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HAZARD SOURCE ANALYSIS FOR THE ORGANIZATION OF DISASTER TOURISM: A CASE STUDY OF LAVA TOUR IN MOUNT MERAPI NATIONAL PARK

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Abstract

Mount Merapi National Park is a conservation natural tourism area located in a disaster-prone area because there is the most active volcano and is included in the Ring of Fire area. In its use, lava tour natural tourism has safety risks that need to be considered. This study aims to identify sources of danger in the Mount Merapi National Park area, especially in lava tour tourism activities. The research method carried out is a descriptive qualitative and HIRARC analysis techniques. The descriptive qualitative method used is to collect and analyze data with interviews related to hazards in tourist destinations. The results showed that there are 4 very high risks (extreme) and 5 high risks (high) that need to be controlled by tour managers. Risk control efforts that have been carried out have not been fully effective in preventing accidents. It is recommended to tour managers to limit visitor capacity, appeal to tourists to be careful when standing, use seatbelts, repair safety equipment regularly, and provide cushioning on the jeep frame.

Keywords: Mount Merapi, Disaster Tourism, Hazard Sources, HIRARC, Lava Tour

1. INTRODUCTION

Indonesia is one of the countries included in the region Ring of Fire because it is located at the confluence of three active tectonic plates of the world, namely the Indo-Australian plate which moves northward, the Eurasian plate which moves southward, and the Pacific plate which moves westward. The three plates shifted and collided with each other, forming volcanoes along the impact trajectory. The potential threat posed by volcanoes is eruptions with 4 levels from highest to lowest ranging from alert, alert, alert, and normal (Regulation of the Minister of Energy and Mineral Resources Number 15 of 2011).

Volcanic eruptions can cause a lot of damage. Wesnawa and Christiawan (2014: 85) mentioned that damage caused by volcanic eruption disasters can be in the form of damage to infrastructure facilities, damage to community activity center buildings, declining

environmental quality, to damage to regional spatial planning. In addition, damage from the eruption can have an impact on the paralysis of the economy and disruption of activities around the area (Sutikno et al., 2007).

Java Island has 23 A-type volcanoes so that the most volcanism activity occurs in this region (Verstappen, 2013). Mount Merapi is located at an altitude of 2986 meters above sea level which is one of the active volcanoes in Indonesia located in Sleman Regency, Special Region of Yogyakarta. In 2010 Mount Merapi experienced an eruption that resulted in many victims ranging from 1,412 victims of minor injuries, 293 victims of serious injuries, 332 victims of death and victims who experienced psychological disorders as many as 4,874 people (Brotopuspito et al., 2011).

Volcanic eruptions are the most significant natural hazard in Mount Merapi National Park. Volcanic eruptions can cause a wide variety of hazards such as hot clouds, lahars, and ashfall. Extreme weather such as heavy rain, strong winds, and fog can also be a natural hazard for the implementation of natural tourism in Mount Merapi National Park. Extreme weather can cause landslides, floods, and accidents. Other natural disasters such as earthquakes and flash floods, can also occur in Mount Merapi National Park. These natural disasters can cause damage to infrastructure and loss of life.

As for the dangers that can be caused by humans such as vehicle accidents, climbing accidents, and other accidents, can also occur in Mount Merapi National Park. These accidents can be caused by human factors such as negligence, ignorance, and natural conditions (Sulaksono, 2023). Irresponsible visitor behavior, such as littering, damaging flora and fauna, and carrying out dangerous activities, can also be a source of danger to the environment and the safety of other visitors.

Based on the occurrence of volcanic eruptions that have occurred in the past, comprehensive and integrated efforts are needed to reduce the risk of disasters that may occur in the future. One of these efforts is by mapping the dangers of volcanoes (Hadmoko et al., 2012). Based on the background, the purpose of this study is to identify sources of hazards, improve safety and security protocols for tourists, and guiding policy development in the Mount Merapi National Park area, especially in Lava Tour activities.

In Law Number 5 of 1990, it is explained that a National Park is a nature conservation area characterized as a conservation area that has an original ecosystem. This area is managed using a zoning system that is used for research, science, education, supporting cultivation, tourism, and recreation. In government regulation No. 68 of 1998 the national park area has a zone divided into 3 parts, namely the core zone, jungle zone and utilization zone.

Disaster tourism is a tourist phenomenon whose causes can be due to natural, non-natural, and human behavior factors (Bappenas &; BNPB, 2011). According to Zein (2017), the definition of disaster tourism tends to still be a debate. But in the world and also in Indonesia, disasters that are part of tourism have been widely practiced. There is a lot of debate whether disasters can be a tourist commodity or not, this refers to the definition of tourism, which is recreational activities by leaving the domicile with the aim of finding a new atmosphere or breaking away from daily work (Damanik et al., 2006). One of the popular tourist destinations with potential hazards is Lava Tour Yogyakarta. Disaster tourism is the basis for understanding the impact of disasters through tour tours (Miller & Ritchie, 2003). According to Miller (2003), disasters can be an attraction because they have something to do with high emotional impact if someone comes to visit the disaster site.

Hazard or hazard according to Cross (1998) is a situation that has the potential to cause losses. Something can be called a source of danger if it has a risk that causes negative results. Danger (hazard) can be a natural hazard (natural hazard) or other dangers that do not necessarily occur and may not necessarily cause disaster (disaster). In the theory of Awatona (1997) it is explained that Natural Hazard Or natural hazards can occur anywhere because they are part of the environment around us. floods, landslides, earthquakes,

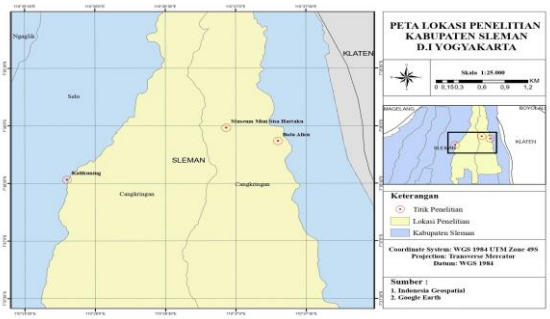
volcanoes, weather extreme and other natural events that can trigger disasters. The cause of the disaster can occur due to natural events (natural disaster) and by man (man-made disaster) (Bakornas, 2006). Hazards can be characterized by their location, intensity, frequency, and chance of occurrence. United Nations - International Strategy for Disaster Reduction (UN-ISDR) divides hazards into 5 groups, namely:

1. Geological hazards, such as: volcanic eruptions, landslides, and earthquakes
2. Hazards with hydrometeorological aspects, such as: tidal waves and floods
3. Biological hazards, such as: disease outbreaks, pest outbreaks, and bird flu outbreaks
4. Technological hazards, such as: transportation accidents and technological failures
5. Environmental hazards, such as: environmental damage and forest fires

This research contributes to the existing literature by providing an in-depth analysis of the hazard sources in Lava Merapi tourism and offering practical recommendations for improving tourist safety. The research findings can be used by policymakers, tourism operators, and other researchers to strengthen the organization of safe and responsible disaster tourism.

2. METHODS

The location of this research is in the Merapi Ngipiksari Lava Tour Area, Hargobinangun Village, Pakem District, Sleman Regency, Yogyakarta Special Region Province (Picture 1). There are 3 research tourism sites, namely Sisa Hartaku Mini Museum, Alien Stone, and Kalikuning.



Picture 1. Location Distribution Map
[Source: Annisa Pitriani, 2023]

The research was conducted on November 19, 2023. The research method used is a descriptive qualitative method by collecting and analyzing data.

This research uses primary data through observation or direct observation in the field (Riyanto, 2010) as evidenced by photos from GPS Maps Cam, Interview Directly depth interview (Moleong, 2018) by researchers to business actors providing natural tourism services in the Mount Merapi National Park area, namely three transportation service drivers Jeep, three street vendors, and one manager of Mount Merapi National Park.

Drivers and local people are likely to have a deeper understanding of the local area compared to tourists who are only visiting for a short period. They will be familiar with the geography, potential hazards, and past disaster events.

They may have witnessed firsthand how past disasters impacted the area and how tourists reacted, Although drivers might not have formal training in disaster management. Their knowledge may be based on experience rather than official protocols. They can identify seasonal changes or gradual shifts in the environment that might impact disaster risk.

Interview questions about:

1. Safety equipment available to tourists.
2. The form of anticipation that has been prepared by the manager.

3. Possible occurrence of events/accidents.

Then hazard identification is carried out using techniques HIRARC namely documents containing hazard identification, and risk assessment to reduce the risk of accidents (Soeyono &; Widiawan, 2021). Field observation aims to obtain data on the physical condition of the object of study (Riyanto, 2010).

Secondary data collection is obtained from various writings in the form of articles and related journals contained in literature studies (Nazir, 2005) and data from the management of Mount Merapi National Park. The variable of this study is a single variable with the identification of problems related to sources of danger for the implementation of disaster tourism Lava Tour in Mount Merapi National Park. Assessment of the level of disaster vulnerability involves evaluation and other factors to determine the extent of potential hazards and their impact on humans and the environment (National Disaster Management Agency, 2022).

Risk Frequency	Risk Impact				
	1	2	3	4	5
5	H	H	E	E	E
4	M	H	E	E	E
3	L	M	H	E	E
2	L	L	M	H	E
1	L	L	M	H	H

Picture 2. "Risk Rating" scale on AS/NZS 4360 standard
[Source: AS/NZS 4360]

HIRARC research is carried out with several stages that have been previously defined, namely:

1. **Hazard Identification,**

Researchers have analyzed various kinds of dangers that may even have occurred in Lava Tour, Mount Merapi National Park. Risky traveller behaviour was also found in the results of the study (Muntasib et al., 2019) which states that visitor involvement is still minimal in hazard management, even though visitors are one of the stakeholders who must adapt.

2. **Risk Assessment**

In the results of the study analyzed there are several risks of Lava Tour activities and scale assessments in certain categories. The assessment is stated based on the AS/NZS 4360 standard where L (Low) is green which means the risk of danger is very low, M (Medium) yellow which means the risk of danger is low, H (High) orange which means the risk of danger is high and dangerous, and E (Extreme) red which means the risk of danger is very high and dangerous.

Explanation of each risk level:

L : Low; Low risk; Handled by procedures.

M : Medium; Medium risk; Management responsibility must be specific. Needs basic treatment. Example; first aid kit

H : High; High risk; Requires attention from top management. Needs medical procedure and can cause permanent disability.

E : Extreme; Very high risk; Requires more medical action and can cause death.

3. **Risk Control**

Based on the results of analysis and interviews related to risk control of activities Lava Tour, there are several risk control measures as listed in Table 1. The purpose of these efforts is to prevent accidents and injuries to tourists (OHSAS, 2007).

The assessment is carried out by researchers based on the scale stated according to AS/NZS 4360, provided that the higher the impact produced and / or the higher the possibility of danger and risk, the higher the assessment with a maximum risk of extreme hazard. The researcher then conducts an analysis related to the anticipation of what has

been provided by the manager based on the results of observations and interviews, then the researcher provides suggestions for related hazards.

3. RESULT AND DISCUSSION

Tourism Activities

Many tourist activities are carried out by tourists and become one of the attractions in Mount Merapi National Park, namely activities Lava Tour (Dinas Wisata, 2015). This tour invites tourists to do Tour Circling the area where the Mount Merapi disaster has occurred by car Jeep.

Picture 3. *Safety Helmet*
[Source: Author's Documentations]

The jeep car provided by the manager has been equipped with a standard helmet (Picture 3). Tourists will go around the foot of Merapi Volcano and enter the village affected by the eruption. The first destination visited was the Sisa Hartaku Mini Museum (Picture 4), a tourist attraction which is the remains of the houses of residents affected by the eruption of Mount Merapi.

Picture 4 Sisa Hartaku Mini Museum
[Source: Author's Documentations]

This museum is a house affected by the eruption that leaves debris without a roof and wall leftover household items that are still shaped like clocks, musical instruments, kitchen utensils, animal bones, motorcycle frames, and many others. There is a large stone in front of the Museum terrace which officials say came out of the crater during the eruption of Mount Merapi in 2010.

After touring the Sisa Hartaku Mini Museum, tourists return to the jeep to continue the journey to the Alien Stone. Alien Stone is one of the tourist attractions that is part of the Lava Tour series of activities (Picture 5).

Picture 5. Alien Stone
[Source: Author's Documentations]

In this destination, tourists can take pictures with the background of cliffs and dry river formations due to lava flows from Mount Merapi.

After touring Alien Stone, tourists are directed to go to the next attraction of Lava Tour activities, namely offroad in Kalikuning. In this attraction (Picture 6) tourists will circle the river at high speed.

Picture 6. Offroad in Kalikuning
[Source: Author's Documentations]

Results of Hazard Identification, Risk Assessment and Risk Control (HIRARC)

HIRARC (Hazard Identification, Risk Assessment and Risk Control) is a basis for assessing, regulating and identifying hazards and risks in order to avoid accidents (US/NZS 4360: 2004, 2004). In tourism Lava Tour, safety aspects (safety) dangerous at a number of points because of activities on Mount Merapi, including in the Disaster Prone Area III (KRB III) and Disaster Prone Area II (KRB II).

From the community health journal, according to the Indonesian Red Cross, lava tour attractions are a little difficult to reach by ordinary cars and health teams. Activities and processes of hazard potential analysis and hazard risk assessment start from the point of departure of the jeep car until returning to the starting point of departure again.

At the beginning of tourists riding a jeep, there is a potential danger for tourists if tourists stand (Picture 7) because the road or terrain to the destination locations is uneven, this can result in tourists shaken, scratched and even bounced out of the jeep.

Picture 7. Stand on Jeep
[Source: Author's Documentations]

Safety equipment owned by jeep cars such as some safety helmets are damaged and not suitable for use. The road has been paved but most of the road is also damaged due to frequent traffic by jeeps and sand mining trucks, this also causes more dust. Dust is one of the dangers because it can risk causing blurred vision, circumference, and also shortness of breath.

In the first location, namely the Sisa Hartaku Mini Museum, the potential dangers and risks that can occur are the amount of sand, sharp rocks and air pollution due to the flying of sand can cause tourists to slip and asphyxiate. The low wooden frame at the Sisa Hartaku Mini Museum can also risk making tourists bumped.

Picture 8. Visitors to the Sisa Hartaku Mini Museum
[Source: Author's Documentations]

The lack of restrictions on visitors entering the museum can cause excessive capacity (Picture 8) so that crowded tourists have a risk of experiencing shortness of breath and can damage the facilities in the museum.

The second location, tourists visit the Alien Stone. There are several potential dangers and risks at this Alien Stone tourist spot, namely when exploring the location of the Alien Stone there are many rocks that make tourists tripped and sprained, this is a low risk for tourists as well as the slope of the road which is low risk to tourists and makes tourists injured due to slips and falls. Then the lack of accessibility for pedestrians that can cause accidents between pedestrians and jeeps, this risk is considered moderate to danger.

Picture 9 and Picture 10. Hand Sculpture and Rock Cliff
[Source: Author's Documentations]

Then photo activities at several locations in this Alien Stone (Picture 9 and Picture 10) also have risks that cause danger to tourists because of the absence of a buffer fence and this location also has a sandy road.

The last location is offroad in Kalikuning (Picture 6). In this activity, the potential risks and dangers that can occur are caused by winding and uphill roads, jeep speed, and river water depth. This can result in tourists falling and bruising. In addition, jeeps that drive at high speeds are at risk of accidents and collisions.

Furthermore, there is also a danger from the geological aspect, namely the active status of Mount Merapi itself. This affects the point of tourist sites located in the highlands or the foot of Mount Merapi. Mount Merapi, which still has an active status today if it erupts, can be potentially dangerous such as causing hot clouds, molten lava, volcanic ash, toxic gases, and cold lava that cannot be avoided, controlled, or prevented. This danger can only be anticipated with safeguards such as evacuation routes and directions related to disaster mitigation.

Table 1. Hazard Identification and Risk Assessment
[Source: Processed by Researchers, 2023]

HAZARD IDENTIFICATION				RISK ASSESSMENT AND ANALYSIS				RISK CONTROL	
No	**Activity**	**Danger**	**Risk**	**(P)**	**(S)**	**PxS**	**Risk Category**		
My Treasure Time Mini Museum								**Now**	**Suggestion**
1.	Take a Jeep from the Shelter to the parking lot of the Sisa Hartaku Mini Museum	Stand	Bounce	3	5	15	E	Safety helmet	Caution when standing, seatbelts, periodic repair of safety equipment
		Bumped	Bruise	3	2	6	M		Provision of bearing on the frame of the jeep
		Dust and sand	Twisting, blurred vision	3	1	3	L		Provides glasses
		Inadequate security tools	There was an accident	2	4	8	H		Equipping security tools and first aid kit
2.	Surround the Sisa Hartaku Mini Museum to see the condition of the former eruption of Mount Merapi in 2010	Sandy roads	Slip	2	2	4	L		Appeal for tourists to use mountain shoes or sandals
		Over capacity	Overcrowding, shortness of breath, damaging facilities	2	3	6	M	Appeal not to touch museum items	Limit visitor capacity

		Pollution	Shortness of breath	1	2	2	L		Limit visitor capacity
Alien Stone									
1.	Take a Jeep from the Museum to the location of the Alien Stone	Stand	Bounce	3	5	15	E	Safety helmet	Caution when standing, seatbelts, periodic repair of safety equipment
		Bumped	Bruise	3	2	6	M		Provision of bearing on the frame of the jeep
		Dust and sand	Twisting, blurred vision	3	1	3	L		Provides glasses
		Inadequate security tools	There was an accident	2	4	8	H		Equipping security tools and first aid kit
2.	Search for the location of the Alien Stone	Lots of rocks	Stumble, sprains	2	2	4	L		Appeal for tourists to use mountain shoes or sandals
		Lack of accessibility for pedestrians	Hit by a jeep	1	3	3	M		Appeal to tourists to be careful
		Road slope	Slips, falls	1	2	2	L		Create an alert sign
3.	Take pictures at several locations (Hand sculptures,	Absence of support fences	There was an accident, a fall	2	4	8	H	Availability of warning sign	Making guardrails

	Alien Stone, and rock cliffs)	Sandy roads	Slip	2	2	4	L		Appeal for tourists to use mountain shoes or sandals
Lava Tour in Kalikuning									
1.	Take a Jeep from Alien Stone to the Lava Tour activity location	Stand	Bounce	3	5	15	E	Safety helmet	Caution when standing, seatbelts, periodic repair of safety equipment
		Bumped	Bruise	3	2	6	M		Provision of bearing on the frame of the jeep
		Dust and sand	Twisting, blurred vision	3	1	3	L		Provides glasses
		Inadequate security tools	There was an accident	2	4	8	H		Equipping security tools and First aid kit
2.	Circumnavigating Kalikuning River by jeep	The road is winding and uphill	Falls, bruises	2	5	10	E		Provision of bearing on the frame of the jeep
		Jeep speed	There was an accident	1	5	5	H		Make warning signs for maximum jeep speed, check jeep regularly
		River water depth	The car broke down and there was a collision	1	2	2	L		Regular jeep checks

According to the assessment results on the HIRARC table, action is needed to minimize risk so that danger can be anticipated as early as possible so that losses are not too large. There needs to be cooperation between managers and tourists to unite thoughts about the risks of what dangers can occur. Unexpected dangers such as hot clouds and volcanoes that erupt suddenly risk having a major impact on public safety. In addition, the level of danger that has a high risk is also caused by the condition of tourist sites, rainfall and weather, as well as winding and uphill paths.

The risk of geological aspects is a risk that must be accepted (acceptance) Because the risk comes from natural processes and is a threat from the eruption of Mount Merapi (Sari &; Boyolali, 2013). The involvement of all community leaders is needed in spreading understanding of the risks and dangers that exist. These Pictures include tourists, local governments, communities, communities, and also drivers Jeep as well as a tour guide. In addition to the appeal and supervision from the manager, it is also necessary to pay attention to the behavior of tourists who come to tourist sites.

The results of the risk evaluation value are categorized by scale Low, Medium, High, and Extreme Furthermore, a priority scale is created to determine risk control measures using the concept of ALARP (As Low As Reasonably Practicable) (Ramli, 2010). It has been identified that the main activities that tourists often engage in are: Lava Tour. Action Lava Tour This is done by walking along the route of the Mount Merapi area set by the manager with more than 1-2 hours. Tourists by car Jeep which can accommodate 4 people, then they go along the road of Mount Merapi guided by Driver car Jeep itself.

There are potential dangers in this Lava Tour activity, namely air pollution, inadequate security equipment and the speed of the jeep driven by the guide is very risky to the safety of tourists. From the observations, managers and the public assume that the most dangerous potential danger when riding a jeep is falling and bumping. This has been experienced several times by tourists.

4. CONCLUSION

Based on the results of HIRARC analysis in lava tour activities in Mount Merapi National Park, there are 4 very high risks (extreme) and 5 high risks (high). Risk control efforts have not been fully effective in preventing accidents. There are still several shortcomings that need to be corrected immediately so that risk control efforts can run more optimally. It is recommended to tour managers to limit visitor capacity, make guardrails at several points of tourist sites, conduct basic occupational safety and health training and complete security equipment and first aid kit make warning signs / signs for maximum jeep speed and check jeeps regularly, install sponges for bearings on the jeep frame and advise tourists to be careful when standing, use seatbelts, and wear mountain shoes or sandals to prevent harm in an effort to exercise self-control. These efforts are carried out with the aim of avoiding accidents or injuries to tourists. By improving the safety of tourists, lava tour managers can provide a pleasant and memorable tourist experience.

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