

Collective Memory and Disaster Risk Reduction in Turgo and Karangkandal Communities Around Merapi

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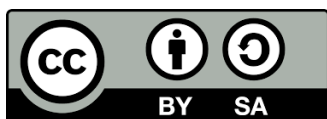
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Abstract

Communities surrounding Mount Merapi have experienced recurrent volcanic eruptions for generations, developing local knowledge and disaster preparedness practices that have been preserved and transmitted through collective memory. This study examined how collective memory influenced disaster risk reduction (DRR) practices and explored why inherited local wisdom did not always prevent casualties during volcanic eruptions. A qualitative study was conducted between 2025 and 2026 in Turgo Hamlet and the Karangkandal Permanent Resettlement Area (Hunian Tetap or Hujung Karangkandal), Sleman Regency, Indonesia. Six participants, comprising community members and key informants, were interviewed in depth. Data collection was supported by field observations of residential settlements, observation of the labuhan ritual procession, and a review of historical eruption records and relevant literature. The findings revealed that collective memory evolved following the major eruptions of 1994, 2006, and 2010. Delayed evacuation or failure to evacuate was associated with responsibilities for livestock, previous experiences of settlements remaining unaffected, beliefs regarding natural protective barriers and predictable eruption pathways, perceived moral obligations, the rapid onset and progression of volcanic hazards, and the absence of timely warnings during the 1994 eruption. Disaster risk reduction practices gradually shifted from reliance on natural warning signs and manually operated warning devices toward official volcanic alert levels, siren systems, digital communication technologies, household emergency preparedness, designated evacuation routes, disaster preparedness training, and evacuation simulations. Collective memory was transmitted through family narratives, annual commemorative activities, memorial monuments, and youth participation, although declining interest among younger generations posed challenges to its intergenerational continuity. The findings demonstrated that collective memory could strengthen community preparedness and disaster resilience while also perpetuating inaccurate assumptions about volcanic hazards. Therefore, historical verification and the integration of scientifically validated hazard information were essential to ensure that collective memory contributed effectively to local disaster knowledge, risk communication, and evidence-informed disaster risk reduction strategies.



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INTRODUCTION

Disaster risk remains a major global development challenge because disaster-related losses result not only from hazardous events but also from the interaction of exposure, vulnerability, preparedness, and risk perception. The Centre for Research on the Epidemiology of Disasters (CRED) reported that 393 disasters associated with natural hazards occurred

worldwide in 2024, resulting in 16,753 deaths, affecting approximately 167.2 million people, and causing an estimated US\$241.95 billion in economic losses (CRED, 2025). These figures underscore the importance of comprehensive disaster risk reduction (DRR) strategies that integrate scientific hazard monitoring, institutional preparedness, and community-based knowledge rather than relying exclusively on emergency response and post-disaster recovery (Thouret et al., 2022; Subiyanto, 2016).

(Voight et al., 2000) Volcanic hazards are particularly relevant to Indonesia, where densely populated communities reside near active volcanoes and must continuously respond to changing volcanic conditions and hazard information. Mount Merapi, one of Indonesia's most active volcanoes, remains a significant source of volcanic risk for surrounding settlements. The Center for Research and Development of Geological Disaster Technology (Balai Penyelidikan dan Pengembangan Teknologi Kebencanaan Geologi, BPPTKG) reported that Mount Merapi continued to exhibit high levels of effusive eruptive activity during March 6–12, 2026, and remained at Alert Level III (Siaga) (Geologi, 2026). Potential hazards included lava avalanches and pyroclastic density currents extending approximately 5–7 km along several southern and southwestern river channels, while ejected volcanic material from explosive activity could affect areas within a 3-km radius of the summit (BPPTKG, 2026). These conditions demonstrate that disaster preparedness around Mount Merapi is not merely a historical concern but an ongoing public safety priority requiring continuous community awareness, effective risk communication, and coordinated preparedness measures.

Communities living on the slopes of Mount Merapi have developed extensive local knowledge through repeated experiences of volcanic eruptions. This knowledge encompasses interpretations of natural warning signs, evacuation experiences, customary leadership practices, commemorative traditions, and narratives transmitted across generations (Koopman, 2023). Such knowledge can strengthen disaster preparedness when it encourages timely evacuation, supports collective responsibility, and reinforces community responses to official warnings (Arévalo et al., 2025). However, it may also create a false sense of security when previous experiences are interpreted as reliable predictions of future volcanic behavior. Within this context, collective memory plays an important role in shaping how residents perceive volcanic hazards, interpret warning information, assess potential threats, and make decisions regarding evacuation and other protective actions (Pfeiffer et al., 2026).

Previous studies have demonstrated that collective memory and local knowledge can contribute to disaster risk reduction, although their effectiveness depends on the accuracy, continuity, and interpretation of transmitted experiences. (Rahman et al., 2017) highlighted the protective role of the Smong tradition in Simeulue, Indonesia, illustrating how culturally transmitted disaster knowledge can support community preparedness and protective responses. Similarly, (Fanta et al., 2019) demonstrated that collective disaster memory may weaken across generations, potentially reducing the continuity of historical knowledge and preparedness practices. Research concerning Mount Merapi has documented its eruptive history and the social adaptation of communities exposed to recurrent volcanic hazards (Gertisser et al., 2023; Hudayana et al., 2025). Furthermore, (Pisa, 2024) emphasized the relationship between intergenerational memory transmission and disaster risk reduction practices, suggesting that collective memory functions not only as cultural heritage but also as an important component of community-based disaster risk governance.

Despite these contributions, an important research gap remains in understanding the relationship between the historical accuracy of collective memory and its influence on community disaster preparedness. Existing studies have frequently examined local wisdom, volcanic history, community adaptation, and intergenerational memory transmission as separate dimensions of disaster risk reduction (Das et al., 2025). However, comparatively limited attention has been given to systematically comparing residents' collective memories with documented eruption histories and examining how accurate or inaccurate recollections influence evacuation decisions and preparedness practices. This gap is particularly relevant to communities surrounding Mount Merapi because the eruptions of 1994, 2006, and 2010 differed in their characteristics, affected areas, warning times, and consequences. These variations may have contributed to selective recollections, simplified interpretations of volcanic behavior, and differing perceptions of risk among communities exposed to successive eruptions (MacAfee et al., 2024).

The urgency of this research arises from the dual role of collective memory as both a resource for community resilience and a potential source of vulnerability. When collective memory preserves accurate lessons concerning evacuation procedures, warning signals, and protective measures, it can strengthen disaster awareness and encourage timely responses to volcanic threats. Conversely, when inherited narratives reinforce assumptions that pyroclastic density currents follow fixed pathways, natural barriers consistently protect settlements, or eruptions primarily produce ashfall, residents may underestimate changing hazard conditions or disregard official evacuation recommendations. Such assumptions can be particularly dangerous because volcanic hazards vary between eruptive episodes and cannot be reliably predicted solely from previous community experiences. Understanding this tension is essential for strengthening community preparedness around Mount Merapi, where effective disaster risk reduction depends on the integration of locally trusted knowledge with scientific monitoring, official hazard assessments, and evacuation guidance (Khumaeni et al., 2025).

The novelty of this study lies in examining collective memory as a dynamic component of disaster risk perception and preparedness whose historical accuracy can be assessed through comparison with documented eruption records. Rather than assuming that inherited local wisdom is inherently accurate or beneficial, the study investigates how disaster memories are formed, preserved, transmitted, modified, and forgotten, as well as how these processes influence decisions before and during volcanic emergencies. The comparative examination of Turgo Hamlet and the Karangkendal Permanent Resettlement Area (Hunian Tetap Karangkendal, or Huntap Karangkendal) provides insights into two community contexts shaped by different experiences of major Mount Merapi eruptions. This approach enables the identification of shared and context-specific patterns in collective memory, risk perception, evacuation behavior, and disaster preparedness, thereby contributing to a more nuanced understanding of the relationship between local knowledge and disaster risk reduction.

Accordingly, this study aims to explore residents' collective memories of the 1994, 2006, and 2010 Mount Merapi eruptions and examine their implications for disaster risk reduction practices (Handley et al., 2018). Specifically, the study seeks to identify factors contributing to delayed evacuation or refusal to evacuate, investigate the mechanisms and challenges of intergenerational disaster memory transmission, analyze changes in preparedness practices from traditional interpretations of natural warning signs to contemporary early-warning systems,

and compare community recollections with documented historical eruption records. Through these objectives, the research evaluates the reliability of collective memory as a foundation for local disaster knowledge and examines how historical experiences influence contemporary perceptions of volcanic hazards and protective decision-making.

Theoretically, this study contributes to the integration of collective memory, local knowledge, and disaster risk reduction within an analytical framework that recognizes collective memory as both a source of resilience and a potential contributor to disaster vulnerability. Empirically, it provides qualitative evidence from residents of Turgo Hamlet and Huntap Karangkendal who directly experienced or inherited knowledge of major Mount Merapi eruptions. From a practical perspective, the findings are expected to support the development of disaster risk communication strategies that acknowledge culturally embedded knowledge while strengthening its reliability through scientific monitoring, historical documentation, and official early-warning information. This integrated approach may help bridge the gap between community-based knowledge and institutional disaster management practices.

The study focuses on community members and local stakeholders in Turgo and Karangkendal whose personal experiences, social roles, and inherited knowledge influence disaster preparedness and responses to volcanic hazards. The anticipated benefits extend to residents, community leaders, disaster preparedness volunteers, Regional Disaster Management Agencies (Badan Penanggulangan Bencana Daerah, BPBD), BPPTKG, and researchers working in community-based disaster risk reduction. By identifying collective memories that encourage appropriate protective behavior and inherited assumptions that may increase vulnerability, the study seeks to inform intergenerational disaster education, evacuation communication, community commemorative activities, and locally appropriate preparedness programs. Ultimately, the findings are expected to support disaster risk reduction strategies that preserve valuable cultural knowledge while preventing the continued transmission of potentially hazardous misconceptions about volcanic behavior and community safety.

METHOD

The study was conducted between 2025 and 2026 in Turgo Hamlet and the Karangkendal Permanent Resettlement Area (Hunian Tetap Karangkendal, or Huntap Karangkendal), Sleman Regency, Indonesia. Both locations had experienced significant impacts from Mount Merapi eruptions. Turgo was affected by the 1994 eruption, whereas Huntap Karangkendal was established to accommodate residents relocated from Kinahrejo following the devastating 2010 eruption. These locations were selected to explore differences in collective memory and disaster preparedness among communities shaped by distinct volcanic eruption experiences.

A qualitative research approach was employed to investigate residents' recollections of volcanic eruptions, interpretations of inherited local knowledge, and the relationship between collective memory and contemporary disaster risk reduction practices. Data were collected through in-depth interviews and field observations. Six informants participated in the study, including hamlet and neighborhood leaders, a local Mount Merapi knowledge holder, and residents of Karangkendal and Turgo, as presented in Table 1.

Table 1. Resource Persons Who Participated in the Interviews

Code	Gender	Location	Age	Role
K1	Male	Karangkendal	60	Current Merapi Locksmith
K2	Male	Karangkendal	59	Head of Kinahrejo/Karangkendal Hamlet
K3	Male	Karangkendal	36	Chairman of RT 01 Karangkendal
T1	Male	Turgo	51	Chairman of RT 01 Turgo
T2	Women	Turgo	50	Residents
T3	Male	Turgo	16	Residents

Source: Interview data processed by the authors, 2026.

Interviews were conducted in Javanese or Indonesian according to each informant's language preference. Field observations focused on settlement conditions and local disaster preparedness practices. The researcher also observed the labuhan ritual procession on January 30–31, 2025. These data were supplemented by a review of historical eruption records to compare participants' recollections with documented events.

RESULTS AND DISCUSSION

Eruption Collective Memory

Eruption 1994

The evidence is presented in three connected analytical domains: collective memory of major eruptions, reasons for delayed or absent evacuation, and changes in disaster-risk-reduction practices. Participant recollections are retained as experiential evidence, while historical sources are used separately to check the accuracy and durability of remembered eruption patterns. For the 1994 eruption, participants recalled a sudden event on Tuesday Kliwon during a celebration, without an initial warning or siren. Hot clouds (wedus gembel) rapidly reached RT 4 near the Boyong River, causing around 60 deaths in Turgo, severe burns, damage to houses, and extensive livestock losses. The disruption of livestock-based livelihoods contributed to occupational changes and relocation, dividing Turgo into the older settlement and the relocation area while maintaining one hamlet administration.

Eruption 2006

Merapi's activities gradually increased through the status levels from Alert, Alert, to Alert, to Alert, thus giving time for residents to prepare and evacuate. The evacuation period lasted up to 3 months. Residents who evacuated were prioritized vulnerable groups such as the elderly, children, and pregnant women. Some residents, especially men and youth, remained in the hamlet to protect the area and take care of livestock. Damage caused by the eruption was limited to the Kaliadem bunker area and its surroundings. Residents' settlements in Kinahrejo Hamlet are still safe from hot clouds. Livestock are relatively safe or successfully rescued. The experience of the 2006 eruption that did not damage the hamlet had formed the perception of some residents of Kinahrejo Hamlet that their settlements were safe from the Merapi eruption.

Eruption 2010

The eruption in 2010 was explosive and sudden in the midst of ash rain conditions. The change of status from Alert to Alert took place very quickly. When the Alert status was determined, vulnerable groups were evacuated. The time span between the determination of the Alert status and the eruption lasted only one day. During the eruption, the hot cloud reached the settlement within about 5 minutes after the eruption. The following is the experience of the 2010 eruption from one of the speakers:

"It really happened after Maghrib there was an eruption. I had just finished Maghrib when there was a drizzle of rain. Then at the top there was a thunderbolt. Now I thought it was just thunder or thunderbolt. Wow, it turned out that after a few seconds there was a shout from the residents. While turning on the motorcycle horn, it was right while shouting. Let's go down and run Merapi Merapi Merapi. I immediately rushed directly to the road, at that time it was already raining ash. Then I just reached the yard, the power went out. I rode my mother, my father couldn't ride but ran slowly. Running was a bit slow. Well, my father finally after about 250 meters he was able to ride. I got a ride with this front neighbor. My father was brought with that person. Actually, that person wanted to find his father-in-law. But fortunately, Alhamdulillah, he didn't go up immediately, but met my father, took my father down. Yes, because of what? The hot clouds were from the north (and almost to the hamlet). After that, I continued to descend together. But yes, don't panic everyone, don't panic that. Always maintain safety and be careful because your view is covered with ashes. The helmet is used closed invisible, it must be opened slowly." (K2, Head of Kinahrejo Hamlet/Karangkendal, 2026).

This eruption hit a much wider area with a threat range of up to 15 km. Kinahrejo Hamlet and its surroundings were hit by hot clouds. It resulted in 39 fatalities in Kinahrejo Hamlet, 37 of whom were residents of Kinahrejo Hamlet, including the keyman at that time, Mbah Maridjan. Residents evacuated independently as soon as they heard the Merapi danger siren or the horn and shouts of residents. The evacuation lasted for 3-4 months with evacuation sites to urban areas such as Maguwoharjo and UPN. All houses, village facilities, and vegetation in Kinahrejo Hamlet were completely destroyed. Livestock such as dairy cows belonging to Kinahrejo residents were destroyed and burned to death. The damage to the livestock sector caused some residents to switch to the tourism sector.

The Reason Why Some Residents Are Not Evacuated

Taking Care of Farm Animals

Most residents work as farmers. Evacuating livestock requires adequate preparation and shelter facilities. This is because not all evacuation centers have livestock shelter facilities. Some residents, especially men and youth, choose to stay or go back and forth from the evacuation camp to the hamlet to graze, feed, and keep their livestock in dangerous conditions.

K2 recounted his experience of having to go back and forth from hamlet-refugee to take care of livestock:

"At that time, the evacuation period was for 3 months. So it went up and down. At home I was also not calm because later in the new house I knew that there would be to run again, later when I was calm I would go home again. At that time, I had an experience, because I raised cows, at that time the status of Merapi was alert and had to graze in the forest. Well, grazing in the forest, yes because the grass is in the forest. Well, it is all troublesome not to be given grass,

it's a pity. If you are given grass, you have to look for grass in the forest. I am forced to go to the forest." (K2, Head of Kinahrejo Hamlet/Karangkandal, 2026).

Even though they stayed at home or went back and forth to the evacuation camp, most people tried to secure themselves when an eruption occurred. K2 recounted his experience of running away from an eruption while grazing.

"Well, that day was Thursday at that time. Together with my parents, I went up (to look for grass). At that time, yes, the name was already in the status of Was, yes, there were already many sounds of the rocks slideing, and finally there was an eruption. I knew that there was an eruption that led to a river near me, the Gendol River. I ran for a long ride, I ran about a kilometer down to the village. My parents stayed and I stayed until the village when it had subsided, it had subsided, and I stopped. Fortunately, at that time my parents and I were still safe" (K2, Head of Kinahrejo Hamlet/Karangkandal, 2026).

Historical Perceptions & Previous Eruption Experiences

Past experiences, both from personal experiences and stories of older people, may instill an understanding that the eruption of Merapi generally reached the hamlet only in the form of heavy ash rain. Residents consider sheltering in the house to be safe enough to take shelter.

"If Merapi used to erupt, it would only be ash." (K2, Head of Kinahrejo Hamlet/Karangkandal, 2026)

"It's not like in 2010. In the past, it was just dark, and it rained ash. So there are no hot clouds, it's just ash rain but it's dark." (K1, Merapi Locksmith, 2026).

In the case of Kinahrejo Hamlet, in the 2006 eruption the hamlet remained safe and was not hit by hot clouds. The damage was only limited to the Kaliadem bunker area even though the hot clouds were heading south. This experience formed a prejudice among some residents that the 2010 eruption would also not destroy their settlements. This is shown by the increase in the number of residents who insisted on staying during the eruption in 2010 compared to in 2006.

"When the 2006 eruption, there were people who lived in the area. The four of them took refuge in the mosque to pray with Mbah Maridjan. But at that time they were still safe." (K2, Head of Kinahrejo Hamlet/Karangkandal, 2026)

So during the 2010 Merapi eruption, the number of residents who chose to stay in the hamlet until the end increased to 37 people. All the people who remained in the hamlet died due to the hot clouds, including Mbah Maridjan.

Belief in "Natural Fortresses" and Eruption Paths

Some residents of Kinahrejo Hamlet have a prejudice that the hills/hills above the hamlet function as a fence or natural fortress. They believe that the hill will hold or divert the flow of lava and hot clouds towards the river so that settlements remain safe.

"Right above our hamlet there are high hills. Yes, some people may think that if there is lava, it will also flow into the river and not into the village." (K1, Head of Karangkandal/Kinahrejo Hamlet, 2026).

Some residents of Turgo Hamlet also have an understanding that the Merapi eruption already has its own path.

"There are those who are reminded that there is an eruption but ignore it. Hot clouds already have their own way (through the river)." (T1, Chairman of RT 1 Turgo, 2026).

Moral Responsibility and Character (Key)

Figures such as the late Mbah Maridjan chose to stay in the hamlet because they felt that they had a moral responsibility for their duties. He felt that if he participated in the displacement, his image would be considered less good or considered an escape from duty.

"If the father does not want to evacuate, it is because he has a responsibility. If later the father is evacuated, his image is not good, it is considered a fugitive. His name is responsibility, under any conditions, it will be done." (K1, Current keyman, 2026).

Very Fast Eruption (2010 eruption)

The 2010 eruption occurred suddenly. Hot clouds slid and reached settlements in just about 5 minutes after the eruption, so some residents who survived or were late made decisions that did not have time to save themselves. This rapid eruption was different from previous eruptions.

No Danger Warning (1994 eruption)

The warning of the danger sign did not light in the 1994 eruption. Residents did not know that an eruption had occurred.

Collective Memory Inheritance & Its Challenges

Turgo residents commemorate the 1994 eruption every November 22 which is filled with prayers and pilgrimages to the graves of victims. The commemoration of the 2010 eruption is carried out in a series of events every year. The commemoration is filled with prayers to pray for the victims and the safety of the community around Merapi. The commemoration of the 2010 eruption was carried out in the former Hamlet of Kinahrejo. This commemoration, in addition to being attended by residents, is also open to the public.

Parents instill in their children an understanding that the relocation of their homes is the result of the sacrifices of disaster victims. Parents also introduce the history of the eruption by showing the location of the former destroyed house building to their children.

"I told you that this used to be your father's house, this is a house of worship, but now it doesn't exist. This used to be the house damaged by the eruption." (K3, Chairman of RT 1 Karangkendal, 2026).

There are challenges in conveying disaster memories to the younger generation due to the lack of interest and distraction from gadget technology.

"It just so happens that our children are not as curious as us. Sometimes at home the two of us can talk to each other on cellphones so they are not interested in the stories of the past. The story is that the parents themselves are no longer interested, the stories from their parents are no longer interested because the times are different. We are invited to talk seriously, but it is still and as if our conversation is less or less interesting, it is more interesting to play the game. If we were children, we didn't have a cellphone, not everyone even had a radio. So it's more fun to listen to parents' fairy tales, when you want to sleep in a fairy tale." (T2, Residents of Turgo Hamlet, 2026)

Even so, youth have a big role in the mitigation of eruption disasters. Youth have the responsibility to monitor Merapi activities. Youth who have graduated from school are generally young adults around the age of 20-35 years old and are in charge of maintaining monitoring posts when Merapi activity increases.

"This monitoring post was activated during the eruption. When the eruption was a bit bigger, many young people slept here." (T2, Turgo resident).

Changes to Disaster Risk Reduction

The Past

Residents in previous generations relied on observation of natural behavior called *titen science*, such as the movement of mountain animals that descended into the village, changes in air temperature, and inner premonitions.

"Parents know there are signs of an eruption, it's just because we don't know the time. It's just that these signs want to erupt, to determine the exact time, even though parents can't know exactly. Premonitions exist, but you can't determine a certain date or a certain time." (K3, Chairman of RT 1 Karangkendal, 2026).

Electricity has not yet entered, roads have not been paved, and the availability of portable radios is still very rare. Danger signal signals still use manual tools at monitoring posts. Officers at observation posts such as in Mount Pelawangan in the past used tools such as *kentongan*, *bende*, and manual sirens to inform residents if they saw hot cloud avalanches or lava avalanches from the Merapi eruption. The absence of this automatic siren causes that if there is something that causes officers to not be able to turn on the danger sign, it is difficult to convey information, and some even do not get information. The 1994 eruption was sudden so that officers did not have time to turn on the danger sign.

"Suddenly (the 1994 eruption), my father was grazing up there. So you know that when the eruption erupted, the lava rolls looked like smoke rushing into Plawangan, which you can see that the woods are like the bamboo. The sound is like an explosion and there is lightning." (K2, Head of Kinahrejo Hamlet/Karangkendal, 2026).

"During the 1994 eruption, there was no warning at all (from the observation post)." (T1, Chairman of RT 1 Turgo, 2026).

Transition Period (2006 eruption)

The determination of the official status of volcanic activity by the government (Normal, Alert, Alert, to Alert) and eruption information is distributed in a structured manner through the official status level from BPTTK/Government. BPTTK also notifies the extent of the eruption and residents are urged to vacate the area in that radius.

"The 2006 eruption was given a range of 6 kilos. It is true up to 7 kilometers." (K2, Head of Kinahrejo Hamlet/Karangkendal, 2026).

Thanks to this more planned evacuation, residents can evacuate before the eruption actually occurs. Residents prioritize vulnerable groups to evacuate first. Some residents, especially men and youth, live or go back and forth to protect their villages and livestock. This system is not perfect, the determination of the status of Merapi's activities can be wrong. This is as conveyed by K2:

"In the refugee camp for 3 months, I was finally allowed to go home. At that time, I was allowed to go home because the status was alert or I forgot what it was. Then if those who want to go home, they can go home, it's okay. If you're still a bit worried, it's okay to go home in the evacuation camp. Eee, but yes everyone automatically goes home. Everyone goes home at 3 am. In the afternoon, at 3 o'clock, there was a big eruption. Come back again, go back to the evacuation camp. Wow, that's a long ride. People from home are even more panicked. Wow, it's finally to the evacuation again." (K2, Head of Kinahrejo Hamlet/Karangkendal, 2026).

Present (2010 – Present Eruption)

The use of traditional tools such as kentongan has been abandoned and replaced by a siren warning sign from BPBD. Here are some statements from the speakers regarding this:

"I don't use traditional tools anymore." (K1, Merapi Key, 2026).

"Now sirens, don't use kentongan. What is the name of EWS? Now there are how many here, three places in one village. (K2, Head of Kinahrejo Hamlet/Karangkendal, 2026).

"Kentongan is no longer used, it relies on siren." (T1, Chairman of RT 1 Turgo, 2026).

This siren is very useful. In the 2010 eruption, as soon as the BPBD siren sounded, residents immediately evacuated independently.

"There is a warning from the siren. Yes, it is definitely dangerous in the situation if the siren has been sounded. The siren is installed by the officers." (K3, Chairman of RT 1 Karangkendal, 2026).

Real-Time Communication & Information Technology: Merapi's activity information spreads very quickly through mobile phones, SMS, streaming channels, to volunteer radio communication networks and residents' guard posts.

Each household alerts ready-to-use vehicles with a position facing the outside road, secures important documents/letters, and prepares emergency supplies.

"My mother, wife, and son were already in the evacuation camp at that time. I had anticipated, I had to be ready. I had put the valuables and papers in my bag and my wife had taken them to the evacuation center. Continuing at home, the motorbike had to be on standby. It must be prepared and always lead to the road, so you don't have to go around anymore." (K2, Head of Kinahrejo Hamlet/Karangkendal, 2026).

Turgo Hamlet has regular livestock data collection so that it is ready to be evacuated in the event of an eruption. There are also routine contributions from residents for emergency consumption funds when evacuating.

"According to my brother, livestock have also been in the data. This is the one A has how many goats or cows. Later one day the eruption will just have to transport it. Then for the fleet, at least the motorcycle is ready. For the mothers, each member has also prepared a monthly fund, each of the mothers prepares a contribution of IDR 2,000 for later one day we will eat it, we already have the funds to make rice like that" (T2, Turgo Resident, 2026)

The evacuation route has been equipped with clear directional signs, supported by regular disaster management training and simulations from BPBD.

"The training contains how if Merapi will erupt, yes, we are prepared. We must bring anything in case of a disaster. We prepare valuable papers. It is also important to bring enough provisions." (T1, Chairman of RT 1 Turgo, 2026).

Taken together, the field evidence shows that evacuation decisions were shaped by more than access to formal warnings. Livestock responsibilities, confidence based on previous eruption experiences, beliefs about natural barriers and fixed eruption paths, and the moral expectations attached to community figures all influenced how residents interpreted danger. These findings are important because they show how collective memory can operate as a practical decision framework. When the remembered pattern is 'the hamlet is usually safe' or 'hot clouds follow the river,' the memory may reduce perceived urgency even when official risk conditions change. The 1994 Turgo and 2010 Kinahrejo experiences therefore illustrate the central argument of this research: local knowledge generated from collective memory can

support disaster preparedness, but selective or outdated memory can also become a source of risk when treated as universally reliable.

Collective memory can nevertheless be highly valuable for disaster risk reduction when it preserves clear and actionable lessons. The Simeulue case shows how smong transmitted knowledge of tsunami signs and appropriate response across generations, supporting rapid evacuation in 2004 (Rahman et al., 2017). The comparison with Merapi is instructive because it demonstrates that the usefulness of local wisdom depends not only on whether memory is transmitted, but also on what content is transmitted and whether that content remains consistent with the hazard. In Merapi communities, inherited knowledge about ash rain, eruption direction, or supposedly protective landforms may have been reasonable within particular past experiences but become unsafe when generalized to later eruptions. This difference supports a more critical view of local wisdom: it should be respected as community knowledge while also being periodically checked against historical records and formal hazard information.

Historical comparison provides the basis for that verification. Communities currently living around Merapi have long settlement histories, and repeated westward eruptions may have strengthened a perception that southern settlements were relatively protected. Kompas (2018) places long-term settlement around Merapi in the period of Sultan Hamengkubuwana VII, while Voight et al. (2000) document repeated eruption directions and also record southward eruptions in 1865 and 1872. Subiyanto (2016) likewise reports an assumption that the southern 'gate' of Merapi was closed. These sources do not prove exactly how each belief developed, but they show why recent experience could selectively reinforce a sense of safety even though the longer historical record was more complex. The evidence therefore supports treating memory loss or transformation as a plausible interpretation rather than as a directly observed causal mechanism.

Collective memory can weaken or change across generations. Fanta et al. (2019) is cited in this manuscript to suggest that disaster memories may diminish within a limited number of generations, while the interviews in Turgo indicate concern that younger people are less interested in listening to family stories. In the present research, this does not establish that all historical knowledge has disappeared; rather, it indicates a transmission challenge. Annual eruption commemorations, visits to former settlement sites, monuments, museums, and youth involvement in monitoring provide alternative mechanisms for maintaining memory when family storytelling becomes less effective. These practices can preserve both emotional remembrance and practical preparedness, especially when they are connected with verified historical information and official disaster education.

The scientific contribution of these findings is to conceptualize collective disaster memory as dynamic, selective, and risk-sensitive rather than automatically protective. Memory is maintained through storytelling, commemorations, physical markers, and participation, but its content can be simplified or reshaped by more recent experiences. For disaster management, this means that local wisdom should be integrated with formal risk communication through a process of mutual validation. Community narratives can identify locally meaningful signs, places, responsibilities, and barriers to evacuation, while historical and scientific records can help correct assumptions that no longer match the hazard. This integration is especially important for evacuation education, livestock planning, intergenerational learning, and communication by local leaders and disaster agencies.

CONCLUSION

The communities of Turgo and Karangendal possessed local knowledge shaped by collective memories of Mount Merapi eruptions, although these memories were dynamic and not always historically accurate. Beliefs that eruptions would produce only ashfall, that surrounding hills would serve as natural protective barriers, or that pyroclastic density currents would remain confined to river channels contributed to a false sense of security. (Kurata et al., 2022) Other factors influencing evacuation decisions included responsibilities for livestock, perceived moral obligations among community leaders, the rapid onset and escalation of volcanic hazards, and the absence of timely warnings during the 1994 eruption. Disaster risk reduction practices gradually shifted from reliance on *titen* (traditional observation of natural signs) and manually operated warning devices toward official volcanic alert information, siren systems, rapid communication technologies, household emergency preparedness, designated evacuation routes, disaster preparedness training, and evacuation drills. Collective memory was transmitted through family narratives, annual commemorations, memorial monuments, former settlement sites, and youth participation, although declining interest among younger generations posed challenges to its intergenerational continuity (van Gevelt et al., 2024; Cai et al., 2023; Hafida et al., 2022).

This study contributed to disaster memory research by demonstrating that collective memory could strengthen community preparedness while also perpetuating unsafe assumptions when past experiences were regarded as reliable predictors of future volcanic hazards (Bimardhika & Moorena, 2025). The findings highlighted the importance of integrating historically verified collective memory into community-based disaster education, intergenerational knowledge transmission, evacuation training, livestock evacuation planning, and official disaster risk communication. Nevertheless, the study was limited to six informants from two communities, restricting the transferability of its findings to other volcanic hazard contexts (Pallister & McNutt, 2015). Future research should involve larger and more diverse groups of participants across multiple Mount Merapi communities and generations to examine how different eruption histories influence collective memory, risk perception, preparedness, and evacuation behavior. Such investigations could strengthen the integration of local knowledge, historical evidence, and scientific hazard assessments into more effective and context-sensitive disaster risk reduction strategies.

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CONFLICT OF INTEREST

The author states that there is no conflict of interest, either in the form of commercial, financial, or other relationships that have the potential to affect the objectivity and integrity of the research.

AUTHOR'S CONTRIBUTION

All authors contribute in a balanced manner in all stages of research, including the formulation of ideas and concepts, data collection and analysis, manuscript preparation, and revision and improvement of manuscripts.

AI USAGE STATEMENT

In the process of research and manuscript preparation, artificial intelligence (AI) is used as an analytical tool to support the process of processing and reviewing information. The use of AI does not replace the author's responsibility in conducting analysis, interpretation, verification, and drawing research conclusions.

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