Tourists’ Perception on Volcanic Hazard and Risk in Guci Hot Spring, Slamet Volcano, Indonesia

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Abstract. Guci Hot Spring is one of the tourist destinations in Central Java Province renowned for its beautiful scenery as well as its health-healing beneﬁt. In 2016, this touristic destination attracted more than 650,000 visitors, this number is growing each year. However, this touristic spot has its hidden hazard and risk of the Slamet Volcano eruption. The historical eruptions of this volcano, recorded since the 18th century, have shown that this volcano is known for its explosive type of eruption. Despite its potential hazard and risk, this hot spring area is growing continuously as a touristic spot. Therefore, this study aims to understand tourists’ perception on volcanic hazard and risk in this area, by interviewing 31 respondents using questionnaires. The results show that 74% of respondents are aware that Slamet Volcano has different potential hazards such as volcanic ashfall, lahars, lava and pyroclastic ﬂows. Although Guci Hot Spring is located in Slamet volcanic hazard area, only a few tourists know this information (42%). Majorities of the respondents did not have any experience on volcanic disaster (68%). Most of the respondents did not get any information on Slamet volcanic hazard (58%), while others only get information through television and/or social media. Nevertheless, almost all of the respondents claimed that they will follow any instructions given by government or related institutions if any volcanic eruption occurs (97%). Therefore, awareness program towards tourists in the volcanic touristic spot should be strengthened through different means to give information on volcanic hazard, its risk as well as mitigation and crisis management.

1. Introduction

Volcanoes fascinate many tourists since a long time ago, i.e. Vesuvius and Etna in the 17th or 18th centuries [1] until today for different reasons, i.e. adventuruous, educational, love of nature, cultural or ecological motives. Volcanoes are also known for their natural resources which are then used for agricultural activities, plantations, animal husbandry and other economic activities including tourism. Despite its beneﬁcial natural resources, volcanoes have potential hazards that may range from pyroclastic ﬂows, surges, lahars or volcanic ash. Although the exact number of victims from volcanic eruptions is still uncertain, but a study conducted by Tanguy et al. (1998) most of the volcanic eruption related fatalities because of post-eruption famine and epidemic disease (30.3%), pyroclastic ﬂows and surges (26.8%), lahars (17.1%), and tsunamis triggered by volcanic eruption (16.9%). The risk of volcanic eruption may higher when it happens in the densely populated area like in Java Island where more than 145 million inhabitants living [3] and more than 18 active volcanoes located on this island.

Slamet Volcano which is located in Central Java, Indonesia is a large stratovolcano inside the Sunda magmatic arc. According to Vukadinovic and Sutawidjaja (1995), there are two different parts on Mount Slamet, namely Slamet Tua (old) and Slamet Muda (young). Old Slamet in the western region with the composition of andesite and basaltic andesite, with rare basalt. Whereas Slamet Muda with basalt composition and basaltic andesite forms the eastern cone. There are three hazard zones according to Abdurachman et al. (2006) including (i) hazard zone I which is potentially affected by lahars and possibly affected by pyroclastic and lava ﬂow; (ii) hazard zone II which is potentially affected by pyroclastic ﬂows, lava ﬂows, ejected rocks (incandescent), thick accumulation of heavy ash falls and lahars; (iii) hazard zone III which is located as the eruption source and the surrounding,
which are always threatened by all kinds of the eruption products such as pyroclastic flows, ejected rock fragments (glowing), lava flows and toxic volcanic gases. This hazard III area is not allowed for settlement or commercial purpose in permanent. There were more than thirty volcanic eruptions recorded during the two last centuries [5]. The historical eruptions of this volcano, recorded since 18th century, have shown that this volcano is known for its explosive type of eruption.

![Figure 1. Slamet Volcano Hazard Zones: Most hazardous area (KRB III); Medium hazardous area (KRB II) and Least hazardous area (KRB I) (Source: Abdurachman et al., 2006)](image)

Located on the northwest slope of Slamet Volcano, Guci Hot Spring is one of the tourist destinations in Central Java Province renowned of its beautiful scenery as well as its health-healing benefit. Unfortunately, Guci Hot Spring is located in areas that can be destroyed by lava or pyroclastic flows, as it is located in the KRB II zone, only 9 kilometers from the center of eruption. In addition, since August 9, 2019, Slamet Volcano is declared by the Indonesian Center of Volcanological and Geological Hazards and Mitigation as one of volcanoes in level II (on-guard/advisory level) based on its activity level.

In 2016, Guci Hot Spring touristic destination attracted more than 650,000 visitors, this number is growing each year. Tourism sector is therefore seen as one of the biggest sectors which contributes to regional income. However, if this sector is to be developed sustainably, efforts are needed to educate tourists to understand the volcanic region, not only its beauty but also the potential hazards and its mitigation in order to minimize the potential risk.

In order to develop safe volcano tourism, there is a vital necessity to prepare risk prevention with sufficient information for all potential visitors in one hand and suitable training for operators and guides on the other hand [6]. Therefore, this study aims to understand tourists’ perception of volcanic hazard and risk in the Guci Hot Spring area.
2. Material and Method

Data were collected by a questionnaire survey towards tourists at Guci Hot Spring, the Slamet Volcano. The questionnaire contains questions to assess tourist perceptions regarding the threat and risk of volcanic eruptions. The questionnaire is closed questions with different types of answers: yes; not; possible (doubtful); and do not know. There are four themes in the questionnaire: (i) knowledge on volcanic hazards; (ii) experience on volcanic eruption; (iii) perception towards volcanic hazards; (iv) knowledge and experience on volcanic disaster risk and mitigation, and (v) respondents’ attitude towards volcanic eruption in the future. In addition to the five themes of questions as mentioned above, we also ask respondents’ characteristics including age, sex, level of education, occupation, area of origin, motivation or reason of tourism, duration of stay and number of visits in Guci Hot Spring. There were 31 respondents selected accidentally during the fieldwork in June 2019. The results of the surveys are therefore evaluated using descriptive analysis and cross-tabulation.

3. Results and Discussion

3.1. Characteristic of respondents

There were 31 respondents with 61 percent men and 39 percent women. The age of respondents ranged from 15-25 years old (52%), 26-35 years old (29%), 36-45 years old (16%) and more than 46 years old (3%). Most of the respondents coming from other provinces (42%), while 32% coming from the same province and the other 26% coming from the same regency. The education background of respondents ranged from elementary school (6%), junior high school (13%), senior high school (32%) and university (48%). Respondents have various work backgrounds, but most of them are private company workers (39%), entrepreneurs (16%), university students (19%) and others are teachers, students, police officers, search and rescue workers, housewives and unemployed.

Most of the respondents mentioning coming to Guci Hot Spring to recreation (90%), while 7% of the respondents mentioning they come to Guci Hot Spring for health-healing benefit of the spring and 3% of the respondents come for business affair (making a documentary video) within the duration of 1 up to two days visit only. Tourists’ motivations and reasons for visiting volcanic and geothermal areas may differ according to Erfurt-Cooper (2011), it can be differentiated into two categories: (i) recreation, tourism and adventure, and (ii) science, study, and research.

Most of the respondents visit Guci Hot Spring for their first time (45%), while others mentioning more than 5 times (26%), two times (6%) and between three up to five times (23%). More than 90% of respondents visit Guci Hot Spring without any tourist guide, only 9% of them using tour guide services.

3.2. Knowledge on volcanic hazards

In order to know respondents’ knowledge on volcanic hazards, we ask twelve questions including volcanic hazard and its types of Slamet Volcano, the location of Guci Hot Spring, their knowledge of volcanic hazardous areas, the existence of hot spring in relation with the volcano as well as their knowledge of previous volcanic eruption (Table 1). According to the result, most of the respondents believe that Slamet Volcano has different hazards such as volcanic ash (61%), lahar (42%), pyroclastic flow and lava also considered as hazards by 39% of respondents. As stated in the Slamet Volcano map, Guci Hot Spring area is located in KRB II which is prone to pyroclastic flows and lava hazards [5], but unfortunately, not all tourists know this information (only 42%). In addition, the majority of respondents not giving an opinion in regards to the question what is volcanic hazardous area (42%), while the other 19% did not even know what volcanic hazardous area is, and most of them do not understand the level of volcanic hazardous area. Even though most tourists understand that the existence of hot spring correlates with the volcano (77%) and they also know that Slamet Volcano erupted (58%). This data shows that although the majority of respondents know that Slamet Volcano has its hazards but there is still a lack of information regarding the areas that might be affected by volcanic hazards. This problem might be minimized if there are a prevention and mitigation effort to educate tourists on the volcano and its hazards by giving them information about volcanic related information and volcanic hazardous areas. However, as stated by Scarlett and Riede (2019) that all actions towards disaster risk reduction including translations of risk, vulnerability, resilience needs cultural understanding.
| Knowledge on volcanic hazards | Yes  | No  | No opinion |
|-------------------------------|------|-----|------------|
| Has Slamet Volcano volcanic hazard? | 74,0% | 16,0% | 10,00% |
| What kind of volcanic hazard Slamet Volcano has? | | | |
| Pyroclastic flow | 39,0% | 42,0% | 19,0% |
| Lahar flow | 42,0% | 39,0% | 19,0% |
| Lava flow | 39,0% | 42,0% | 19,0% |
| Volcanic ash | 61,0% | 26,0% | 13,0% |
| Is Guci Hot Spring located in volcanic hazardous area? | 42,0% | 26,0% | 32,0% |
| Do you know what volcanic hazardous area is? | 39,0% | 19,0% | 42,0% |
| Is volcanic hazardous area I (KRB I) is the lowest prone area? | 29,0% | 16,0% | 55,0% |
| Is volcanic hazardous area III (KRB III) is the highest prone area? | 19,5% | 22,5% | 58,0% |
| Does the existence of hot spring correlate with Slamet Volcano? | 77,0% | 7,0% | 16,0% |
| Do you know that Slamet Volcano erupted before? | 58,0% | 23,0% | 19,0% |

Source: Data Analysis (2019)

In this study we also tried to analyze tourists’ knowledge on volcanic hazards according to the level of education, as we can see in table 2, majority of respondents having higher education (university level) understand that Slamet volcano as an active volcano has volcanic hazard(s) in different forms such as volcanic ash, pyroclastic flows, lava flows or lahar flow.

| Level of education | Does Slamet Volcano have volcanic hazard (s) | Yes | No | No opinion | Total |
|--------------------|---------------------------------------------|-----|----|------------|-------|
| Primary School     | 0                                           | 2   |    |            | 2     |
| Senior High School | 8                                           | 1   |    |            | 10    |
| Junior High School | 2                                           | 2   |    |            | 4     |
| University         | 13                                          | 0   |    |            | 15    |
| Grand Total        | 23                                          | 5   | 3  |            | 31    |

Source: Data Analysis (2019)

3.3. Experience on volcanic eruption

Experience may affect the perception of future event as stated by [8], therefore this study also tries to identify are the respondents having experience towards volcanic eruption. The results show that among 31 respondents, there were only 32% who experienced volcanic eruptions (four respondents have experienced Slamet volcanic eruption, two respondents have experienced Merapi volcanic eruption, two respondents experienced Gede volcanic eruption, one respondent has experienced Sinabung volcanic eruption, and one respondent has experienced Kelud volcanic eruption). Two respondents having experienced Sinabung and Merapi eruptions lost their family members and had to evacuate during the volcanic crisis.

3.4. Perception towards volcanic hazards

Among 31 respondents, only 77% who confirm that Slamet Volcano may erupt in the future, most of them also state that the future eruption of Slamet Volcano may affect the Guci Hot Spring area (88%). Their perception that Slamet Volcano may erupt in the future affect the fear of respondents to re-visit the Guci Hot Spring area, as evidenced by 71% of respondents feeling afraid of the possibility of an
eruption in the future. However, some respondents also state that even Slamet Volcano erupts in the future, they would still visit Guci Hot Spring area, 23% of them do not want to visit the area and the rest of them (19%) did not give any opinion (Table 3).

### Table 3. Tourists’ perception towards volcanic hazards.

| Perception towards volcanic hazards                                      | Yes   | No    | No opinion |
|--------------------------------------------------------------------------|-------|-------|------------|
| Do you think Slamet Volcano may erupt in the future? (n=31)               | 77.0% | 10.0% | 13.0%      |
| Do you think the future eruption of Slamet Volcano may affect Guci Hot Spring area? (n=24) | 88.0% | 0.0%  | 13.0%      |
| If Slamet Volcano erupts in the future, would you still coming back to visit Guci Hot Spring? (n=31) | 58.0% | 23.0% | 19.0%      |
| Do you feel worried if there is any eruption of Slamet Volcano in the future (n=31) | 71.0% | 19.0% | 10.0%      |

Source: Data Analysis (2019)

3.5. **Knowledge and experience on volcanic disaster risk and mitigation**

In order to identify respondents’ knowledge and experience on volcanic disaster risk and mitigation, we asked four questions (table 4). According to the results, majority of respondents did not receive any information related to Slamet Volcanic Hazards (58%), only 39% of respondents who received the information, mainly from television (42%), social media (25%), internet (17%), family (8%) and handy-talky (8%). However, most respondents do not any mitigation tools (evacuation route, evacuation shelter, early warning system) in case a volcanic eruption occurs. In addition, only 19% of respondents who are involved in disaster-related organizations (i.e. police officer, search and rescue team, nature lover community). These results show that efforts to educate tourists regarding Slamet Volcano, its hazards and mitigations are needed in order to minimize the risk of a volcanic eruption in the future. As stated by [9] that direct and specific education campaigns are needed to increase knowledge of tourists in volcanic touristic areas in order to be able to cope with a future volcanic eruption. In addition, also highlighted that good education campaigns on risk may motivate individuals to request additional inquiries and pursuit more information [10].

### Table 4. Knowledge and experience on volcanic disaster risk and mitigation (n=31).

| Knowledge and experience on volcanic disaster risk and mitigation | Yes | No | No opinion |
|------------------------------------------------------------------|-----|----|------------|
| Have you received any information related to Slamet Volcanic Hazard? | 39% | 58% | 3%         |
| Do you know where is the evacuation route for a volcanic eruption in this area? | 13% | 65% | 23%        |
| Do you know where is the evacuation shelter located in this area? | 10% | 68% | 23%        |
| Do you know any early warning system for Slamet volcanic eruption? | 13% | 68% | 19%        |
| Are you involved in disaster-related organizations?               | 19% | 81% | 0%         |

Source: Data Analysis (2019)

3.6. **Respondents’ attitude towards volcanic eruption in the future**

According to a study conducted by [11], attitude is one of the variables that may affect preparedness including other variables such as awareness, risk perception, experience with hazards, emotions, trust in authorities and responsibilities. In this study, we try to identify how tourists will react if they have to face a volcanic eruption of Slamet Volcano in the future while visiting Guci Hot Spring area, the results shows that most of the respondents will follow the government’s advice and evacuation order (97%) (Table 5). It is important to know that respondents are willing to obey government’s advice and evacuation order, as sometimes people try to postpone the evacuation until they can feel that the hazard is imminent. This kind of response is common in some area in Indonesia, such as the latest evacuation of Merapi volcanic eruption in 2010 [12].

In this study, we would like also to know whether the tourists still want to revisit Guci Hot Spring area when there is no volcanic activity in this area or when the volcanic activity is in level I (normally active). The result show that most of the respondents stated that they are willing to visit the area once the volcanic eruption is decreasing. As stated in the earlier subchapter 3.1 there are three reasons to
visit Guci Hot Spring area (recreation (90%), health-benefit (7%), and business affair (3%). All of the respondents visiting Guci Hot Spring area for health-benefit and business affair reasons stated that they are willing to visit the area again, but some respondents visiting the area just for recreation reasons do not want to return to Guci Hot Spring touristic area (table 6). Health-benefit reason of the Hot Spring visit is not only in Guci, but also in several geothermal touristic areas such as in Toya Lake (Usu Volcano, Japan) [13], in Croatia [14], or Taupo Volcanic Cone, New Zealand [15].

Table 5. Respondents’ attitude towards volcanic eruption in the future (n=31).

| Attitude towards volcanic eruption | Yes | No | Probably |
|------------------------------------|-----|----|----------|
| If there is any volcanic eruption, would you follow the government's advice? | 97% | 3% | 0% |
| If there is any volcanic eruption, would you follow the evacuation order? | 97% | 0% | 3% |
| After the volcanic eruption settles down, will you return to tour the Guci Area? | 84% | 3% | 13% |

Source: Data Analysis (2019)

Table 6. Willingness to revisit Guci Hot Spring area (n=31).

| Reason to visit | Willingness to revisit Guci Hot Spring area | Total |
|-----------------|-------------------------------------------|-------|
|                 | Yes | No | Perhaps |
| Business affair | 1   | 0  | 0        | 1     |
| Health-benefit  | 2   | 0  | 0        | 2     |
| Recreation      | 23  | 1  | 4        | 28    |
| Total           | 26  | 1  | 4        | 31    |

Source: Data Analysis (2019)

4. Conclusion
This study aims to understand tourists’ perception on volcanic hazard and risk in Guci Hot Spring area. The results show that 74% of respondents are aware that Slamet Volcano has different potential hazards such as volcanic ashfall, lahars, lava and pyroclastic flows. Although Guci Hot Spring is located in Slamet volcanic hazard area, only a few tourists know this information (42%). Majorities of the respondents did not have any experience on volcanic disaster (68%). Most of the respondents did not get any information on Slamet volcanic hazard (58%), while others only get information through television and/or social media. Nevertheless, almost all of the respondents claimed that they will follow any instructions given by government or related institutions if any volcanic eruption occurs (97%). Therefore, awareness program towards tourists in volcanic touristic spot should be strengthened through different means in order to give information on volcanic hazard, its risk as well as mitigation and crisis management.

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