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Perception of agroforestry adopter and non-adopter on volcano risk and hazard: a case in Mt. Merapi, Java, Indonesia

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Abstract. *Rozaki Z, Rahmawati N, Wijaya O, Khoir IA, Senge M, Kamarudin MF. 2021. Perception of agroforestry adopter and non-adopter on volcano risk and hazard: a case in Mt. Merapi, Java, Indonesia. Biodiversitas 22: 3829-3837.* Agroforestry is an agricultural system that many people use in mountainous areas. Some experts have proven that this system can become the mitigation strategy in volcano areas. This study analyzes the risk and hazard perception of agroforestry adopters and non-adopters in the Mt. Merapi prone area. 139 agroforestry adopters and 130 non-adopters were randomly taken from four different areas in Mt. Merapi. Results show that both adopters and non-adopters show different perceptions regarding hazards and risk. The effectiveness of agroforestry practice for mitigation strategies needs to be studied more. The awareness of hazards and risks in the Mt. Merapi prone area is essential to save more lives during the eruption. The challenge is how to persuade agroforestry adopters and non-adopters to flee when the big eruption comes. Even though they flee, they still insist on returning home to take care of their livestock, farm, and protect properties. Mitigation education is needed; also, the infrastructure is important in supporting the mitigation efforts.

Keywords: Agroforestry, biodiversity, hazards and risks, Mt. Merapi

Abbreviations AF: Agroforestry adopter, NAF: Agroforestry non-adopter

INTRODUCTION

Mt. Merapi is an active volcano with a height of 2,930 meters above sea level in 2010. This volcano is located within two provinces, namely Central Java (Boyolali Regency, Klaten Regency, and Magelang Regency) and the Special Region of Yogyakarta (Sleman Regency). Ratdomopurbo et al. (2013) explained that this mountain is special as it frequently erupts, with an average interval between eruptions, in the last century, of less than seven years. The volcano, in fact, erupted in 2006 and 2010 also had a big eruption. It had a big impact on the surrounding area, especially the area prone to this Mt. Merapi. On the 2010 eruption, 353 people dead.

Hazards from Mt. Merapi felt by people living at the prone area of this mountain are pyroclastic flows, surges, hot clouds, and lahars (Dove 2008; Thouret et al. 2000). The hazards affect the socio-economic of society (Maharani et al. 2016). Even though the hazards of Mt. Merapi are significant, many people live there (Mei et al. 2013). People who live in the Mt. Merapi prone area are usually already there since their ancestors. When disaster comes, they commonly move to a safe place until the eruption stops and their place is safe for coming back (Muir et al. 2020). Resettlement programs are also facilitated in some areas, but they move back to their village (Muir et al. 2020).

People who live and stay in the Mt. Merapi prone area get the blessing from the land, which is fertile (Hardiansyah et al. 2020). They are utilizing that blessing with practicing agriculture. Relying on natural resources has become a common thing (Bachri et al. 2015). Agriculture practices commonly use terracing techniques or farming in the space between trees or agroforestry. This practice is suitable for mountainous areas. Some areas in the world also use this to cope and conserve the land that is prone to eruption disaster (Utami et al. 2018). Agroforestry is useful for conserving biodiversity in volcano areas prone to eruption hazards (Budiyanto 2021; Rozaki et al. 2021a). Farmers who are not practicing agroforestry can also be found in this volcano mountain, especially in the Tlogolele area, where the land slope is quite extreme, making agroforestry practices difficult. Without applying agroforestry, farmers actually can also do farming well. Nevertheless, based on some researches, agroforestry practice has been proven to help more crop production (Sagastuy and Krause 2019).

Mt. Merapi, as one of the most active volcanos in Indonesia, has significant hazards and risks, especially to the surrounding people. Moreover, many people lost their life due to the eruption (Sullivan and Sagala 2020). Efforts to reduce the disaster risk must be made for all parties (Gob et al. 2016), including AF and NAF farmers in Mt. Merapi prone area. They are the most vulnerable groups when disasters come (Avvisati et al. 2019). Pearce et al. (2020) showed that the level of preparation affects the amount of damage from the disaster. Therefore, early mitigation is necessary as efforts of disaster risk reduction.

Risk awareness culture needs to be developed among communities (Avvisati et al. 2019). The awareness comes from how people think about the hazards and risks, or perception of hazards and risk (Ahmed et al. 2019). Khan et al. (2020) explained that risk and hazard perception is very important in understanding disaster risk. It is used to determine the self or community measures against disaster. Yang et al. (2020) stated some hazards and risk perceptions, such as the hazard occurrence, hazards survival, and worrying about the damage.

Understanding risk and hazard or mountain disaster such as debris flow perception can reduce disaster risk in mountain environments. Disaster risk reduction will be more effective when individual-based measures into government-led programs, with comprehensive implementation involving all stakeholders (Huang et al. 2020). Local knowledge needs to adapt to the development of disasters (Pearce et al. 2020).

Risk and hazards from Mt. Merapi are equally being felt by agroforestry adopters (AF) and non-agroforestry adopters (NAF). AF has an economic and environmental benefit for its adopter (de la Cruz and Galang 2006; Kiyani et al. 2017). Thouret et al. (2000) explained that a study about risk and hazard perception is needed to design disaster risk management followed by mitigation strategies. Gob et al. (2016), Huang et al. (2020), and Maharani et al. (2016) also added that assessing the hazard of Mt. Merapi is important as an effort for disaster risk reduction. Atil et al. (2020) and Bee (2016) agreed that risk and hazards perception is important in understanding environmental shocks or disaster risk. It is used to determine the self or community measures against disaster. Risk and hazard perception can lead to how well prepared people are to face disasters (Pearce et al. 2020). In Indonesia, volcano disaster mitigation is one of the priorities as the country has many active volcanos. Thus, this study aims to analyze the risk and hazard perception of AF and NAF in the Mt. Merapi prone area.

MATERIALS AND METHODS

Study area

Hazards' area of Mt. Merapi is divided into four based on the radius to the top of the mountain: ring 1 (0-5 km), ring 2 (6-10 km), ring 3 (10-15 km), and ring 4 (16-20 km) (BNPB 2010). Each ring has different hazard degrees; the closer the area to the top, the bigger the hazards. The study area is ring 2, or 6-10 km radius area from the top of Mt. Merapi (as seen in Figure 1). It was chosen because this area will get a quite severe impact from the hazard of Mt. Merapi, and ring 1 cannot be chosen because it is prohibited for people to use it for farming or other activities. To understand the whole area of Mt. Merapi, four different areas were chosen as the location to take the sample. They are Jemowo Village (Tamansari Sub-district, Boyolali Regency) in the East part, Tlogolele Village (Selo Sub-District, Boyolali Regency) in North part, Krinjing Village (Dukun Sub-district, Magelang Regency) in West part, and Glagaharjo Village (Cangkringan Sub-district, Sleman Regency) in South part.

Sampling procedure and data collection

The total sample in this study was 139 AF and 130 NAF respondents. Those samples were collected randomly from four different areas surrounded by Mt. Merapi. Based on previous eruption history, each area has a different degree of disaster impacts. One of the severely damaged areas in the 2010 eruption was Glagaharjo Village.

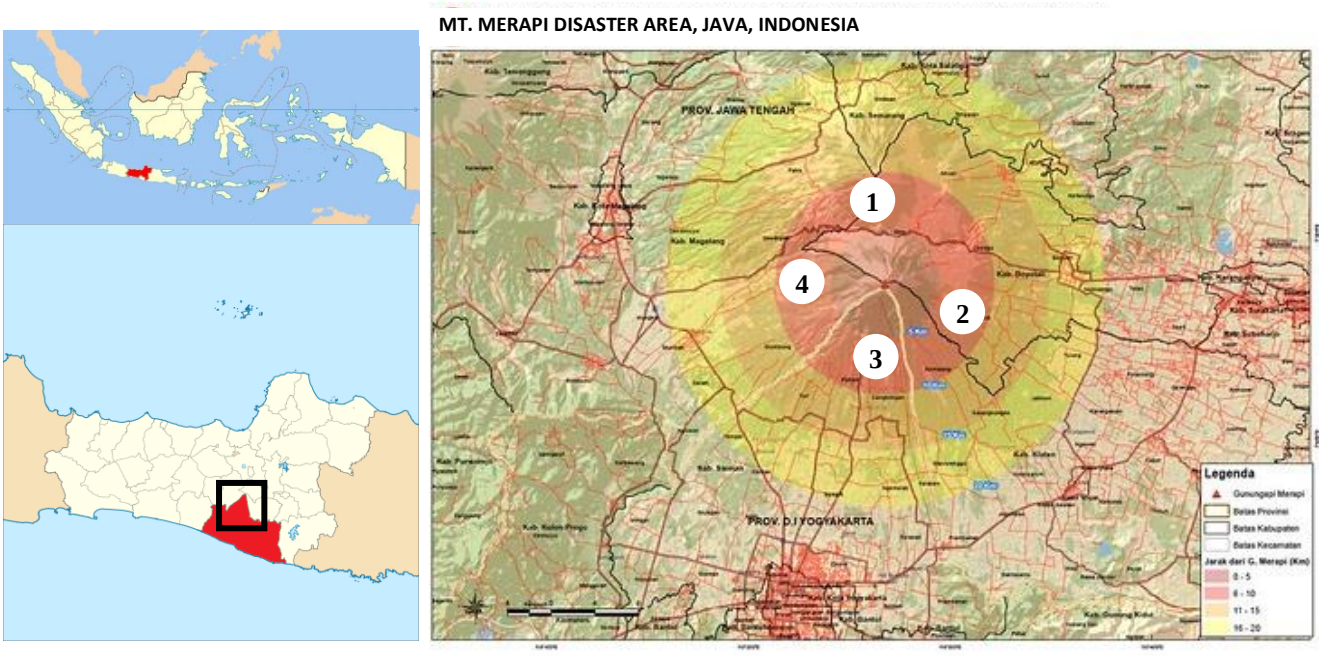

Figure 1. Study area located around Mt. Merapi, in Central Java and Yogyakarta provinces, Indonesia (*red square*): 1. Tlogolele Village, 2. Jemowo Village, 3. Glagaharjo Village, 4. Krinjing Village

Risk and hazard perception consists of three indicators: hazards, frequency of hazards and risk, response to hazard, and damage achieved. Most of the indicators were measured with the Likert scale, while some are open questions to understand the real situation of respondents (detail can be seen in Tables 1, 2, and 3). Factors affecting the risk and hazards perception come from internal factors: demographics data, and external factors: social access, government support, and environmental condition. To support these, depth-interview and observation also were done.

In addition, depth interview with key informants was done during the eruption in January 2021, where the climax activity was on 27 January 2021 (Mustaqim 2021). This interview aims to know the real-time condition of AF and NAF farmers during the Mt. Merapi eruption.

Analytical technique

Descriptive method was used to present the findings. Mean, frequency, and percentage also were used to describe risk and hazard perceptions and to know the different perceptions between AF and NAF. Independent T-Test analysis was used to know whether the difference in perception between AF and NAF is significant. Logistic Multinomial Regression was used to know the factors affecting risk and hazard perception, where demographic respondents and external factors are the independent variables, and hazards and risk perception are the dependent variables.

RESULTS AND DISCUSSION

Demographic of respondents

AF and NAF are living together in Mt. Merapi prone area. Both AF and NAF respondents are dominated by males, 80.58% and 72.31% respectively (Table 5). The AF respondents are mostly 41-53 years old (29.50%) and 64 years (12.95%) old. Meanwhile, NAF respondents are dominated by 28-40 years old, 33.08%. Meanwhile, the average age of AF is 46.92 years old, and NAF is 48.05. It could resonate that aging farmers are happening all around the world (Saiyut et al. 2017).

In terms of education, both AF and NAF people are mainly elementary school graduates, 53.96% and 57.69% respectively. Respondents who could reach a diploma or university are still very limited, 4.32% and 3.06% respectively. People with higher education tend to be more aware of hazard possibilities (Echavarren et al. 2019). Regarding farming experience, NAF is higher with a mean of 28.73 years while AF is 26.73. However, in terms of the number of family members, AF has a higher mean of 3.42%, while NAF is 3.22%. Most respondents, both AF and NAF, 52.52% and 50.77% respectively, have stayed in Mt. Merapi prone area for more than 41 years. Moreover, the average length of stay is 41.68 and 43.08 years, respectively.

Mt. Merapi hazards

Many hazards are being faced by people who live in the surrounding area of Mt. Merapi. In the 2010 eruption, Glagaharjo was the one that got the most severe damage from the eruption (Nofrita and Krol 2014). This happened as this area is the direct area from the lava road. Brata et al. (2014) explained that Glagaharjo was the area with severe hazards due to this. In addition, in the 2010 eruption, other areas are dominated by volcanic ash rain. As shown in Figure 2, both AF and NAF are majority facing volcanic ash rain, 71.22% and 80.76% respectively. Throughout 2010 and afterward, no respondent from both AF and NAF stated about landslides. Instead, respondents felt hot clouds, bomb, and lava, especially during big eruptions such as 2010. Yet, after that, no big eruption, so neither bomb nor lava was felt by respondents, both AF and NAF

Table 1. Demographic variable

Variable/indicator	Measurement
Gender	Male or Female
Age	Interval (5 scales)
Education	None to Diploma or University (5 scales)
Farming experience	Interval (5 scales)
Family number	
Length of stay	

Table 2. External factors variable

Variable/indicator		Measurement
Social access	Participate in social activities, especially regarding disaster mitigation	1 (strongly disagree) - 5 (strongly agree)
Government Support	Government often holds mitigation education/drill	
Environment condition	Environment (nature and infrastructure) conditions support the Mt. Merapi adaptation	

Table 3. Risk and hazards perception

Variable/Indicator		Measurement
Hazard and risk	Type of hazards that being faced	Open answer, and 1 (extremely unharmful) - 5 (extremely harmful)
	How serious the hazards	
	How dangerous the hazards	
Hazard and risk frequency	Frequency of getting impacts from Mt. Merapi	1 (very rare) - 5 (very often)
Damage achieved	Type of damage achieved in agriculture	Open answer, scale, and percentage
	Type of damage achieve in non-agriculture	
Response to hazard and risk sign	Response to hazard and risk sign	

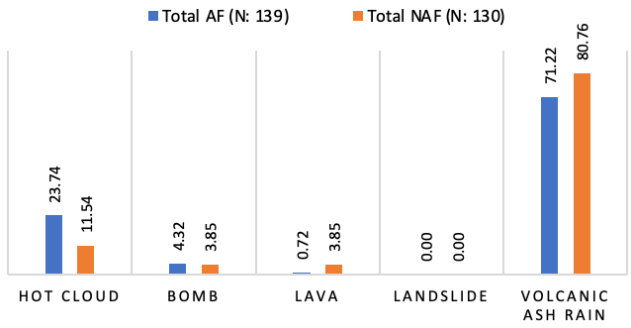

Figure 2. Type of Mt. Merapi hazards (percentage)

Table 5. Demographics of respondents

	AF (N: 139)				NAF (N:130)			
	Freq.	%	Mean	Sd.	Freq.	%	Mean	Sd.
Gender								
Female	27	19.42			36	27.69		
Male	112	80.58			94	72.31		
Age			46.92	14.33			48.05	15.22
15-27	15	10.79			9	6.92		
28-40	38	27.34			43	33.08		
41-53	41	29.50			31	23.85		
54-64	27	19.42			21	16.15		
More than 64	18	12.95			26	20.00		
Education			2.40	0.99			2.26	0.87
None	18	12.95			18	13.85		
Elementary	75	53.96			75	57.69		
Junior	24	17.26			26	20.00		
High	16	11.51			7	5.38		
Diploma/Univ.	6	4.32			4	3.08		
Farming Experience			26.73	15.54			28.73	16.69
0-10	22	15.83			20	15.38		
11-20	30	21.58			28	21.53		
21-30	36	25.90			28	21.54		
31-40	28	20.14			20	15.38		
41 and more	23	16.55			34	26.15		
Family number			3.42	1.82			3.22	1.06
1 or none	5	3.59			1	0.77		
2	32	23.02			36	27.69		
3	42	30.22			44	33.85		
4	40	28.78			36	27.69		
5 or more	20	14.39			13	10.00		
Length of stay			41.68	18.42			43.08	18.19
0-10	8	5.75			5	3.85		
11-20	11	7.91			10	7.69		
21-30	23	16.55			22	16.92		
31-40	24	17.27			27	20.77		
41 and more	73	52.52			66	50.77		

External factors

There are three external factors; social access, government supports, and environmental condition. These factors are expected to have an effect on AF and NAF perception regarding Mt. Merapi hazards and risk. Social access means how they can interact with society and adapt to the Mt. Merapi hazards and risks. Through community or social interaction, important information can be shared and help others (Birowo 2011; Rahman et al. 2016). Figure 2 shows that AF has a higher score because many farmers in Mt. Merapi prone area are practicing AF, so their social engagement is higher than NAF. Only environmental conditions have the same score for AF and NAF (Figure 3). Environmental condition is the infrastructure or other surrounding things that support people to adapt and face the Mt. Merapi hazards, such as evacuation road, access to shelter etc. Both AF and NAF felt the same condition of the environment.

Government support regarding the hazards of Mt. Merapi, such as in providing disaster information and providing mitigation training. In coping with disaster, the government needs time to prepare anything required. Thus, precisely at the moment of disaster, the victim needs to survive themselves with their communities (Avvisati et al. 2019; Birowo 2011). Perception regarding government support is higher for AF. Based on in-depth interviews during the latest eruption (January 2021), government support is big enough for farmers, such as providing real-time information about the activities of Mt. Merapi through many channels such as volunteer, village advisor, social media, etc. Those who can access the internet can watch through live Youtube streaming by Research and Development Center for Geological Disaster Technology (Youtube: BPPTKG CHANNEL). Atil et al. (2020) stated that in disaster time, trusted information is very important. Respondent stated that they could not work on the farm properly if they always watch the news or information regarding Mt. Merapi because they will feel over worry. So, even though they are ready, they still keep themselves not overthinking about the news. Van Manen (2014) explained that livelihood, infrastructure, and the availability and accessibility of information are becoming concerns about risk and hazard perception.

Only government support has Levene's test score less than 0.05, which means the data variance is heterogeneous (Table 6). Nevertheless, social access and environmental condition are more than 0.05, which means the data variance is homogenous. T-test only shows significance for social access, which is 0.012, which means the perception of social access between AF and NAF is significantly different.

Risk and hazard perception

Hazards of Mt. Merapi are equally being felt by AF and NAF, regarding the degree and seriousness of hazards, highest mean in Glagaharjo Village, as this village is the road of lava when big eruption comes, such as in 2010. Another area is quite saved. Even in the massive eruption in 2010, Krinjing Village, for instance, had no severe damage, only volcanic ash that covered people's homes and agricultural land. Through Figure 3, the hazards and risk of Mt. Merapi are more felt by AF, where AF faces hazards such as lava, hot cloud, and bomb. However, AF has more advantage in protecting landslides when it comes together with the eruption.

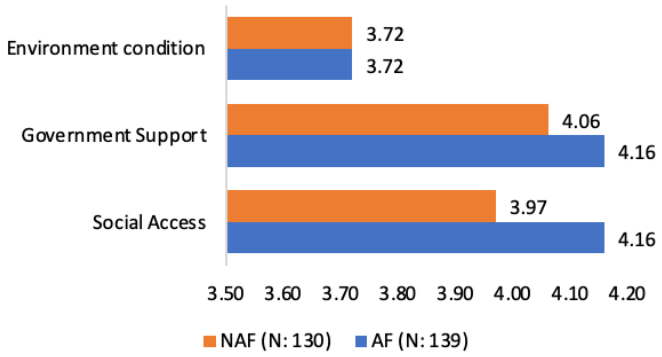

Figure 3. External Factors (Mean)

Tabel 6. Independent T-Test Results for External Factors

Variable	Levene's Test		t-test		
	F	Sig.	t	df	Sig.
Social access	0.524	0.470	2.527	267	0.012
Government support	5.067	0.025	1.946	267	0.053
Environmental condition	0.392	0.532	-0.050	267	0.960

Regarding the frequency of hazards and risk, the score is 3.02 for AF and 2.91 for NAF (Figure 4). Mt. Merapi is often erupting after the 2010 big eruption, and this condition continues till today. The latest eruption was in January 2021, where the climax was on 27 January 2021 (Wikanto 2021). Dove (2008) explained that people in Mt. Merapi had developed a system of agro-ecological practices that reduce the impact of Mt. Merapi hazards. In terms of response to hazards, AF has higher responses, while NAF has a higher damage rate.

Among four variables, only the 'damage achieved' variable has Levene's Test score less than 0.05. This means the data variance is heterogeneous (Table 7). Meanwhile, other variables are homogenous. Hazard risk, damage achieved, and response to hazards show T-Test significance, which means the perception of these variables is significantly different.

Type of damage achieved

Mt. Merapi eruption caused damage to people's lives, including agriculture and non-agriculture. Non-agriculture damage is about the damage that occurs to the family of respondents. Casualties only happen in Glagaharjo, as the most severe area impacted the eruption, both AF and NAF (Figure 5). Other areas had no severe damage to family members. In addition, most of the respondents' family members were not injured. Data show that more than 90% of AF and NAF family members were not injured. Meanwhile, the most severe damage to agriculture, the ultimate land losses, also struck AF and NAF in Glagaharjo. Figure 6 shows that in total severe damages to land struck AF and NAF with 33.09% and 47.69% respectively.

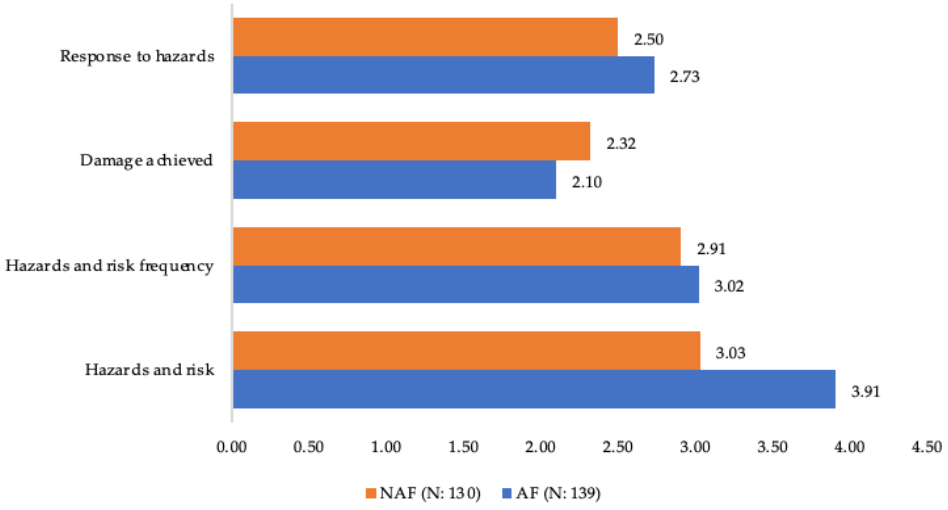

Figure 4. Hazards and risk perception (Mean)

Table 7. Independent T-test for hazards and risk perception

	Levene's Test		t-test		
	F	**Sig.**	**t**	**df**	**Sig.**
Hazard risk	121.333	0.000	4.825	267	0.000
Hazard frequency	5.431	0.021	0.950	267	0.343
Damage achieved	0.014	0.905	-1.976	267	0.049
Response to hazards	0.426	0.514	2.631	267	0.009

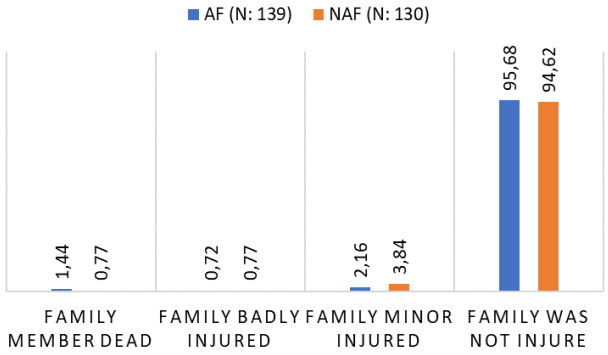

Figure 5. Type of damage achieved on non-agriculture (percentage)

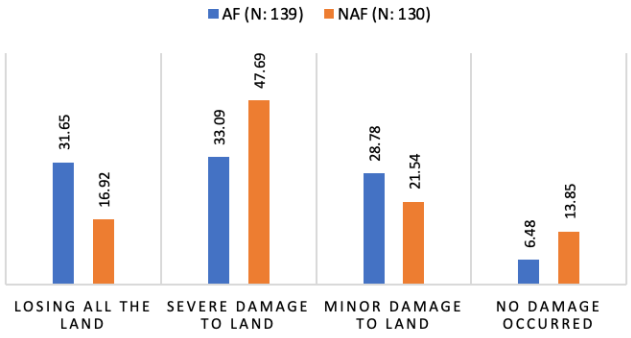

Figure 6. Type of damage achieved on agriculture (percentage)

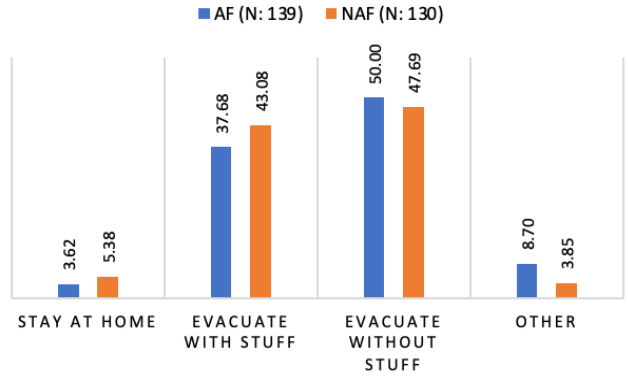

Figure 7. Type of response to hazards and risk sign (percentage)

Type of response to hazard sign

How the people respond to the hazards sign is important, the level of preparation affects the amount of damage from disaster (Pearce et al. 2020). People who live in Mt. Merapi prone area have different type of response when the hazard sign come (Figure 7). Some evacuated with their belongings, some were without belongings, and some chose to stay at home. Based on Figure 7, the T-Test analysis shows significantly different responses. Where compared to AF, NAF tends to evacuate when the hazards come. Glagaharjo Village had become the area that often got instruction to evacuate due to high risk compared to other areas. Actually, the awareness of "save life first" is comprehended by many people. Therefore, the evacuation route must be prepared and maintained (Muir et al. 2020).

Volcano hazard status, including Mt. Merapi, has four levels: *Normal* (Normal - Level 1), *Waspada* (Alert - Level 2), *Siaga* (Standby - Level 3), and *Awas* (Beware - Level 4) (BNBP 2021). During the latest eruption in January 2021, Mt. Merapi's hazards level status raised to *Siaga*. In this level, the closest area to the top of Mt. Merapi is sometimes instructed to evacuate, especially for the most vulnerable groups such as the elderly, children, and women. Respondents interviewed during the latest eruption stated that their place was in ring 2 (radius 6-10 km for the top of Mt. Merapi), so they were not instructed to evacuate. Some were instructed but only for vulnerable groups that stay in shelter until stable. For men, they will come back home in the daylight to take care of the livestock, protect properties, and care for agriculture. Both AF and NAF were the same in this situation. When the hazard level enters *Siaga*, people will prepare at least the important documents such as resident cards, so they are prepared to evacuate anytime.

To increase awareness, hazard mitigation education and evacuation protocol are important (Tuswadi and Hayashi 2014; Bakkour et al. 2015). These will become more effective with support from AF and NAF's experience of living in Mt. Merapi area. Experience in facing disaster builds the local wisdom that can be used for mitigation (Herningtyas and Surwandono 2015; Rozaki et al. 2021c). AF who have trees near the main road will cut the trees to make the evacuation road clear. NAF also would help because to clear the evacuation road is the job for all people. Another preparation could include the village chief making the list of people who own a car (pickup car). When people must go, these cars will be used to carry the people. Avvisati et al. (2019) showed that people are more interested in the information regarding hazard management from brochures and public meetings. Therefore, mitigation training in public meetings is a good choice to increase awareness. Nevertheless, some respondents prefer to do farming without overthinking the Mt. Merapi hazards because if they overthink, they cannot work properly.

Factors affecting the perception

Demographics and external factors are expected to affect the risk and hazard perception of AF and NAF. The regression model for both AF and NAF are fit with Pearson value all are more than 0.05. The data variance can be seen

in R2, for AF is around 72% to 79% (Table 8), and meanwhile for NAF is 58% to 77% (Table 9). AF's hazard risk perceptions are affected by age, farming experience, government support, and environmental condition. On the other hand, NAF does not have significant factors that affect hazard risk.

Farming experience becomes the only independent variable that affects the hazard frequency of AF. Meanwhile, for NAF, there are education and social access. Damage achieved of AF is not affected by farming experience and social access. This social access also does not affect damage achieved of NAF, as the degree of damage from Mt. Merapi is beyond human control. Government support and environment do not affect response to hazard for AF, and meanwhile, for NAF, there is no independent variable that affects response to hazard.

The agroforestry system has become the method to conserve land, water and protect crops in volcano areas (Budiyanto 2021; Gross 2015; Rahayu et al. 2014). This situation makes many farmers in Mt. Merapi prone area are practicing AF. Those who are not practicing AF are not at fault at all, but it is just that the agroforestry practices have been found useful for agriculture practice in the Mt. Merapi area. Therefore, through the finding of this study, it hopes many farmers will practice agroforestry in Mt. Merapi. Rozaki et al. (2021b), through their study in Mt. Merapi, found that AF practices vary depending on the purpose of the farmers, such as some farmers are practicing AF for economic purposes. Some only use AF for livestock feeders or to protect their crops from small hazards from the Mt. Merapi-prone areas. The perception of AF adopters regarding Mt. Merapi's risk and hazards seems to be different from that of NAF because adopters have more mitigation strategies with AF than NAF. This study proved that in some aspects, AF and NAF are different in perception. However, in general, both adopters and NAF feel that the risk and hazards of Mt. Merapi are real and they need to think the mitigation strategies to reduce the risk and hazards of Mt. Merapi.

Comparing the hazard and risk perception between AF and NAF could be used for formulating further policies regarding mitigation strategies in Mt. Merapi prone area. More AF benefits are felt, more the farmers are willing to adopt this system. AF adoption in Mt. Merapi prone area may be caused by the benefits of AF for one of the mitigation strategies toward Mt. Merapi risk and hazards, but it needs more study about this. A study by Nguyen et al. (2021) themed the reason of farmers to adopt AF also come from the benefits of AF as good livelihood and ecologically beneficial. Further study on how farmers adopt AF in Mt. Merapi prone areas must be conducted to contribute to the literature regarding AF and volcano disaster mitigation strategies. To increase the adoption rate of AF, policies and supported by scientific research are needed (Siarudin et al. 2021).

Table 8. Factor Affecting Risk and Hazard Perception of AF

	Hazard Risk		**Hazard Freq.**		**Damage Achieved**		**Response to Hazard**	
	Chi-Square	**Sig.**	**Chi-Square**	**Sig.**	**Chi-Square**	**Sig.**	**Chi-Square**	**Sig.**
Age	24.709	0.016*	13.456	0.639	39.755	.000**	120.259	.000**
Education	7.177	0.846	23.502	0.101	35.124	.000**	270.064	.000**
Family Number	7.473	0.825	14.515	0.560	41.305	.000**	225.352	.000**
Farming Experience	23.596	0.023*	38.856	0.001	17.033	.148	1106.702	.000**
Length of Stay	19.573	0.076	15.669	0.476	43.887	.000**	363.804	.000**
Social Access	8.703	0.465	3.642	0.989	5.604	.779	113.312	.000**
Government Support	19.580	0.021*	15.328	0.224	42.023	.000**	5.438	.942
Environment Condition	35.491	0.000**	8.722	0.726	30.711	.000**	5.004	.958
Pearson	1.000		1.000		1.000		1.000	
R2	0.733		0.784		0.770		0.728	

Table 9. Factor affecting risk and hazard perception of NAF

	Hazard Risk		**Hazard Freq.**		**Damage Achieved**		**Response to Hazard**	
	Chi-Square	**Sig.**	**Chi-Square**	**Sig.**	**Chi-Square**	**Sig.**	**Chi-Square**	**Sig.**
Age	13.158	0.661	12.211	0.429	18.268	0.108	16.714	0.161
Education	9.683	0.883	58.901	0.000**	22.278	0.035*	13.837	0.311
Family Number	6.388	0.983	14.457	0.273	24.301	0.019*	5.469	0.940
Farming Experience	10.294	0.963	24.082	0.064	25.615	0.042*	16.996	0.319
Length of Stay	12.222	0.729	9.895	0.625	25.434	0.013*	10.657	0.559
Social Access	9.222	0.904	31.685	0.002**	19.218	0.083	6.607	0.882
Government Support	3.854	0.999	5.056	0.956	33.877	0.001**	13.957	0.303
Environment Condition	2.498	0.962	10.083	0.121	10.416	0.108	3.801	0.704
Pearson	1.000		0.948		0.380		1.000	
R2	0.597		0.704		0.770		0.585	

Note: *Significant at 0.05 level, **Significant at 0.01 level

In conclusion, Mt. Merapi brings positive and negative impacts on the surrounding people, and even if they got negative impacts, they still live there. Economic and culture (preserving ancestor heritage) are the main reasons for them to stay. Agroforestry is being practiced by some of the farmers in the Mt. Merapi-prone area. Besides producing valuable products, this system can also protect the land from eruption or erosion. Hazards and risk perceptions of AF and NAF were analyzed in this study. The results show that some of the variables are showing different perceptions. Rank Spearman correlation analysis showed that length of stay and environment condition significantly correlate with hazards and risk frequency, and hazards and risk, respectively. Increasing the awareness of hazards and risks in Mt. Merapi prone area is important to protect people's lives and their land from current or future eruption disasters. Further research about the effectiveness of agroforestry systems as mitigation strategies in the Mt. Merapi area is needed to make more farmers are interested in practicing this system to protect their local biodiversity. Collaboration of all stakeholders is necessary to disaster risk reduction management: pre, on, and post-disaster.

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