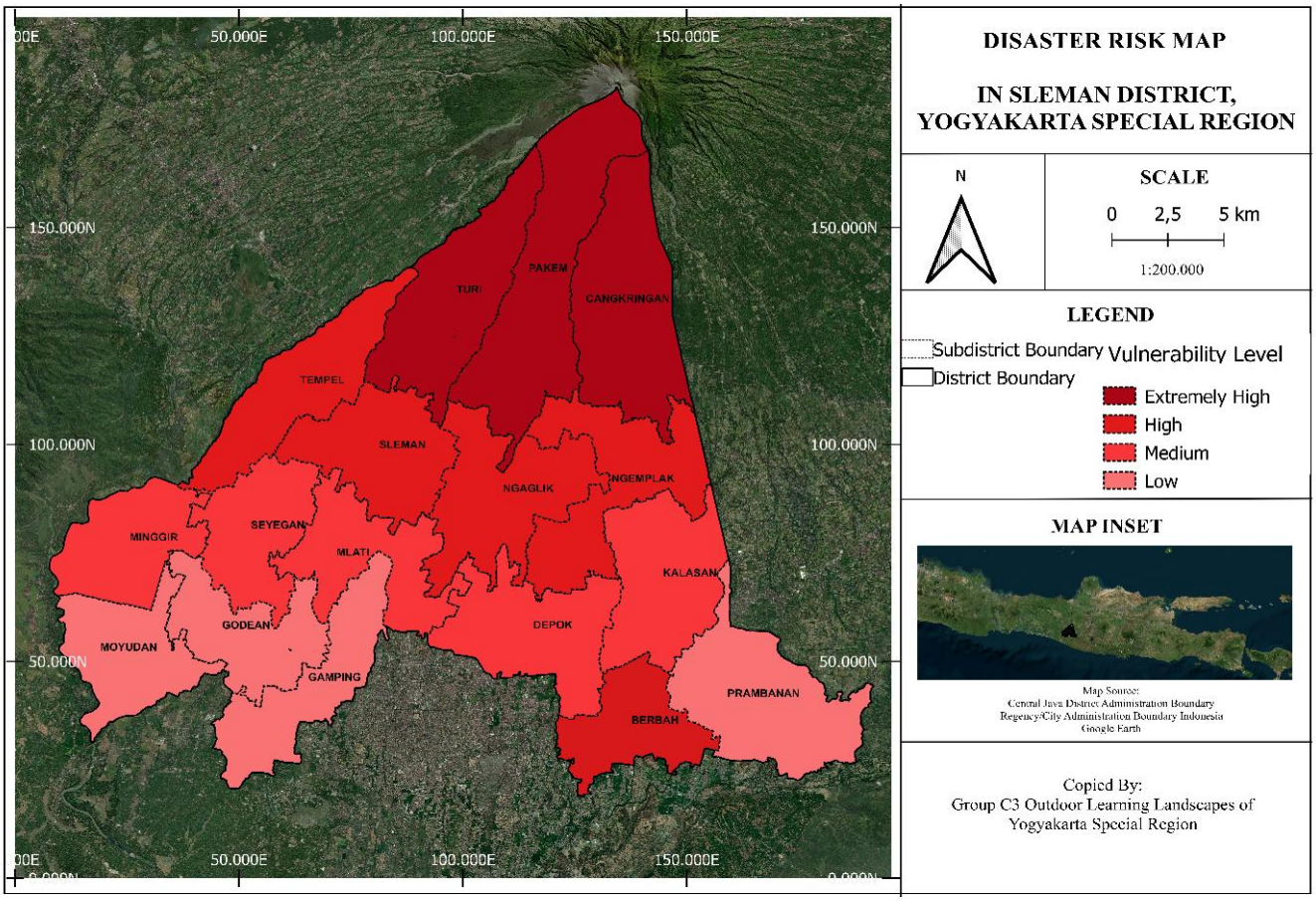

Figure 4. Disaster risk map of Sleman Regency, DIY

Survey results from the study indicate that the socialization and education program has been nearly eighty percent effective. This demonstrates that the communities around Bukit Klangon have understood the dangers of lahar floods and the importance of conservation efforts. These findings suggest that the program successfully increased awareness and knowledge among the local population regarding these issues. Furthermore, the involvement of local communities in the planning, implementation, and monitoring of disaster risk reduction initiatives can enhance the program's effectiveness and sustainability.

These results align with experiences in Bukit Klangon, Glagaharjo, Cangkringan, where community participation has proven crucial in efforts related to the "Conservation of Volcanic Landforms for Disaster Management of Mount Merapi and Tourism Development in Bukit Klangon, Glagaharjo, Cangkringan, Sleman Regency, Yogyakarta." The active role of local communities in conserving the Merapi area is also closely tied to their interest in sustaining the local economy, which heavily depends on tourism activities around Merapi. Based on field observations, economic activities near the tourist site are evident from the presence of small local shops established around Bukit Klangon (Figure 5).

Figure 5. Rows of Local Stalls in Bukit Klangon
Source: Observation, 2024

Community participation in tourism activities around Merapi is an indication of the community's resilience to volcanic eruption disasters (Rindrasih, 2018). The people living near Merapi are known to have a high level of resilience to eruptions, which has developed over a long time as a result of their unique interaction with volcanic disasters. This interaction is known as the *volcanic sub-culture of Merapi*, a culture formed by the characteristics of volcanic disasters (Donovan et al., 2012).

CONCLUSION

Based on the results and discussions of this study, it can be concluded that the conservation of volcanic landforms in Bukit Klangon, as an effort to reduce the impact of Mount Merapi's eruptions, is closely linked to the sustainability of the local community's culture. In addition, this conservation also serves to support the community's economic activities, especially in the context of tourism development. This further emphasizes that volcanic landform conservation in eruption disaster mitigation requires active community participation.

Conservation practices in Merapi have been ongoing long before Merapi was designated as part of Mount Merapi National Park. The conservation of volcanic landforms in Merapi is carried out through four main approaches. First, the maintenance of Bukit Klangon as a site for cultural and nature tourism. Second, agricultural practices based on local wisdom. Third, reforestation (greening). Fourth, socialization and education regarding eruption disaster mitigation.

These conclusions indicate that environmental conservation creates a sustainable landscape. Volcanic disaster mitigation can be synergized with the development of Bukit Klangon as a natural tourism destination characterized by its uniqueness as a conservation-based tourism site.

Acknowledgement: We would like to express our gratitude to Drs. Bambang Hariyanto, M.Pd. and Dr. Lidya Lestari Sitohang, S.Si., M.Sc., our supervising lecturers, for their guidance in completing this research article. Our thanks also go to all members of the out-of-class learning team (PLK) who have collaborated so well. Without such solid cooperation, this article could not have been completed on time. Additionally, we extend our thanks to the Bachelor's Program in Geography Education, Faculty of Social and Political Sciences, Universitas Negeri Surabaya, for supporting the 2024 Yogyakarta PLK (Out-of-Class Learning) program.

Conflict of Interest: The authors declare that there are no competing interests relevant to the content of this article.

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