Risk and Response to Disaster Assessment of Urban Village in The Framework of Sustainable Development

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Risk and Response to Disaster Assessment of Urban Village in The Framework of Sustainable Development

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Abstract: In this disruptive era, nations, cities, or even smaller entities, i.e. communities, must strengthen their resilience capacities to adapt, anticipate, and absorb any shocks, including the Cofid 19. Cities in Indonesia facilitate urban village (kampung) communities to creatively innovate particular themes to increase their urban village's capacities. This research has two aims. Firstly, to measure the risks faced by four thematic villages in Malang City. Secondly, to measure the resilience of the villages from the aspects of policy, strategy, program, and project (PSPP). Purposive sampling was used to select key informants that were taken from each village, especially those related to policies, strategies, programs and projects related to disaster resilience.The risks, which were categorized into four hazard families: geophysical, hydrological, biological, and anthropogenic generated hazards, were measured using the quick risk estimation (QRE) tool. The research finds that the risk matrix output (RMO) varies from moderate to very low-risk likelihood ranking with insignificant severity. The most significant hazard was biologically related, although the risk in the four villages was low. This risk output of urban villages with moderate risk likelihood ranking should correspond with the policy priority the state and the local Government choose.

Keywords: hazard families; quick risk estimation (QRE); resilience; thematic villages

1. Introduction

Various literature related to resilience has a consensus on the dimensions of resilience, which include social, economic, urban community (population), institutions, infrastructure, disaster, ethics, and environmental (ecology) dimensions[1)]. This opinion shows that resilience is a multi-dimensional performanc[2)]. A city or community is defined as having resilience if an entity can respond appropriately to disaster risks that are being or will be faced through understandings of stress adaptation, wellness, and resource dynamics[3)]. As with resilience, the literature on disaster risk, particularly on exposure, vulnerability and action, is also multi-dimensional. For example, vulnerability includes infrastructure, economic, basic services, demographic, and social dimensions[4)]

Increasing the resilience of cities and communities in Indonesia is carried out by establishing the Resilient Cities Program as a national strategy to achieve Goal 11 of the SDGs, that is sustainable cities and communities[5)]. The increase in resilience is also aimed at increasing sustainable welfare[6)], which refers to an individual's positive mental and physical state of being[7)], so that a community system is formed that has the independent ability to withstand, absorb and adapt as well as recover after experiencing a disaster/shock. So the resilience of this community also plays a vital role in reducing disaster risk[1)]. The resilience of urban communities in Indonesia is also related to the problems of urban settlements that form urban villages (kampung) due to urbanization. The urban village is considered an unregulated asset despite its disorder and unruliness [8)]. Limited infrastructure and urban facilities in these villages encourage the growth of slum areas with low disaster resilience[9)]. The Law of the Republic of Indonesia Number 1 of 2011 related to Housing and Settlement Areas clearly states that housing and residential areas should be governed by the principles of safety, security, and order. This means that residential areas must be protected from any hazards, including natural disasters [10)]

There are many approaches to measuring the resilience and preparedness of an area against disaster threats, both natural (geological, hydro-meteorological, biological) and human-caused (environmental degradation and negative impacts of technology)[11)]. Several approaches include those used in the Hyogo Framework, Sendai Framework, UNISDR, and UNDRR. One of the tools used to measure

vulnerability is the Quick Risk Estimation (QRE) used by UNDRR[4]. Meanwhile, one of them is the sustainable development analysis grid to measure resilience from the perspective of policies, strategies, programs and projects that have been implemented[12].

One of the creative efforts to overcome the problem of urban village resilience is by innovating to form thematic villages based on community participation[13]. This is also done in Indonesia[14]. This thematic village is part of resilience because, according to Vidianti et al[15], one of the adaptations is building the capacity to change efficiently and encouraging local communities' flexibility, creativity and innovation. These thematic villages are the product of policies, strategies and programs at the regional and community levels to improve the quality of life for urban villages in Indonesia. It is important to maintain the sustainability of these thematic villages. According to Schwind[16], as a criterion of community resilience, it is necessary to evaluate the policies, strategies, programs and projects implemented in each village, especially after the pandemic.

Malang, a big city in East Java Province, also implements village development as one of the solutions for developing and arranging slum settlements. In this research, 4 (four) thematic villages have been studied that have developed in Malang City for more than 2 (two) years, namely: Kajoetangan Heritage Village, Glintung Kultur Village, Therapy Village, and Ginger Village. These themes have empirically supported the development of the four villages by becoming local tourist destinations, but their sustainability has been disrupted by the pandemic[15]. The study area (Fig. 1) was chosen with the following considerations: 1) The challenges faced by the Malang City thematic village during the pandemic, which resulted in a lack of visitors during the pandemic and threatened the sustainability of community life[17]; 2) The four villages have a high density of buildings (RPLP Kota Malang) so that it is more susceptible to viruses, primarily because transmission occurs in air media[18].

Concerning city and community resilience, this study aims to: estimate the disaster risk of the four villages that are the object of study, measure the resilience of the thematic village communities in facing disasters, and formulate recommendations for improving health based on the performance evaluation of the study object.

2. Method

The data collection method is in the form of secondary data collection and primary data. Secondary data include

Fig 1 Four Selected Thematic Kampungs in Malang City

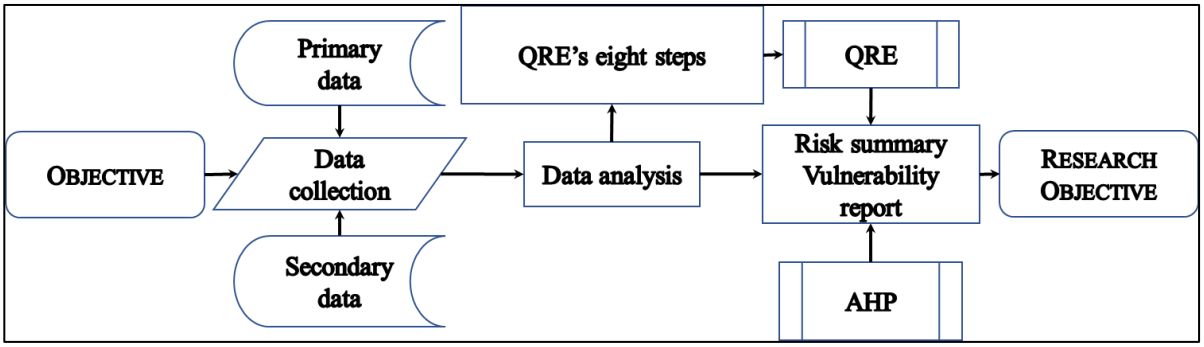

Fig. 2: Research Framework

planning documents, disaster data, and responses from existing institutions (Public Works Agency, BPBD, and Malang City Local Development Body). Primary data were obtained from interviews. Samples were taken from each village (purposive sampling), involving the heads of the four villages (Kajoetangan Heritage Village, Glintung

The independent variables to measure disaster risk (objective 1) are hazard, exposure, vulnerability, and response, while the dependent variables are included in the disaster mitigation rating that consists of the likelihood ranking score, severity, and risk rating. The results from QRE weighted by the result of AHP were used to measure the resilience of the thematic village communities (objective 2). The research framework is described in Fig. 2.

Quick Risk Estimation (QRE) Assessment

The resilience of each village is measured from the social, infrastructure, economic, governance, and environmental dimensions. Each of these dimensions has indicators. The analytical method for measuring risk and vulnerability is Quick Risk Estimation (QRE), using a decision-making framework (DMF) to assess exposure and vulnerability.

QRE has eight steps:

1) provide the location and asset information,
2) identify hazard families and sub-families,
3) identify main hazards,
4) select hazard events,
5) assess exposure,
6) assess vulnerability,
7) assess the level of current actions or measures undertaken,
8) analyze results.

Steps 1-4: the identification of location and asset information, identification of hazard families and sub-families, identification of main hazards, and selection of hazard events.

Steps 5-6: Exposure and vulnerability assessment

The exposure assessment was conducted for four types of prominent hazard families: geophysical, hydrological, biological, and anthropological, with a scoring system ranging from 0 to 10 with the criteria: 0 – negligible; 1-

Kultur Village, Therapy Village, and Ginger Village.) and other key persons/informants/ especially those related to policies, strategies, programs and projects which were conducted in their villages. The samples involved the heads of the four villages and other important key persons in the villages (kampung).

extremely unlikely; 2- very unlikely; 3- unlikely; 4- improbable; 5- possible; 6- probable; 7- likely; 8- very likely; 9- extreme likely; 10- inevitably. In comparison, the vulnerability of each village was the average score of each hazard (geophysical, hydrological, biological, and anthropological) towards infrastructure, productive sectors, basic services, and (human) social aspects stated in the index from 1 (low) to 100 (high). Step 7: Responses to disaster (actions undertaken)

The response is any positive measure related to actions conducted by the Government or the community to mitigate the disaster. The rating score is also from 0 to 10, defined as follows: 0- no measure in place; 1- extremely few measures in place; 2- very few measures in place; 3- few measures in place; 4- some measures in place; 5- reasonable measures in place; 6- good measures in place; 7- high measures in place; 8- extremely high measures in place; 9- immense measure in place; 10- complete control of disaster.

Step 8: Analyse results

Two results of the analysis are 1) likelihood ranking score and severity rating and 2) risk rating for the hazard. The likelihood ranking score is related to the potential requirement for action. The lower the score, the lower the potential requirement for action. The scores refer to the prioritization of events. The severity rating ranges from 1 (the lowest) to 100 (the highest). The rates correspond to the impact and consequence levels. Risk rating ranges from very low to catastrophic, which refers to allocating a risk rating that depends on calculating the likelihood ranking score and severity rating.

The value of the likelihood ranking score is based on the severity criteria ranging from insignificant to catastrophic. The likelihood ranks resulting from the score was grouped into very low to very high. The description of the likelihood ranking and risk matrix is described in Table 1, while the likelihood level is guided by Table 2.

Table 1. Likelihood ranking and risk matrix of the QRE Tool

Likelihood ranking		**Very low (VL)**	**Low (L)**	**Moderate (M)**	**High (H)**	**Very High (VH)**
		0-2	**2-4**	**4-6**	**6-8**	**8-10**
Severity	Insignificant 0-10	VL1	VL2	L3	L4	M5
	Minor 11-25	VL2	L3	L4	M5	M6
	Moderate 26-50	L3	L4	M5	M6	H7
	Major 51-75	L4	M5	M6	H7	H8
	Catastrophic 76-100	M5	M6	H7	H8	VH9

Source:[19)]

Table 2. Guide to Likelihood

Level	**Definition based on the likelihood**	**Definition based on historical data**
Very High	It is almost certain to occur at least once	Has occurred 3 or more times in the last 5 years
High	Reasonable chance of occurring at least once	Has occurred twice in the last 5 years
Moderate	May occur at least once	Has occurred once within the last 5 years
Low	Not expected to occur	May occur and has occurred once in the last 10 years
Very Low	Only occur in exceptional circumstances.	May only occur in exceptional circumstances and has occurred in the last 20 years.

Source:[4)]

3. Result and Discussion

Steps 1 to 4 are associated with identifying and selecting hazard events on the four kampungs. Existing hazard events are classified into four types: geophysics, hydrology, biological, and anthropogenic. Common geophysics hazards in the study areas are earthquakes and volcanic ash falls; hydrological hazards are floods and landslides; biological hazards are viral diseases (Covid-19, malaria, dengue and the like); and anthropogenic hazards are environmental pollution and road/traffic accidents. QRE showed the risk of each kampung, starting from Heritage Kampung, Therapy Kampung, Glintung Culture Kampung, and Jahe (Ginger) Kampung.

3.1 Step 5-6: Exposure to Vulnerability Assessment

Heritage Kampung is exposed to earthquakes, volcanic ash falls, landslides, viral disease transmission, and traffic accidents with exposure scores and their vulnerability as follows:

Table 3 shows that the earthquakes in Malang region (occurred about three times a year) and vulcanic ash fall (Malang City is in the proximity of Mt. Semeru and Mt.Kelud) did not cause big problems: unlikely to damage the infrastructures and improbable to cause problems to basic services. Meanwhile, landslides (landslides often occur in riverbank areas.), viral diseases, and road accidents caused impacts on infrastructures and social aspects. Landslides impacted infrastructures but caused less impact on other aspects. Viral disease (Cofid-19) has significantly impacted the productive sector and social aspects. This situation happened because most people lost their jobs. In addition, PPKM (Imposition of Restrictions on Community Activities) caused the trade and service sector not to run optimally. The road accidents that occurred about 10 times fatal road accidents per year with 50% due to speeding were likely to cause impacts on social aspects but did not damage infrastructures.

Table 3. Guide to Disaster Likelihood of Heritage Kampung

Disaster types	**Exposure scores**	**Vulnerability rates**				
		Infra-structures	**Productive sectors**	**Basic services**	**Social aspects**	**Total vulnerability**
Earthquake	7	3	1	4	2	25
Volcanic ash fall	4	1	1	4	1	18
Landslide	4	7	2	3	6	45
Viral disease (Covid 19 and water-borne related diseases (malaria and dengue).	8	2	6	4	8	50
Road accidents	3	2	1	4	7	35

Table 4. Responses to Disasters of Heritage Kampung

Disaster types	Exposure scores	Vulnerability rate	Respond score	Likelihood ranking score	Severity rating	Risk level
Earthquake	7	25	7	3	-20	VL1
Volcanic ash fall	5	25	7	3	-20	VL1
Note						
Landslide	4	45	2	3	-20	VL1
Viral disease	8	50	8	4	20	L3
Road accident	3	35	3	3	-20	VL1

Table 4 shows that the risk of viral disease relatively caused risk higher than other types of disaster. The risk was low (L3) and the severity was minor. The score was influenced by the efforts of the Government of Malang City to assist the affected residents. There are rules that the community is required to wear masks, maintain distance, and maintain health from Covid-19 because that is a new type of virus that does not discriminate between people based on regional borders, financial status, race, religion, gender and age20). Also, the Camats (Head of District) and Lurahs (Head of Urban Village) regulate Micro PPKM up to the RT (Neighborhood Unit) and RW (Community Unit) levels in their area (Circular Letter of Mayor of Malang No. 7 of 2021). Covid-19 vaccination was carried out with a target of 181.5 million people spread across Indonesia (Ministry of Health Circular Letter on Optimizing Implementation of Covid-19 Vaccination). In addition, there is a Covid-19 task force at the RT and RW levels. Some residents volunteered to become Covid-19 volunteers to increase public awareness of the dangers of Covid-19. Not only that, the volunteers also provided handwashing stations and appeals in the form of pictures. So, these regulations certainly reduce the number of cases that are increasing. In addition, residents took the initiative to close the tourist villages by guarding the entrances to the tourist villages; Local Police Office and BABINSA (Village Guidance Non-Commissioned Officer of Indonesia Military) assisted in the form of hand washing stations, based on directions from the sub-district a Covid task force was formed for each RW, the task force was tasked with monitoring residents affected by Covid and assisting in reporting to POSYANDU (a community-based health program) and assisting residents affected by Covid.

The risk level of earthquakes, volcanic ash falls, and landslides in Heritage Kampung was very low, and the severity was insignificant. On average there were 3 earthquakes occurred in Malang City, including the Heritage Village. The area was also affected by the ash fall resulting from the eruptions of Mount Kelud and Mount Semeru. The BPBD also already has 16 regional disaster management projects and an evacuation route (RKPD Malang City 2020). The Government has provided training programs related to disaster anticipation steps assisted by BMKG (Indonesian Agency for Meteorological, Climatological, and Geophysics), BNPB (the Indonesian National Agency for Disaster Management) and Basarnas (the Indonesian National Search and Rescue Agency), which the TNI the Indonesian National Armed Forces) and Polri (the Indonesian National Police) support. In addition, BNPB has provided funds for handling the impact of the earthquake disaster. Even so, the earthquake had no impact on aspects of the community's infrastructure. So, it can be said that this disaster is at a very low level (VL1) for Heritage Kampung. Problems related to landslides were also insignificant since the Government of Malang City has provided assistance to affected residents.

The risk of road accidents was also very low. The Malang City Health Office had an Accident Prevention and Management Program. significant hazard with the highest vulnerability rate. Thus it creates the highest risk. This situation is also affected by exposure, vulnerability, and response to the hazards. The highest response is also targeted to viral disease in the last five years. This performance can be described in Fig. 3. The viral disease is higher than the other four types of disaster, while the severity rating shows a similar score.

3.2 Step 7 – 8: Responses and Analysis: Respond to disaster, likelihood ranking score, severity rating, and risk level.

Based on exposures, vulnerability rates, and disaster response, the risk level in Heritage Kampung can be estimated as in Table 4:

Table 3 and Table 4 show that viral disease is the most significant hazard with the highest vulnerability rate. Thus it creates the highest risk. This situation is also affected by exposure, vulnerability, and response to the hazards. The highest response is also targeted to viral disease in the last five years. This performance can be described in Fig. 3. The viral disease is higher than the other four types of disaster, while the severity rating shows a similar score.

3.3. Analysis for Therapy, Culture Glintung, and Ginger Kampung

The exact process and procedure, as measured to Heritage Kampung, were conducted in the three kampungs The analysis of the four kampungs can be combined into tables and a graph of disaster likelihood

and severity in the study areas, as shown in Table 5 and Table 6, and Fig. 4

Table 5 shows that Heritage Kampung is the most vulnerable. Its vulnerability rate is caused by its density and location. Most of the location is on a riverbank, and the other is next to the urban main road. However, Heritage Kampung prepares good responses to anticipate the hazards so that the risk level is mostly very low (Table 6), except for viral disease hazards, particularly during the Covid-19 outbreak; all kampungs were very vulnerable due to settlement patterns in kampungs. The least vulnerable is Therapy Kampung. Earthquakes occurred thrice in the last three years, and volcanic ash falls occurred twice every 15 years. One spot is vulnerable to flood hazards, but the flood happens only during heavy rain and does not last long. The level of risk is also influenced by differences of the public's perception and preparation of disaster types, as also mentioned by Cvetkovic et al.[20)]

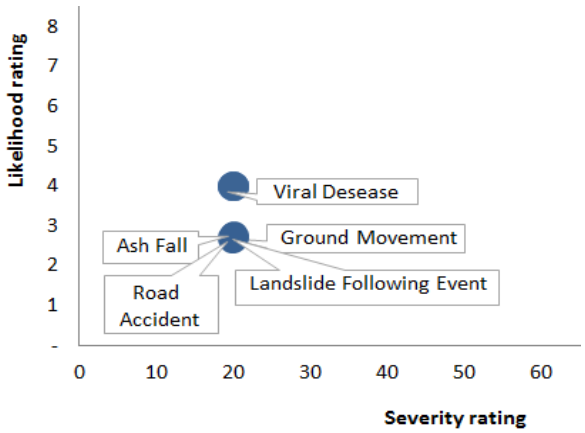

Fig.3: Disaster Likelihood and Severity

Table 5. Responses to Disasters of Heritage Kampung

Disaster types	**Exposure scores**	**Vulnerability rates**				
		Infra-structures	**Productive sectors**	**Basic services**	**Social aspects**	**Total vulnerability**
Earthquakes:						
Heritage Kampung	7	3	1	4	2	25
Therapy Kampung	7	0	0	1	0	3
Culture Glintung Kampung	4	3	0	2	0	13
Ginger Kampung	7	0	0	1	0	3
Volcanic Ash Fall:						
Heritage Kampung	4	1	1	4	1	18
Therapy Kampung	2	0	1	0	1	5
Culture Glintung Kampung	4	1	1	4	1	18
Ginger Kampung	2	0	1	0	1	5
Flood and/ landslides:						
Heritage Kampung	4	7	2	3	6	45
Therapy Kampung	6	1	0	0	0	3
Culture Glintung Kampung	4	1	0	1	0	5
Ginger Kampung	6	2	1	1	1	13
Viral disease: covid /malaria:						
Heritage Kampung	8	2	6	4	8	50
Therapy Kampung	8	3	10	8	10	70
Culture Glintung Kampung	5	3	9	8	10	75
Ginger Kampung	8	3	9	9	9	75
Pollution, road accidents						
Heritage Kampung	3	2	1	4	7	35
Therapy Kampung	4	4	0	2	0	15
Culture Glintung Kampung	4	3	1	5	3	28
Ginger Kampung	4	4	0	2	0	15

Table 6. Responses to Disasters of Heritage Kampung

Disaster types	**Exposure scores**	**Vulnerability rate**	**Response score**	**Likelihood ranking score**	**Severity rating**	**Risk level**
Earthquake:						
Heritage Kampung	7	25	7	3	-20	VL1
Therapy Kampung	3	3	212	3	-10	VL2
Culture Glintung Kampung	4	13	111	2	-30	VL1
Ginger Kampung	7	3	216	3	10	VL2
Volcanic ash fall						
Heritage Kampung	5	25	7	3	-20	VL1
Therapy Kampung	2	5	1	0	-10	VL1
Culture Glintung Kampung	4	18	1	2	-30	VL1
Ginger Kampung	2	5	2	0	-20	VL1
Flood and/ landslides:						
Heritage Kampung	4	45	2	3	-20	VL1
Therapy Kampung	1	3	1	2	-10	VL1
Culture Glintung Kampung	4	5	2	1	-40	VL1
Ginger Kampung	6	13	4	3	-10	VL1
Viral disease: covid /malaria:						
Heritage Kampung	8	50	8	4	20	L3
Therapy Kampung	4	70	6	5	10	L4
Culture Glintung Kampung	8	75	5	5	20	L4
Ginger Kampung	8	75	6	7	10	L4
Pollution, road accidents						
Heritage Kampung	3	35	3	3	-20	VL1
Therapy Kampung	4	15	2	2	0	VL1
Culture Glintung Kampung	4	28	2	2	-30	VL1
Ginger Kampung	4	15	2	2	0	VL1

Table 6 shows that responding to hazards is essential in reducing the severity rating. Heritage Kampung and Ginger Kampung respond well to the four types of common disasters. The risk levels of those kampungs during the pandemic were low (L3 and L4). Those data analyses also prove that the thematic kampung program greatly empowers local capacity and community to be resilient to disaster. Response scores in Table 6 indicate the readiness of the kampung community to prepare and mitigate the four types of hazards, i.e., geophysical, hydrological, biological, and anthropological disasters. This data shows the kampung community's resilience to

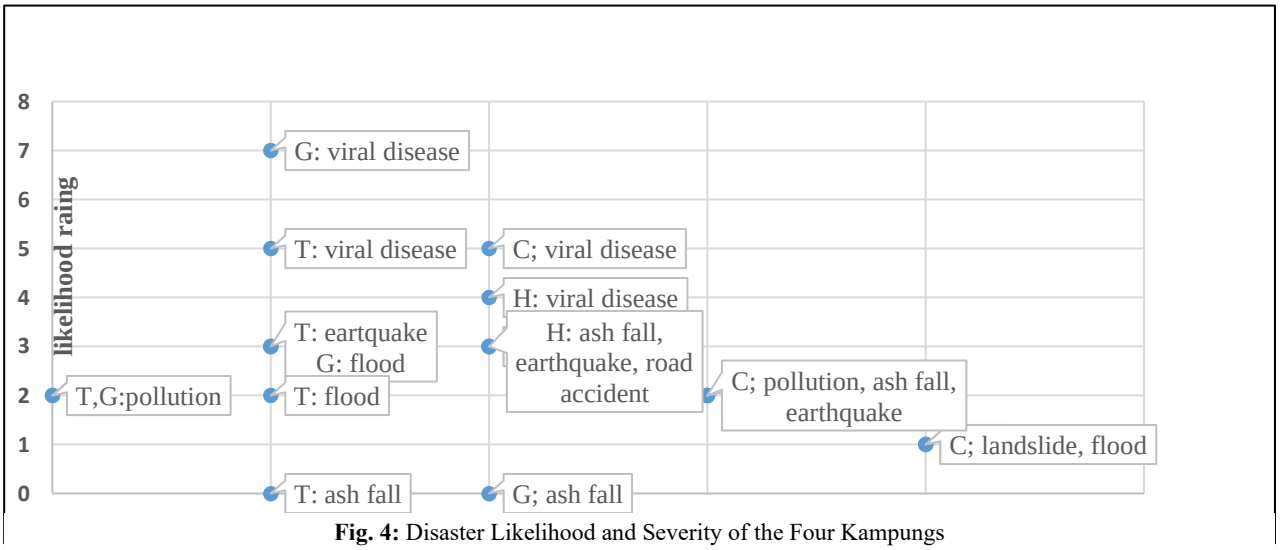

Fig. 4: Disaster Likelihood and Severity of the Four Kampungs

Note: H: Heritage Kampung; T: Theurapic Kampung; C: Culture Glintung Kampung; G: Ginger Kampung

disaster, from the highest to the lowest, Heritage Kampung, Ginger Kampung, Therapy Kampung, and Culture Glintung Kampung. Even though Ginger Kampung shows a good disaster response, the kampung is risky from earthquakes and floods.Figure 4 indicates that the highest likelihood rating is a viral disease in the four kampungs. Therefore, the kampung must develop a vivid mechanism to mitigate viral diseases before its vaccine's invention, as Prabakaran et al. proposed [21]. The strategy should also take into account a person's vaccination behavior, which may depend on the severity of the disease, geographic proximity, and socioeconomic factors[22]. The severest disaster is landslide and floods in Culture Glintung Kampung. Several significant efforts to reduce the impact of floods in Glintung Culture kampungs are the introduction of infiltration wells and bio-pores[23]. The lowest likelihood rating is ash fall in Theurapic Kampung and Ginger Kampung, while the lowest severity rating is (water) pollution in Theurapic Kampung and Ginger Kampung. Heritage Kampung shows even performance on likelihood and severity rating. Figure 4 also indicates that the performance of responses and mitigation to viral diseases was good since its severity rating was low (severity rate at 10), although the likelihood rating was high.

3.4 Project and Program for Kampung Resilience

Programs and projects conducted by the government and its experts will depend on two things: 1) how the community react to the risks they perceive; and 2) the level of knowledge related to how the community respond to the hazards[24]. Based on expert choices (Analysis Hierarchy Process), which is also based on the vulnerability-capability framework[25], important dimensions to support kampung's resilience to disasters are, from the highest priority, economy, infrastructures, social, governance, and environment. The economic dimension has three variables: workforce, poverty reduction, and development culture. Infrastructures have three indicators: settlement, water, and sanitation. The social dimension has six variables: education, community participation, gender equity, food security, health, and physical security. The governance dimension has five variables: innovation, risk management and resilience, institution, community engagement, and information. Lastly, the environmental dimension has three variables: energy consumption, outputs, and land uses[12]. The priority of programs and projects for each kampung differs due to its characteristics (existing performance of policies, strategies, programs, and projects).

Table 7. Performance of Resilience Dimension

Dimension	Heritage	Therapy	Culture Glintung	Ginger
Social	82%	81%	69%	89%
Infrastructures	79%	98%	90%	94%
Economy	65%	75%	65%	83%
Governance.	85%	75%	52%	85%
Environment	51%	84%	42%	68%
Average:	**72%**	**83%**	**64%**	**84%**

The performances of local existing policies, strategies, programs and projects related to kampung resilience are shown in Table 7. The best performance is Ginger Kampung, followed by Therapy Kampung, Heritage Kampung and Culture Glintung Kampung. The current Local Government policy is to boost Heritage Kampung as a tourist destination in downtown Malang. Culture Glintung Kampung, which was known as Glintung Go Green, is promoted by the Government as a role model for sustainable kampung but shows lower performance due to recent internal management conflicts. Ginger Kampung shows the best performance in the dimension of social, infrastructure, and economy. Since the theme of these kampungs is tourism, it is important to improve their social capital, particularly trust, in generating community participation [26]. Despite facing various challenges and the volatile situation in the region, sustainable development has proven to be resilient and able to withstand attacks[27].

We recognize that there are some limitations to the current research. We measured kampung resilience based on the data available in the media and other official local government publications and also based on the interviews with the key persons at the village (kampung) level. There was no specific measurement tool related to community resilience that was already in place at the village level. Another limitation of the research is that we did not measure the sustainability of community activities related to the branding or themes of the villages.

4. Conclusion

QRE analysis results show that the four thematic kampungs had the highest risk in the biological aspect, i.e. the Covid-19 virus, which was a pandemic worldwide. Apart from Covid-19, the risks in all kampungs were very low (VL1 and VL2). This proves that the kampungs already have an adequate quality of life associated with safety from disaster.

The resilience of the thematic kampungs is considerably good, 64% to 84%. Based on the Sustainable Development Analysis Grid[28], 60% to 100% performance belongs to 'no priority', meaning most processes go well. Recommendations for improvement can be based on each kampung's risk analysis and resilience performance, referring to Table 6 and Table 7.

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