JURNAL PENATAAN RUANG
Volume 20, Special Edition I, Juli, 2025
Integrated Infrastructure and Disaster Risk Reduction: Innovations and Challenges
P-ISSN 1907-4972 | E-ISSN 2716-179X
DOI: https://doi.org/10.12962/j2716179X.v20iI.5185

To Evacuate or to Stay: Understanding the Behavioral Dynamics of Evacuation Decision-Making Among Communities Affected by the Semeru Eruption

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Received: 16/06/2025 | Reviewed: 04/07/2025 | Accepted: 09/07/2025

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Abstract: The delays and refusals to evacuate during the 2021 and 2022 Semeru eruptions indicate that multiple factors influenced the behavior of affected communities. This study investigates the drivers and constraint factors that shape evacuation decisions. Through a literature review, seven driving factors and seven constraining factors were identified. Data were collected via structured interviews with 100 residents from Supiturang and Sumberwuluh villages in the Lumajang district. Descriptive statistical analysis was employed to assess the influence of each factor on evacuation behavior. The findings reveal that all seven driving factors significantly influenced the decision to evacuate immediately, with the most prominent being the perceived threat of eruption hazards, such as seismic vibrations and volcanic ash. Conversely, only three of the seven constraining factors, concern for family safety, the evacuation behavior of neighbors, and the desire to protect personal assets, were found to contribute to delays or refusals to evacuate. These social and emotional considerations were central to postponing or disregarding evacuation orders. This research highlights critical gaps in current emergency response management, particularly in addressing the social dimensions of evacuation behavior. The results also highlight the need for targeted training and simulation exercises to enhance public understanding of eruption risks and evacuation protocols. Furthermore, the provision of appropriate facilities by authorities is essential to foster community compliance. Overall, this study contributes to a deeper understanding of the complex dynamics underlying evacuation decision-making in volcanic disaster contexts.

Keywords: Evacuation; Decision Making; Emergency Management; Volcanic Eruption; Mount Semeru.

1. Introduction

The evacuation process, as part of the response and preparedness phase, represents the most critical stage in the disaster risk management cycle (Tay et al., 2022). Even a slight delay in evacuation can result in high fatality rates. At the same time, evacuation is essential to minimizing losses and casualties (Naismith et al., 2024). However, the effective implementation of an evacuation plan can be challenging, as it involves a complex interplay of environmental factors and individual behavior (Sheu, 2024; Maas et al., 2025). This complexity is further heightened in the face of uncertain disaster conditions, which can significantly influence individual responses and decision-making during the evacuation process (Doyle et al., 2014).

Indonesia, located within the Pacific Ring of Fire, is home to 127 active volcanoes, making volcanic eruptions one of the most serious natural hazards the country faces. Over the past two centuries, 268 significant eruptions have been recorded (PVMBG, 2023; BNPB, 2024). Mount Semeru is among the most active volcanoes in Indonesia, with an eruption cycle that remains largely unpredictable (Irawan et al., 2024). The major eruption in December 2021 occurred abruptly, triggering cold lava flows and pyroclastic surges, which resulted in 51 fatalities and 169 injuries (BNPB, 2021; Thouret et al., 2022). During evacuation processes, the sudden onset of volcanic hazards can induce panic and psychological pressure. Such conditions often lead to risky, delayed, or irrational responses and decision-making (Luo et al., 2024).

Evacuation responses and decision-making are strongly influenced by individuals' risk perception and prior experiences (Favereau et al., 2018). However, Lavigne et al., (2017) emphasize that hazard underestimation often stems from the risk perceptions of those with prior disaster experience. This often leads to delayed evacuations or, in more severe cases, outright refusal to evacuate (Jumadi et al., 2018). In the case of the Semeru eruption, many residents frequently prioritise agricultural and mining activities over evacuation efforts (Rokhmah et al., 2020; Irawan et al., 2023). Their limited understanding of risk, shaped more by experience than scientific knowledge, contributes to a tendency to underestimate the potential dangers of volcanic activity (Ida et al., 2023). Moreover, low trust in government authorities has been identified as a significant barrier to effective evacuation. During the 2022 eruption, some residents reportedly ignored official evacuation orders (Kompas, 2022; Thouret et al., 2022). A lack of disaster preparedness further impairs the ability to make rational decisions under pressure, ultimately contributing to higher casualty rates (Putra et al., 2023).

The Semeru eruption illustrates how evacuation responses and decision-making are shaped by a complex interplay of social, economic, and demographic factors. Previous studies have also shown that local cultural beliefs can contribute to evacuation refusal during volcanic events (Jumadi et al., 2018; Paripurno et al., 2020). Other factors such as the availability of evacuation facilities (Barclay et al., 2019), attachment to personal assets (Nyandwi et al., 2023) and the clarity of evacuation plans (German et al., 2022), have also been reported to shape individual evacuation decisions. Although the complexity of individual-level factors plays a critical role in evacuation behavior, this dimension is often overlooked in disaster risk management strategies (Haghani & Yazdani, 2024). Moreover, some previous studies, such as those by Thakur et al., (2022) and Nyandwi et al., (2023) have tended to group individual behavior under a single influence factor, without examining its specific role in evacuation decision-making. To address this gap, the present study adopts a more structured approach by categorizing behaviors into drivers and barriers to decision-making. Through this contribution, this research aims to provide a more comprehensive understanding that can inform emergency response planning and intervention strategies. The findings from this study are also expected to enhance community preparedness and responsiveness in future eruption events.

2. Methods

2.1. Study Area

The Jonggring Saloko crater of Mount Semeru opens toward the southeast, channeling volcanic material through the Lengkong, Besuk Kembar, Besuk Bang, and Besuk Kobokan rivers (Badan Geologi Kementerian ESDM, 2024). This geomorphological configuration places approximately 50,000 residents living on the eastern, southern, and southeastern slopes, particularly in Lumajang District, at heightened risk of volcanic hazards (Thouret et al.,

2023). According to the Volcanic Hazard Map (KRB) issued by PVMBG (2022), six villages in Lumajang District are located within the KRB III zone, which is frequently exposed to pyroclastic flows, lava flows, ejected volcanic materials, and incandescent rockfalls. During the major eruption of 2021, Mount Semeru released hot clouds and pyroclastic flows that rapidly traveled through the Besuk Kobokan River, impacting two of the six villages located in the KRB III zone: Supiturang Village in Pronojiwo Sub-district and Sumberwuluh Village in Candipuro Sub-district (Cahyadi et al., 2023). The disaster resulted in 51 fatalities, 169 injuries, 17 missing persons, and the displacement of 10,395 residents (BNPB, 2021; Bachri et al., 2024a). Numerous public facilities in both villages were affected, along with approximately 2,417.2 hectares of damaged land, including forests, open areas, agricultural fields, plantations, and residential zones (Bachri et al., 2024a; Bachri et al., 2024b). hese impacts positioned Supiturang and Sumberwuluh as the most severely affected areas during the 2021 Semeru eruption (Permatasari et al., 2024). Considering these conditions, the scope of this study is limited to the administrative areas of Supiturang and Sumberwuluh Villages (Figure 1).

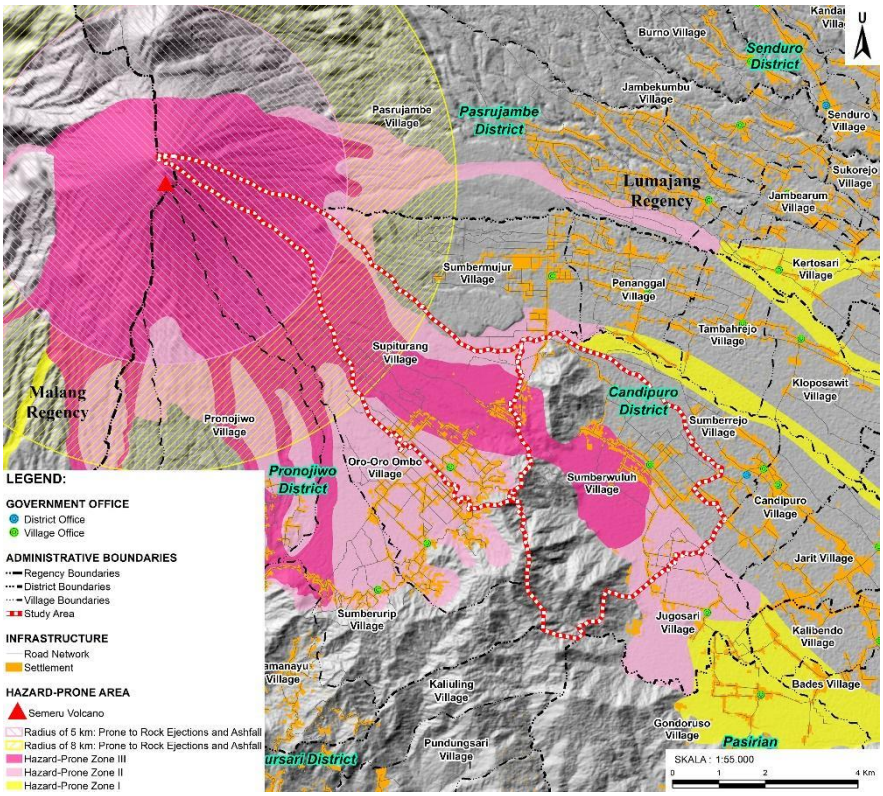

Figure 1. Study Area
Source: PVMBG (2022)

2.2. Research Variable

Evacuation decisions are strategic actions aimed at reducing the impact of disaster risk (Gupta et al., 2016). The decision-making process typically results in one of two outcomes, remaining to stay or evacuating immediately (Ki & Yoon, 2023). However, Strahan & Gilbert (2021) propose a more nuanced classification, categorizing evacuation decisions into three types, refusal to evacuate, delayed evacuation, and immediate evacuation.

Evacuation decisions are often made under considerable pressure, particularly in the context of volcanic eruptions, which are characterized by rapid onset and uncertainty due to the unpredictable nature of lava and pyroclastic flows (Su et al., 2022). Consequently, individuals may make decisions that are delayed, high-risk, or irrational (Luo et al., 2024). This situation is further compounded by the interplay of social, economic, and demographic complexities (Thouret et al., 2022). Drawing upon a comprehensive literature review, this study

identified 14 relevant variables, which are subsequently categorized into those that serve as driving and constraining influences on evacuation decisions (Table 1).

As a driving factor, the occurrence of ground tremors and the presence of volcanic ash, both indicative of escalating eruptive activity, can evoke fear and prompt individuals to take immediate protective action (Rego et al., 2018; Nyandwi et al., 2023). Prior experience with volcanic eruptions, as noted by Lechner & Rouleau (2019), may enhance cognitive capacity and support more effective decision-making. Although Lavigne et al., (2017) highlight that such experience may, in some cases, lead to hazard underestimation, this risk can be mitigated through disaster preparedness training. Disaster training is critical in strengthening individuals' knowledge and practical skills for responding to eruption-related crises (Lin et al., 2023). As emphasized by Bird & Gísladóttir (2018), effective response and successful evacuation are often outcomes of prior participation in evacuation drills. Furthermore, the clarity of evacuation plans is essential in motivating individuals to evacuate. Given the dynamic nature of volcanic activity, clear and well-communicated evacuation procedures are vital for enhancing decision-making capacity and situational awareness (Naismith et al., 2020; German et al., 2022). Another driving factor influencing evacuation decisions is compliance with government advisories. This compliance is shaped by two key elements, the accuracy of early warning systems and the availability of evacuation infrastructure. Accurate warning systems enhance the effectiveness of community responses and foster trust in official evacuation directives (Khan et al., 2024). Similarly, the availability of adequate facilities, such as shelters and transportation, can significantly encourage public compliance with evacuation orders (Martinez-Villegas et al., 2021).

Meanwhile, constraining factors are generally associated with cultural and spiritual beliefs, social dynamics, and place attachment. As explained by Syahbana et al., (2019), ritualistic philosophies and practices may limit individual rationality during emergencies. In some communities, the presence of traditional leaders has been shown to influence collective decisions to remain in place (Yuanjaya & Meiwanda, 2021). Another frequently cited constraint is concern for family safety, which often leads individuals to delay evacuation until all members gathered and relocate together (Naismith et al., 2020). Broader social interactions also play a role, as individuals tend to follow the decisions of neighbors or community groups, including the choice to stay (Naismith et al., 2024). In several eruption cases, the motivation to protect personal assets has been a key reason for remaining behind (Bartel & Naismith, 2023). This aligns with employment-related concerns, where fear of job loss due to relocation away from work sites discourages evacuation (Martinez-Villegas et al., 2021). Finally, a perceived sense of safety at home contributes to the decision not to evacuate, as individuals often feel secure in familiar environments (Qing et al., 2022).

Table 1. Research Variable

Factor	Variable	Source
Driving Factor	Seismic Vibration	Rego et al., (2018); Martinez-Villegas et al., (2021); Nyandwi et al., (2023)
	Volcanic Ash Appearance	Lechner & Rouleau (2019); Iguchi (2021); Martinez-Villegas et al., (2021)
	Experience with Volcanic Eruptions	Lavigne et al., (2017); Bird & Gísladóttir, (2018); Lechner & Rouleau (2019); Andreastuti et al., (2023)
	Participation in Disaster Training	Bird & Gísladóttir (2018); Andreastuti et al., (2023); Lin et al., (2023)
	Clarity of the Evacuation Plan	Naismith et al., (2020); German et al., (2022); Andreastuti et al., (2023)
	Accuracy of Early Warning Systems	Ahsan et al., (2015); Martinez-Villegas et al., (2021); Khan et al., (2024)
	Availability of Evacuation Facilities	Martinez-Villegas et al., (2021); Thakur et al., (2022); Andreastuti et al., (2023)
Constraining Factor	Family Safety	Bird & Gísladóttir (2018); Naismith et al., (2020); Thakur et al., (2022); Nyandwi et al., (2023); Naismith et al., (2024)
	Evacuation Behavior of Neighbors	Wei & Lindell (2017); Bird & Gísladóttir (2018); Naismith et al., (2024)
	Spiritual Traditions	Lavigne et al., (2008); Syahbana et al., (2019)
	Presence of Spiritual Leaders	Lavigne et al., (2008); Yuanjaya & Meiwanda (2021)
	Protect Valuable Assets	Bartel & Naismith (2023); Nyandwi et al., (2023); Settle (2023)

	Perceived Safety Sheltering at Home	Lechner & Rouleau (2019); Martinez-Villegas et al., (2021); Settle (2023)
	Access to Employment	Qing et al., (2022); Irawan et al., (2023); Settle (2023)

2.3. Data Collection

Data collection was primarily conducted through structured interviews using closed-ended questions. The questionnaire assessed respondents' level of agreement regarding the influence of driving and constraint factors on evacuation decisions, measured using a Likert scale. While Likert-based instruments typically include five response options, this study employed a four-point scale: 1 (strongly disagree), 2 (disagree), 3 (agree), and 4 (strongly agree), to minimize central tendency bias and reduce the likelihood of neutral responses (Wakita et al., 2012). The respondents comprised residents of Supiturang and Sumberwuluh Villages who experienced the 2021 or 2022 Semeru eruption. A total of 100 individuals were selected to meet the minimum sample size, calculated using Slovin's formula with a 10% margin of error. This error rate represents the maximum threshold commonly accepted in social science research (Sitorus et al., 2023). To ensure representativeness, respondents were proportionally distributed based on vulnerable groups and population demographics in both villages.

2.4. Research Analysis Tools

This study employed descriptive statistical analysis using SPSS 27, with the analytical framework illustrated in Figure 2. Analisis statistik deskriptif dimanfaatkan untuk mengintepretasikan data numerik secara informatif (Green et al., 2023). Specifically, the analysis was applied to process and interpret questionnaire responses assessing the influence of driving and constraint factors on evacuation decisions, based on structured interviews. However, this analysis was conducted only after confirming the validity and reliability of the questionnaire data. Accordingly, the statistical procedure began with validity and reliability testing. Construct validity was assessed using Pearson's correlation coefficient (r), while reliability (i.e., response consistency) was evaluated using Cronbach's alpha. A questionnaire was considered valid if the calculated r value exceeded the critical r table value or if the significance level was below 0.05. Reliability was deemed acceptable when the Cronbach's alpha coefficient exceeded 0.6 (Hair et al., 2009). Subsequently, mean values were calculated to identify trends and the magnitude of influence of each driving and constraint factor on evacuation decisions, with standard deviation used to verify the consistency of the mean scores (Aybar et al., 2024). Additionally, mode and variance were employed to examine data distribution across specific response categories.

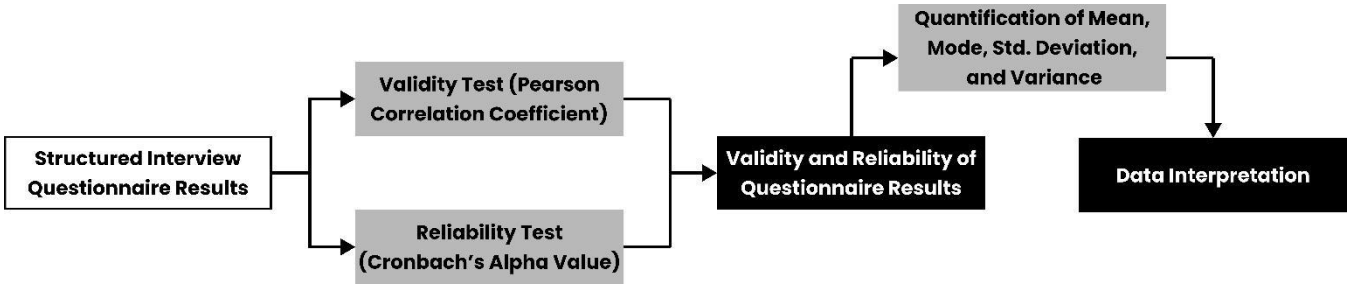

Figure 2. Analytical Framework
Source: Author, 2025

3. Results and Discussion

3.1. Results

3.1.1. Respondent Characteristics

This study involved 100 respondents to assess the perceived influence of driving and constraint factors on evacuation decisions, comprising 35 individuals from Supiturang Village and 65 from Sumberwuluh Village. The distribution reflects the population ratio between the two areas. In terms of gender, 56% of respondents were female and 44% male, closely mirroring the overall gender composition of the local population. The majority (78.6%) were aged between 20 and 59 years, while the remainder were over 59 years old. Additionally, 33% of

respondents came from households with children under the age of five, a group considered particularly vulnerable. Four respondents (3.25%), two male and two female, were identified as persons with disabilities. Regarding household size, 39% of respondents reported a family size of four, 33% had three members, and the remainder had fewer than three or more than four. In terms of children, 43% had one child, 35% had two, 10% had three, and the rest had none.

In terms of educational attainment, 37% of respondents had completed senior high school, 21% had graduated from junior high school, and 26% had completed primary education, while the remainder had only received non-formal education. None of the respondents had pursued tertiary education. This educational profile may influence their level of awareness and understanding of volcanic risks, including preparedness and emergency response. As is typical in rural communities, the most common occupation among respondents was farming (35.9%). A significant proportion (19.4%) were employed in sand mining, a high-risk activity due to its location within former lava flow zones. egarding income, 64% of respondents reported earning below the district minimum wage (UMK), which is set at IDR 2,430,000. In terms of asset ownership, the majority of respondents (91.26%) owned a dwelling with freehold status, while the remainder either rented or lived with relatives. However, most respondents reported not owning livestock, with only 16.5% indicating livestock ownership. lthough livestock ownership was relatively limited, it may still represent a constraining factor contributing to delayed evacuation, as individuals might choose to remain behind to safeguard their assets. Conversely, 91.26% of respondents owned a vehicle, and 97% possessed a communication device. These forms of ownership are likely to serve as driving factors, facilitating access to hazard information and enhancing mobility during emergencies, thereby supporting timely evacuation decisions.

From the perspective of volcanic disaster, all respondents in both Supiturang and Sumberwuluh villages had prior experience with the Semeru eruption and had evacuated at least once to three times. However, approximately 73% of respondents had never participated in any disaster training or simulation. This aligns with the majority of respondents (93.2%), who primarily rely on family and neighbors as their primary sources of information regarding volcanic activity. Additionally, 52% of respondents require more than 10 minutes to evacuate, despite the fact that lava flows and pyroclastic density currents can reach residential areas within this timeframe (Thouret et al., 2022). This indicates a limited understanding of volcanic hazards and underscores the driving factor for enhancing emergency preparedness and response strategies.

3.1.2. The Influence of Drivers and Constraints Factors towards Evacuation Decision-Making

Before assessing the contribution and influence of each variable on evacuation decisions, the validity and reliability of the respondent assessment questionnaire were tested. The driving factors, comprising seven variables, successfully met the validity criteria. All seven variables exhibited a Pearson’s correlation coefficient (r count) ranging from 0.7 to 0.9, exceeding the r table threshold of 0.192. This confirms that all driving factors are valid for evaluating their impact on evacuation decisions, given their significance values below 0.1. Meanwhile, the constraint factors influencing evacuation showed r counts ranging from 0.4 to 0.8, with all variables demonstrating significance values below 0.1. Although the constraint factors exhibited a lower range of r counts compared to the driving factors, they nonetheless satisfy the validity test requirements.

In terms of reliability, the driving factors for evacuation exhibit a Cronbach’s alpha value of 0.911, indicating very high reliability, whereas the Constraint Factors have a Cronbach’s alpha value of 0.733, denoting high reliability based on the criteria established by Hair et al., (2009). The disparity in reliability between these factors is attributed to the distinct characteristics of the variables being measured. Driving factors, such as the clarity of evacuation plans and the accuracy of early warning systems, are typically more concrete and uniform in respondents' perceptions. In contrast, constraint factors, including spiritual beliefs, social networks, and attachment to one's place of residence, tend to be more subjective and context-dependent. These variables are significantly influenced by cultural background, personal experience, and individual interpretation, resulting in greater variability in assessments

Table 2. Statistical Analysis of Drivers and Constraints Factors towards Evacuation Decision

Factor	Variable	Proportion of Approval Rate (%)	Average	Mode	Std. Deviation	Variance
Driving Factor	Seismic Vibration	2.91, 3.88, 45.63, 47.57	3.379	4	0.702	0.492
	Volcanic Ash Appearance	2.91, 3.88, 36.89, 56.31	3.466	4	0.711	0.506
	Experience with Volcanic Eruptions	4.85, 17.48, 33.98, 43.69	3.165	4	0.887	0.786
	Participation in Disaster Training	10.68, 25.24, 31.07, 33.01	2.864	4	1.000	1.001
	Clarity of the Evacuation Plan	6.8, 29.13, 28.16, 35.92	2.932	4	0.963	0.927
	Accuracy of Early Warning Systems	8.74, 20.39, 36.89, 33.98	2.961	3	0.949	0.900
	Availability of Evacuation Facilities	7.77, 20.39, 31.07, 40.78	3.049	4	0.964	0.929
Constraining Factor	Family Safety	7.77, 6.8, 41.75, 43.69	3.214	4	0.882	0.777
	Evacuation Behavior of Neighbors	27.18, 37.86, 23.3, 11.65	2.194	2	0.971	0.942
	Spiritual Traditions	61.17, 24.27, 13.59, 0.97	1.544	1	0.764	0.584
	Presence of Spiritual Leaders	66.02, 30.1, 0.97, 2.91	1.408	1	0.663	0.440
	Protect Valuable Assets	50.49, 24.27, 16.5, 8.74	1.835	1	1.001	1.002
	Perceived Safety Sheltering at Home	71.84, 21.36, 4.85, 1.94	1.369	1	0.671	0.451
	Access to Employment	71.84, 23.3, 2.91, 1.94	1.350	1	0.637	0.406

Legend: Strongly Disagree (1) | Disagree (2) | Agree (3) | Strongly Agree (4)

The mean statistics (Table 2) for each variable within the driving factors and constraint factors represent the extent to which these variables influence community evacuation decisions. For driving factors, higher mean values indicate a stronger influence in motivating individuals to take self-protective actions. Conversely, higher values for constraint factors reflect an increased likelihood of individuals delaying evacuation or opting to remain in place. Furthermore, the mode, standard deviation, and variance (Table 2) provide insights into behavioral tendencies and patterns in decision-making during emergency situations.

The Driving Factors exhibit relatively high mean scores, ranging from 2.8 to 3.5 on a four-point scale, indicating their substantial influence on evacuation decision-making. Among these, hazard-related variables such as seismic vibration and the presence of volcanic ash are identified as the most influential, with scores of 3.37 and 3.46, respectively. This suggests that individuals are likely to evacuate upon experiencing seismic tremors or visually confirming an eruption. Furthermore, these hazard-related variables have the lowest standard deviation and variance, indicating a high degree of uniformity in respondents' perception of eruption risks. Beyond the direct threat posed by volcanic activity, prior experience exhibits a strong influence on evacuation intentions. However, its significantly higher variance compared to the hazard-related variables suggests that experience is more subjective. The availability of evacuation facilities demonstrates a similar level of influence and consistency. Conversely, disaster training emerges as the Driving Factor with the least impact on evacuation decisions. This

variable also shows a high variance value of 1.001, indicating that not all individuals perceive participation in training as a significant motivator for evacuation, as reflected in the nearly equal distribution of Likert scale responses.

In contrast, the constraint factors exhibit lower average values, suggesting that these variables are not particularly significant in preventing individuals from evacuating. In other words, most people do not consider these factors when deciding whether to remain in place during an emergency. Variables such as spiritual traditions, guidance from religious leaders, perceived safety at home, and access to employment demonstrate minimal relevance in decisions to delay evacuation among local communities. This is further supported by their low standard deviation and variance, indicating a general consensus among respondents regarding their limited influence. However, three constraint factors display notably higher mean values. Among them, family safety emerges as the most compelling reason for individuals to remain, with a mean score of 3.24, higher than most driving factors. Despite the high variance and standard deviation, the distribution of Likert scale responses indicates that variations in individual perspectives primarily fall within the categories of agreement and strong agreement. This finding suggests that individuals may opt to delay evacuation to ensure their family's safety or remain together before deciding to evacuate. Additionally, the evacuation behavior of neighbors significantly influences individual evacuation decisions, as people tend to consider the responses and actions of others when determining their own course of action. Among the constraint factors, asset protection exhibits a notable influence despite its relatively low mean value compared to other research variables. However, it has the highest standard deviation and variance, indicating substantial variation in perceptions and decision-making processes among individuals during evacuation.

3.2. Discussion

3.2.1. Driving Factors in Evacuation Decision-Making

Eruption threats—such as perceived seismic activity and the visible presence of volcanic gases, can trigger fear and panic, thereby influencing individual risk perception (Nyandwi et al., 2023). Similar findings were documented by Lechner & Rouleau (2019) during the Pacaya Volcano eruption, where residents ultimately agreed to evacuate following repeated seismic activity and visible volcanic ash approaching settlements. A comparable pattern was observed in the Mayon Volcano eruption, where local people rushed to safety upon witnessing plumes of smoke and volcanic ash (Martinez-Villegas et al., 2021). The high impact of volcanic hazards is closely linked to the geographical positioning of affected communities. With the presence of eruption-related threats such as lava flows, pyroclastic density currents, and hot clouds, individuals residing in hazard zones must promptly undertake self-protection measures (Haney & Havice, 2019; Lechner & Rouleau, 2019).

Prior experience with volcanic eruptions plays a significant role as a driving factor in evacuation decisions. It serves as a foundation for individuals to learn from past events, shaping their understanding of disaster risks and the consequences of previous choices (Wachinger et al., 2013). Dube & Munsaka (2018) further emphasize that experience influences knowledge acquisition and risk perception in disaster contexts. However, Lavigne et al., (2017) & Martinez-Villegas et al., (2021) highlight that prior exposure to eruptions may also act as a constraint factor, as experienced individuals often underestimate hazards, leading to delayed evacuations.

Furthermore, the availability of evacuation facilities is a key determinant in evacuation decision. Nyandwi et al., (2023) in the context of the Nyiragongo Volcano eruption, highlight that designated evacuation routes, adequate shelters, and accessible transportation significantly reduce both technical and psychological barriers to early evacuation. Other Driving Factors, such as disaster training, the clarity of evacuation plans, and the accuracy of early warning systems, also play a crucial role in encouraging prompt evacuation (Andreastuti et al., 2023; Vinnell et al., 2021).

3.2.2. Constraining Factors in Evacuation Decision-Making

Descriptive statistical analysis identifies three primary constraint factors that contribute to evacuation delays or refusals, including family safety, neighbors' evacuation behavior, and the desire to protect valuable assets. Many individuals are reluctant to leave hazardous areas due to the need to ensure the safety of all family members or their unwillingness to separate from loved ones (Lavigne et al., 2017). Buylova et al., (2020) further highlight that

evacuation postponement is often driven by individuals seeking separated family members during crises. This tendency aligns with findings by Naismith et al., (2020), which indicate that people generally prefer to wait for their families to reunite before evacuating together.

Community social behavior plays an ambivalent role in evacuation decisions. When neighbors choose to remain in place, individuals often mirror their actions, leading to a collective decision to delay evacuation, a constraint factor in emergency response (Fu et al., 2021). Fundamentally, individuals rely on the expectation that their neighbors or local community will provide assistance during crises. Consequently, they frequently seek information from neighbors regarding evacuation intentions, whether to leave or stay, further shaping decision-making processes (Naismith et al., 2024).

The decision to remain in place due to the motivation to protect valuable assets has been documented by Bartel & Naismith (2023) during the Fuego Volcano eruption, where local people refused to evacuate due to attachment to their property and shelter. Walpole et al., (2019) further observed that across various disaster events, individuals with strong emotional or economic ties to their assets tend to delay evacuation or even choose not to evacuate at all. However, this constraint factor appears to be less relevant to the decisions of residents near Mount Semeru. This may be a consequence of the 2021 eruption, which resulted in significant casualties due to hazard underestimation and economic-driven evacuation delays (Rokhmah et al., 2020; Ida et al., 2023; Irawan et al., 2023). Such experiences have likely led affected communities to adopt a more rational approach in their decision-making. This shift may also explain why factors such as spiritual barriers, perceived safety of home shelters, and access to employment, previously noted by Lechner & Rouleau (2019), Martinez-Villegas et al., (2021) and Naismith et al., (2024), no longer relevant to the local community of Semeru.

3.2.3. Implications for Emergency Response Management

The findings of this study provide a comprehensive understanding of how individuals consider various driving factors and constraint factors in evacuation decision-making. This insight enables authorities to design and assess emergency response policies more effectively within the local context. Existing policies, as well as those developed for future disaster preparedness, can be tailored to align with the behavioral tendencies of local communities identified in this study. Thus, public non-compliance, delays, and other obstacles during the evacuation process can be addressed to minimize losses and casualties.

In the context of macro-scale emergency response policies, authorities must conduct regular mapping of areas at risk of eruption exposure (KRB). Integrating this information into disaster management plans is essential, as it provides the public with critical guidance regarding unsafe zones during an eruption, particularly areas susceptible to hot clouds, volcanic ash, and incandescent lava flows. KRB data should serve as the foundation for determining genuinely safe evacuation sites. Furthermore, properly equipped shelters must be established to accommodate evacuees' needs, addressing concerns often associated with displacement. The availability of other evacuation facilities, such as emergency mass transportation, can enhance efficiency and mitigate congestion along evacuation routes. The presence of evacuation personnel or designated officers can further facilitate the process, particularly for vulnerable groups. An accurate and accessible disaster warning system constitutes a driving factor in ensuring timely evacuations. Given that local communities frequently rely on social networks for information, often uncertain or inconsistent, formalized warning systems play a crucial role in enhancing response effectiveness.

The various driving factors that must be integrated into the emergency response management framework, as outlined above, serve as critical stimuli for promoting compliance with evacuation directives. However, an equally important consideration is community understanding, which plays a fundamental role in decision-making processes. Disaster education services are essential for enhancing individuals' capacity to assess risks and make informed evacuation decisions. These services not only improve evacuation behavior but also mitigate the tendency of experienced individuals to underestimate eruption hazards, as reported by Lavigne et al., (2017) & Martinez-Villegas et al., (2021). The presence of structured educational programs strengthens the rationality of decision-making, thereby addressing constraint factors such as emotional attachment to protecting assets and reliance on disaster-related information from uncertain social sources.

Furthermore, disaster training and simulation serve as essential follow-ups to education initiatives, supporting emergency response policies with technical applications such as contingency planning. These initiatives translate macro-level policies into actionable frameworks and procedures. For instance, regular training and simulations can be conducted for communities residing in high KRBs, demonstrating the selection and navigation of the safest evacuation routes. This includes fostering a better understanding of eruption indicators, such as increased seismic activity and volcanic ash emissions. Importantly, contingency plans must also account for family safety, as it remains a constraint factor in evacuation delays. Implementation may involve the strategic distribution of evacuation shelters across residential areas, ensuring accessibility, such as one shelter per hamlet. Furthermore, both macro and micro-scale policies, including contingency plans, should incorporate insights into the factors shaping individual evacuation decisions. Thus, emergency response management policies and procedures can be formulated to align with the local context. This is expected to encourage more effective self-rescue actions to minimize losses and casualties

4. Conclusion

This study aims to examine the decision-making process behind evacuation choices, including the factors considered and their influence on the preferences of communities affected by the Semeru eruption. Descriptive statistical analysis reveals that the seven tested variables function as driving factors, encouraging individuals to evacuate promptly. Direct eruption threats, such as seismic vibrations and the presence of volcanic ash, serve as the primary contributors, followed by prior experience and the availability of evacuation facilities. Conversely, only three constraint factors, such as family safety concerns, neighbors' evacuation behavior, and attachment to asset protection, have been identified as triggers for postponing or refusing evacuation.

The findings of this study expand the understanding of how evacuation intentions are shaped by the complexity of influencing factors and community behavior. Some results align with previous research on volcanic disasters, while others present novel insights specific to this study. These variations can be attributed to the diverse cultural and geographical conditions across different volcanic regions. Consequently, this study underscores the necessity of incorporating local context, particularly community behavior, into emergency response management planning for enhanced effectiveness. However, this study has methodological limitations. The analysis was conducted solely using quantitative approaches, without incorporating qualitative insights from open-ended interviews that could clarify intangible influencing factors. Additionally, it does not account for the evolving dynamics of decision-making over time. These limitations should be considered in future research to improve the understanding of evacuation behavior.

Acknowledgement

This study is part of the first author's Master's research at the Department of Urban and Regional Planning, Institut Teknologi Sepuluh Nopember (ITS). We express our sincere gratitude to the Lumajang Regency Disaster Management Agency (BPBD), village officials, and the residents of Supiturang and Sumberwuluh for their invaluable assistance in completing this research.

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