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MAPPING THE LEVEL OF PREPAREDNESS COMMUNITY FOR EARTHQUAKE DISASTER USING SPATIAL APPROACH IN CENTRAL OF SULAWESI

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ABSTRACT

The impact of earthquakes and floods in the Kulawi, Central Sulawesi district informed the choice of research location. The primary feature of this research site is the general lack of community readiness for local calamities. This study aims to assess the degree of community readiness for earthquake disasters using the Spatial Approach, which provides a succinct and precise description of the entire study. Spatially-based quantitative descriptive method. use the CVR (Content Validity Ratio) approach to assess the questionnaire's validity and the AHP (Analytical Hierarchy Process) method. The community's comprehension of the spatial approach that exists in the surrounding environment and is connected to the possibility of disaster as both a risk component and a vulnerability factor is the unresolved issue. Thus, the community needs to imitate obtaining progressively greater knowledge about disasters. Despite the most weight (25), earthquake-resistant infrastructure highlights the significance of high-quality building construction and the presence of emergency facilities to lower the danger of damage and casualties. The requirement for training and simulations to improve the community's comprehension of preparedness measures is shown by the 20-point weight assigned to mitigation and community awareness. With a weight of 20, the Early Warning System emphasises the efficiency and dissemination of information to provide the public adequate time to take action before a crisis strikes. With a weight of 15, coordination and rapid response help to speed up disaster management by fostering agency collaboration and prompt action. On the other hand, logistics readiness, which has a weight of 10, places a strong emphasis on having emergency supplies like food and water.

Keywords: *Disaster Preparedness; Spatial Approach; AHP*

INTRODUCTION

An area impacted by the seismic calamity of September 28, 2018, is the Sigi Regency. The region impacted by the tragedy is the Kulawi sub-district Central Sulawesi, which includes the villages of Namo, Bolapapu, and Boladangko. The earthquake caused casualties and damage to public

buildings, residential areas, and infrastructure. A disaster is an occurrence or sequence that endangers and disturbs people's lives and means of subsistence due to a combination of human and/or natural forces. The consequences may include loss of life, property destruction, environmental harm, and psychological effects.(LE et al., 2019; Tentang Penanggulangan Bencana, 2007; Umar, 2019; Widodo, 2017). Kulawi subdistrict, part of Sigi Regency, is 1053.56 square kilometres in size, with a 20.28 per cent population (Badan Pusat Statistik, n.d.). Disasters such as flash floods and earthquakes followed by liquefaction disasters are reported to be possible in the Kulawi sub-district (Kulawi.sigikab.go.id, 2023). The September 28, 2018, earthquake that struck the cities of Palu, Donggala, and Sigi had a significant effect on local events. The primary effect is ground vibration, which damages structures and results in casualties. The dwelling of the Sigi Regency's Kulawi subdistrict is one of the buildings affected. A certain amount of readiness is essential to survive a natural disaster that claims many lives, including understanding disasters (Pulungan F.R, 2020; Wulandari et al., 2023). Due to the Kulawi sub-district's steep slope geography, landslides and floods are a significant risk here. A spatial method is one tool that can be used to map the level of community readiness in this area.

The Kulawi District, Sigi Regency, Central Sulawesi, has a disaster preparedness community that influences public opinion in disaster-prone areas. The community comprises several organisations that react quickly to natural disasters, including Basarnas, the National Disaster Management Agency, and the Regional Disaster Management Agency, which operate at the district and province levels in Sigi and Central Sulawesi, respectively. Additionally, NGOs and volunteers play a passive role in influencing the Kulawi community's readiness for disasters.

It is impossible to forecast when an earthquake tragedy happens (Ayub et al., 2019). In Indonesia, earthquakes are one type of natural disaster that happens frequently. The high death toll and property damage rates are a sign that Indonesia's disaster management is still inadequate before, during, and after natural disasters. This implies that we must educate ourselves further on catastrophe readiness. We can learn from

the experience that Indonesia is prone to natural calamities. As a result, the community needs to be ready for future disasters. A lack of knowledge about catastrophe preparedness will lead to a rise in fatalities (Christiawan, 2017; Rahmawati et al., 2021). Communities can better organise and plan for necessary steps to be taken in the event of a disaster when they are prepared for earthquake and tsunami disasters (Ismayani et al., 2019; Torus et al., 2022).

This research aims to determine the level of community preparedness for earthquake disasters based on a spatial approach in the area of research. In the Kulawi subdistrict, there is an excellent need for preparedness in terms of awareness and proactive measures taken by the community in the event of a disaster. Different concepts and approaches have been used in research on preparedness conducted in different regions. One is the Welahan sub-district of the Jepara district's community readiness for flash flood catastrophes. Following the rules and being well-prepared as a community will reduce the danger of disaster (Aji, 2015; Rosida & Adi, 2017; Sekartaji, 2021). In this instance, understanding the nature of the calamity is the main component of preparedness. An essential component of controlling natural disasters is preparedness. This also applies to earthquakes and other natural disasters. Every town ought to be extremely ready for the possibility of a calamity(Hasrul, 2019). Five factors are used in research on the level of community preparedness utilising preparedness indicators. These are as follows: Knowledge and attitudes regarding disaster risk, as stated by LIPI-UNESCO/ISDR (2006), family preparation rules or recommendations, Emergency action plans, disaster alert systems, and resource mobilisation (Marlyono et al., 2016; Nisa' et al., 2024).

MATERIALS AND METHODS

This study uses a spatial methodology and is quantitative descriptive. Use the CVR (Content Validity Ratio) approach to assess the questionnaire's validity and the AHP (Analytical Hierarchy Process) method (Djatsa Nguedia et al., 2024). Both primary and secondary data are used. Secondary data originates from connected organisations like BPBD, Bappeda Sigi, and BMKG, and the primary information is gathered through observations, questionnaire distribution,

and interviews. The Kulawi District served as the site of this investigation. Research locations were chosen based on the effects of earthquakes and floods on the Kulawi sub-district (**Figure 1**). The main feature of this research site is that the Kulawi sub-district region saw several fatalities as well as the destruction of building structures. Even from that, field observations indicate that the fundamental issue is the absence of community preparedness for localised disaster response. In order to map levels of preparedness using a spatial approach, more research is needed. An administrative map that will serve as a study site is provided below.

The geographic area of Bolapapu Village, Namo Village, and Boladangko The village in Kulawi District serves as the population in this study, and it is the smallest unit of analysis in terms of social, economic, and environmental factors. In addition to using questionnaire distribution, the research team interviewed village officials, youth organisations, community leaders, religious leaders, and locals to gather additional data. In order to collect data for this study, the AHP Questionnaire instrument was dispersed among the three primary impacted villages in the Kulawi sub-district. The AHP method is used for data processing. Purposive sampling is used in each village according to the data most negatively impacted at the study site. With three villages and 30 people in each village, the respondent selection process is meant to yield an estimated 90 respondents in the research region.

The purposeful decision of key informants considered their familiarity with the community and the time (more than five years) spent working directly with it. An index is a comparison number that can be used to compare two numbers with the same or different features at various periods and locations. The parameters measured include knowledge (P), policy (K), emergency response plan (RTD), disaster warning (PB) and resource mobilisation (MSD). The index is measured from several data sources, namely household (RT), village government (P) and school community (KS). Category Disaster preparedness index value (**Table 1**).

Table 1. Preparedness index value categories

No	Index Value	Category
1	76-100	Very ready
2	50-<75	Ready
3	25-<50	Less ready
4	0-<25	Not ready

Source: UNESCO/LIPI:2006

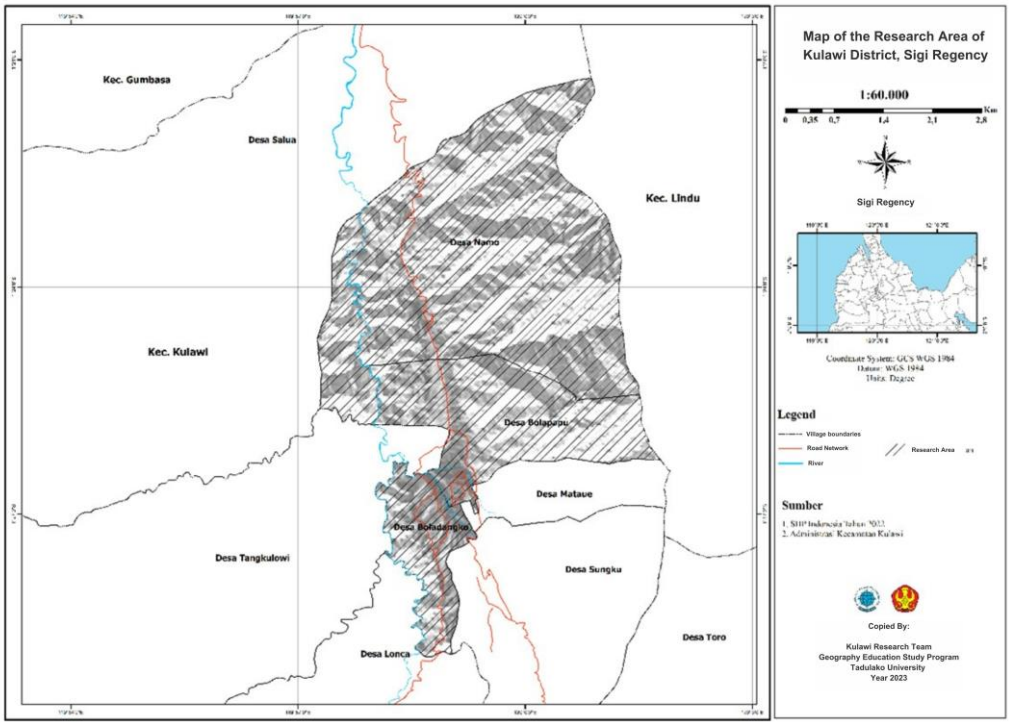

Figure 1. Map of the research area

Assessing is done by the instrument design and by distributing questionnaires to resource persons/experts who are practitioners, households, and academics. This weighing is done utilising the Analytical. Hierarchy Process (AHP) approach. The weight values on the scale used by the method known as AHP range from 1 to 9 (De Lima et al., 2024). "Equally important" is represented with a weight of 1, indicating that the weight values of the two items are equally significant. On the other hand, a nine-weight indicates that one element is "essential" to the others. A Content Validity Ratio (CVR) test for each question item and a Content Validity Index (CVI) test for the overall test is conducted to ascertain if the questionnaire is acceptable and related to the goal of creating the instrument.

With the formula:

$$CVR = (n\_(e-N/2)/(N/2)….1)$$

Description:

n_e = Is the number of panellists who answered "important"

N = Is the total number of panellists.

This formula produces values that range from +1 to -1; positive values indicate that at least half of the panellists rated the item as important or vice versa.

Level of Data Collection:

1. Input data

This section is associated with essential questions covering every facet of evaluating community readiness, including knowledge and attitudes on the risk of disasters, family preparedness policies or guidelines, emergency plans, disaster warning systems, and resource mobilisation. Each indicator's important questions are addressed in order to complete the evaluation. When the questions for each indication are completed, the score value will be automatically calculated. The score has a minimum of 0 and a maximum of 1. The total number of scores divided by the total number of questions is the score.

2. Assessment

Includes an assessment questionnaire based on the findings for each component of the preparedness assessment. The indicators are then multiplied by the weight to determine the final score.

3. Final report

A preparation assessment recapitulation form based on the evaluation outcomes of each component is included in the final report. After determining the final score, the outcomes are divided into nine (9) levels. The levels show by indicator each variable (Putra et al., 2020).

There are several primary phases involved in conducting data analysis with AHP. Establish the primary goal first, then create a decision hierarchy including goals, standards, and sub-standards. The importance weights are then determined by comparing the AHP scale criteria. Next, determine the average priority weight for each criterion and normalise the comparison matrix. Test the matrix's consistency by computing the consistency ratio (CR) to ensure the evaluation is consistent. The results can be used if CR is less than 0.1. To determine the ultimate priority, add the weights from each level, then analyse the findings in light of the study's goals.

RESULTS AND DISCUSSION

Central Sulawesi's Kulawi District is renowned for being an earthquake-prone region. Due to its proximity to active faults, this area frequently sees high levels of seismic activity. The Indo-Australian and Eurasian plates converge in Central Sulawesi, resulting in tectonic processes that frequently create earthquakes. History reveals that several significant earthquakes have hit the Kulawi District. The region is in a significant earthquake risk zone, as indicated by the high level of seismic activity. In addition, there is a greater chance of earthquakes due to the geological characteristics surrounding Kulawi, which include a variety of weak rock formations.

Infrastructure in rural areas such as Kulawi often does not meet earthquake-resistant building standards. This increases the level of vulnerability to severe damage when an earthquake occurs. Many buildings are built without paying attention to safety standards, so the risk of injury and loss of life increases. The lack of community preparedness in dealing with earthquakes is also a factor that worsens the situation. Lack of training and understanding of actions to take during and after an earthquake can lead to ineffective disaster management. However, several mitigation steps can be taken to reduce the risk of earthquake disasters in Kulawi District. Improving construction standards and strengthening infrastructure with earthquake-resistant buildings is an important first step.

Furthermore, frequent training programs and earthquake simulations can assist in raising community awareness and readiness, which will better equip locals to handle disaster circumstances. Creating an early warning system is crucial to delivering timely and precise information about possible earthquakes. With an early warning system, people can act quickly to safeguard their families and themselves. Effective communication and collaboration amongst the community, government, and disaster management organisations are critical to a prompt and efficient earthquake response.

The risk and effects of earthquakes in Kulawi can be reduced by being aware of these vulnerability characteristics and implementing the necessary mitigation measures. All parties working together will make a big difference in making the environment safer and more earthquake-resistant. Topographic conditions refer to

the status of the natural landscape in a particular area, as shown by the slopes of those slopes. Topographic circumstances can also cause flood disasters; regions with sloping topography are more likely to have flood disasters. The elevation of each subdistrict above sea level determines the number of areas in the Sigi Regency. Mapping the following three communities' levels of preparation as a community. The parameters measured include knowledge (P), policy (K), emergency response plan (RTD), disaster warning (PB) and resource mobilisation (MSD). The index is measured from several data sources, namely household (RT), village government(P), and school community (KS) (**Figure 2**).

The analysis's findings demonstrate that while post-disaster rehabilitation makes communities robust in the face of calamities, the residents of three vulnerable villages do not fully comprehend what happens after a disaster. The area's continued dearth of disaster-related socialisation is a weakness. Endeavours to cope with damage and other effects of a disaster, preserve lives, and safeguard property. In contrast, an emergency is a situation brought on by an extraordinary event that exceeds the community's capacity or resources to handle, making it impossible to meet basic needs and resulting in a sharp decline in the standard of living, health, or safety for a large number of people in a community or location (Gunawan et al., 2023; Novarita et al., 2024). Disaster is a gift and a blessing that humans must face, especially those living on this earth, especially in disaster-prone areas (J et al., 2023; Novarita et al., 2024). The sudden arrival of disaster cannot be avoided but must be faced. This is due to the significance of enhancing readiness, particularly for key stakeholders, including government, education, and family communities. This is meant to ensure that every Indonesian community in a disaster-prone location is equipped to handle any calamity. As everyone is aware, Indonesia is prone to natural disasters.

The analysis results show that the people of three disaster-prone villages do not fully understand disasters; post-disaster recovery makes communities resilient in responding to disasters. The weak side is that there is still a lack of socialisation regarding disasters in this area. Efforts to save lives, protect property, and deal with disaster damage and other impacts.

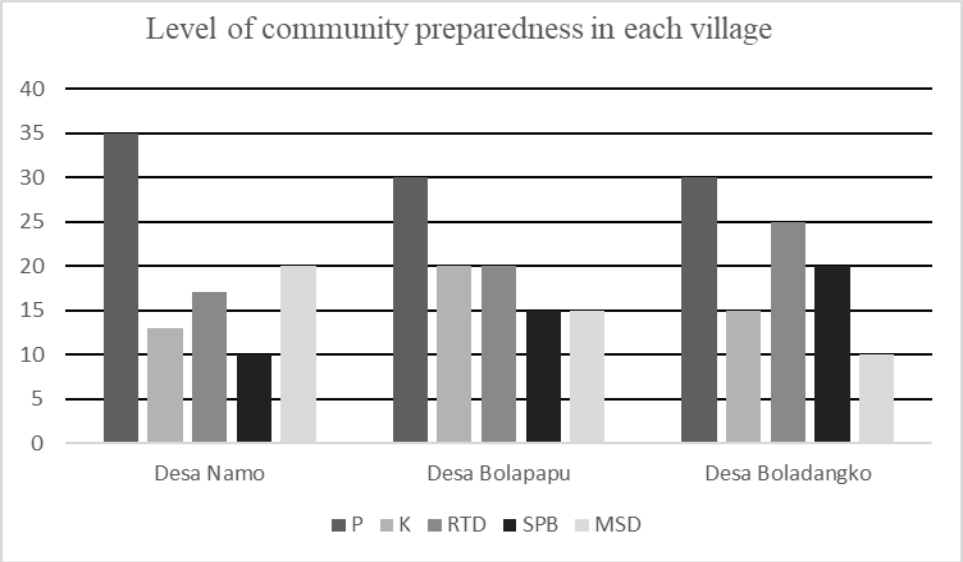

Figure 2. Chart of mapping the level of preparedness of the sub-district community

Meanwhile, an emergency is a condition caused by an extraordinary event that is beyond the community's ability to deal with existing resources or capacity so that it cannot meet basic needs, and there is a drastic reduction in the quality of life, health or a direct threat to the security of many people. People in a community or location. This is because of the importance of increasing preparedness, especially for main stakeholders such as family, school, and government communities. By providing disaster education to people living in disaster-prone areas, they can gain knowledge, perspectives, and skills about disaster preparedness and emergency response(Nisa' et al., 2024; Putra, 2021). This is intended so that the community can be fully prepared to face disasters in every disaster-prone area in Indonesia. As we all know, Indonesia is a disaster-prone country. As we know, the level of aggregation needs criteria.

Table 2. Weight Aggregation

No	Main Criteria	Weight (%)	Subcriterion	Weight (%)	Explanation
1.	Public Education Awareness	30	Training and Simulation	20	Regular training and simulations are very important to increase community preparedness. Through training and simulations, people can learn what actions to take during and after an earthquake, thereby reducing the risk of injury and death.
2	Earthquake Resistant Infrastructure	25	Awareness Campaign	10	Awareness campaigns aim to spread information about the dangers of earthquakes and ways to stay safe.
			Building Construction Quality	15	Strengthening building construction to withstand earthquakes is a top priority in this category. Improving the quality of buildings can reduce damage and loss of life when an earthquake occurs.
3	Early Warning System	20	Availability of Emergency Facilities	10	Emergency facilities such as temporary shelters, health posts and aid distribution centers also need to be prioritised to ensure quick assistance is available to earthquake victims.
			Effectiveness of Warning Systems	15	The effectiveness of an early warning system is very important to provide fast and accurate information to the public before an earthquake occurs, so that they can immediately take rescue action.
4	Quick Coordination and Response	15	Warning Information Range	5	Wide and equitable dissemination of warning information is important to ensure all levels of society receive warnings in a timely manner.
5	Logistics Readiness	10	Inter-Agency Coordination	10	Good coordination between the government, disaster management agencies and non-governmental organisations is essential for an effective response, including clear division of tasks and good communication during the emergency response.
					A quick response in providing assistance and evacuating

No	Main Criteria	Weight (%)	Subcriterion	Weight (%)	Explanation
			Response Speed	5	victims is also important, but has a lower weight than coordination, because a quick response often depends on good coordination.
			Stock Up on Emergency Materials	5	Providing sufficient quantities of emergency materials such as food, water and medicine is an important part of preparedness, although it weighs less than other criteria.
			Access to Help	5	Ensuring easy and fast access to aid is important to support post-disaster rescue and recovery efforts.

The table provides an overview of disaster preparedness evaluation based on five main criteria: Mitigation and Community Awareness, Earthquake-Resistant Infrastructure, Early Warning System, Coordination and Rapid Response, and Logistical Readiness. Earthquake-resistant infrastructure has the highest weight (25), emphasising the importance of building construction quality and the availability of emergency facilities in reducing the risk of damage and casualties. Additionally, Community Mitigation and Awareness, weighing 20, indicate that training and simulations are greatly needed to enhance the public's understanding of preparedness measures.

The Early Warning System is significant (20), emphasising the effectiveness and reach of information that can give the community time to act before a disaster occurs. On the other hand, Coordination and Rapid Response (15) become crucial elements in accelerating disaster management processes through inter-agency coordination and quick responses. Lastly, Logistics Readiness, weighing 10, focuses on providing emergency supplies such as food, water, and medicine, which are necessities during a disaster. Overall, this table emphasises that success in disaster response requires a combination of strong infrastructure, community awareness and preparedness, effective warning systems, good coordination among agencies, and adequate logistical readiness. All these factors must work

synergistically to reduce the impact of disasters and enhance public safety. The Main Criteria Weighting Chart in Earthquake Disaster Preparedness is shown in **Figure 3**.

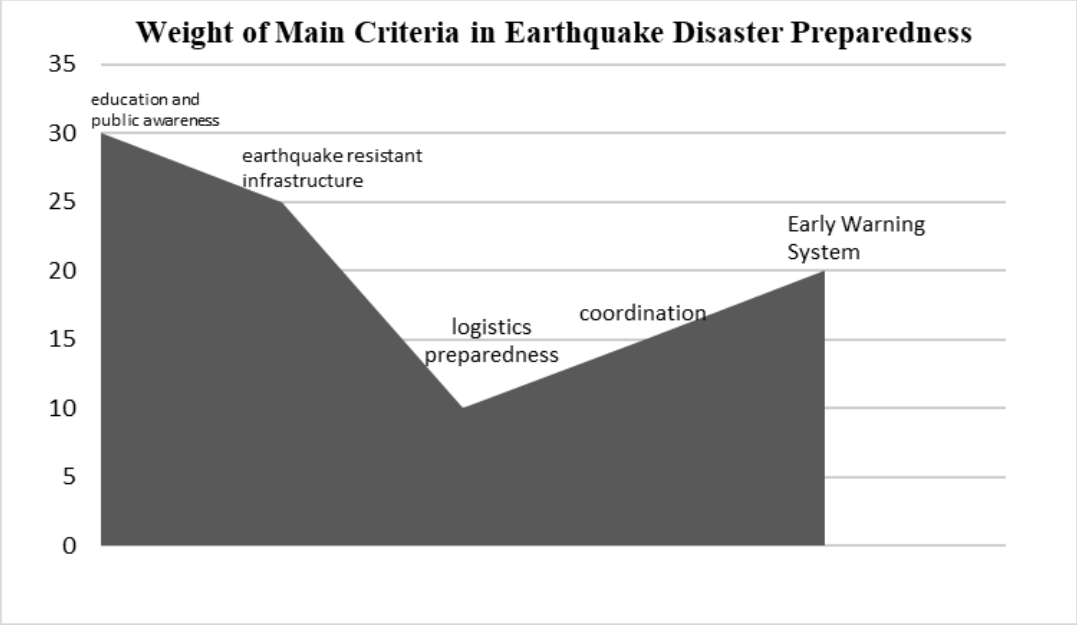

Figure 3. Graph of the Weight of Main Criteria in Earthquake Disaster Preparedness

Strategies for managing earthquake disasters must have a holistic and sustainable approach. A few coping mechanisms that can be used are as follows:

1. **Education and Awareness**

Regularly instruct communities, schools, and businesses on what to do in the event of an earthquake. by raising public knowledge of the possibility of earthquakes and appropriate earthquake response measures through social media, the media, and local events. Media could be a good platform to increase impactful community, especially in school (Putra, Exsa, et.al 2024)

2. **Planning and Preparedness**

Plans for emergencies: Create and distribute emergency plans for communities, families, and schools. Practice evacuation drills frequently to ensure everyone knows what to do in the event of an earthquake and stockpile emergency supplies like food, clean water, first aid kits, and communication devices. Other research assesses the preparedness of the community around the ITB campus for earthquakes using a spatial approach and community

perception analysis. The results show that disaster knowledge greatly influences community preparedness, the effectiveness of early warning systems, and the availability of evacuation infrastructure.

3. **Earthquake Infrastructure Development**

Establish earthquake-resistant building guidelines for newly constructed buildings and fortify existing structures by regularly inspecting residential and commercial structures to ensure earthquake-resistant guidelines are followed. According to this study, the Disaster Preparedness Team (SIBAT) improves community readiness through social network building, training, and local resource management. The community empowerment model demonstrates how cooperation among local groups, the community, and the government may enhance disaster preparedness.

4. **Early Warning System**

Technology is used to notify the public of earthquakes and rapidly detect them early. In addition to guaranteeing the presence of dependable and efficient communication channels to distribute early alerts and organise emergency support. In other studies, regions with inadequate levels of earthquake preparedness are identified using risk modelling and spatial data. The findings emphasise how crucial it is to incorporate spatial data into evacuation planning and community education to improve readiness.

5. **Response & Recovery Management**

To perform rescue, medical aid, and evacuation, assemble and train a quick reaction team. Enhance coordination among communities, non-governmental groups, and the government to expedite reaction and recovery. Additionally, Give earthquake victims emotional and psychological support to enable them to move past their trauma and start the healing process.

6. **Disaster Risk Reduction (DRR)**

Identify the most vulnerable regions through routine risk assessments, then create mitigation plans. Participate in the design and execution of disaster risk reduction initiatives with the local community.

CONCLUSIONS

Comprehensive planning must be done for community preparedness against catastrophes. The community has a unique role in disaster preparedness as

they are the ones who will have awareness when a crisis is approaching. The level of community awareness and preparedness for flood management indicates that throughout all informants, there are still individuals who lack understanding regarding readiness or the necessary actions to take prior to, during, and after a flood. The Kulawi sub-district's residents are aware of the environmental symptoms connected to the possibility of a disaster, both as hazard and susceptibility factors, thanks to a spatial approach. More studies are required on community preparedness to mitigate the detrimental effects of floods. In this scenario, disaster simulations will be used to teach and educate community members.

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