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Harmonising Social Capital and Community Participation in Puncu Village: A Digital Approach to Mitigating The Threat of Mount Kelud's Eruption

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Abstract

Puncu Village, situated in the high risk zone of Mount Kelud, continues to face significant volcanic threats that necessitate effective and locally relevant disaster mitigation strategies. This study investigates how the integration of social capital and community participation can support the development of a digital mitigation model rooted in the social fabric of the community. Employing a qualitative case study approach, data were obtained through in-depth interviews, nonparticipant observation, and document analysis. The analysis was conducted using content analysis, relational content analysis, and descriptive qualitative methods. The findings indicate that elements of social capital such as mutual trust, norms of cooperation, and strong social networks serve as crucial foundations for inclusive preparedness. Nevertheless, the current level of community participation is limited to the stage of information sharing, suggesting minimal involvement in digital-based mitigation processes. The proposed strategy seeks to design a digital system that is inclusive, culturally relevant, and responsive to the lived experiences of the local population. This research highlights the need to balance technological innovation with social values to build a sustainable disaster mitigation framework in volcanic risk areas such as Puncu Village.

Keywords : community participation; digital strategy; disaster mitigation; Mount Kelud; social capital

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INTRODUCTION

Indonesia is among the countries with the highest levels of disaster vulnerability in the world. Its geographical position at the convergence of three major tectonic plates renders the region highly susceptible to earthquakes, volcanic eruptions, and other natural hazards (Hermon 2015; Arum et al. 2021). According to the National Disaster Management Agency (BNPB), approximately 80 percent of more than 83,000 villages and sub-districts in Indonesia are situated in disaster-prone areas (Rahman & Van den Broeck 2025; Skwarko et al. 2024). In the National Medium-Term Development Plan (RPJMN) 2025 to 2029, the government emphasises the importance of strengthening village capacities and reducing the number of disaster-prone villages as a strategic effort to address increasingly frequent threats (RPJMN, 2025).

One of the areas identified as being at high risk is East Java Province, which is home to several active volcanoes including Semeru, Raung, and Kelud (Kozin, 2016). Mount Kelud in particular has a long and recurring eruption history, with an average eruption cycle of fifteen to twenty years (Liperda et al. 2025; Sugara et al. 2018; Imaduddinah et al. 2021). Its most recent eruption in 2014 caused extensive damage in various regions, with Puncu Village in Kediri District being one of the most severely affected (Paripurno et al. 2015). Volcanic ash and pyroclastic material not only damaged buildings and agricultural land but also disrupted the social and economic life of the community for an extended period (Nurinayanti and Hidayat 2015).

Puncu Village is geographically vulnerable due to its location just eight kilometres from the crater of Mount Kelud. Each eruption poses substantial risks to human safety, settlements, and livelihoods. In such conditions, mitigation efforts cannot rely solely on structural approaches administered by the government (Paripurno et al. 2015; Hizbaron et al. 2018; Margaretta et al. 2024). A community-based approach is required, one that draws upon local strengths as part of a disaster risk reduction system (Indriyanto et al. 2023; Kasbani et al. 2019). In this context, social capital and active citizen participation play central roles and serve as key foundations for building a contextual and sustainable mitigation system (Tsani, 2019; Hidayati et al. 2019).

The theory of social capital developed by Robert D. Putnam highlights three core elements: trust, social norms, and social networks (Gu 2024; Hussain et al. 2024), all of which contribute to social cohesion and collective community capacity (Anam and Zukhri 2025;

Vongvisitsin et al. 2024)). In the context of disaster management, social capital functions as a social force that enables residents to assist one another, share information, and coordinate collective action during crisis situations. Trust among community members fosters open and responsive communication, while cooperative norms form the basis for collective understanding. Social networks, both formal and informal, serve strategic roles in accelerating the mobilisation of resources and coordination across groups in times of risk (Ulum 2014).

On the other hand, community participation in mitigation processes can be understood through the framework of the Eight Rungs of Citizen Participation introduced by Sherry Arnstein. This theory categorises participation into eight levels, ranging from non-participation and tokenism to full citizen control over decision-making processes (Putri 2024). Higher levels of participation reflect active engagement by residents in shaping policy, planning evacuation strategies, and managing disaster information systems (Ritonga 2024). In participatory approaches such as these, communities are not merely beneficiaries but active agents who influence the direction and form of mitigation policy. Therefore, linking social capital with levels of participation becomes essential in designing inclusive, contextual, and sustainable mitigation systems (Hizbaron et al. 2021).

Several previous studies have underscored the importance of community-based approaches in addressing the risks posed by Mount Kelud's eruptions. Windiani et al. (2018) noted that threats from volcanic flows and debris have severely damaged settlements and endangered long-term community resilience in Puncu Village. Aryawan et al. (2023) stressed the need for adaptation strategies that align with local characteristics. Tsani (2019) also affirmed that the Community Based Disaster Management (CBDM) approach is effective in enhancing community resilience because it promotes participation in every phase of mitigation. However, these studies have not explicitly examined the connection between social capital and participation levels in relation to digital technologies. Therefore, this study offers a state-of-the-art contribution by integrating social capital and community participation within a digital disaster mitigation framework. The harmonisation of these two elements is believed to offer a pathway towards building a mitigation system that is not only responsive to local needs but also adaptive to technological developments.

RESEARCH METHODS

This study employs a qualitative approach with a case study design, focusing on Puncu Village in the Puncu Subdistrict of Kediri Regency, a location that is historically and geographically situated within a high-risk zone for Mount Kelud eruptions. This approach was chosen to explore in depth the complex social dynamics related to the harmonisation of social capital and community participation in the context of disaster mitigation. Data collection was carried out through in-depth interviews with community leaders, village officials, the Kediri Disaster Management Agency, and the East Java Provincial Disaster Management Agency. These interviews were complemented by non-participant observation of the local environment, including field visits to areas affected by the 2014 eruption of Mount Kelud. Document analysis was also conducted to enrich the data, drawing from village policy archives, official reports from disaster agencies, and records of local mitigation activities.

The data analysis process was conducted in stages using content analysis and relational content analysis to uncover meanings, relationships, and patterns among the concepts emerging from participant narratives. Qualitative descriptive analysis was then applied to organise the findings thematically, with particular attention to aspects such as trust, norms, social networks, and levels of community participation based on Arnstein's theory of participation. This approach enabled the researcher to interpret not only the visible social practices but also the underlying structures embedded within local social and cultural relationships. Consequently, this research offers not only conceptual insight but also strategic direction for developing a digital mitigation system rooted in the social strengths of the local community.

RESULTS AND DISCUSSION

An Overview of Social Capital Conditions in Puncu Village

Social capital plays a crucial role in strengthening community resilience to disasters, particularly in the context of Mount Kelud's recurring eruptions. Based on in-depth interviews with residents of Puncu Village, various forms of social interaction were identified that reflect the key elements of social capital, namely trust, norms, and social networks. These elements not only reinforce the spirit of mutual cooperation during times of crisis, but also contribute to the dissemination of information, the implementation of evacuation procedures, and the process of post-eruption recovery. The following is a summary of the forms of social capital found within the community of Puncu Village:

Table 1. The State of Social Capital in the Community of Puncu Village

Element of Social Capital	Findings from the Field	Interview Excerpts
Trust	Residents place their trust in local figures such as neighbourhood heads and hamlet leaders, as well as in traditional warning tools like slit drums and local symbols.	“Biasanya Pak RT atau Kepala Dusun kasih tahu warga kalau statusnya udah awas…” (I6)
Norms	Social norms of mutual cooperation emerge during evacuation efforts, post-eruption house repairs, and in the preservation of traditions commemorating eruptions.	“Warga saling bantu pas rumah rusak, ada yang bantu genteng, ada yang bantu kayu…” (I4)
Networks	Youth organisations are activated during disasters, with informal collaboration among residents in rescue activities, and family-based networks playing a key role during displacement.	“Pemuda diarahkan untuk bantu evakuasi lansia pas erupsi…” (I7)

Source: Researcher’s Data Compilation, 2025

Upon comprehensive examination, it becomes evident that the community of Puncu Village relies on long-established social relations as a responsive mechanism in the face of disaster. Trust in informal figures such as hamlet heads and neighbourhood leaders serves as the primary channel for disseminating information, particularly when formal warning systems do not function effectively. Traditional communication tools such as slit drums continue to be employed as an early response method in emergency situations.

Social norms such as mutual cooperation and collective care remain embedded in daily life, including during times of crisis. This is reflected in residents' initiatives to repair damaged homes independently, as well as through voluntary contributions of building materials. Additionally, cultural activities such as the annual eruption commemoration at Jedhing Gedhe reinforce the community’s collective awareness of Mount Kelud’s risks, although such practices are not yet fully integrated into formal mitigation systems.

Social networks in the form of youth groups, family ties, and neighbourly solidarity serve as key pillars in evacuation efforts and post-disaster recovery. The involvement of local youth organisations and village volunteers, although often spontaneous and unstructured, proves effective in assisting vulnerable groups such as the elderly during evacuations. These

findings suggest that the community's existing social strength constitutes a vital asset that should be further reinforced through participatory and collaborative approaches in the development of technology-based and policy-driven mitigation planning.

The Level of Community Participation in Puncu Village

Community participation is a crucial aspect of community-based disaster mitigation efforts. However, participation does not always imply active or equitable involvement. Within the framework of the participation ladder developed by Arnstein (1969), informing occupies the lowest level in the category of tokenism, where citizens are merely given information without opportunities for dialogue, decision-making, or control. In the context of Puncu Village, community participation in mitigating the eruption of Mount Kelud remains largely one-directional. Residents tend to wait for instructions from authoritative figures, such as local leaders or officials, with limited involvement in disaster planning or policy-making processes. The following table illustrates the current level of community participation in Puncu Village at the informing stage.

Table 2. Level of Community Participation in Puncu Village

Arnstein's Category	Level of Participation	Description of Community Participation	Participation Position
Tokenism	Informing	Residents are given information regarding alert status, evacuation routes, and shelter locations by neighbourhood heads or village officials, without any dialogical process	Passive-informative

Source: Researcher's Data Compilation, 2025

To strengthen this position, the following are excerpts from resident interviews that reflect forms of participation which remain at the informing level:

Table 3. Reinforcement of Community Participation Level in Puncu Village

Informant Code	Interview Excerpt	Interpretation of Participation
I6	"Biasanya dikasih tahu sama Pak RT atau polisi, kita langsung siap-siap."	Information is delivered top-down from local authorities; participation is reactive.

I2	"Kalau ada tanda sirine atau kentongan, ya berarti udah harus siap ngungsi."	The response is based on command cues, without involvement in planning processes.
I8	"Kami cuma dengar dari masjid kalau sudah status awas nanti bakal ada informasi dari TOA masjid mas."	Communication functions only as a means of broadcasting orders, not facilitating dialogue.
I3	"Waktu itu nggak tahu harus ke mana, nunggu disuruh ngungsi aja."	Residents await instructions without understanding the mitigation strategy.
I1	"Pokoknya kalau disuruh naik truk, ya kita ikut aja, nggak banyak tanya."	Participation reflects compliance rather than active engagement or initiative.

Source: Researcher’s Data Compilation, 2025

From the interview excerpts above, it is evident that disaster mitigation communication in Puncu Village remains predominantly vertical and centred around formal authority figures. Information is relayed during emergency situations without any genuine dialogue or community involvement in planning processes. This indicates that residents have not yet been empowered as active agents within the disaster risk reduction cycle. Participation in the form of informing may serve as a necessary initial step to raise risk awareness, but without efforts to strengthen the community's critical capacity, such a pattern tends to limit local initiatives and distance the people from strategic roles in decision-making. Citizens are positioned merely as recipients of instructions, rather than as contributors to the direction of mitigation strategies.

Therefore, future efforts should focus on elevating community capacity towards higher rungs of participation, particularly consultation and partnership. Creating spaces for dialogue, involving residents in simulation exercises, and developing two-way communication channels are concrete steps to shift the participatory model from passive to active transforming residents from listeners into co-creators of policy. In doing so, disaster mitigation ceases to be solely a government-led initiative and instead becomes a collective practice rooted in the strengths of the community itself.

Formulation of a Digitised Mitigation Strategy Based on the Harmonisation of Social Capital and Community Participation

The following table presents the formulation of disaster mitigation digitalisation which specifically integrates social capital (trust, norms, and social networks) with community participation (based on Arnstein’s framework) in Puncu Village. The detailed components are as follows:

Table 4. Strategy Formulation for Digitalisation Based on the Harmonisation of Social Capital and Community Participation

Stage	Formulation	Integrative Description (Social Capital and Community Participation)
1. Planning and Needs Identification	Participatory deliberation and local risk mapping	Residents are involved in open discussions with the local disaster management agency (BPBD) and village authorities to identify disaster information needs based on local experiences. Trust in traditional leaders and village officials serves as a bridge between authorities and the community.
2. Selection of Technological Platform	Development of an interactive and adaptive village website	Social capital in the form of community networks (youth groups, women's associations, religious leaders) is empowered as content contributors. Community participation is realised through consultation in the design and structuring of the website based on everyday needs.
3. Website Design and Development	Simple layout and content rooted in local wisdom	The norm of mutual cooperation (gotong royong) is reflected in the involvement of village youth as website operators. Residents contribute ideas in feature development, making the process resemble a partnership as defined by Arnstein's ladder of participation.
4. Content Creation for Mitigation Education	Integration of scientific data and local knowledge	Community members actively contribute as storytellers, testimonial providers, and sources of traditional signs of nature. Trust in local experience is combined with data from the Meteorological Agency (BMKG) and BPBD, enhancing the legitimacy of the website's content and bridging the scientific and cultural domains.
5. Community-Based Digital Literacy Enhancement	Community digital training via local forums	Activities are organised through social groups with existing trust networks (such as religious gatherings, health posts, and farmers' forums). Participation evolves into a delegated power model where communities are not only trained but also manage the system independently.
6. Dissemination and Evaluation	Joint monitoring and online reporting	The system includes a feature for citizen-led disaster reporting. Through trust networks and local solidarity, residents independently input data, and evaluations are conducted under the principle of community

	transparency. This strengthens socially driven digital control.

Source: Researcher’s Data Compilation, 2025

This table demonstrates that the digitalisation strategy in Puncu Village is not simply a matter of applying technology. More importantly, it highlights how social values such as trust, community networks and shared norms can act as cultural foundations that support the success of the programme. The involvement of local residents from the earliest planning stages ensures that the digital initiative is not a directive imposed from above but rather a collective effort that emerges from the community’s own needs. This approach not only improves the speed and reach of information but also builds a strong sense of ownership among residents towards a risk mitigation system they understand and believe in. As a result, there is greater space for the development of local capacity to manage disaster risks in a more autonomous and sustainable manner. In the long term, this harmony between technological and social elements encourages the progression of citizen participation from simple informing to genuine partnerships and even citizen control, where the community takes the lead role in shaping disaster risk reduction in their own area.

Stages of Disaster Mitigation Digitalisation Based on the Harmonisation of Social Capital and Community Participation in Puncu Village

a. Planning and Needs Identification

In the early stage of formulating digital disaster mitigation, well-structured planning plays a decisive role in ensuring the successful implementation of an effective system. This planning process involves mapping the various hazards faced by the community, including natural disasters such as volcanic eruptions, earthquakes, tsunamis, and floods, as well as non-natural hazards such as fires or industrial accidents. A sound understanding of these threats forms the basis for designing a digital system that is not only efficient but also capable of responding to urgent needs during times of disaster. Research and data collection on the types of threats specific to a particular area will support the process of prioritising the information that must be provided within the digital mitigation system.

Moreover, identifying the community's information needs is equally vital. In the context of disaster mitigation, the required information can vary significantly depending on the geographical and demographic characteristics of the region. Therefore, the involvement of

local communities and relevant institutions, such as the Regional Disaster Management Agency (BPBD), is essential to gain deeper insights into the actual needs present. The community, as the most directly affected group, possesses valuable knowledge and understanding about how they perceive disaster threats and how they prefer information to be communicated. These aspects will be elaborated further in the Community Needs Identification Table.

Table 5. Confirmation of the Urgency of Digital Education in Disaster Mitigation

Informant	Interview Excerpts	Frequency	Result
BPBD Jawa Timur	"Kalau lewat website belum... Kami hanya membentuk Desa Tangguh Bencana sebatas Pratama..."	1x	Digitalisation has not been fully implemented and is not yet a priority in mitigation programmes.
BPBD Kediri	"...sistem informasi desa itu berbasis website... tapi dari pemerintah desa sendiri belum maksimal untuk keberlanjutannya... akhirnya macet..."	2x	Digitalisation was initiated via a website but did not continue and capacity strengthening needed.
Head of Puncu Village	"Kalau website desa sudah ada, tetapi terkait tentang informasi publik yang terkait tentang kebencanaan belum kita buat di website kita."	1x	The village website exists but has not been utilised for disaster education and digital opportunity exists.
Welfare Affairs (Kaur Kesra) Puncu Village	"Website desa sudah tersedia. Tapi sampai saat ini belum dimanfaatkan secara khusus untuk informasi kebencanaan..."	1x	Use of the website for mitigation purposes is not yet effective and limited resources remain an issue.
Informant 1 (Puncu Local Citizen)	"Setahu saya untuk menyeluruh di masyarakat Desa Puncu ini masih belum ada sih mas"	1x	Unaware of any digital education; the community has not yet felt the impact of digitalisation.

Source: Researcher's Data Compilation, 2025

Based on the coding confirmation derived from interviews with several key and primary informants, it is evident that the urgency of digitalisation in disaster mitigation for the eruption of Mount Kelud in Puncu Village has yet to receive adequate attention. Although a digital

initiative was previously attempted through the Village Information System website programme by the Kediri Regency Disaster Management Agency (BPBD), its implementation has not been sustained due to limited resources at the village level. This observation aligns with statements from the East Java Provincial Disaster Management Agency, which indicated that mitigation education continues to rely on conventional approaches such as forums and face-to-face training, rather than employing digital media. Such limitations have resulted in the dissemination of disaster-related information via online platforms not becoming an integral part of the overall disaster management strategy.

On the other hand, from the village government’s perspective, including the Village Head and the Welfare Affairs Officer, it is acknowledged that while the village website exists, it has not been specifically utilised to convey disaster-related information. Moreover, the community, as articulated by Mrs Suliyati, has yet to experience comprehensive digital education regarding disaster preparedness. This situation underscores a clear gap between the potential of digital technology and its actual application in the context of community disaster preparedness. Therefore, there remains a critical need for digitalisation in disaster mitigation not only to broaden the reach of educational efforts but also to accelerate the dissemination of emergency information equitably among the population. This phase of analysis forms part of the problem tree identification, the details of which are illustrated in the following figure.

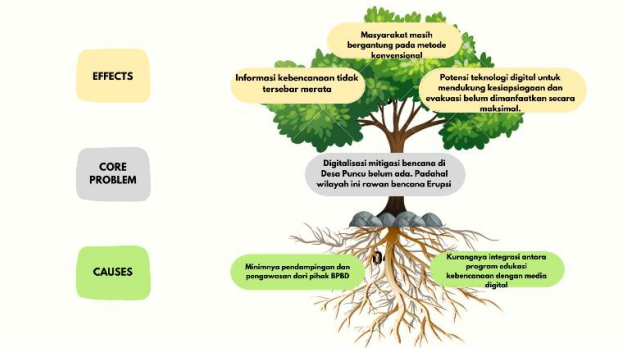

Figure 1. Problem Tree Analysis

The main issue identified is the lack of an optimal implementation of disaster mitigation digitalisation in Puncu Village. Although initial efforts such as a web-based village information system were introduced, the programme failed to continue in a sustainable manner. This suggests that digitalisation has not yet been perceived as an urgent necessity, despite the ever-present risk of disaster. The root causes are diverse. One contributing factor is the limited guidance and supervision from the Regional Disaster Management Agency (BPBD) concerning the utilisation of digital technologies. In addition, there has been no strong effort to integrate disaster education programmes with digital media accessible to the wider community.

As a result, technology-based initiatives remain unfamiliar and, in many cases, completely unused.

The consequences of this shortfall are particularly evident in the community's level of preparedness. Disaster-related information is not disseminated evenly, especially among groups residing far from the village centre. Moreover, the community still relies more heavily on traditional methods such as slit drums (*kentongan*) or loudspeakers. Meanwhile, the substantial potential of technologies such as mobile applications, websites, and digital early warning systems remains underutilised. This leaves the community more vulnerable when disasters occur unexpectedly.

Once the problem tree analysis confirmed that disaster mitigation digitalisation in Puncu Village remains suboptimal, it became necessary to develop an objective tree as a framework for improvement. The objective tree has been constructed to illustrate concrete actions that may be taken to address the root causes and minimise the resulting impacts. By emphasising the strengthening of digital systems alongside the integration of local wisdom, the tree demonstrates that technology can be employed without displacing longstanding community traditions. This is essential to ensure that mitigation strategies are not only modern and effective, but also culturally acceptable and well-received by the local population.

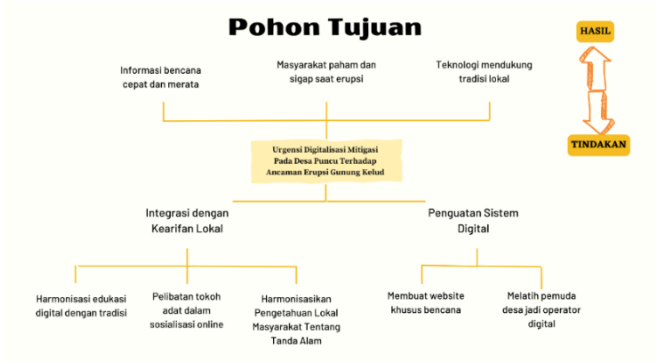

Figure 2. Goals Tree Analysis

This objective tree has been designed as a response to the root causes previously identified. At the top of the tree are three key goals: the rapid and equitable dissemination of disaster-related information, improved public understanding and preparedness in the event of an eruption, and the use of technology to support – rather than replace – local traditions. These three objectives are interconnected and serve as the foundation for developing a more responsive and sustainable disaster mitigation strategy. To achieve these aims, two primary actions have been formulated: strengthening digital systems and integrating them with local wisdom. Digital system enhancement involves the development of a dedicated disaster website

and training local youth to serve as digital operators. Meanwhile, the integration of local wisdom includes aligning digital education with traditional practices such as the *kentongan* (bamboo slit drum) and natural signs, as well as engaging community elders in online dissemination efforts. These two approaches aim to ensure that digital strategies are not only efficient but also contextually relevant to the daily lives of local residents.

The digitalisation of disaster mitigation has now become an urgent necessity in Puncu Village due to the continued reliance on limited and traditional methods of information dissemination. The speed and accuracy of information are critical in responding to the sudden eruptions of Mount Kelud. Past experiences have demonstrated that delays in information can have severe consequences for residents' safety. Therefore, technology must be leveraged to accelerate early warning systems, broaden the reach of disaster education, and strengthen coordination between disaster-prone areas.

b. Selection of Technological Platform

The use of a website as a medium for disaster mitigation education is considered more effective due to its ability to reach the wider community quickly. Information regarding early signs of eruptions, evacuation routes, and safety guidelines can be accessed at any time without the need to wait for face-to-face socialisation. This is particularly crucial in high-risk areas such as Puncu Village, where time is a critical factor in ensuring safety. With a centralised platform, information can be organised clearly, systematically, and updated in real-time in line with the latest developments from official agencies.

Moreover, websites can accommodate a wide range of educational content in various formats, including text, images, videos, and infographics. These formats allow people from diverse educational backgrounds to engage with the material in a way that suits their learning style. For instance, younger generations may absorb information more effectively through video tutorials or interactive simulations. Meanwhile, older residents can still benefit from simple guides presented in local languages. In this way, the educational approach becomes not only swift but also inclusive, reaching various age groups and levels of ability.

Web-based platforms also create space for community participation in mitigation efforts. Residents can report environmental conditions, share experiences during disasters, or provide feedback on evacuation systems through interactive features. On the other hand, the village government or disaster management agency (BPBD) can announce training schedules, issue

volcano status updates, and share evaluation results transparently. This helps to build a culture of disaster awareness that is not only top-down but also nurtured from community consciousness (bottom-up). Therefore, website-based digitalisation functions not merely as a communication tool, but as a collaborative platform that promotes shared preparedness.

c. Website Development Design

The design of the disaster mitigation website for Puncu Village must be tailored to the local community's diverse characteristics, including age groups, educational backgrounds, and levels of digital literacy. Therefore, the website interface should be simple, responsive, and easy to navigate. The main menu could include updated information on Mount Kelud's activity status, interactive evacuation routes, gathering point locations, and emergency response guidelines. The language used should prioritise clear and communicative Indonesian, and where possible, include explanations rooted in local wisdom as a form of cultural adaptation that resonates more closely with residents.

In addition to providing informative content, the website should offer interactive features that allow residents to report environmental conditions in real time, download disaster education materials, and participate in virtual simulations. A reminder feature via WhatsApp or SMS could be added to reach those who may not regularly access the internet. For website management, a dedicated team of village operators particularly young people should be formed and trained in technical skills by partners such as the local disaster management agency (BPBD) or universities. With a simple, locally adapted, and participatory design, this website could serve as an effective tool for fostering a disaster-aware culture among the community. The following is a preliminary homepage design concept for disaster digitalisation, which can be used as an educational and mitigation tool integrating local wisdom within Puncu Village:

Figure 3. Website Design

The website design adopts a bold visual identity with dominant deep red and black tones, symbolising urgency and disaster threats as well as the potential destruction caused by

Mount Kelud's volcanic activity. This aesthetic choice supports the main objective of the site, which is to enhance community preparedness, while images of the village covered in volcanic ash serve as strong visual reminders of the constant risk. The homepage opens with the Javanese greeting “Sugeng Rawuh”, reflecting a culturally sensitive approach that embraces local wisdom and helps the content feel more familiar and accepted by the community. The navigation is simple and user-focused, with main menus such as Home, Culture, Local Knowledge, Disaster Risk Map, and Information, allowing visitors to easily access important topics. The Disaster Risk Map helps users identify vulnerable areas and safe evacuation routes, while the Culture and Local Knowledge sections strengthen the use of indigenous knowledge in disaster education. The tagline “Achieving Zero Victims Through Harmonised Adaptation and Mitigation” reinforces the website’s vision as a platform that not only shares information but also encourages active participation, highlighting that successful disaster mitigation relies on both technological innovation and strong community involvement.

Overall, the design of PuncuTangguh.id reflects a balance between informative functionality and cultural sensitivity. Its strong visual identity, simple structure, and use of local language make the website not only informative but also contextually grounded. This strategy enables the platform to bridge the need for digital disaster mitigation without disregarding the identity and local wisdom of the Puncu community, making it a relevant, effective, and sustainable educational tool. Furthermore, to reinforce the digital mitigation formulation, the author has conducted a product model canvas analysis as shown in the following table.

Table 6. Product Models Canvas Analysis

Name	Goals	Metrics
PuncuTangguh.id	The website aims to enhance disaster literacy among the residents of Puncu Village by providing fast and easily understood access to information. Its ultimate goal is to foster a more alert and self-reliant community in facing the threat of Mount Kelud’s eruption.	The success of the website is measured through daily visit numbers, user engagement time, and community involvement in the reporting features and downloads of educational materials. Additionally, increased participation in mitigation training serves as a direct indicator of the platform’s impact.
User	**Picture (Design)**	**Product Details**

The main users of the website are residents of Puncu Village across various age groups, including village officials, youth, housewives, and traditional leaders. Secondary users include volunteers, BPBD officers, and NGO disaster facilitators engaged in community education		PuncuTangguh.id features disaster risk maps, evacuation route information, educational documentation, and participatory spaces for community reporting. All content is presented in a user-friendly interface, available in Indonesian with embedded Javanese language to reach all layers of society.

Source: Researcher's Data Compilation, 2025

The presence of this website is expected to enhance the preparedness and responsiveness of Puncu Village residents in facing the potential eruption of Mount Kelud. Fast, clear, and easily accessible information is a crucial element in disaster risk reduction efforts. Beyond serving as an educational platform, the website is also envisioned as a collaborative space where the village government, local residents, and disaster response partners can exchange knowledge and experiences. The integration of technology is not intended to replace traditional practices but rather to strengthen existing early warning systems. Through PuncuTangguh.id, it is hoped that all elements of the community can remain connected and work hand in hand to ensure collective safety.

d. Scientifically-Informed and Locally-Grounded Content Development

Content development for the disaster mitigation website plays a vital role in delivering reliable and accessible education to the community. To ensure credibility, the materials must be grounded in scientific knowledge, drawing from academic research, data provided by the Meteorology, Climatology, and Geophysical Agency (BMKG), and official updates from the Regional Disaster Management Agency (BPBD). Topics include volcanic activity status, pre-eruption signs, evacuation procedures, and safety protocols. Scientific accuracy is crucial to help the public avoid misinformation and hoaxes.

Equally important is the integration of local knowledge, which reflects how the community has historically interpreted natural signs, such as animal behaviour, wind patterns, or changes in the sky's colour, to anticipate eruptions. This traditional wisdom strengthens residents' connection to their environment and complements modern science. By combining both approaches, the content becomes more relevant, culturally appropriate, and accessible for

all segments of society in Puncu. To ensure optimal usability, each section of the PuncuTangguh.id website is tailored to community needs and cultural context. The following table outlines the proposed structure of the main menus, from the homepage to features linked with official disaster response agencies.

Table 7. Website Content Description

Website Menu	Brief Description
Homepage	The homepage presents a main visual of Mount Kelud and post-eruption conditions in Puncu Village as a reminder of the importance of preparedness. A warm local greeting in Javanese, *Sugeng Rawuh*, enhances the cultural identity. The main narrative outlines the website’s purpose as a digital platform for education, collaboration, and early warning, with navigation buttons to access other features.
Culture	This section highlights local wisdom used by residents to interpret natural signs such as changes in animal sounds, wind direction, and darkened skies. It also explains the traditional use of the *kentongan* as an emergency communication tool, and the role of community elders in maintaining social cohesion. Content is presented through stories, photos, and videos to preserve and honour local values.
Local Knowledge	This menu presents documented community experiences in dealing with disasters and their inherited adaptation strategies. A “Learning from Locals” feature shares first-hand testimonies gathered during in-depth interviews. Local wisdom is combined with scientific data to provide a more contextual and grounded understanding of disaster risks.
Disaster Risk Map	An interactive map displays risk zones in Puncu Village, categorised into red, orange, and yellow areas based on the potential impact of Mount Kelud’s eruption. It includes evacuation routes, assembly points, and key emergency facilities such as health posts and logistic storages. The map also visualises lahar flow and potentially affected areas.
Information	This section provides real-time updates on Mount Kelud’s status, weather forecasts, and early warnings from BMKG and BPBD. It is directly linked to the Puncu village admin, Kediri Regency BPBD, and East Java Province

	BPBD. A quick messaging feature allows residents to ask questions or report local conditions.

Source: Researcher's Data Compilation, 2025

With a clear menu structure and contextually relevant content, the website is expected to serve not only as an information source but also as a platform for learning and collective memory for the community. By integrating scientific knowledge, local wisdom, and technological support, *PuncuTangguh.id* can become a dynamic, inclusive, and adaptive space that responds to the needs of residents in facing the threat of Mount Kelud's eruption.

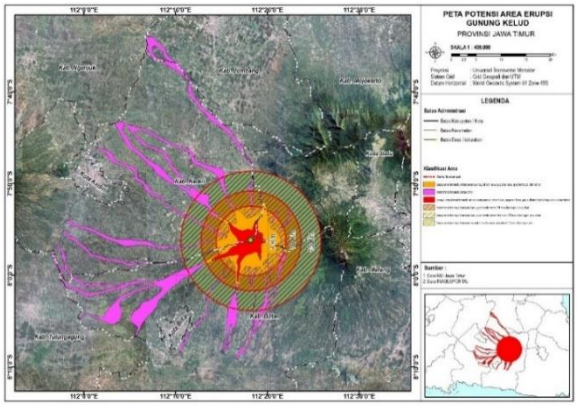

Figure 4. Disaster Risk Maping Kelud Volcano Eruption

The volcanic hazard map featured on the website will display concentric danger zones centred on Mount Kelud's crater (marked in green), with radii of 5 km (dark red), 7 km (orange), 10 km (yellow-green dashed), and 15 km (blue dashed), along with lahar flow paths (purple) following river valleys westward, northwestward, and southward. Puncu Village lies squarely within the red zone (±5 km radius), categorised as a high-risk area exposed to pyroclastic flows, lava, volcanic bombs, and thick ashfall. The map is rendered at a 1:400,000 scale using updated satellite imagery overlaid with administrative boundaries across East Java. A legend on the right helps identify hazard levels, from "high risk of pyroclastic flows" (red) to "potential for light ashfall" (dashed green). The purple lahar paths are mapped based on valley morphology and historical eruption deposits, highlighting likely flow directions towards Kediri, Blitar, and parts of Tulungagung.

This spatial data serves as a vital reference for local authorities and communities to develop contingency plans, including setting a permanent exclusion zone within a 7 km radius, constructing monitoring posts and evacuation routes that avoid river valleys, and prioritising relocation for vulnerable populations in villages like Puncu. Furthermore, the map supports the designation of gathering points, regular evacuation drills, and disaster-resilient spatial planning

to reduce casualties and economic loss during future eruptions. Displayed on the website, the map will guide residents in remaining vigilant against the threat of Mount Kelud’s volcanic activity.

CONCLUSION

Based on the overall findings and discussion, it can be concluded that digitalising disaster mitigation efforts in Puncu Village must be pursued seriously through an approach that harmonises social capital and community participation. Existing mutual trust, communal norms, and established social networks are critical assets that must be integrated into the design of socially accepted digital systems. As community involvement currently remains at an informing stage, it is essential to deepen engagement so that residents evolve from passive recipients of information to active drivers of preparedness. Strengthening digital literacy, involving locals in planning processes, and integrating local wisdom with digital tools are crucial steps to ensure that digitalisation is not merely a symbol of modernity, but a response rooted in community needs and traditions. This initiative is not an optional add-on but an urgent necessity to enhance Puncu Village’s resilience against the ever-present threat of Mount Kelud’s eruption and to achieve zero victims.

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