

Research Article

Zuhud Rozaki*, Nur Rahmawati, Oki Wijaya, Sofa Nur Azizah, Anggit Candra Pratama, Yudhi Pramudya, Fajar Novianto, Farrah Fadhillah Hanum, Ali Rahmat, Jumakir, Waluyo

Farmers' food security in the volcanic area: A case in Mount Merapi, Indonesia

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Abstract: Although Mount Merapi is the most active volcano in Java Island, many people still opt to stay there, with most of them working as farmers. This study aimed to analyze the food security of farmers living in the Mount Merapi area. A total of 303 farmers from four different surrounding areas in Mount Merapi were randomly interviewed, and the factors that affect their food security were determined. The findings indicated that Glagaharjo has the

highest mean score for food availability variable; it seems effected by the farmers that have livelihood diversification such as sand miner. With regard to food utilization, rice and vegetables are commonly consumed. Farm size has a significant effect on food availability and food utilization. Effort to increase the farm size is less likely possible, therefore other effort such as controlling the number of family member through family planning program can be implemented to support food security in the study area. People, especially farmers, who live in the hazardous areas in Mount Merapi seem to be unwilling to leave their current lives.

Keywords: Farmers, food security, food availability, food utilization, volcano

* **Corresponding author: Zuhud Rozaki**, Department of Agribusiness, Universitas Muhammadiyah Yogyakarta, Jl. Brawijaya, Kasihan, Bantul, Yogyakarta 55183, Indonesia, e-mail: zaki@umy.ac.id

Nur Rahmawati: Department of Agribusiness, Universitas Muhammadiyah Yogyakarta, Jl. Brawijaya, Kasihan, Bantul, Yogyakarta 55183, Indonesia, e-mail: rahma_wati_mf@umy.ac.id

Oki Wijaya: Department of Agribusiness, Universitas Muhammadiyah Yogyakarta, Jl. Brawijaya, Kasihan, Bantul, Yogyakarta 55183, Indonesia, e-mail: okiwijaya@umy.ac.id

Sofa Nur Azizah: Alumni of Gifu University, Yanagido 1-1, Gifu 501193, Japan, e-mail: sofa.nura@gmail.com

Anggit Candra Pratama: Department of Agribusiness, Universitas Muhammadiyah Yogyakarta, Jl. Brawijaya, Kasihan, Bantul, Yogyakarta 55183, Indonesia, e-mail: anggitcandra123@gmail.com

Yudhi Pramudya: Politeknik LPP Yogyakarta, Jl. Urip Sumoharjo No. 1, Klitren, Gondokusuman, Kota Yogyakarta, Yogyakarta 55222, Indonesia, e-mail: pramudyayudhi@polteklpp.ac.id

Fajar Novianto: Center for Research and Development of Medicinal Plants and Traditional Medicine (B2P2TOOT), Jl. Raya Lawu No. 11, Tawangmangu, Karanganyar, Central Java 57792, Indonesia, e-mail: dr.fajarnovianto@gmail.com

Farrah Fadhillah Hanum: Universitas Ahmad Dahlan, Jl. Kapas No. 9, Semaki, Umbulharjo, Kota Yogyakarta, Yogyakarta 55166, Indonesia, e-mail: farrah.hanum@che.uad.ac.id

Ali Rahmat: National Research and Innovation Agency, Jl. Raya Jakarta-Bogor, Cibinong, Bogor District, 16911, Indonesia, e-mail: Alyrahmat@yahoo.com

Jumakir: National Research and Innovation Agency, Jl. Samarinda, Paal V, Kota Baru, Jambi 36129, Indonesia, e-mail: jumakirvilla@gmail.com

Waluyo: National Research and Innovation Agency, Jl. Kol. H. Barlian No. 83, Palembang 30153, Indonesia, e-mail: waluyo240@yahoo.com

1 Introduction

Indonesia is located in the Ring of Fire where many volcanoes are active. Java Island has the densest population in the country. It has 16 active volcanoes, with Mount Merapi being the most active [1]. Some parts of Mount Merapi belong to the Central Java Province (Boyolali Regency, Klaten Regency, and Magelang Regency), whereas some parts belong to the Special Region of Yogyakarta (Sleman Regency) [2]. The history of this volcano stands from hundreds of years and always leaves destruction in the surrounded areas [3]. The biggest eruption of this volcano occurred in 2010, during which many people died and were displaced. The eruption activities still continue until today at varying degrees. Although the risks and hazards in Mount Merapi are high, many people from different generations still live there. This is because despite the destruction being caused by this volcano, it benefits the area, especially in terms of farming [4]. Active volcanoes spread volcanic ashes to the land, making it fertile and suitable for agriculture [5].

Most of the people in Indonesia are working in the agricultural sector [6]. In the rural area, many of the people are working as farmers, as this livelihood seems to be the only option for them. Also, majority of the

people living in the Mount Merapi area are working as farmers [7]. Despite the risks and hazards induced by volcanic activities, many farmers still opt to live there and do farming to fulfill their needs [8]. Moreover, most of them were born and grew in this area, and the agricultural land is the most precious thing they have inherited from their ancestors. The harvest loss resulting from volcanic eruption is an added risk to farming that is already vulnerable due to high price of inputs, pest, disease attack, or price fluctuation [9].

The vulnerable situation faced by farmers leads to issues in food security [10]. In addition, majority of the farmers have a small farming land, preventing their economy from growing significantly due to the limited resources [11]. These conditions bring more food security issues among farmers [12]. Food security has also become a national and local issue, and achieving a high level of food security is difficult [13]. It has been proven that Indonesia itself is still struggling to achieve food security; the food security in each area has different degrees, or it is not even [14].

With regard to the farmers in the Mount Merapi area, they are still doing farming and facing various challenges, which may be driven by their personal motivation to fulfill their needs [15]. But it is questionable, when their farming is more risky than usual farming, especially to fulfill their food needs. Research on farmers' food security in areas with active volcanoes is scarce. Therefore, this study aimed to analyze the food security of farmers living in the Mount Merapi area.

2 Materials and methods

2.1 Study area

This study was conducted in the area of Mount Merapi, which is located in the Central Java Province and the Special Region of Yogyakarta. Four different areas of

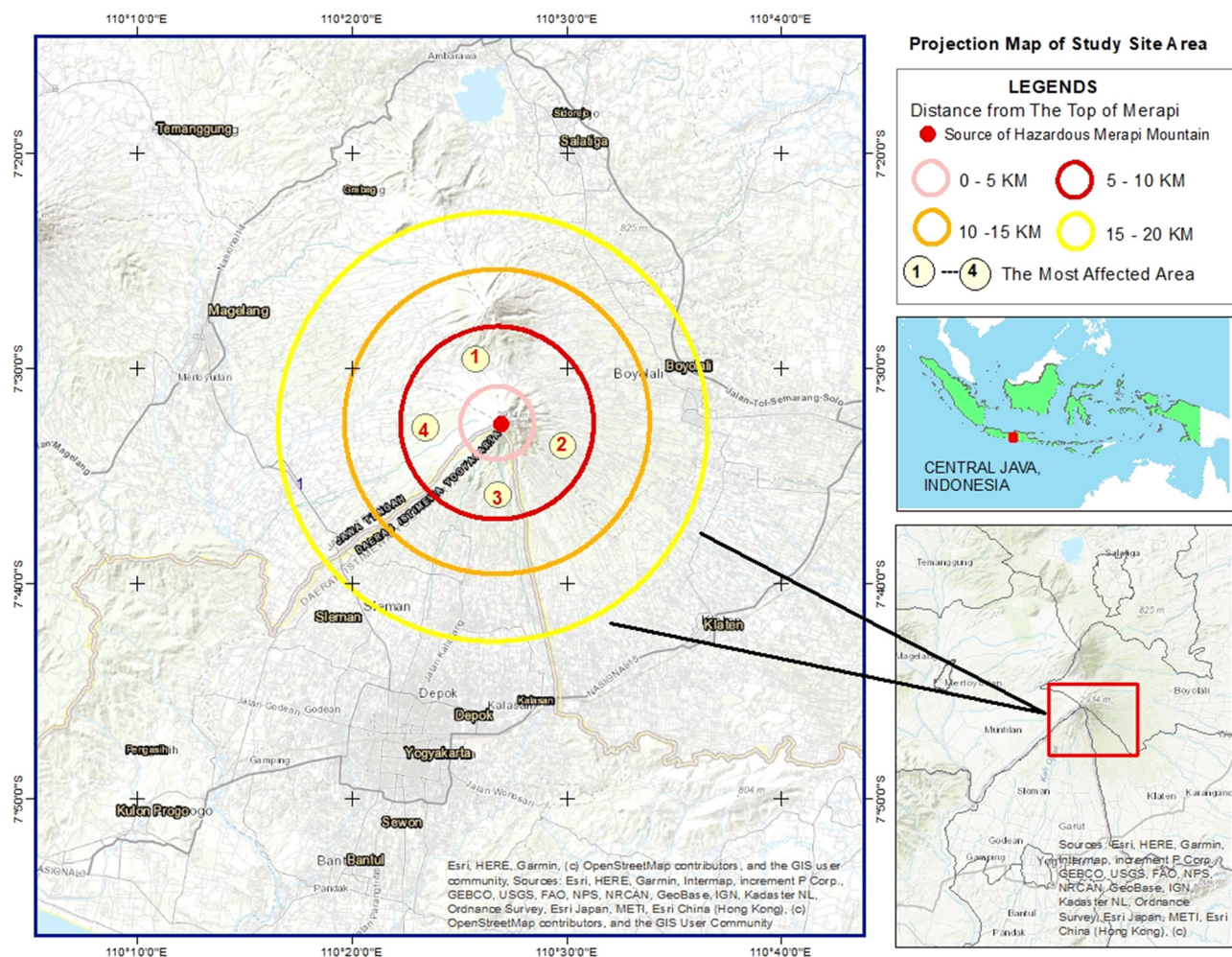


Table 1: Sample detail of each area

No.	Area	Sample
1	Jemowo Village (eastern part)	74 farmers
2	Tlogolele Village (northern part)	135 farmers
3	Krinjing Village (western part)	33 farmers
4	Glagaharjo Village (southern part)	61 farmers
	Total	303 farmers

this volcano were selected to represent the comprehensive situation in all areas, namely, the Jemowo Village (Tamansari Sub-district, Boyolali Regency) in the eastern part, Tlogolele Village (Selo Sub-district, Boyolali Regency) in the northern part, Krinjing Village (Dukun Sub-district, Magelang Regency) in the western part, and Glagaharjo Village (Cangkringan Sub-district, Sleman Regency) in the southern part (Figure 1). The criterion used was that these areas should be located within the radius of 6–10 km, which is the closest area from the top of Mount Merapi where people are allowed to live and do farming.

2.2 Sampling procedure and data collection

A total of 303 farmers from 4 different surrounding areas in Mount Merapi were involved in this study (Table 1). Based on previous eruption history, each area has different degrees of disaster impacts. The area that was

severely impacted in the 2010 eruption was the Glagaharjo Village.

Data were collected using a semi-structured questionnaire modified after the Rural Household Multiple Indicator Survey or RHoMIS (<https://www.rhomis.org/>). The food security analysis in this study focused on two main variables, namely, food availability and food utilization; each variable consisted of indicators. Such indicators were measured using Likert scale (Table 2). The factors affecting food security are demographic data, such as age, education, number of family members, farm size, and farming experience. Those variables were included in this research and later in the regression analysis as they commonly affect both social and economic farming activities [18,19]. To support the data, an in-depth interview and survey or observation were conducted. The variables and indicators in this research were chosen based on prior observation in the study area. In addition, an in-depth interview with a key informant was conducted for January 2021 eruption, during which the climax activity was on January 27, 2021 [17]. This interview was conducted to know the current conditions of the farmers living in the surrounding areas of Mount Merapi during the eruption.

Informed consent: Informed consent has been obtained from all individuals included in this study.

Ethical approval: The conducted research is not related to either human or animal use.

Table 2: Variables and indicators

No.	Variable	Indicator	Measurement
1	Food availability (FA)	1 In 1 year, there is a time when we do not have money or other resources (FA-1)	1 (strongly insecure)–5 (strongly secure)
		2 Worry about the insufficient food consumption (FA-2)	
		3 Have to pass the eat (FA-3)	
		4 Eat lesser than the ideal consumption (FA-4)	
		5 Families face food shortage (FA-5)	
		6 Feel hungry but cannot eat (FA-6)	
		7 Does not eat for a whole day (FA-7)	
2	Food utilization (FU)	1 Cannot eat healthy and nutritious food (FU-1)	1 (very rare)–5 (very often)
		2 Only eat a few kinds of foods (FU-2)	
		3 Eat meat in a week (FU-3)	
		4 Eat eggs in a week (FU-4)	
		5 Eat vegetables in a week (FU-5)	
		6 Eat fruits in a week (FU-6)	
		7 Eat corn in a week (FU-7)	
		8 Eat rice in a week (FU-8)	
		9 Eat tubers in a week (FU-9)	
		10 Eat beans in a week (FU-10)	

2.3 Analytical technique

A descriptive method was employed to present the findings. The mean value, frequency, and percentage were also used to describe the food security in four different surrounding areas of Mount Merapi, and also the total. To identify the factors that affect food security, the multiple linear regression analysis was employed, in which the demographic data of the respondents were used as the independent variables and food security as the dependent variable. Other statistical analyses that were employed in this study were Independent *T* Test for understanding whether there is difference between the food availability and food utility, and One Way ANOVA for understanding whether there is difference among regions.

3 Results and discussion

3.1 Demographic data of the respondents

3.1.1 Gender

Gender is the most common demographic data of the respondents. Male and female respondents commonly exhibit particular characteristics in terms of perception or activities; males are generally dominating the physical activities. In the agricultural sector of Indonesia, gender is also an issue of concern for many parties. In Thailand or Philippines, female farmers are quite active in agricultural activities, but in Indonesia, male farmers dominate the activities [18,19]. But this study demonstrates that females also significantly contribute to agricultural activities. In this study, the genders of the respondents are presented by area (Table 3). With random selection, male or female respondents are not divided during the interview, as long as they are representing their households.

In Jemowo, Tlogolele, and Krinjing, majority of the farmers are male (72.97, 77.04, and 57.58%, respectively); the total is dominated by male with 67%. Contrarily, Glagaharjo has a different result; it is dominated by female farmers (52.46%). During the interview, since

males were working outside, as sand miner [20,21], the interviewer met with female farmers representing their household. Aside from being related with physical activities, gender issues also arise in household management, for example, females dominated selling of agricultural products and controlling of household economy, this finding is supported by ref. [22], which reported that females are dominating the lighter agricultural activities compared with males.

3.1.2 Age

Numerous farmers in Indonesia are old. Aging farmers have become the current and future challenge in agriculture not only in Indonesia [23] but throughout the world, and this trend is raising due to low motivation of young people to work in agriculture [24]. Tlogolele, Krinjing, Glagaharjo and total show that farmers in the 28–40-year-old age range are dominating, with 37.78, 42.42, 29.51, and 30.36%, respectively. Meanwhile, Jemowo is dominated by farmers in the 41–53-year-old age range (Table 4). Based on the analyzed data, the average age of farmers from Jemowo, Tlogolele, Krinjing, Glagaharjo and total area were 53.07, 43.73, 44.49, 47.57, and 46.87, respectively. This shows that Jemowo has the highest mean age of farmers.

The older the farmers, the more vulnerable the agriculture as the human resources are not strong enough to carry out agricultural activities. Age is also included in the analysis of factors affecting food security because it tends to affect people's ability to work and perform decision-making [25]. Although this variable is not the only one that affects food security, it plays an important role in food availability and utilization.

3.1.3 Education

Education has become an important factor for people to live and survive in this modern life. With adequate education, people can perform accurate decision-making for their lives [26]. Indonesia itself already has a regulation to encourage people to study in a formal institution. It supports free education until senior high school and

Table 3: Gender of respondents

Category	Jemowo (N: 74)		Tlogolele (N: 135)		Krinjing (N: 33)		Glagaharjo (N: 61)		Total (N: 303)	
	Freq.	%	Freq.	%	Freq.	%	Freq.	%	Freq.	%
Male	54	72.97	104	77.04	19	57.58	29	47.54	206	67.99
Female	20	27.03	31	22.96	14	42.42	32	52.46	97	32.01

Table 4: Age of respondents

Category (year)	Jemowo (N: 74)		Tlogolele (N: 135)		Krinjing (N: 33)		Glagaharjo (N: 61)		Total (N: 303)	
	Freq.	%	Freq.	%	Freq.	%	Freq.	%	Freq.	%
15–27	1	1.35	19	14.07	1	3.03	7	11.48	28	9.24
28–40	9	12.16	51	37.78	14	42.42	18	29.51	92	30.36
41–53	28	37.84	31	22.96	10	30.30	12	19.67	81	26.73
54–64	20	27.03	16	11.85	6	18.18	15	24.59	57	18.81
≥65	16	21.62	18	13.33	2	6.06	9	14.75	45	14.85
Total	74	100.00	135	100.00	33	100.00	61	100.00	303	100.00
Mean	53.07		43.73		44.49		47.87		46.87	

developed the program “12 years compulsory education,” in which people are required to finish formal education until junior high school [27].

Many Indonesian farmers, aged greater than 50 years old, have low formal educational level [28]. It may be due to not high awareness regarding achieving formal education in the past [29]. Currently, in the rural areas of Indonesia, many people are hesitant to send their children to formal education. Table 5 presents the farmers’ educational background, where in all places, including total, only graduated from elementary school are dominating, with percentages of 48.65, 62.22 45.46, 54.10, and 55.45%, respectively. Tlogolele has the highest percentage of farmers who only graduated from elementary school. In all areas, many people were still found to be uneducated in formal school. Glagaharjo was found to have the highest percentage of farmers who were uneducated, i.e., 22.95%. Glagaharjo is the most severely impacted area by frequent eruptions. Therefore, low educational level might be caused by the fact that people are more motivated to protect their properties and livelihood rather than getting formal education [6].

3.1.4 Family members

In Indonesia, there is no restriction in the number of kids, but it has a campaign called *Keluarga Berencana* or

family planning to control the population [30]. This campaign motivates people to have only two kids. However, this campaign is not really effective in the rural areas. Many farmers in Indonesia have more than two kids, which is also affected by the Islam religion belief that many kids would drive a large amount of sustenance.

This study noted similar trend among the majority of the farmers to have family consisting of three or more members. Table 6 presents the number of family members that the respondents have. It can be seen that in all areas, a three-member family is common. Conversely, in Krinjing no respondent had only one family member. With many family members, farmers are more vulnerable because they need to feed more mouths with limited resources [31].

3.1.5 Farm size

Smallholder farmers are common in developing countries, including Indonesia. Farm land is an important factor of adequate food production. With limited farmland, farmers cannot produce food well [11]. Even if an intensification method exists, it is still limited [32]. Indonesia itself has only 360 m² average farm land owning by farmers. This farm size is very small to be optimized for food production, even only for farmers’ self-consumption [33].

Table 5: Education of respondents

Category	Jemowo (N: 74)		Tlogolele (N: 135)		Krinjing (N: 33)		Glagaharjo (N: 61)		Total (N: 303)	
	Freq.	%	Freq.	%	Freq.	%	Freq.	%	Freq.	%
None	7	9.46	15	11.11	3	9.09	14	22.95	39	12.87
Elementary	36	48.65	84	62.22	15	45.46	33	54.10	168	55.45
Junior	17	22.97	21	15.56	12	36.36	9	14.75	59	19.47
High	10	13.51	10	7.41	3	9.09	3	4.92	26	8.58
Diploma/Univ.	4	5.40	5	3.70	—	—	2	3.28	11	3.63
Total	74	100.00	135	100.00	33	100.00	61	100.00	303	100.00

Table 6: Family member of the respondents

Category	Jemowo (N: 74)		Tlogolele (N: 135)		Krinjing (N: 33)		Glagaharjo (N: 61)		Total (N: 303)	
	Freq.	%	Freq.	%	Freq.	%	Freq.	%	Freq.	%
≤1	2	2.70	2	1.48	—	—	2	3.28	6	1.98
2	16	21.62	32	23.70	8	24.24	18	29.51	74	24.42
3	24	32.43	44	32.59	13	39.39	19	31.15	100	33.00
4	21	28.38	39	28.89	8	24.24	15	24.59	83	27.39
≥5	11	14.86	18	13.33	4	12.12	7	11.47	40	13.20
Total	74	100.00	135	100.00	33	100.00	61	100.00	303	100.00
Mean	3.37		3.31		3.24		3.49		3.353	

This study also shows same trend where farmers are having small farm size with average of all respondent in each area and total are below 0.4 ha, they are 1841.08, 3655.89, 2875.76, 2718.83, and 2939.05 m², respectively (Table 7). In Jemowo and Glagaharjo, a 0–999 m² farm size is predominant with 33.79%. Meanwhile, Krinjing is predominated with farm size of 1,000–1,999 m² with 30.30%. Tlogolele shows the highest percentage of the farm size, i.e., over 4,000 m² with 30.37%. This area is known for vegetable production, and many farmers are optimizing their farm for commercial farming. For small-holder farmers like in this study, farm land expansion is difficult because the land prize is high, so they are trying to optimize the land they own.

3.1.6 Farming experience

The agricultural sector has many challenges. To overcome them, various changes should be done, and whether farmers will implement these changes or not will be determined depending on their knowledge, farming experience, and other motives [34]. As can be seen in Table 4, the average age of the respondents is more than 43 years old, which indicates that these farmers in general have

quite long farming experience. In the Mount Merapi area, when agriculture is the main livelihood, people usually start working in agriculture in early age.

Farming experience as one of the factors affecting the farmer's decision-making make it an important variable to be studied. In this study, the average of farming experience in all areas is more than 24 years (Table 8); it is matched with the average age, which is more than 43 years. Thus, it shows that farmers have started to farm at the age of around 20 years. Jemowo and Glagaharjo are dominated by farmers who have farming experience of more than 40 years (35.13 and 26.23%, respectively). Other areas are dominated by a range of more than 20 years. This long farming experience is expected to help farmers do better farming and accept any innovation for disaster mitigation.

3.2 Food security condition

Indonesia is still struggling to achieve food security through local food production, which is also referred to as food self-sufficiency. In achieving food security at the national level, there are four conditions that should be fulfilled: food availability, food accessibility, food stability, and food utilization. But at the household level in

Table 7: Farm size of the respondents

Category (m ²)	Jemowo (N: 74)		Tlogolele (N: 135)		Krinjing (N: 33)		Glagaharjo (N: 61)		Total (N: 303)	
	Freq.	%	Freq.	%	Freq.	%	Freq.	%	Freq.	%
0–999	25	33.79	29	21.48	6	18.18	22	36.06	82	27.07
1,000–19,999	17	22.97	34	25.19	10	30.30	17	27.87	78	25.74
2,000–2,999	17	22.97	28	20.74	7	21.21	4	6.56	56	18.48
3,000–3,999	7	9.46	3	2.22	2	6.06	4	6.56	16	5.28
≥4,000	8	10.81	41	30.37	8	24.24	14	22.95	71	23.43
Total	74	100.00	135	100.00	33	100.00	61	100.00	303	100.00
Mean (ha)	1841.08		3655.89		2875.76		2718.83		2939.05	

Table 8: Farming experience of the respondents

Category (year)	Jemowo (N:N: 74)		Tlogolele (N: 135)		Krinjing (N: 33)		Glagaharjo (N: 61)		Total (N: 303)	
	Freq.	%	Freq.	%	Freq.	%	Freq.	%	Freq.	%
0–9	4	5.41	21	15.55	2	6.06	14	22.95	41	13.53
10–19	15	20.27	32	23.70	8	24.24	9	14.75	64	21.12
20–29	11	14.87	34	25.19	9	27.27	14	22.95	68	22.44
30–39	18	24.32	25	18.52	9	27.27	8	13.11	60	19.80
≥40	26	35.13	23	17.04	5	15.16	16	26.23	70	23.11
Total	74	100.00	135	100.00	33	100.00	61	100.00	303	100.00
Mean	31.54		24.611		26.21		26.36		26.830	

Indonesia, it is common to use food availability and food utilization to measure the household food security condition. These are also used in this study.

3.2.1 Food availability

Food availability is the situation in which the available food is sufficient for the household members; it is not limited from self-food production or otherwise. Figure 2 presents the mean score of each indicator, FA-1 to FA-7; each indicator in each area has different results. FA-1 is concerned about the situation in which the farmers do not have money or other resources at a particular time in a year. In this variable, Glagaharjo has the highest score (4.07), suggesting that its situation is better compared with the other areas. Contrarily, Jemowo has the lowest score (3.38), suggesting that this area is quite drier compared with Tlogolele or Krinjing. Thus, the income of farmers is not high enough; some of them are raising livestock to support their families. FA-2 is concerned about the insufficient food, and Glagaharjo again has the highest score (4.11). This area also has the highest

score in FA-3 (have to pass the eat), FA-5 (face food shortage), FA-6 (feel hungry but cannot eat), and FA-7 (does not eat for a whole day). Glagaharjo is also the area that was severely affected by the eruption, but the farmers here seem to have sufficient food. This may be due to the livelihood diversification conducted by farmers, such as working as sand miners. Research works [7,35] demonstrated that livelihood diversification is needed for rural households to overcome the challenges that they may encounter. Meanwhile, for FA-4 (eat lesser than the ideal consumption), Tlogolele has the highest score (4.01).

The average of the total food availability variables is presented in Figure 4. Similar to the indicator of food availability in which Glagaharjo has the highest score, this area also has the highest score (4.14) in total also, followed by Tlogolele (4.01). Krinjing and Jemowo have scores of 3.95 and 3.63, respectively. The high score of Glagaharjo may be due to its economy, which is supported by sand mining. Meanwhile, the high score of Tlogolele may be due to its fertile land suitable for vegetables; this commodity has good earning and is sustainable for 1 year [36]. In one planting, farmers can harvest mixed crops at different harvest times, enabling them to

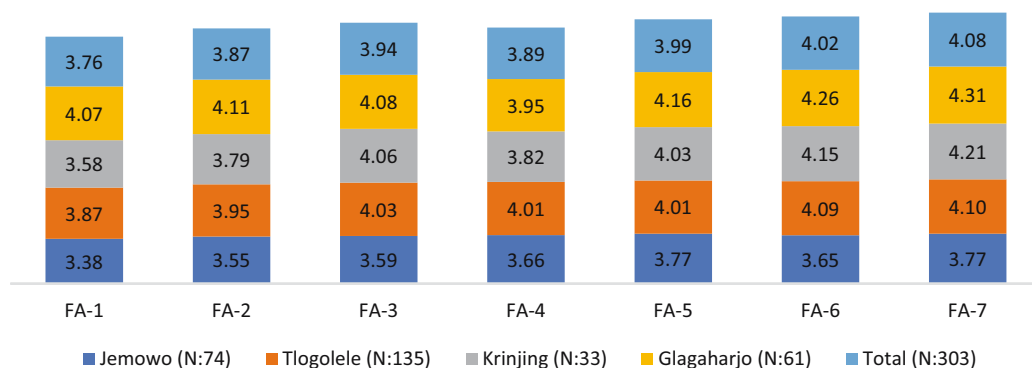


Figure 2: Mean of each indicator of food availability. FA-1 (in 1 year, there is a time when they do not have money or other resources); FA-2 (worry about the insufficient food consumption); FA-3 (have to skip the meal); FA-4 (eating less than the ideal consumption); FA-5 (families face food shortage); FA-6 (feel hungry but cannot eat); FA-7 (does not eat for a whole day).

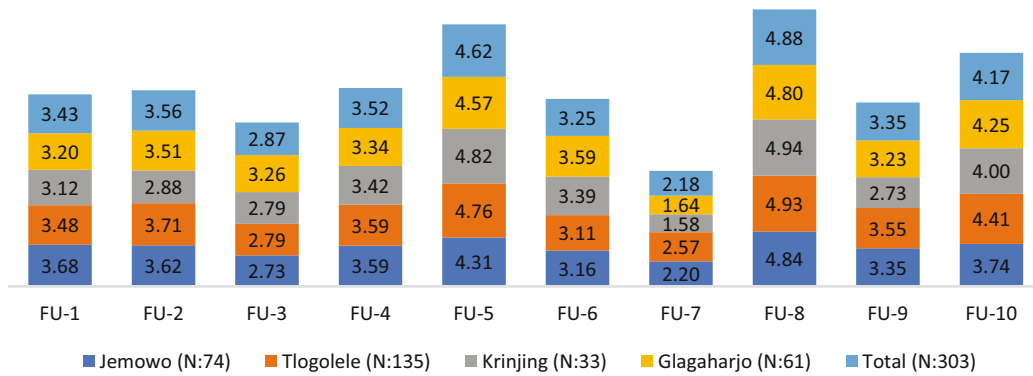


Figure 3: Mean of each indicator of food utilization. FU-1 (cannot eat healthy and nutritious food); FU-2 (consumption only of limited kinds of food); FU-3 (eating meat in a week); FU-4 (eating eggs in a week); FU-5 (eating vegetables in a week); FU-6 (eating fruits in a week); FU-7 (eating corn in a week); FU-8 (eating rice in a week); FU-9 (eating tubers in a week); and FU-10 (eating beans in a week).

earn money every month. Jemowo, which has the lowest score, has limited potency for commercial farming. The farmers in this area usually plant chili pepper, corn, and trees, such as clove and jackfruit; however, these trees cannot give enough money for the farmers' households [37]. Additionally, one way ANOVA analysis shows that there is significant difference among regions regarding this food availability utilization with p -value 0.00 which is less than 0.05.

3.2.2 Food utilization

Food utilization means people are eating sufficiently energetic and nutritious foods [31]. Ten indicators have been used to describe this variable (as presented in

Figure 3). The score of the food utilization indicator is quite different from that of the food availability indicator, in which Glagaharjo has the highest scores. The indicators in this variable show a quite different trend or score. FU-1 (cannot eat healthy and nutritious food) is seen to be below 4, Jemowo has the highest score (4.68), and Krinjing has the lowest score (3.12). It shows general condition of their daily consumption, where they think that their food utilization is not well enough, even above 3.

Rice (FU-8) and vegetables (FU-5) are being consumed well by farmers, with all scores being more than 4. Rice is a staple food in Indonesia [38], especially in the study area. People in this area eat rice every day to obtain energy from carbohydrates. Vegetables are consumed as side dishes when eating rice [39]. Vegetables are also more affordable at all economic levels compared with

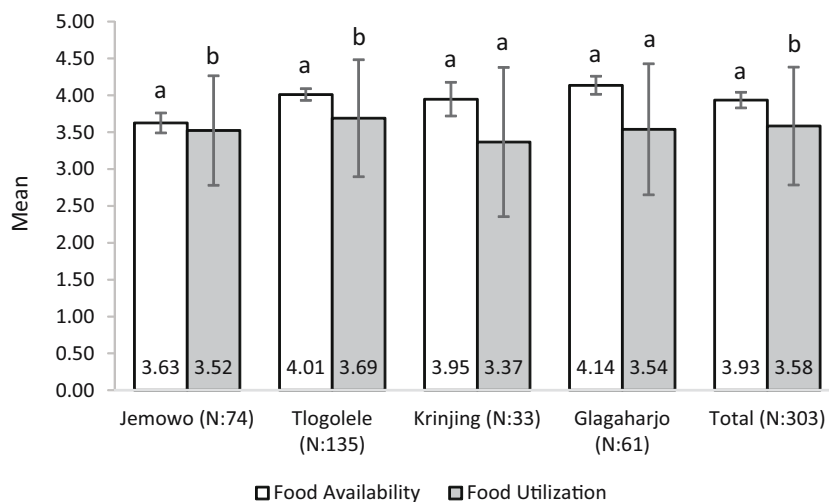


Figure 4: Mean value and standard deviation of total food availability and food utilization. Mean values $\pm$ standard deviation with different letters are significantly different ($p < 0.05$).

Table 9: Factors affecting food availability (multiple linear regression, sig.)

Variable	Food availability			Food utilization		
	Significance	Collinearity		Significance	Collinearity	
		Tolerance	VIF		Tolerance	VIF
Age	−0.054 (0.510)	0.472	2.121	0.016 (0.206)	0.472	2.121
Education	−0.075 (0.221)	0.847	1.180	0.065 (0.300)	0.847	1.180
Family member	−0.055 (0.349)	0.914	1.094	0.029 (0.628)	0.914	1.094
Farm size	0.202 (0.000)***	0.972	1.029	0.101 (0.085)*	0.972	1.029
Farming experience	−0.128 (0.125)	0.125	2.201	−0.082 (0.336)	0.454	2.201
ANOVA	0.001***			0.293		
Model summary (R^2)	0.069			0.02		

*Significance at 0.1, **Significance at 0.05, ***Significance at 0.01.

meat [40]. Glagaharjo has the highest score for FU-3 (meat), which is 3.26, whereas the other areas have scores above 2.7 but below 3. The farmers commonly eat chicken meat as it is affordable; they can also raise chicken by themselves. Farmers that also raise cows (for cow milk or cow meat) can also consume cow meat during special occasions [41]. Other sources of carbohydrate being consumed by farmers are corn and tubers, with the latter being more common in the study area. Tubers such as cassava are commonly planted in the farm field usually for own consumption [37]. Corn has the lowest score compared with the other indicators. This may be because corn is not a staple food, and some of the farmers use it for livestock feed or sell it.

Fruit (FU-6) has a score of more than 3 for all areas, with Glagaharjo having the highest score (3.59). The fruits commonly consumed by farmers are banana and papaya, as these fruits can be easily planted in their home garden. Bean (FU-10) is commonly consumed as *tempe* (fermented soybeans) or *tahu* (tofu), which is very common for Indonesian people; they call it as Indonesian traditional food [42].

The average of the food utilization variable is presented in Figure 4. The food utilization in four areas had scores below 4, which is different from the food availability results for two areas with scores over 4. Tlogolele has the highest score (3.69), followed by Glagaharjo (3.69), Jemowo (3.54), and Krinjing (3.52). The high score of Tlogolele may be because in this area, a sufficient amount of vegetables is available, and also, this area is close to the market. The standard deviation of food utilization is more widely dispersed compared with food availability, for which the standard deviation is almost zero. It might be caused by the fact that food availability is quite equal for the majority of the farmers. Comparing food availability condition in each area, Independent *T* Test analysis shows

that Jemowo, Tlogolele, and Total are significantly different, it means that in those areas, the food availability and food utilization are different, while they are significantly different in Krinjing and Glagaharjo (Figure 4). Additionally, one way ANOVA analysis shows that there are significant differences among regions regarding this food utilization with *p*-value 0.00 which is less than 0.05.

3.3 Factors affecting food security

The demographics of farmers tend to affect their decision-making ability with regard to any change in their activities, both in farming and in their daily lives [43,44]. Table 9 presents the multiple linear regression analysis results with regard to the correlation between the demographic variables and food security conditions. The variable inflation factor (VIF) for all variables are less than 10 and the tolerance values are above 0.1, so it means that there is no multicollinearity. Even though model summary shows small value of R^2 , collectively for food availability it is significant with 0.001, it shows that farmers' characteristics such as age, education, family member, farm size, and farming experience collectively affect food availability. Meanwhile, there is no significant effect on food utilization that shows that farmers are not affected by their internal factors collectively in food utilization.

Partially, only farm size has a significant effect on both food availability and food utilization, with 0.000 and 0.085, respectively. Author of ref. [45] proved that farm size has an effect on food security, this study obtained the same finding. As known that majority of farmers in Indonesia, including in this study, are small-holder farmers, this might cause this variable to have a significant correlation with food security variables where

the increase in farm size will more likely increase the food availability, they can also lead to better food utilization because they can afford more food options.

Regardless of the results of the multiple linear regression analysis, other farmers' characteristics may affect food availability and food utilization, it is based on other research findings such as from ref. [46] that found older farmers to be wise in terms of food utilization; they consume foods, taking into consideration first the nutritional values, not the taste, so the age may affect the food utilization. Research work [47] demonstrated that education has an effect on household food security, both for food availability and food utilization. In this study, education partially does not have a significant effect on food security, this may be due to the low educational level of the farmers, where the elementary school is dominating in all of the areas, and some of the farmers have did not even have formal education. This study also shows that education distribution is dominated by low education, i.e., elementary school, 55.45% (Table 5), and only 3.63% could achieve diploma of university.

The number of family members is becoming quite a challenge in the agriculture sector in Indonesia, including in this study. It is understood that the more the family members, the more mouths to feed. Therefore, food availability will decrease if there is no increase in food production. It is the same as food utilization, more family members mean farmers' households will be more aware of how to fulfill the food need, rather than aware of nutritious foods. Therefore, a family planning program is being campaigned in Indonesia, especially in the rural areas, aiming to have less family members in one household to avoid poverty and hunger. This study shows that the average number of family members in one household is more than three. Such a number is quite many for the farmers' households with limited resources. This finding is similar to previous studies [31,46].

The farming experience commonly affects farmers' farming activities, but this study shows partially that farming experience does not affect food security. Food security seems to be rather related with farmland and other resources. Therefore the food availability, especially from the self-production, cannot increase sufficiently. Farming experience has a significant positive correlation with food utilization, suggesting that as the farming experience increases, food utilization also increases. The increase in farming experience will help farmers understand the household food security condition. Thus, the farmers tend to increase food utilization for their family's health. Ref. [48] supports the fact that farming experience affects household food security.

4 Conclusion

Mount Merapi benefits the people living there with fertile land. The farmers are carrying out agricultural activities to fulfill their family's needs, including food. Food security, which is a local and national issue, has also become an issue for farmers living in the surrounding areas of Mount Merapi. Among the four areas that have been studied, Glagaharjo has the highest mean score for the food availability variable, which may be due to the livelihood diversification conducted by the farmers living there. Thus, their economy is better, and the area has increased food availability. Meanwhile, for food utilization, rice and vegetables have the highest mean score. Other carbohydrate sources that are commonly consumed are tubers and corn. Farm size has a significant effect on food availability and food utilization. Even though the effort to increase the farm size is less likely possible due to high land price, but with agriculture intensification, good agriculture management may lead to a better result for food security. Regardless of the factors affecting food security, the number of family members is likely to cause food security to decline. A family planning program seems to be a good method for controlling the number of family members in order to maintain food security, this program will likely be more effective with support from improvement of formal education. Other thing to support the farmers' food security is effective policy to guarantee access to a minimum income for the farmers who live in the poorest areas. Because the effort to reduce poverty can more likely increase the food security condition. The food security issue prevents farmers living in Mount Merapi hazard and risk area from leaving their settlements located in the surrounding of the volcano. The people, especially farmers, living in the vicinity of Mount Merapi would opt to stay there despite the challenges they may face.

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