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Community Engagement for Disaster Preparedness in Rural Areas of Mount Merapi, Indonesia

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ABSTRACT

The rural slopes of Mount Merapi in Yogyakarta Province, Indonesia, existed as vulnerable areas due to recurrent eruptions every few years, necessitating improved strategies to enhance local resilience to volcanic disasters. This study investigates community engagement in fostering disaster preparedness in the Kepuharjo and Umbulharjo, the most vulnerable villages of Merapi slopes in the Cangkringan District of Sleman Regency. Utilizing a qualitative field method, data was collected through on-site observations, document studies, interviews with 14 purposive informants, and FGDs with 21 local voluntary and related stakeholder members. The findings reveal that structural and cognitive social capital mutually reinforce disaster preparedness capacity. The structural dimension evolved with the initiative of resilient village programs, subsequently reinforced by the villagers' engagement in local mitigation actions such as developing volunteer groups, village contingency plans, and diverse communal work for risk prevention. This structural existence was intertwined with the cognitive dimension, referring to the preserved traditional values and beliefs that maintain collective norms and collaboration culture. The finding implies the significance of encouraging structural and cognitive approaches in developing policies to strengthen community-based disaster resilience and, in the theoretical insights, broadening the social capital lens in social studies of disaster.

1. INTRODUCTION

Mount Merapi (2,968 m) is one of Indonesia's most frequently erupting volcanoes, causing significant risks to the surrounding areas. Sited on the border of the Yogyakarta Special Province and Central Java Province, the volcano has erupted six times in the past 25 years: 1994, 1997, 1998, 2001, 2006, and 2010. The most catastrophic eruption occurred in October 2010, resulting in 367 human losses and forcing approximately 400,000 residents to the evacuation zone. The reports of the Indonesian National Agency for Disaster Management (BNPB) mentioned the extensive environmental damage in Merapi National Park, which caused the destruction of over 2,300 houses on rural slopes and more than 2,400 hectares of farmland, with estimated material losses reaching up to US$781 million [1]. The villages of Cangkringan District in Sleman Regency were significantly affected, witnessing the destruction of 2,271 residential buildings and 277 casualties.

Due to the recurrence of eruptions every five to ten years, the rural areas on Mount Merapi slopes in Sleman Regency of Yogyakarta remain highly vulnerable to the volcano's dynamics. The volcanic threat cannot be ignored, as the accumulation of Merapi's lava at the crater reaches 20,000 cubic meters daily, posing an ongoing hazard to the surrounding communities. In response to past incidents and the potential future hazards of Merapi's eruptions, the Yogyakarta government has prioritized disaster mitigation programs in Sleman Regency, specifically targeting the rural areas on the volcano's slopes. Consequently, local communities are encouraged to actively participate in preparedness programs to anticipate and minimize the impacts of future eruptions.

One of the main disaster risk reduction areas in Sleman Regency is Cangkringan District, consisting of five villages with a total area of 4,779 hectares on the southern slopes of Mount Merapi. The 2022 local government statistical document recorded that the population in the district was 31,767, divided into five villages [2]. Two villages in the district, Kepuharjo and Umbulharjo, are the most at risk of exposure to eruption material if a massive eruption occurs because the geographical position of the villages is closest to

the Merapi crater (4-10 km from the top of the crater). With a total population of 8,669 residents, there is a crucial necessity for mitigation strategies to reduce the potential risks associated with volcanic eruptions, including developing sustainable preparedness based on local capacity.

According to various disaster experts [3, 4], it is widely acknowledged that human unpreparedness is a major factor contributing to disaster vulnerability. In areas with high levels of risk and vulnerability, the consequences can be far-reaching without adequate adaptability. Thus, the fundamental understanding of disaster resilience involves recognizing, preventing, and effectively managing challenges posed by potential hazards [5].

Numerous researchers have recognized the key components integral to modern disaster management: mitigation, preparedness, response, and recovery [3, 6, 7]. This comprehensive approach encompasses planning, prevention, risk management, and post-disaster actions. Mitigation focuses on reducing or eliminating risks, preparedness involves equipping communities to enhance their survival capabilities, response encompasses actions to mitigate impacts, and recovery entails repairing and reconstructing affected areas and resources. The recovery phase also includes preventive measures to reduce the negative consequences of potential future disasters [8, 9]. Moreover, several researchers have indicated that community resilience significantly influences recovery speed, as higher resilience leads to faster post-disaster recovery [10, 11].

In rural areas on Mount Merapi's slopes, concerted efforts have been assembled over the past decade to improve local resilience through community-based disaster preparedness initiatives. At the village level, the initial step was taken in 2011 by implementing the village resilience program. The government actively facilitates the program and oversees preparedness activities at the village level. The program has been extensively implemented in the Merapi disaster-prone areas, involving local communities in collective activity processes [12, 13]. Villagers actively contributed through bottom-up initiatives by forming community-based disaster volunteer groups that expanded into community service activities, risk mapping, evacuation training, and developing community broadcasting. The collective effort strengthens the government's mitigation programs to foster local resilience.

The primary objective of this research is to explore the extent to which local community participation has contributed to the initiative through the structural and cognitive social capital lens. The basic research question is, what are the dynamics of local community involvement in strengthening disaster preparedness on the rural slopes of Merapi? It is intriguing to reveal how these two capitals complement each other in strengthening disaster risk reduction strategies in the research location. This question also implies a hypothesis that the government initiative to reduce potential disaster risks will be successful if it obtains collective support from the local community. Adopting collective and sustainable management approaches can assist in reducing the impact of catastrophic events. Within this framework, achieving a comprehensive understanding of the development dynamics of locals' participation in rural areas on the slopes of Merapi is fascinating. The primary focus of this study is to deeply comprehend community involvement, particularly in strengthening disaster preparedness through the resilient village program in Merapi's slopes areas.

2. LITERATURE REVIEW

Disaster resilience has received significant attention in development discourse and public policy, mainly in vulnerable countries. The cumulative losses caused by disasters disrupt development trajectories, requiring extensive recovery efforts over several years. Consequently, contemporary public policy emphasizes disaster prevention or mitigation through appropriate strategies. Disaster management policies aim to encourage the formation of a resilient community, which means returning quickly from the disaster impact to normal conditions. The human ability to detect, prevent, and effectively address challenges posed by potential hazards is the prerequisite for resilience.

Recognizing its responsibility to protect and ensure the safety of citizens, the government is responsible for adopting relevant mitigation methods to comprehensively reduce risks covering all segments of society [14]. From a social welfare perspective, disaster risk reduction is closely related to community protection and the sustainability of local livelihoods. It means that disaster management programs are intertwined with sustainable economic initiatives to minimize disaster risks that can stop the community's economic chain in the future [15, 16].

Among the various existing strategies, a participatory approach has been recognized as essential for creating an adaptive society in a disaster-prone environment [17]. This approach emphasizes the significance of building and strengthening the capacity of households and communities through continuous collective efforts to reduce potential risks in the environment where they live. The participatory approach aims to increase the capacity needed for collective disaster preparedness, including reducing fatalistic mindsets toward future events.

The participatory perspective has revolutionized the paradigm of disaster management by recognizing that community members are more than just beneficiaries but active participants who can take the initiative. The participatory approach involves a combination of top-down and bottom-up practices, emphasizing partnership and empowerment to overcome disaster problems [18, 19]. This approach demonstrates multidimensional notions, noticeable in various aspects. Firstly, governmental authorities are responsible for implementing practical regulatory and appropriate administrative efforts for disaster risk reduction. The second includes implementing self-reliance policies for disaster-prone communities through disaster mitigation education or training models. Third, it involves strengthening local resources to support disaster-prone communities [20], which can be achieved through human resource management at the community level to ensure the safety of its members. The fourth aspect is collaboration with other stakeholders to manage the impact of disasters, which involves the participation of external parties interested in community well-being [21].

The fifth aspect focuses on developing a culture of resilience by embracing local wisdom and socio-cultural values that support community resilience in vulnerable environments. This aspect is related to local resilience in sociological and anthropological dimensions, which are then known as the cultural multiplicity paradigm [22]. Cultural multiplicity emphasizes a grassroots participatory approach to development efforts, respecting cultural diversity to address community disaster challenges [23]. Every culture has its

distinctive system of beliefs and norms, preserved and passed down from generation to generation in social interaction. Norms and beliefs significantly influence people's behavior in responding to disaster situations. Specific local values can serve as powerful assets in building disaster resilience and are recognized as adaptive tools to promote the collective resilience of communities [24-26].

The capability to effectively cope and respond to disaster is encapsulated in the concept of adaptive capacity, encompassing the collective skills required to uphold essential structures and vital functions throughout the various stages of the disaster cycle [19, 27, 28]. From a social standpoint, these adaptation mechanisms are closely tied to the functioning of social capital, which comprises networks, values, beliefs, norms, and group relationships. Much research has consistently demonstrated that social capital significantly reduces potential disaster risks [29]. By fostering and leveraging these social resources, communities can enhance their resilience and ability to address challenges posed by disasters effectively.

According to several empirical studies, participatory approaches are beneficial for improving disaster risk reduction. Local community involvement is instrumental in mitigating risk, mainly through social capital support among community members. The research conducted by Hovelsrud et al. [30] examines the benefits of social capital in Northern Norway's avalanche-prone communities. The study highlights the importance of trust, social networks, and local connections in enhancing these communities' ability to adapt and respond effectively to potential avalanche-risky situations. Similarly, Yang and Wu's [31] study on flood-prone communities in Yilan County, Taiwan, underlines the significance of utilizing social capital to strengthen local adaptation efforts for flood risk reduction. Ward's [32] research on the aftermath of the 2011 earthquake and tsunami in East Japan reveals the notable role of social capital in enhancing group dynamics, fostering economic growth, and facilitating recovery, particularly in the Minamisanriku area, Miyagi. Also, Sadeka's [33] exploration of the Orang Asli traditional community in Tasik Chini, Malaysia, underscores the urgency of social capital, particularly bonding social capital, in developing local adaptation strategies to mitigate the risk of flood disasters.

In Indonesia, several disaster studies also reveal the involvement of local communities in reducing disaster risk. A study by Rochim et al. [34] showed the work of the Garda Caah community volunteer communication network in Bandung, West Java, in improving community-based early warning of the danger of flooding in the city. Likewise, in the case of COVID-19, Prayitno's [35] investigation states the benefits of social capital for community adaptation, primarily through stimulating collective action. Partelow's research on Indonesia's Gili Trawangan tourism areas after the 2018 earthquake also revealed a positive correlation between social capital and disaster resilience [36]. Shared collective experiences, behaviors, and actions demonstrate how social capital drives collective action and provides critical resources when outside assistance is insufficient during a catastrophic event.

These empirical studies serve as a valuable point of reference for understanding the dynamics of local engagement within the scope of this research. It was fascinating to explore how the governance of the resilient village program contributes to increasing the adaptability of vulnerable villagers on the slopes of Merapi. The intentions of its residents that even prefer the Merapi disaster-prone area as a livelihood area certainly become a unique background. Despite elevated risks, the locals have decisive economic and unique socio-cultural preferences and, therefore, became substantial reasons for the necessity of sustainable preparedness agendas.

3. METHODOLOGY

The study was conducted in Kepuharjo and Umbulharjo, the two highest villages of the Merapi slopes in Sleman Regency, Yogyakarta Special Province. Situated in the northernmost of the Cangkringan District (Figure 1), the villages studied are located at an altitude ranging from 600 to 1200 meters above sea level, less than five kilometers from the Merapi crater. Kepuharjo Village consists of eight hamlets, while Umbulharjo Village consists of nine hamlets. The geological composition of both villages primarily consists of young volcanic deposits from Mount Merapi, including materials such as sand, volcanic ash, volcanic residue, ash, breccias, agglomerates, and solidified lava. The previous activity of Mount Merapi has geologically shaped the remaining areas for thousands of years.

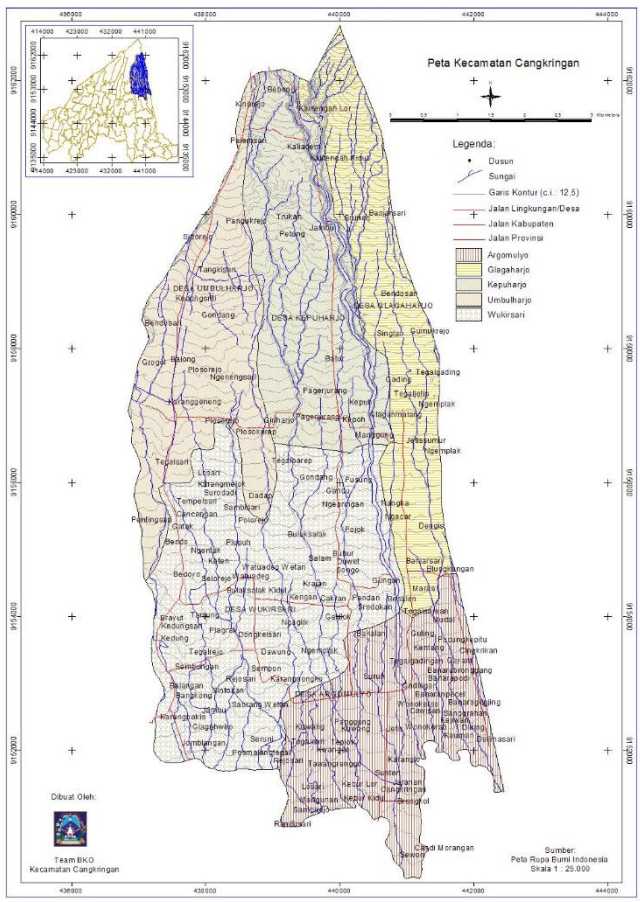

Figure 1. Map of Kepuharjo and Umbulharjo (Cangkringan District, Sleman Regency)

In the 2010 Merapi eruption, the massive villages' affected areas, consisting of nine hamlets directly exposed to the volcanic explosions, were declared unsuitable for permanent residential purposes. Since 2012, the government has designated these two villages as resilient villages and has taken

initiatives to implement preparedness programs.

Following the qualitative field method advocated by several scholars [37-40], the data collection process involved several methods: conducting field observations, interviewing purposive informants, facilitating focus group discussions (FGDs), and tracking document data. Field observations were conducted to gather visual data, including the area's topography, infrastructure and facilities, physical artifacts, and other relevant elements. These observations also provided insights into institutional practices, including disaster preparedness and community activities.

Detailed field observations were made following a protocol that included constructing notes about the environment and physical objects, facilities and infrastructure, community activities, institutional practices, and how residents interact. Environmental aspects and physical artifacts involve recording topographical elements and various objects related to disaster preparedness. Aspects of facilities and infrastructure are recorded and documented based on observations of preparedness infrastructure elements at the research location, such as roads, buildings, vehicles, and other evacuation facilities. Aspects of community participation and institutional practices are recorded based on observations of local activities correlated with preparedness practices, such as evacuation training, volunteer group meetings, or other community activities. Meanwhile, residents' social interaction aspects were recorded based on direct experience of meeting residents and through community forums and communal activities.

Semi-structured interviews were conducted, with research questions aligned with the key themes under analysis. The interviews with the purposely informants were conducted in naturalistic contexts, such as in the afternoon, during sideline work times, or during other available free time. The interviewees comprised representatives from the hamlets and village government, the Regional Disaster Management Agency (BPBD), The Yogyakarta Institute for Research and Technology Development of Geological Disaster (BPPTKG), members of disaster volunteer groups, and selected community members to deeply explore detailed information about preparedness initiatives at the grassroots level. Interviews were held with 14 individuals in the examined villages, with each session spanning 45-60 minutes.

The semi-structured interview commenced with the research team posing questions to explore participants' perspectives on Mount Merapi and the potential eruption threat. The team delved into participants' experiences following the 2010 eruption and their attitudes towards the ongoing Disaster Resilient Village initiative. Participants were asked to articulate how they engage in local preparedness programs, communicate during eruptions, and provide early warnings to relatives and the neighborhood. Additionally, the interview sought insights into the local values and norms embraced by participants within their village, how these values manifest in daily life, and whether participants perceive the influence of these values on their attitudes toward disaster preparedness. Lastly, the team explored participants' involvement in communal activities, encompassing traditional ceremonies, spiritual events, and community service.

The research process conducted focus group discussions (FGDs) with community representatives to comprehensively understand how to enhance disaster capacity in the two studied villages. The objective was to gather detailed information on the various approaches implemented at the local level to strengthen disaster preparedness. Two FGDs involving 21 participants, 11 and 10 participants, respectively, were held at different times at the Sleman Regency Disaster Management Post in Pakem District. Each participant represents an interest group involved in developing preparedness programs at the research location. Invited participants included government representatives (BPBD, BPPTKG, Village leaders), village-level disaster volunteer groups (TRC, SAR, the Tagana, and PKK), and hamlet leaders.

The FGD questions covered aspects: how participants responded to the Disaster Resilient Village initiative in each village; the task of participating and division of the working group; what community programs and activities to reduce disaster risk at the local level; how communication dynamics between groups related to production and distribution of information of the Merapi issues; and how local contribution of norms and rules in supporting risk preparedness in each village. In addition to complementing primary data with interviews and FGDs, the research process also explored secondary data sources, including policy manuscripts, books, media reports, and other textual sources. The total number of participants was 35, as summarized in Table 1.

Table 1. Research informants

Representative of	Amount	Informant in
Local Government (Chief of Kepuharjo & Umbulharjo Villages)	2	FGD & interview
Regional Disaster Management of Sleman Regency (BPBD)	2	FGD and interview
Institute for Research and Technology Development of Geological Disaster of Yogyakarta (BPPTKG)	2	FGD & interview
Quick Response Team (TRC / *Tim Reaksi Cepat*)	2	FGD
Local SAR (Search and Rescue)	2	FGD
Village Disaster Preparedness Cadets (TAGANA / *Taruna Siaga Bencana*)	2	FGD
Local Youth Organization (the *Karang Taruna*)	2	FGD & interview
Hamlet Chiefs	9	FGD
Family Well-being Program (PKK - *Pemberdayaan dan Kesejahteraan Keluarga*)	2	FGD
Household Representatives	5	Interview
Community Leader	2	Interview
Community Protection Unit (SATLINMAS / *Satuan Perlindungan Masyarakat*)	2	Interview
Local Community Radio	1	Interview

Compliance with the ethical rules of this research is carried out to ensure the protection and safety of informants and participants. In the practice of interviews and FGDs, each participant was given information regarding the purpose of this research before being asked for consent to participate. The confidentiality of personal data is secured, and all collected data is kept anonymous, primarily for reporting research results. The collected data is also stored and can only be accessed by the research team, and for data management, recording material of all interview and FGD data are based on participant permission. Including visual recordings and field notes, they can only be accessed by the research team and are used solely for academic purposes.

The technique of data reduction in this research includes: (1) selecting and simplifying an eclectic spectrum of initial information obtained from the field, (2) organizing them into

themes, and (3) summarizing or condensing the data into clusters. The data were categorized by allocating it to specific sub-themes and interpreting it through the analytical lens in the resilience perspectives. The material data from research participants was coded into conceptual labels based on similarities to obtain patterns or trends in more significant categories and subthemes. These sub-themes are then developed into themes. For example, the sub-theme "structural approach to preparedness" is obtained from the categorized codes: institutional initiatives and activities, local participation, and communication channels. The subthemes bonding is then reflected in the final theme, which is interpreted according to the theoretical lens of the research.

4. RESULTS AND DISCUSSION

For many years, the eruption hazard that periodically occurs for five to 10 years has been the leading causality of vulnerabilities to the Merapi communities. Such a situation pushes residents of slope areas to always be on standby whenever the mountain shows symptoms of increased volcanic activity. The 2010 eruption was the most massive explosion in the last 100 years, which forced a displacement wave of around 400,000 inhabitants. The eruption's impact has also resulted in a change in the slopes landscape, resulting in several villages close to the peak of Merapi being damaged and no longer suitable for permanent residence.

The condition caused the Merapi rural slopes to receive primary attention continuously from the local government and has become a priority for developing resilient rural villages in Sleman Regency. Besides the hazards to physical safety, the potential eruption can cause disturbance in the surrounding economic and social lives. As part of post-eruption management, the spatial policy became the first to authorize mitigation programs. Parallel with the post-eruption recovery of Merapi in 2010, the Sleman Regency Government officially expanded the coverage area of the Merapi disaster-prone area through Sleman Regent Regulation Number 20 of 2011. It was stated in the regulation that the Merapi slopes areas in Sleman district were split into three Disaster-Prone Areas (DPA): I, II, and III. The larger the DPA label indicates, the higher the value of the vulnerability, which consequently requires more vital preparedness than the lower level.

Particularly for DPA III, the regulation notes a coverage area of approximately 4,672 hectares spread over four subdistricts: Cangkringan, Pakem, Turi, and Ngemplak. It contains the nine hamlets most impacted by the 2010 eruption that can no longer be allowed as permanent residences, including Pelemsari, Pangukrejo, Kaliadem, Petung, Jambu, Kopeng, Kalitengah Kidul, Kalitengah Lor, and Srunen. All of them are located in three villages in the Cangkringan District: Umbulharjo, Kepuharjo, and Glagaharjo. Most hamlet residents were relocated to new settlements in less vulnerable areas in DPA I or DPA II. Every household received cost aid to build a house on 100 square meters of allocated land.

As shown in Figure 2, the two villages studied are situated close to each other on the southern slopes of the mountain, with altitudes ranging from 600 to 1,200 meters. The closest distance from the top of the crater is 4 km, covering two hamlets on the north side (Pelemsari Hamlet in Umbulharjo Village and Kaliadem Hamlet in Kepuharjo Village). Both villages are traversed by nonperennial rivers (the Opak and the Gendol), routes for most pyroclastic clouds and volcanic eruption material during the 2010 eruption. In the eruption of October 2010, Pelemsari Hamlet, alternatively recognized as Kinahrejo Hamlet in Umbulharjo Village, encountered direct impact with pyroclastic flows and was covered by volcanic debris, leading to the casualties of 39 inhabitants. A memorial monument at the upper boundary of the DPA III area presently inscribed the names of the victims as a remembrance of the catastrophic event.

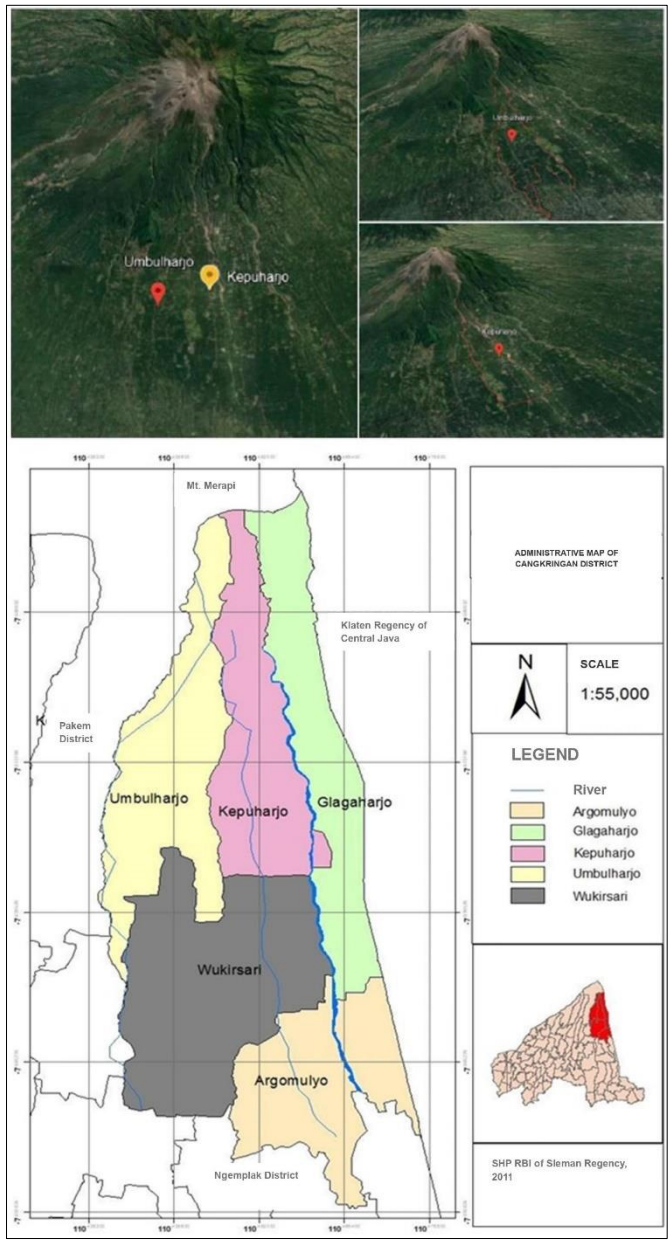

Figure 2. The location of the studied villages (Umbulharjo and Kepuharjo)

The villages studied have a total area of 1,701 hectares covering 17 hamlets, the details of which are shown below (Table 2).

Table 2. Demography of research site

Variable	Kepuharjo	%	Umbulharjo	%
Hamlet	8		9	
Total area	875 ha		826 ha	
Population	3,442		5,227	
Male	1,669	48.5	2,586	49.5

Female	1,773	51.5	2,641	50.5
Education				
Formally uneducated	481	14	873	16.7
Haven't completed elementary school	347	10.1	632	12.1
Elementary school	1,055	30.7	1,193	22.8
Secondary school	564	16.4	954	18.3
High school	852	24.8	1,309	25
Higher education/College	143	4.2	266	5.1
Households occupation				
Civil servant	27		57	
Police/Military	5		8	
Local employee	116		358	
Farmer/Stock farmer	1,063		1,185	
SMEs	436		714	
Entrepreneur	282		321	
Medical	0		5	
Tourism	18		23	

4.1 Structural approach in mainstreaming preparedness

Modern disaster management emphasizes preparedness as a comprehensive, dynamic, and sustainable process, which implies the significance of a participatory approach with the main characteristics of partnerships, resource enhancement, and community empowerment. A participatory approach can increase communities' capability in disaster-prone areas to adapt and develop a disaster risk reduction framework in the future. At the local scale, strengthening preparedness must be considered a continuous process involving community members at every stage of the disaster cycle, including planning, prevention, risk management, and response. Additionally, the participatory approach can be an influential instrument for generating adaptive capacity, enabling social systems comprising individuals, families, and communities to manage better, cope with, and adapt to the changing risks and opportunities in their vulnerable environment.

Based on the viewpoint of participatory practice, the development of disaster mitigation programs requires the active involvement of the community members while representing a mutual integration of top-down and bottom-up approaches. In the context of preparedness in the villages studied the Regional Disaster Management of Sleman Regency initiated the top-down approach, which started the program of Disaster Resilient Village (DRV). The research team concluded that this was a structural approach, where at first, the initiative arrived from the local government but then received good support from community members by voluntarily involving themselves in preparedness practices in the area studied.

The characteristics of the structural approach are marked by institutionalization, which requires participatory actions in local disaster management. After the eruption of Merapi in 2010, the local government designated Umbulharjo and Kepuharjo Villages as the DRV, whose structure was separate from the village government structure but connected in a coordinative pattern with the village government. DRV executors consist of a chairperson, secretary, and at least four divisions, including evacuation, public kitchen, logistics, and temporary barracks. The district government budget supports the funding, used to implement community empowerment programs related to disaster preparedness. The DRV programs are summarized in Table 3.

DRV employs a proactive approach to involve the village community in carrying out activities by actively mobilizing self-help groups. These groups play a vital role in conducting various activities, primarily for mitigation and preparedness campaigns, by providing on-field training for local disaster risk reduction efforts. Table 4 provides the various village voluntary groups actively engaged in the practical work of DRV, showcasing the collaborative efforts that bolster the local's response capabilities to disaster threats.

Table 3. The DRV activities

Activity	Objectives
Contingency plan making	Guidelines in handling disaster emergency
Community extensions	Risk and preparedness education for community members
Early warning	Early warning for community members
Mapping	Database of evacuation map
Inventory	Maintain and create orderly administration of facilities and infrastructure
Logistic and food barning	Food storage and maintaining the distribution (if a disaster occurred)
Training, simulation, and preparedness parade	Upgrading skills, practicing discipline and responsibility
Local networking	Expand cooperation and network
Risk mapping	Disaster risk mapping and analysis

Table 4. Local voluntary groups in Umbulharjo and Kepuharjo

Group Name	Activities
The Karang Taruna team (youth village organization)	Extension education for mitigation, contingency plan
The Linmas team (team for community safety)	Protection and evacuation training
The Tagana team (youth local preparedness team)	Infrastructural and environmental protection, evacuation
Communication Forum of Cangkringan Disaster Groups (SKSB)	Voluntary cooperation of the district for disaster communication
The PKK team (social well-being team on women and family)	Mainstreaming gender and family well-being based on women
The Posyandu team (children wellbeing programs groups)	Children's health mainstreaming programs health
Community radio	Mainstreaming disaster risk reduction via community broadcasting

The field investigation has highlighted the commendable efforts of community-based disaster voluntary groups involved in DRV programs as structural approaches in promoting preparedness strategies within the village studied. These groups have emerged as agents of change, motivating and inspiring community members to be well-prepared for the event of a catastrophic eruption. Their pivotal roles include public education, early warning dissemination, and active involvement in evacuation practices, fostering informal collective learning within the community to enhance emergency preparedness and disaster response.

Volunteer groups are typically organized to fulfill specific roles and functions, providing crucial support within each environment. The Karang Taruna is a village-level youth organization whose function is to carry out mitigation campaigns and increase disaster literacy at the community level. Karang Taruna's activities usually focus on youth

training, organization, risk mapping, and building external networks. The Linmas, an abbreviation of *"Satuan Perlindungan Masyarakat"* (Community Protection Corp), is a group of village-level community members who are prepared with the knowledge and basic skills to carry out disaster mitigation activities. The Linmas functioned in the preparedness actions by maintaining security and mobilizing community participation in many prevention activities. Its members voluntarily engage in emergency response training, environmental security, first aid, evacuation, and building food barning or public kitchens in temporary barracks.

The Tagana, an abbreviation for "*Taruna Siaga Bencana*" (Youth Corp for Disaster Preparedness), plays an essential role in community preparedness efforts at the village level. Consisting of trained youths facilitated by the Regional Agency for Disaster Management (BPBD), Tagana is dedicated to conducting local emergency training, executing search and rescue operations, facilitating victim evacuation, and guiding villagers in effective risk-reduction strategies. Beyond these roles, Tagana actively engages in participatory actions such as risk mapping, developing early warning systems, and managing facilities and infrastructure during emergency responses.

The PKK, an abbreviation for "Pemberdayaan Kesejahteraan Keluarga" (Family Empowerment and Wellbeing), is a group of married women to support family-level welfare. In practice, the PKK has a role in educating family members, helping prepare women's groups in providing food during emergency response, public kitchens during evacuation, spiritual formation, and household health. Meanwhile, the Posyandu Team, which is from the PKK and is specifically involved in maternal and child health matters, participates through the support of facilitating health facilities for residents.

To enhance the information network among residents, volunteer groups established the SKSB ("*Saluran Komunikasi Sosial Bencana"* / Disaster Social Communication Forum) as a communication hub to connect members of voluntary teams across the district. Beyond encompassing local volunteer groups, the SKSB forum actively engages various stakeholders, including Cangkringan's TRC ("*Tim Reaksi Cepat*" or Quick Reaction Team), PMI (Indonesian Red Cross) of Sleman Regency, BPBD, BPPTKG, and diverse village-level disaster preparedness groups. Every few months, the forum members hold meetings to exchange experiences or design new ideas for risk reduction strategies on the slopes of Merapi. At the grassroots level, crucial information on disaster developments is widely disseminated to residents through interpersonal communication by group members and local media platforms in the Merapi slopes areas. Gema Merapi FM, a community broadcasting radio initiated by local activists in the Cangkringan District following the 2010 massive eruption, plays an essential role in conveying local information, serving as a preparedness campaign channel for disaster-prone Merapi area communities.

Local media broadcasting is villager empowerment through community radio activities, and "Gema Merapi" plays a vital function in increasing awareness of the threat of the Merapi disaster. Radio involves villagers in managing its operations and is a valuable platform for sharing disaster-related information with the community. By collaborating with other community radios around the slopes of Merapi, the radio is extending its reach to disseminate information on the volcanic dynamics of Mount Merapi.

Furthermore, the Tagana youth group, operating at the village level, mobilizes disaster volunteers and collaborates closely with the village government and Sleman BPBD. The group's activities encompass a range of disaster preparedness actions, including risk assessment, emergency training, action plan development, and post-disaster rehabilitation. Their collective efforts exemplify the structural agent roles in promoting community safety and preparedness.

Inter-group communication is facilitated through the disaster communication forum named *Saluran Komunikasi Sosial Bencana* (SKSB) to strengthen preparedness across all disaster-prone areas. This forum fosters collaboration between disaster volunteerism activities at district and regency levels under the coordination of the Sleman BPBD. It encompasses various training programs, cooperation of voluntary groups, and collaboration with BPPTKG for observing danger signs at the Merapi volcano observation post.

One of the Tagana volunteer members stated*, "We from Tagana have quite a lot of activities to support preparedness in our village. For example, we carry out data collection and risk mapping, involving elements of village officials, Karang Taruna, Linmas, and volunteer groups, including women from PKK, Posyandu, and so on. We also made a database on which locations should be avoided in the event of an eruption, which evacuation routes there are, and where the gathering points are. Another activity is an evacuation simulation for residents, then we also build posts for monitoring. These posts are important for monitoring Merapi Peak and whether there is lava falling or not. These posts also require facilities, for example, electricity, lighting, loudspeakers, and so on. Yes, we founded it together by gotong royong; also in preparing evacuation gathering points and maintaining facilities. We also cut down trees occasionally to smooth the evacuation route if an eruption occurs. We do everything together between volunteers and residents. We are also working on providing transportation equipment for evacuation. We created a database for each hamlet, including how many transportation facilities are available, including trucks, pick-up cars, and personal cars. Also, amounts of facilities for refugees in temporary barracks, such as food reserves in warehouses, soap, public kitchen equipment, and so on. To mutually coordinate between volunteers and villages throughout the Cangkringan district, we created a joint forum, called SKSB, occasionally we meet every few months to discuss the latest news and find joint solutions to disaster problems in the villages around here" (*Mr. SS, Tagana Umbulharjo member, FGD*).*

Local officials have also realized villagers' awareness and participation in disaster preparedness on the slopes of Merapi. Through the DRV program, volunteer groups actively contribute to this participatory support, enhancing community preparedness. The program has promoted local disaster literacy, prompting villagers to take appropriate actions to prepare themselves and respond effectively to potential threats. One of the proofs of the effectiveness of the disaster preparedness system is seen in handling the 2018 phreatic eruptions. As stated by the Head of Kepuharjo Village in one of the interview sessions, "*Villagers in his area showed high alertness in responding to signs of an eruption risk by staying away from the danger zone and seeking protection at evacuation locations. Simultaneously, the disaster volunteers performed swiftly, ensuring transportation was prepared, evacuation barracks were set up, and essential logistics were accumulated in case survivors needed to stay overnight at the*

evacuation site" (Mr. HS, Kepuharjo chairperson, interview). This coordinated and proactive response exemplifies the success of the preparedness measures, fostering a sense of security and preparedness within the community during times of crisis.

A village leader acknowledges the strengthened preparedness, stating that apart from the involvement of village volunteers, the community collectively addresses the anticipation of eruption dangers through patrols in each hamlet, especially during an elevated status of Mount Merapi. Each household also prepares an "emergency bag" containing essential documents, spare clothing, and instant food supplies for several days, ready to be taken when evacuating if necessary (Mr. RMJ, the Kinahrejo hamlet chairperson, interview).

This study's findings reveal the groups' positive influence in enhancing disaster risk reduction efforts through mutual collaboration and inter-group coordination. The interconnectedness of disaster preparedness support groups in both villages is apparent through local disaster capacity activities. These groups act as social agents, fostering connectivity among the villagers, the community and the government, and linkage between villagers and external communities. This cooperation plays a crucial role in bridging and linking dimensions, addressing the needs of community members and strengthening disaster preparedness efforts.

The collaborative efforts of community-based volunteer groups highlighted the crucial role of collective action and social cohesion in fostering disaster resilience and reducing vulnerability in the prone villages. The groups maintain a notable benefit and live open to embracing innovative disaster preparedness strategies. Through field investigations and interviews, over 50 networking groups with local volunteers have been identified, proving the widespread awareness of the significance of collaborative action in disaster preparedness within the DRV areas of Merapi. This network of dedicated volunteers exemplifies the strength of community engagement and cooperation in building better residents' resiliency.

Field investigations highlight the significant role community members played in collaborative disaster risk reduction efforts. The Disaster Risk Reduction (DRV) program acts as a catalyst, stimulating community member involvement and triggering voluntary bottom-up movements. Volunteer groups, performing as communities' representatives, serving the function of embodying structural social capital, actively contributing to advancing preparedness practices at the local level. Their involvement spans a range of activities, including risk mapping, conducting preparedness exercises, participating in infrastructure development projects, establishing communication networks through joint forums, and enhancing local communication channels through community media outlets.

These volunteer groups, essential links between villagers and disaster management initiatives, constitute the foundation of community involvement in disaster risk reduction. Through the varied activities, they contribute tangibly to the enhancement of local preparedness and cultivate a shared sense of responsibility and community resilience. This function underscores the dynamic impact of community member engagement in the DRV program, illustrating how grassroots initiatives can effectively strengthen disaster resilience within local communities.

In summary, the collaborative efforts of citizens through volunteer groups demonstrate the power of collective action and community involvement in building disaster resilience and preparedness. The involvement of village community groups in public education, early warning outreach, evacuation practices, and infrastructure management emphasizes the effectiveness of a multi-faceted, community-based approach. The success story of the 2018 phreatic eruption shows the actual result of grassroots initiatives and coordinated responses, highlighting the significance of community empowerment, awareness, and proactive engagement in building resilience. The implications suggest that policymakers and disaster management agencies can improve disaster preparedness by combining and supporting the efforts of local volunteers, fostering collaboration, and recognizing the important role of community-based initiatives in creating more resilient communities.

4.2 The social and cultural values

The study revealed that the functioning community involvement in the two villages studied was also supported by socio-cultural characteristics that positively affected the preparedness program. The determining factor is the existence of social cohesion, and several literature searches show an identical tendency. Some researchers confirm that social cohesion is a form of solidarity that sees collectivity as the basis for forming harmonious human life [24, 41]. This solidarity moves mechanically and organically; mechanical solidarity relies on the existence of influential agents, while organic solidarity is characterized by interdependence between households or individuals in the community.

Their shared feelings drive them to exert considerable effort in recovering and surpassing their previous state. Bouncing back from disaster exposure becomes a communal goal that necessitates collective endeavor. Residing in a vulnerable situation requires mutual actions to overcome diverse natural challenges. These manifestations of cohesion are a prevalent aspect of the Kepuharjo and Umbulharjo communities, predominantly fueled by kinship, friendship, and neighborly relations. This bond fosters interactivity in local collaborations during daily activities, and its strength intensifies further when Merapi activity increases.

In this locality, various activities related to cohesiveness are expressed through specific Javanese terms, like *gotong-royong* and *sambatan*. The term *gotong-royong* signifies a collaborative physical activity undertaken collectively to fulfill common needs within a community. It involves individuals coming together at a designated place and time. For instance, the construction of evacuation facilities is typically accomplished through cooperation, allowing for swift completion. These activities exemplify the spirit of togetherness and sincerity, reflecting a form of collaboration to achieve the greater good for the community.

In comparison, *sambatan* is another distinctive term with a similar meaning to cooperation, but it is primarily focused on personal or household benefits. When community members need help from their neighbors, they willingly come together to assist. For example, the repair or construction of a house is usually done through a *sambatan* between neighbors. Included in this context are funeral and wedding events; neighbors and closest relatives generally voluntarily help in the form of material or labor assistance. The term *sambatan* comes from the verb *sambat*, which means complaining about suffering and expecting help from others. Close relatives and neighbors will soon help someone in such a condition.

In developing resilience, the spirit of togetherness, as reflected in the *gotong royong* culture, is a fundamental pillar of community resilience. The practice of *gotong royong* appears in various collective actions to respond to disaster threats, including communal works in establishing infrastructure for evacuation, training, simulations, and infrastructure maintenance, as well as risk prevention actions such as environmental patrols and monitoring. The essence of *gotong royong* is collaborative cooperation, reflecting the elements of trust, brotherhood, work sharing, and compliance with norms as conceptualized in the theoretical lens of social capital. This mutual collaboration maximizes resource utilization, ensuring a comprehensive and multifaceted preparedness approach. In addition to immediate responses, the connectedness fostered through *gotong royong* also increases long-term adaptive capacity.

As a cultural entity, *gotong royong* is a form of community responsibility in reducing disaster risk presented collectively in vulnerable environments. The ethos of *gotong royong* fosters a sense of shared ownership, connectedness, and the strength of social ties as the bonding function of social capital. From a cultural perspective, *gotong royong* is more than just cooperation; it embodies a cultural identity firmly rooted in solidarity, reciprocity, and behavior that transcend individual interests to achieve social well-being.

The high cohesiveness of the Merapi slope community is further influenced by their ownership of land assets on the slopes of Merapi, which serves as a vital source of livelihood. Residents strongly desire to preserve land ownership in the direct exposure zone of Merapi for future generations. This sentiment becomes a significant factor that binds their survival, even amidst continuous life in disaster-prone areas. For the community members of the studied villages, the disaster-prone area represents a geographical space where they have learned to adapt and domesticate their environment, fostering remarkable resilience for survival in hazardous territories. The villagers' wish to rebuild and recover after disasters reinforces collective adaptation, driven by the values of togetherness, networking, and cooperation.

An intriguing phenomenon has unfolded for several years: the most vulnerable villages in the Merapi disaster-prone area have evolved into the epicenter of people's livelihoods. Despite the risks, these locals demonstrated a determination to bounce back economically within their immediate exposure zones, engaging in agricultural activities, mining, and exploring new opportunities in tourism. Endeavors to utilize the hazard zone as a productive arena are undertaken collectively through group efforts. Remarkably, in recent years, the utilization of the danger zone on the slopes of Merapi in the two villages has expanded, with residents developing various tourist destinations.

The community tourism ventures are managed collaboratively, and the income distribution is adjusted based on the shares contributed by each member. Distribution follows an agreement among group members, wherein the percentage of shares deposited at the beginning of membership and the number of working hours each month determine their respective shares. Asset security is ensured through a rotational protection scheme when eruptions threaten the area. In Kepuharjo and Umbulharjo villages, the villagers transformed the 2010 Merapi-impacted erupted zones into attractive tourist destinations. In recent years, at least eight destinations have been developed by local groups, supported by 29 transportation communities with approximately 700 vehicles.

In the rural slope areas surrounding Merapi, the local villagers generally view the volcano as their primary source of livelihood, crucial for sustaining their lives. Despite having experienced its damaging impact, they also perceive Merapi as a provider of positive benefits. This perspective stems from the belief that Merapi possesses a 'friendly' character that can be harnessed for productive gains. According to numerous informants from the native villagers, the local community strongly adheres to the Javanese cultural belief of *sadumuk bathuk sanyari bumi* (ownership of lands in Merapi will be maintained until death). As a result, the land becomes a fundamental asset that drives their determination to adapt to the challenges of their environmental resources, utilizing them to generate economic benefits.

Understanding the preference of villagers to inhabit vulnerable areas requires consideration of the profound influence of Javanese culture. The self-perception of being "Javanese," rooted in a dignified cultural legacy, is a fundamental motivation for steadfast commitment to preserving Javanese cultural values daily. This commitment encompasses self-esteem, emphasizing the significance of family bonds and land in shaping their worldview. As expressed by one informant, "In matters related to land, we follow the principle of "*sadumuk bathuk sanyari bumi*," maintaining the land we have inherited from generation to generation as much as possible throughout our lives" (SWD, Kepuharjo Village member, interview).

For villagers, land is esteemed as it symbolizes honor inherited from their ancestors. Beyond dwelling, the land also serves as a livelihood source through various endeavors. Their dedication to preserving the land and its surrounding environment is regarded as a responsibility toward the heritage and life source bestowed by God through land ownership. Through such endeavors, they not only uphold rich traditional values but also contribute positively to the sustainability of the local environment. Thus, their lifestyle and perception of the land mirror the continuation of Javanese culture and a commitment to ecological equilibrium and environmental endurance. Recent studies confirm the beliefs [42, 43]; so the concern of land ownership governance on the slopes of Merapi not only involves administrative matters but also closely intersects with local cultural issues.

This finding aligns with the slopes of Merapi survivors' observed reluctance to accept relocation invitations until 2012 [44, 45]. Widodo's research in 2018 further supports this notion, as it highlights social-cultural factors contributing to the villagers' hesitance in settling in new locations [46, 47]. Across generations, the villagers have firmly believed that Merapi holds a significant place in Javanese cosmology, acting as a connection between the small universe (microcosm) and the grand universe (macrocosm). This cosmic perspective has been deeply ingrained in the traditional minds of the Merapi villagers for centuries. Their belief is rooted in Java's ancient religious teachings and legacy [48].

To the locals, Merapi represents an imaginary mountain line that symbolically connects the Yogyakarta palace to the southern sea (the Indian Ocean). This philosophical axis is perceived as a harmonious balance among human relationships with God, other humans, and nature. The spiritual belief system has become an integral part of Javanese customs, forming the background of the community's perspective in facing the dangers of Merapi. This ecological unity is deeply ingrained within Javanese-centric cosmology,

where a common assumption prevails that Merapi embodies the outer universe while the surrounding human beings represent the inner universe [49].

The viewpoint has been deeply embedded, resulting in a mythology that greatly influences how the local community responds to disaster threats. Beyond being perceived merely as a geological phenomenon, Merapi is regarded as the residence place of a supernatural being, personified as the mountain's ruler. According to local beliefs, the imaginary spirit named "*Mbah*" (The Grandfather) guards and oversees Merapi's activities. The slope communities interpret volcanic events as manifestations of Mbah's angered moods. For instance, small eruptions are described as "*Mbah lagi watuk*" (the Grandfather is coughing), and the descending pyroclastic cloud is metaphorically termed "*wedhus gembel*" (sheep), believed to be a form of a symbolic message from the mountain guardian spirit, warning residents to preserve the Merapi's natural environment.

These mythological beliefs are the basis for forming environmental ethics, such as prohibiting excessive deforestation, spring preservation, discouraging the killing of wildlife, or maintaining sand mining practices wisely so as not to cause damage to river borders. These beliefs serve as a foundational element for the community to cultivate a vigilant and prepared stance towards potential disasters, extending beyond the physical realm to encompass spiritual dimensions. From this point of view, these beliefs transformed into the morality of environmental awareness and were symbolically transferred to villagers through ritual practices in rural Merapi. These findings are relevant to previous studies [50-53], which confirmed that the rites on the slopes of Merapi are an instrument for symbolic communication originating from the belief system of these myths.

Local beliefs continue to endure and are evident in traditional ceremonies in the prone villages. Within the Merapi community, the j*uru kunci* (custodian) figure holds a significant role, serving as a cultural leader in the rural area. The *juru kunci* holds a significant position as the cultural leader of the Merapi slope community, actively contributing to preserving collective spirituality through annual rituals and traditional ceremonies. One of them is *sedekah bumi*, the customary ceremony as a community's expression of gratitude to God for the abundance of prosperity and a request for salvation so that it is always protected from the dangers of the Merapi volcano in the future.

For residents, ritual practices are a means of gathering and praying together, which increases their social ties as residents of the slopes of Merapi. Apart from being a form of gratitude for God's gifts in soil fertility, the availability of sand mining sources, and continuously flowing water, ritual ceremonies also become a cultural communication form for the residents to maintain the surrounding environment. As stated by one resident of Kepuharjo, "We in Kepuharjo annually conduct a ritual of the *sedekah bumi*, named the *Becekan Dandan Kali* (Cleaning the River) in the fourth month of the Javanese calendar. We pray together and slaughter several goats, which we cook and consume together. Then, we work together by *gotong royong* to clean the river borders and springs that flow into this village. We hope the lahar through the river will not overflow and hit settlements when Merapi erupts. Although not directly, that is our symbolic means for village preparedness" (Mr. H, the Kepuharjo villager, interview). One of the residents of Umbulharjo also stated, "The *sedekah bumi* or *labuhan* Merapi ceremony is essentially a symbolic request to God, giving gratitude for His grace and at the same time asking for prosperity and community safety" (Mr. A, the Merapi custodian, interview).

From a cultural viewpoint, the development of disaster capacity in Umbulharjo and Kepuharjo is also driven by communal activities, including *pengajian* (Islamic preachment), *yasinan* or *tahlilan* (Islamic praying together by the recitation of the Quran), and a traditional annual ceremony to preserve the safety of village namely *merti desa*. These cultural-based activities are used as a spiritual means to strengthen community spirit and togetherness in inhabiting the Merapi area as a disaster-prone area. The events are apprehended as a symbol of gratitude to God who has given gifts to the community in the form of fertile earth, safety, harmony, and serenity. Even in Javanese belief, humans always have more reasons to be grateful, even when disaster strikes. The positive local wisdom from this traditional ceremony is the peace of mind and destroying negative suggestions for human destiny.

The mutualistic affinity between the structural and cognitive dimensions exemplifies the workings of social capital [54]. The government initiated a top-down preparedness program, which the community later embraced and further developed from a bottom-up standpoint. The DRV programs were achieved and improved by locals through active participation in preparedness management practices and supportive inter-community networks. The spatial planning scheme implemented in 2012, which led to community relocations, and the institutionalization of the DRV were the initial structural approaches that positively contributed to enhancing local preparedness.

In this context, the enhancement of preparedness knowledge and technical skills was facilitated through group and community network activities that served to unite (bonding function), bridge, and connect the strategic needs of local communities in mitigating uncertainty caused by disasters. Meanwhile, the government's involvement (BNPB, BPPTKG, and BPBD) on the slopes of Merapi provides a foundational policy and supports experts for mitigating and handling emergencies. In this case, government institutions also become co-production triggers while developing community independence in reducing potential risks. These findings are relevant to Kawamoto and Kim's notes on the function of social capital [55]. The government plays a regulatory role in strengthening disaster resilience and implementing institutional governance for communities in vulnerable areas [56, 57].

In completing the structural dimension, cognitive-social capital is manifested in the belief systems and social values that form the foundation of local wisdom, shaping the relationships among community members in the hazardous environment of Merapi. Within this viewpoint, collective preparedness efforts are deeply embedded in the community's vigorous cultural foundation, fostering cooperation among residents through mutual support, collaboration, and various traditional activities aligned with the spirit of preparedness. Relevant to this finding are the results of Pramono's research in a disaster village in Ponorogo Regency, East Java, which also recommends similar conclusions. Local socio-cultural values have crucial benefits for supporting the progressivity of disaster management in prone areas [12].

In the local community of the Merapi disaster area, this cognitive-social capital is deeply rooted in the preservation of their cultural heritage, which views their relationship with the

Merapi environment as harmonious. Belief in the environmental benefits of Merapi forms the backdrop for integrating the dangerous natural surroundings into their daily lives with a sense of high self-confidence. These dimensions transform abilities into collaborative practices within the two villages studied.

The findings reveal no essential differences in structural preparedness practices in the Kepuharjo and Umbulharjo villages. However, there are subtle differences in the context of cognitive-social capital, in the form of different local names for the practice of *sedekah bumi*, in one village using the term *Labuhan Merapi*, and in another village using the term *Becekan Dandan Kali*. Even though the essence is the same, the semantic differences in the ritual practice in each village reflect local nuances and cultural richness that are an integral part of cognitive-social capital. These differences in terminology do not change the essence of preparedness and can be considered insignificant linguistic variations in the context of community-based preparedness in the Merapi slope area. The two villages already have similar approaches to preparedness, but the local uniqueness and cultural diversity shape the nuances of preparedness at the cognitive level. Therefore, further understanding of the terms and values typical of each village is important in detailing the differences, which, although subtle, provide an additional dimension to the preparedness context in the two villages.

The interplay between structural and cognitive social capital is manifested in complementary disaster preparedness practices. The DRV program catalyzes community engagement, sparking bottom-up voluntary movements. Volunteer groups, acting as community representatives, actively participate in risk reduction efforts through preparedness practices, including independent risk mapping, evacuation training, and establishing communication networks through joint forums. From the social capital perspective, the roles of volunteer groups as enhancers of social bonds, bridges for information exchange among community members, and links to external stakeholders reflect the main functions of social capital: bonding, bridging, and linking [55, 58, 59]. These findings indicate that grassroots initiatives collaboratively strengthen disaster resilience in the local community.

On the other hand, cognitive-social capital is embodied in local wisdom, consisting of cultural values and behaviors rooted in a spiritual perspective on Merapi and its potential dangers. Cultural practices, such as traditional rituals, function as symbolic communication agencies [60, 61], which serve as instruments to convey messages of environmental ethics, cooperation, communal attitudes, identity, and social resilience for residents on the slopes of Merapi. In this context, rituals are preserved as a medium for community unifier, reflecting the bonding function of social capital in building commonality and the nature of togetherness in the local socio-cultural sphere. This study terminates that these two dimensions mutually strengthen each other, encouraging integrated and inclusive preparedness practices that can be utilized as a prototype for developing resilience movements in various disaster-prone areas. In public policy implication, it would be essential for policymakers and disaster management institutions to improve disaster preparedness by incorporating local wisdom into a community-based structural disaster approach.

5. CONCLUSIONS

The research reveals the utilization of top-down and bottom-up strategies in disaster preparedness in the villages of Umbulharjo and Kepuharjo. The top-down approach takes place through the initiation of policies and the establishment of the DRV after the largest eruption of Merapi in 2010. It begins with regional regulations on prone areas, which are the basis for the use of areas by residents as residential zones and economic zones. Furthermore, the DRV program was established, which involved collaboration between elements of government institutions and support groups at the village level. The support groups work under the DRV team in implementing preparedness activities, including local mitigation and coordination activities. From the social capital perspective, the implementation of DRV represents the structural existence of social capital. Its characteristics are reflected by an official structure recognized by the village government and play a technical role in preparedness according to its function within the structure. The value of participation lies in volunteerism and willingness to cooperate, resulting in the expansion of collaborative networks between volunteer communities in anticipating potential risks posed by eruptions. Bottom-up functions are represented by the operation of the network in response to each disaster event, as evidenced by the dynamics and speed of coping when an eruption occurs.

Thus, the DRV becomes a forum for empowering local communities in developing a disaster preparedness and response culture. Through the DRV program, community mitigation is increased to create shared awareness about the dangers of disasters, encourage cooperation, and improve coping capacity in the event of an eruption. The DRV becomes a formal community arena at the village level through its involvement in volunteer work teams linked to DRV activities. In its development, other structural features are activated through a network of preparedness support communities and other external agents participating in the village. Specific actions, such as the collaborative establishment of evacuation infrastructure and the formation of inter-community networks, highlight the outcomes of the DRV program in strengthening preparedness through structural capital. According to this study's findings, group and community network activities drive technical preparedness knowledge and abilities, properly uniting, bridging, and linking the community's strategic needs in managing the uncertainties caused by disasters. The network of these groups consists of the youth community, community media, and community volunteers.

Another characteristics that encourages structural is cognitive social capital in the form of a set of cultural values that structure relationships between residents and communities at the local level. Local beliefs and wisdom, social cohesion, unity, and collaborative spirit are all examples of cognitive capital in the context of this study. Cognitive capital, linked to structural social capital, serves as the foundation for the sublimation of preparatory behaviors in the investigated villages. Cognitive social capital is derived from the inheritance of local cultural norms, resulting in favorable local features in prone areas on the slopes of Merapi.

The results are relevant to the research objectives to get community participation description in disaster preparedness practices in rural communities on the slopes of Merapi. Through a social capital lens, the study findings reveal that structural and cognitive dimensions have strengthened disaster

resilience in the location studied. Social capital's structural and cognitive dimensions provide its comprehensive functions: bonding, bridging, and linking. The structural aspect commences with implementing the Disaster Resilient Village (DRV) program, which stimulates active community involvement in collaborative preparedness actions and forming stakeholder interconnection. The collaborative nature is influenced by cognitive characteristics such as local beliefs, social ties, shared awareness, and communal culture, continually preserved through symbolic communication practices in mutual social activities and traditional rituals.

The research results provide academic contributions in the shape of enriching social capital insights on the issue of increasing the adaptive capacity of disaster-prone communities. In developing community-based preparedness, this study increases empirical knowledge regarding the disaster mitigation approach by emphasizing the critical role of local wisdom in disaster management. As a practical implication, this research recommends developing future disaster risk reduction frameworks that integrate structural and cognitive approaches through a commitment to the local context and involvement of local groups and community members in preparedness practices. The holistic understanding of community involvement provides a basis for more adaptive and culturally sensitive disaster management policies in the future.

While this study provides valuable insights into the dynamics of local community involvement in disaster preparedness on the rural slopes of Merapi, it faces several unavoidable limitations. Firstly, the geographical setting of a focusing area limits the universal applicability of the findings to regions with different socio-cultural contexts. The exclusive emphasis on the Disaster Resilient Village (DRV) program may overlook alternative community-based initiatives. Moreover, the research highlights social capital's structural and cognitive dimensions, offering an opportunity to explore other factors influencing disaster resilience. Furthermore, the study relies on retrospective data and community perceptions, which might introduce recall bias and subjectivity. Despite these limitations, this study can inspire future research to delve deeper into community engagement in disaster-prone areas, contributing to a more comprehensive understanding of effective disaster risk reduction strategies.

Understanding the community engagement praxis in risk-reducing strategies through the structural and cognitive social capital lens is challenging for future research in diverse disaster-prone areas. The perspective provides essential insights, as highlighted in this study that focused on the rural slopes of Merapi, one of the most active volcanoes in the world. While the findings were specific to this geographical area, this study proposes a foundational framework for investigating community engagement in diverse regions. Further research, with continuously improved methodology, will enrich the findings, depth of analysis, and beneficial implications for many people and stakeholders. The urgency lies in unraveling the complexities of community involvement, enhancing a more comprehensive understanding that is indispensable for developing effective disaster risk reduction strategies globally.

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