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Original Paper

Tourism Hazard Mitigation in Mount Rinjani National Park, West Nusa Tenggara

Euis Rahmah Mar'atusholihah[1], E.K.S Harini Muntasib[1], & Siti Badriyah Rushayati[1]

[1] Bogor, Indonesia

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Abstract

Mountaineering tourism in Mount Rinjani National Park has various potential natural hazards and requires improved mitigation to ensure tourism security and sustainability. The purpose of this research is to identify the perceptions of tourism actors on the tourism hazards, inventory the types of tourism hazards that occur and mitigate the hazards that have been carried out, and develop tourism hazard mitigation. The methods used in this research are interviews, field observations, and literature studies. Public perceptions of the mountaineering tourism hazard are included in the good category, which means people already know and understand the type and risk of hazard tourism. The types of tourism hazards that have occurred are earthquakes, landslides, volcanic activity, fires, ravines, slippery ravines, cold temperatures, fog, wildlife, and plant hazard. The mitigation that has been carried out consists of mitigation before the hazard event and after the hazard event. Mitigation efforts are divided into regulations, facilities and infrastructure, education, and awareness programs. It is necessary to improve mitigation through addition and improvement of climbing procedures and hazard management procedures, improvement of hiking hazard maps, improvement quality of facilities to minimize damage, making secure infrastructure as a means of warning, security, and emergency response, and socialization/education-related hazard mitigation and how to deal with it.

Keywords

hazard, mitigation, mountaineering tourism, perception

1. Introduction

Mount Rinjani is one of the famous tourist destinations in West Nusa Tenggara and is located within the Mount Rinjani National Park area. The beautiful panorama of Mount Rinjani makes climbing a major tourist attraction. However, Mount Rinjani and the surrounding area are in hazard-prone conditions. Nadhira (2018) mentions the existence of various potential hazards in the Mount Rinjani climbing route,

especially in the Sembalun hiking trail including ravines, steep paths, fog, low temperatures, forest, and land fires, landslides, volcanic activities, earthquakes, and the danger of disturbance of animals and plants wild. Mount Rinjani is also included in the Asia Pacific volcano series on the island of Lombok and has moderate to high seismic activity (Agustawijaya et al., 2018).

Readiness to face danger is related to guaranteeing the safety factor for tourists and is directly proportional to the positive image of the tourist area (Suharto, 2016). Such preparedness can be carried out in the form of mitigation that is preceded by the identification of hazards and hazard perception (Bjonnes, 1986). Hazard mitigation is defined by the Federal Emergency Management Agency-FEMA (2013) as an activity to reduce the risks and negative impacts of hazards that can affect people and resources. Mitigation that has been developed in the Mount Rinjani National Park area is mitigating the danger of volcanic activity of Mount Barujari volcanoes and is carried out by BPBD and PVMBG (BPBD NTB 2015 and PVMBG 2014). For earthquakes, mitigation is still being developed by conducting earthquake-related research by BMKG and providing information to the public. The readiness of Mount Rinjani National Park as a tourist area to deal with hazards needs to be improved to ensure tourism sustainability (De Samaurez, 2007). Mitigation is also needed to prepare the tourism community to be able to face the danger.

1.1 Research Purposes

This study aims to design mitigation of tourism hazards in Rinjani with stages:

1) Identify the perception of the tourism community towards the dangers of tourism

2) Inventory types of tourism hazards that occur and mitigation of hazards that have been done

3) Designing mitigation of tourist hazards

1.2 Research Contribution

This research is expected to provide information and recommendations on tourism actors and various stakeholders in mitigation actions that can be carried out on Rinjani climbing tours.

2. Method

2.1 Research Location and Time

The study was conducted at the Sembalun Resort, Gunung Rinjani National Park, and villages adjacent to the official climbing entrance, namely the villages of Sembalun, Sembalun Lawang, and Sajang village, Sembalun District, East Lombok, West Nusa Tenggara in April 2019.

2.2 Research Tools

The tools used in the study are stationery, voice recording devices, interview guides, questionnaires, Microsoft Word 2013, and Microsoft Excel 2013 software.

2.3 Types and Data Collection Methods

The data collected in this study are the general conditions of the Mount Rinjani National Park, mount Rinjani climbing tourism, the perception of the tourism community towards hazards, the types of hazards that occur, and the mitigation and management of hazards that have been carried out. Data collection was

carried out by interview and questionnaire methods, literature studies, and field observations. Interviews were conducted using interview guides and questionnaires in the form of Likert scale statements (Sugiyono, 2013). Informants are parties related to hazards such as NTB Regional Disaster Management Agency (BPBD), NTB Meteorology, Climatology and Geophysics Agency (BMKG), Mataram Search and Rescue (SAR), and the Center for Volcanology and Geological Disaster Mitigation (PVMBG) of Sembalun Pos. While the respondents consisted of those, who played a role in tourism activities (tourism actors) in the Mount Rinjani National Park. They included (1) TNGR manager, Tourism Office, village government, and Sembalun health center; (2) Edelweis Medical Help Center (EMHC) as Mount Climbing health team Rinjani; and (3) The people who become tour operators, consisting of guides, porters, TO (Trekking Organizer) agents, and motorcycle taxis. The selection of respondents was carried out using the purposive accidental sampling method, which is based on specific criteria and through chance encounter (Jogiyanto, 2008).

3. Data Analysis

3.1 Hazard Perception Analysis

Determination of the total score is done using the three-box criteria formula (three-box method) from Riduwan (2009) as follows:

$$\text{Scale interval (RS)} = \frac{m-n}{b}$$

Explanation:

m = The highest score in the answer score

n = The lowest score on the answer score

b = Number of classes/categories of answers

The results of scale intervals and interviews, then perceptions are grouped into three categories: high/good, medium, and low/bad (Table 1) in the form of percentages. The perception was then analyzed descriptively qualitatively.

Table 1. Hazard Perception Category

Category	Explanation
High	Respondents know the hazard and know the risk of the hazard
Moderate	Respondents know hazards but do not know the risks of hazards
Low	Respondents have less knowledge about the danger and less knowledge of risk Danger

3.2 Hazard Analysis and Hazard Mitigation

Hazard data and hazard mitigation that have been obtained are then analyzed descriptively. The hazard mitigation framework was modified from Haifani (2008) and presented in Figure 1.

Figure 1. Hazard Mitigation Framework

The process in stage 3 within the framework is carried out using a mitigation strategy in FEMA (2013), which is divided into three components, namely the objectives, actions, and action plans, which can be seen in Figure 2.

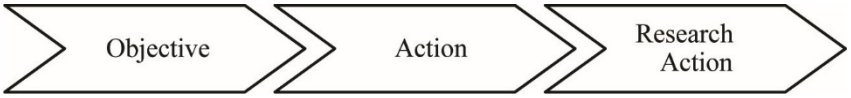

Figure 2. Hazard Mitigation Strategies

4. Results and Discussion

4.1 General Conditions of Mount Rinjani National Park

Mount Rinjani has an altitude of 3726 meters above sea level and includes the Mount Rinjani National Park (TNGR) area. In the valley to the west of Mount Rinjani lies Lake Segara Anak. Topography varies from 500-3726 masl with moderate slope (15-25%), steep (25-40%), and very steep (> 40%). Dominant rainfall between 1500-2000 mm per year. The summit of Mount Rinjani is between 10º-11ºC, especially in the dry season and strong winds. TNGR vegetation consists of savanna forest types, lowland rain forests, and mountainous rain forests (BTNGR 2015).

4.2 Mount Rinjani Climbing Tourism

Rinjani climbing is the main tourism in TNGR and can be seen from the number of tourists (Figure 3) and is a vital tourism sector in increasing the income of rural communities around Rinjani. The decline in the number of tourists in 2017 comes from local climbers because they are more likely to take part in short-term hiking activities around the Mount Rinjani area and as a result of the eruption of Mount Agung in Bali (Nadhira, 2018). The level of visits in 2018 is declining because the climb in Rinjani was closed due to an earthquake.

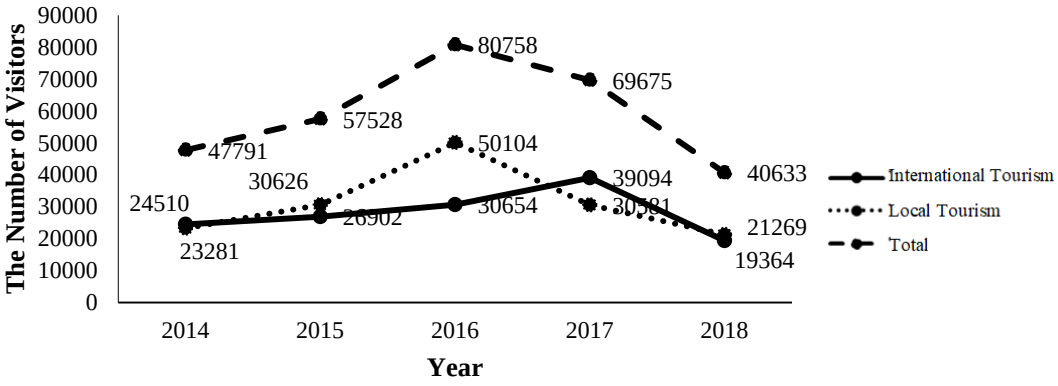

Figure 3. Number of Tourist Arrivals in 2014-2018

4.3 Perception of the Dangers of Climbing Tourism

The perception of tourism hazards is divided into perceptions of earthquake hazards and perceptions of hazards on the hiking trail. In addition to the perception of the tourism community, respondents' perception data from agencies/institutions was also taken as a comparison and additional data.

4.3.1 Perception of Earthquakes

Perceptions of earthquake hazards are based on knowledge and experience regarding the presence of hazards and the risks of hazards. This perception can be seen in Figure 4.

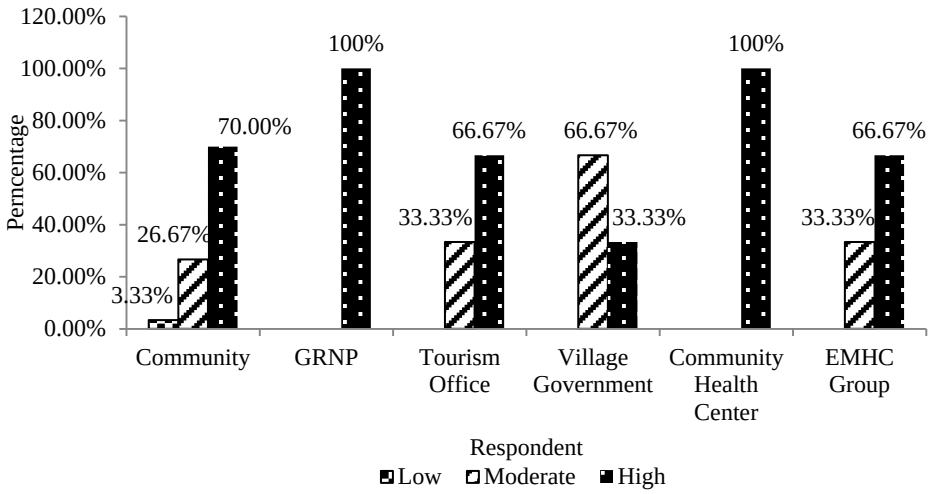

Figure 4. Graph of Respondents' Perceptions of Earthquake Hazards

Figure 4 shows the perception of the tourism community about the danger of 70% being in the high/good category, as well as most of the perceptions of agency respondents. Moderate and low perception is still there because although they already know and understand the risks that can be caused by an earthquake,

there are still those who do not understand the earthquake's vulnerability and are doubtful about the possibility of a massive earthquake that can recur.

4.3.2 Perception of the Dangers of Hiking Trails

The perception of the danger of the hiking trail is based on the knowledge and experience of the existence of hazards and the risk of danger. This perception can be seen in Figure 5.

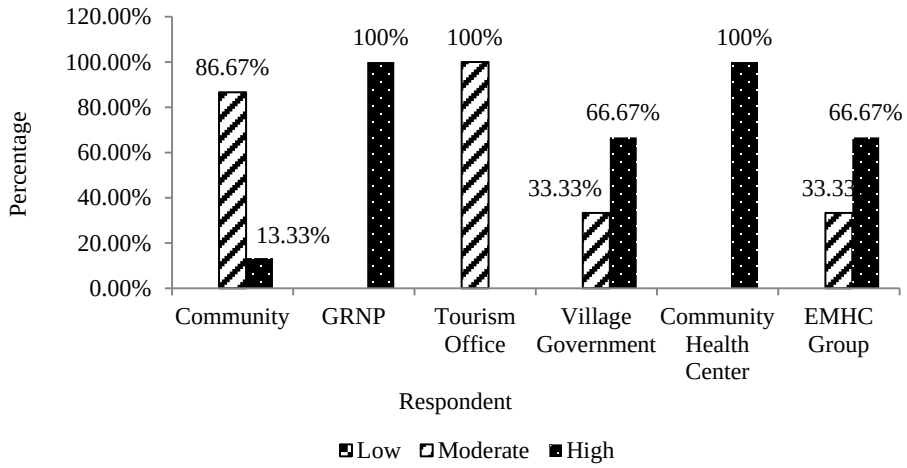

Figure 5. Graph of Respondents' Perceptions of the Dangers of Climbing Tourism

Figure 4 shows the perception of the tourism community towards the greatest danger of climbing routes, including the category of moderate perception, which amounted to 86.67%. Based on experience, the hazards considered at risk are ravines, slippery/steep paths, low temperatures, and long-tailed monkeys. Whereas hazards that are not considered to be at risk are the dangers of volcanic activity, fog, and wildlife such as wild boar and bees. Low perception does not exist because, according to Sarman (2016), this can occur due to the lengthy amount of visit time or, in this case, due to the high frequency of the community in climbing Mount Rinjani. Governments involved in management such as TNGR and Puskesmas consider hazards in the climbing lane to have the same threat and risk. A good perception can occur because of the high level of formal knowledge of agency staff based on their educational background and experience in dealing with the hazards that occur. However, for village government respondents, the tourism office, and EMHC, there are still some who are not aware of the dangers that exist.

4.4 Danger on Climbing Tourism

The danger of climbing tourism is divided into earthquakes and hazards on hiking trails such as landslides, fires, and volcanic eruptions/volcanic activity, slippery/steep paths, low temperatures, fog, longitudinal, and wildlife (long-tailed monkeys, boars, bees).

4.4.1 Earthquake Danger

The felt earthquakes that occurred on the island of Lombok from July 2018 to March 2019 were 214 earthquakes (Figure 6) and had varying strengths ranging from 3-7 on the Richter Scale. The cause is the movement of the Flores fault (BPBD 2018) and the fault on Mount Rinjani that has not been mapped by BMKG.

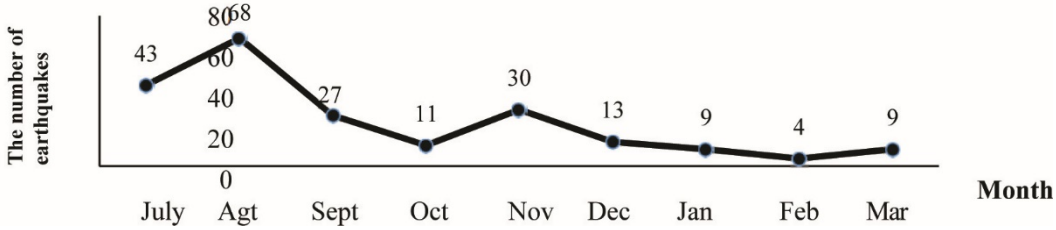

Figure 6. Graph of the Number of Earthquakes Felt in Lombok during July 2018-March 2019

Source: Mataram Geophysics Station 2019

The earthquake was quite massive and had a significant impact on the climb on July 29 (6.4 SR), August 5 (6.8 SR), and August 19 (7 SR) in 2018, and March 17 in 2019 (5.8 and 5.2 SR). The 29 July 2018 earthquake occurred when there were as many as 1226 climbers on Mount Rinjani (BTNGR 2018). Six hundred climbers were trapped near Lake Segara Anak, and one local climber died. Another climber was injured. After the earthquake occurred, the closing of the climb was put in place, and no climbers were allowed to climb except the evacuation team. There are rock and soil avalanches, damage to climbing routes, and infrastructure in the paths such as bridges, iron railings, climbing shelters, and CCTV. Also, the Sembalun resort office and EMHC office suffered severe damage. The earthquake caused a negative impact because there was no income from Rinjani climbing tourism activities.

4.4.2 The Danger of Hiking Trails

The hazards in the hiking trail consist of landslides, volcanic eruptions/volcanic activity, fires, ravines, slippery/steep paths, low temperatures, fog, longitudinal, and wildlife (long-tailed monkeys, wild pigs, bees).

a. Avalanche

The earthquake caused a follow-up danger, which was a landslide, and resulted in part of the hiking trail being interrupted and the spring closed. A path cut off, one of which is the path to the summit and lake Segara Anak. Land conditions that are still unstable, according to PVMBG, still have the potential to return to landslides if an earthquake occurs again or is exposed to rain with high intensity. Landslides in the hiking trail before the earthquake never happened, but there is no official record data. The Rinjani hiking trail in the NTB Soil Movement Vulnerability map is included in a zone that has medium to high ground movement potential and can be especially affected by high rainfall.

b. Volcanic / eruption activity

The volcanic activity of Mount Rinjani has moved into the caldera, namely Mount Barujari (PVMBG 2014). The eruption of the Barujari volcano since 1846 occurred 13 times from 1846-2016 (PVMBG 2014). The status of the Barujari volcano since the last eruption was Level II (Alert). The impact of the Barujari eruption so far has not had much effect on climbers and the community because it occurs inside the Rinjani crater. Volcanic dust from the eruption is usually carried by the wind direction and disrupts flight activity (PVMBG 2014).

c. Fire

Fires in the Rinjani climbing lane have occurred five times (Nadhira, 2018). Fires occur around an altitude of 2000 meters above sea level in the savanna ecosystem, especially at the height of the dry season between July-September each year (BTNGR 2015). The total area burned from 2012 to 2019 was 2255.58 ha, and there was damage to 2 guard posts (BPBD NTB 2017 and BTNGR 2018)

d. Ravine

Climbers, who fell into the abyss in the 2013-2018 period occurred ten times. The incident caused seven climbers to have broken bones, and three climbers died. There is a possibility that a new ravine will be formed due to the earth shifting during an earthquake.

e. Slippery/steep trail

Incidence of climbers who fell and strained due to the condition of slippery/steep path due to rock, soil, and sand, based on official records from the manager, occurred as many as 46 cases in the period 2013-2018. More and more lanes may be slippery/steep due to ground movements during an earthquake.

f. Low temperature

Low temperatures experienced by climbers can cause various diseases such as flu, cough, asthma, and the most severe is hypothermia because it can end in death (Rachmawati et al., 2007). Hypothermia is a condition when body temperature is below 35 ºC (Kurniawan, 2004). Hypothermia in climbers who need evacuation occurred in two cases during the 2013-2018 period. The beginning of the dry season (April-June) and the peak of the dry season (July-August) is the time where the temperature is at its lowest point at night and morning (Ulfah, 2019). The argument is in line with Rianto (2012), which mentions the air temperature in the Rinjani region most low can occur in June-August.

g. Fog/mist

Fog can form due to cold or low temperatures. According to the community, fog often appears in Pelawangan, the peak, and near Lake Segara Anak. Fog can limit visibility and cover the existence of gaps in the hiking trail so that the danger of this mist can be related to the danger of ravines and steep paths.

h. Jelateng

Jelateng plants are generally located near water sources, for example, near springs and Lake Segara Anak. According to the community, climbers affected by this plant will experience the effects of pain, heat, and itching on the skin.

i. Wildlife (Long-Tailed Monkeys, Wild Boar, and Bees)

Long-tailed monkeys often steal climbers' food and belongings, while wild pigs scramble leftovers at night. The behavior of the long-tailed monkey is thought to be due to the habit of climbers who initially often feed them. The presence of wild boar is usually caused by food scraps that are not tidied up properly. As for the bees, there is one incident that has been stung by climbers in 2017. It happened when the hiking trail had just opened.

4.5 Hazard Mitigation in Gunung Rinjani

Mitigation is divided into two, namely mitigation before a hazard event (preventive) and when/after a hazard event (curative). Mitigation actions consist of regulations, facilities and infrastructure, protection of natural systems, and education. Regulations, in this case, can include the authority, policies, and regulations of the manager and the government, and various plans and maps that can affect the arrangement and development of regional land. Facilities and infrastructure is the making or modification of infrastructure as a protection against danger. Protection of natural systems is an action to reduce damage by protecting/restoring the function of natural systems. Education is an action to inform and educate the public and managers about the dangers and ways that can be done to reduce the risk (FEMA, 2013).

Hazard mitigation is carried out by TNGR as a manager through various regulations, infrastructure provision, and education provision. Gunung Rinjani National Park collaborates with PVMBG and BPBD in monitoring and providing volcano information, Amanah Githa Insurance in providing accident insurance, as well as Edelweiss Medical Help Center (EMHC), Tourism Office, BASARNAS, sector police, TNI / Polri, and surrounding communities in handling dangerous events and accidents on climbing. More detailed hazard mitigation can be seen in Table 5.

Table 3. Hazard Mitigation That Has Been Done

Mitigation Type	Mitigation Efforts	Danger type
	Preventive	
Regulation	TNGR Climbing Standard Operating Procedure (SOP)	All dangers
	Enforcement of climbing quota	All dangers
	Provision of accident insurance	All dangers
	Closing and structuring the hiking trail	All dangers
	Trekking Organizer (TO) policy and guide	All hazards except earthquakes, volcanic activity, fires, and landslides
	Barujari volcano contingency plan	Volcanic activity

	Provision of hazard-related maps (map of hiking trails, maps of earthquake hazard, maps of vulnerability to ground movements, maps of volcanic disaster-prone areas, evacuation route maps eruption)	Avalanches, earthquakes, Volcanic activity
Facilities and Infrastructure	Rinjani volcano monitoring	Volcanic activity
	Provision of early warning system	Volcanic activity
	CCTV installation	Avalanches, fires, volcanic activity
	Installation of climbing information boards, warning boards and fire hazard information and direction signs for evacuation	All hazards except landslides and earthquakes
	Bridge infrastructure and iron railings	Slippery/steep, landslides
Natural Protection System	Planting around the hiking trail	Landslides
Education	Guiding the community of tourism actors	Slippery/steep path, cliff, low temperature
	Curative	
Regulation	Preparation of medical and evacuation teams and their equipment	All dangers
	Closing and structuring the hiking trail	All dangers
	Provision of early warning system	Volcanic activity
Facilities and Infrastructure	Provision of fire fighting facilities	Fire

4.6 Purpose of Mitigation

Mitigation objectives are the results to be achieved with the mitigation activities. Hazards/disasters can be a starting point for mitigating the next similar hazard. The general perception of tourism actors towards the dangers of tourism is in the medium category. The people who work as tour operators, especially porters and guides, directly face the risk of tourism hazards during climbing. An understanding of what needs to be prepared and carried out in the event of a hazard that threatens climbing activities is important. Safety and security of climbers is the main thing so that tourism activities can run sustainably. Managers also need sufficient knowledge and the ability to be able to manage hazards. Besides, hazardous events can occur due to a lack of information obtained by tourists. Based on this, the objectives of mitigating the danger of climbing tourism in TNGR are as follows:

a. Increase awareness and readiness of the community of tourism and tourism actors in facing danger
b. Increasing the capacity of managers in dealing with danger
c. Reducing the potential for injury and reducing infrastructure damage

5. Recommendations for Hazard Mitigation

Hazards such as low temperatures, fog, wildlife, and plants are relatively permanent hazards because they are related to the climate and natural conditions in Rinjani. Dangers such as slippery/steep paths and ravines may increase and be riskier after an earthquake.

Critical issues related to hazard/disaster mitigation in the appendix to the Minister of Domestic Affairs Regulation No. 33 of 2006 concerning Guidelines for Disaster Mitigation consist of four factors. Those factors namely (a) information and hazard maps available for each hazard type; (b) socialization to increase understanding and public awareness in facing danger and knowing what needs to be done and avoided; (c) knowing how to save themselves if a disaster arises; and (d) arrangement and arrangement of disaster-prone areas to reduce the threat of disaster. More detailed mitigation recommendations are explained as follows:

5.1 Earthquake Hazard Mitigation

a. Regulation

The manager of the tourism area needs to know the roles and tasks that must be carried out when an emergency such as a natural disaster occurs. The existence of standard operating procedures is essential to reduce the risk of hazards and are specific to each hazard/disaster that occurs (Kumar 2015). The SOP is starting from the coordination of relevant stakeholders, visitor evacuation procedures, and monitoring of developments after a hazard/disaster occurs (Borobudur Conservation Center 2015). The existence of standard operating procedures specific to each hazard (Kumar, 2015) is vital to reduce the risk of danger. Therefore it is necessary to arrange hazard and disaster management procedures and evacuation.

Earthquake events can cause extraordinary panic for climbers, tourists, and community tourism actors such as guide porters. The thing that must be considered is the climber's medical record because there are fears that certain diseases can recur when a panic occurs. Also, the varying age range of Rinjani climbers can pose a risk because groups of children and the elderly, according to Rosyidie (2004), are vulnerable to becoming victims in times of danger, so there is a need to limit the age of climbers in climbing procedures.

b. Facilities and Infrastructure

Evacuation of climbers during an earthquake has a difficult track condition and a long time needed if it is by land. Evacuation routes are important to be able to save climbers faster. Besides helipad infrastructure/helicopter landing pad in mountainous areas can also be access to facilitate and accelerate the process of evacuation of climbers in the event of a hazard (Blancher et al., 2018). To reduce the risk of damage, earthquake-resistant construction needs to be used in buildings to be repaired or buildings to be erected in the future.

c. Education

Mitigation for the category of education and awareness programs is to increase education and information on mitigating hazards and disasters for tourists and guides/porters. Simulations are

especially needed for earthquake hazards related to what must be done before, during, and after the hazard occurs. The information and training provided can be in the form of realistic and interpretive visualizations such as pictures and videos to increase understanding of hazards (Yang, 2016) and can be studied independently.

5.2 Hazard Mitigation of Hiking Trails

a. Regulation

Regulations are needed specifically for earthquakes and volcanic activity. For the danger of volcanic activity, it can adjust to the Barujari volcano contingency plan that has been prepared by BPBD. Mitigation of local plans/regulations can be done by making or improving existing policies and procedures. The age limit of climbers needs to be included in climbing procedures, such as the Mount Semeru climbing procedure which limits climbers to a minimum age of 10 years (Ariani, 2015). This age-limiting procedure for climbers can reduce the risk of danger of low temperatures because the possibility of hypothermia is higher in the elderly and children (Meijer & Jean, 2008).

5.3 Facilities and Infrastructure

Climbing track conditions are more volatile after an earthquake, so it is more prone to experiencing landslides, coupled with high rainfall during the rainy season. The danger of cliffs and slippery/steep paths is also likely to increase. It is necessary to add and improve the information board and warning board facilities because the information boards in the hiking trail are only about the post location and travel time. According to Cahyadi (2014), the lack of warning signs and prohibitions regarding the dangers of being deficient in mountain tourism in Indonesia. Locations that are prone to landslides, slippery/steep paths, and ravines in addition to being given a warning sign can also be repaired and added to the existing safety infrastructure such as bridges and handles. The added infrastructure can be a security fence.

5.4 Education

Besides that, it can be done to improve the quality of briefing and information given by the guide/TO to climbers. The briefings that have been carried out so far depend on the knowledge and experience of the guide. The information and training provided are better in the form of realistic and interpretive visualizations such as pictures and videos to increase understanding of hazards (Yang, 2016) and can be studied independently. The existing hiking trail map does not cover all hazards, so information about hazard-prone locations needs to be added to reduce the risk of injury (Becken & Hughey, 2013). The map can be used as an official map of the climb and used during the climber briefing. Also, there is a need for tighter supervision and more intensive information provision at times where the temperature is likely to be lower, namely the beginning of the dry season and the peak of the dry season (Ulfah, 2019).

6. Conclusions and Recommendations

6.1 Conclusion

The perception of the tourism community towards the danger of climbing tourism in the Mount Rinjani National Park is included in the good category, which means that the public knows the types of hazards and knows the risks of tourism hazards.

Types of tourism hazards that have occurred are earthquakes, landslides, volcanic activity, fires, ravines, slippery/steep paths, cold temperatures, disturbance of wildlife, and wild plants. Mitigation that has been carried out consists of mitigation before a hazard event and after a hazard event. Mitigation includes regulation, infrastructure facilities, protection of natural systems, and education.

The hazard mitigation can be improved by the addition of climbing procedures and hazard management procedures, improvement, and improvement of hiking trail maps that contain hazard information (hazard maps). The mitigation also can be done by improving the quality of facilities and adding facilities such as evacuation routes, helicopter pads, warning boards, and information. Furthermore, the mitigation can be done by increasing knowledge and the ability of community tourism and tourist actors related to hazard mitigation and how to deal with hazards through dissemination, education, and simulation.

6.2 Recommendation

Follow-up should be done from the mitigation of hazards that have been recommended.

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