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Study of the merapi volcano eruption and the impact on community agricultural landuse in sleman regency

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Abstract. This research was conducted with the aim to determine the distribution of agricultural areas affected by the eruption of Volcano Merapi and how the forms of mitigation and adaptation of farming communities in Sleman Regency. The study was conducted in the agricultural land area in Sleman Regency which began with conducting a survey in the field to obtain data related to the area of agricultural land affected and potentially affected by the Merapi eruption, then the research team conducted interviews with farmers regarding the impact of eruption on agricultural land. Not to forget, the research team will also calculate the losses incurred. The next step taken by the research team is processing measurement data, imagery, and maps to produce new maps. These steps will lead to the publication of disaster mitigation studies on the eruption of Volcano Merapi for agricultural land in Sleman Regency. Conclusion This research is an effort to increase the capacity of communities around Volcano Merapi if at one time they face an eruption disaster in general, still at a low level, mitigation of structural and non-structural disasters in the disaster of eruption in general is not optimal. Physical development in the effort to reduce disaster risk is still not available, as well as non-structural mitigation efforts through awareness and education efforts are also not good categories.

1. Introduction ⁶

Volcano Merapi is a Strato type volcano, with an altitude of 2980 meters above sea level. Geographically located at 7 '32.5' South Latitude and 110 '26.5' East Longitude, it is administratively located in 4 regencies namely Sleman Regency in DI Yogyakarta Province, and Magelang District, Boyolali Regency, and Klaten Regency in Central Java Province. Volcano Merapi is located on the border of two provinces D.I. Yogyakarta and Central Java, the type of Strato volcano with lava dome, elevation $\pm 2,911$ masl and have a width of ± 30 km (Bemmelen, 1949; Katili and Siswamidjojo, 1994). Eruption is the most active in Indonesia so that it gets special attention from the government and society. The history of the eruption of Volcano Merapi can be seen based on the age of rocks originating from eruption deposits, hot clouds, and lava deposits in the north, south and west [5].

The eruption of Volcano Merapi from the sixteenth century until the twentieth century experienced changes in rest periods from 71 years to 8 years, with the number of volcanic activities being 7 times to 28 times (Bronto 1996; Widiyanto and A. Rahman, 2008). The latest activity of the eruption of Volcano Merapi 12 October - 5 November 2010 is quite an eruption compared to the eruption of 1870, but smaller than the eruption in the XVI century. The Volcano of pyroclastic material produced by eruption is estimated at more than 140 million m [1].

The presence of Volcano Merapi has a lot of impact on the area on the slopes of the Volcano, both positive and negative impacts. The positive impact that resulted from the eruption of Volcano Merapi was the volcanic ash material which gave a positive effect on increasing soil fertility. In addition, large solid



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materials (bombs) are often used as one of the building materials. Before enjoying the positive effects of the Merapi eruption, people affected by the eruption experienced the negative impact of the eruption, including the destruction of agricultural land. In land use, the composition of the largest land use on the slopes of Volcano Merapi is agricultural land, both in the form of paddy fields and non-rice fields.

Merapi has high social and economic aspects for the progress of the surrounding community. The social aspects related to the existence of Merapi include: being a vehicle for preserving Javanese traditions or culture, becoming an adhesive for the unity and unity of the Javanese community. In terms of economic aspects, the material of Merapi, in addition to being a class C mining resource that can be exploited for a long period of time, also provides potential soil fertility for agricultural and plantation land, except that most of the Merapi region is a tourist attraction that benefits the community's income and area [5].

In the field of agriculture, Merapi plays an important role in supplying minerals needed by plants. Like when there was an eruption in 2010, the volcanic ash released by Merapi was very good for the plants planted by the surrounding population. It's just that the use of agricultural land affected by the eruption cannot be directly utilized as agricultural land. It needs some rehabilitation of the land after the eruption so that the mineral content carried by Merapi volcanic ash has a positive impact on the plants around Volcano Merapi.

The land around Merapi is dominated by volcanic soil, given its location on the slopes of Merapi. Under these conditions the surrounding community manages and uses it to become agricultural land. Sleman Regency is a district that benefits from the existence of Merapi. With the right use of land, Sleman Regency has been named as one of Indonesia's rice barns. Eruption in 2010 has totally changed the economic conditions of the surrounding community. Damage and loss occur along with the occurrence of volcanic eruptions. Not only losses in the social sector such as housing, loss of property, but also losses have an impact on economic losses for surrounding communities such as agriculture, animal husbandry, industry, tourism. And also the damage that occurs affects the environment around the Volcano slopes. There are two formulations of the problems that will be discussed in this study, namely 1). How far is the impact of the Merapi eruption on community farms in Sleman Regency? And 2). How are the mitigation and adaptation efforts carried out by farming communities in Sleman Regency? Then, this research was conducted with the aim to determine the distribution of agricultural areas affected by the eruption of Volcano Merapi and how the forms of mitigation and adaptation of farming communities in Sleman Regency.

2. Method

The research conducted is quantitative and qualitative research. The research location is in Cangkringan Subdistrict, Sleman Regency, which is the most affected area of Volcano Merapi eruption. With a population that works as farmers. Sampling techniques Field surveys and interviews. Field data collection was carried out for: The condition of the farmland that was associated with changes in land use in Sleman Regency after the eruption of Volcano Merapi. Obtain information from the community regarding soil conditions and adaptations that have been carried out in the face of the eruption of Volcano Merapi at the study site. Making maps in the GIS format in the form of a map of land use change at the study site that aims to provide an overview of the eruption of Volcano Merapi that occurred at the study site. The data analysis technique uses descriptive analysis.

3. Results and Discussion

Merapi is located in four administrative regions, namely Sleman Regency in the Special Province of Yogyakarta, and Klaten, Boyolali, and Magelang Districts in Central Java Province. Cangkringan is one of the Sleman sub-districts closest to the peak of Merapi (precisely in Umbulharjo village, Kinahrejo hamlet. Administratively, Cangkringan sub-district is divided into five rural areas, namely: Umbulharjo village, Wukirsari village Kephurejo village, Glagaharjo village, and Argomulyo village. Umbulharjo Village, Kinahrejo Hamlet, Cangkringan Sub-District is in the northeast of the Sleman Regency Capital. The distance of the District Capital to the Government Center of Sleman Regency is 25 Km or is located +25 in the North Central Government of DI Yogyakarta Province.

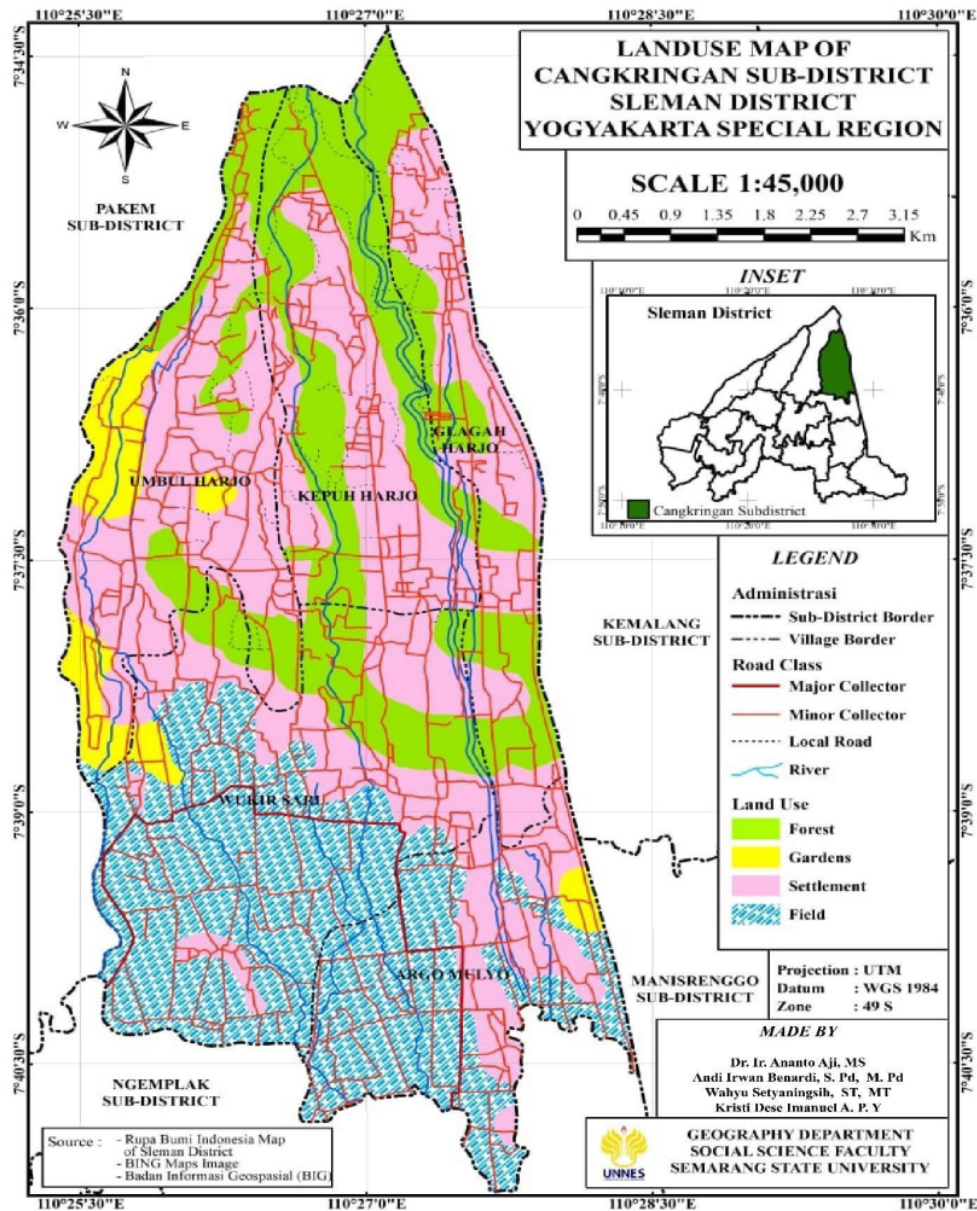


Figure 1. Landuse map of Cangkringan Sub-District sleman Distric Yogyakarta Special Region

3.1. Impact of the Merapi eruption on community agricultural land in Sleman Regency

Innovation-Based Agricultural Development in the Volcano Merapi Eruption Disaster Area of hot lava flows, such as Kali Gendol for the Merapi case. For example, even though it is in the fourth ring location there are still dangerous areas and in these areas many residents and livestock are victims. Conversely, residents living in the ring one can survive the disaster and be evacuated before an eruption or this area is not the direction of lava and hot clouds.

Merapi eruption damaged farmers' settlements, so that they had to flee to the refugee camp. The closeness of farmers to their land, plants and livestock causes farmers not to be moved to certain locations only by expecting help from others. Therefore, because the disaster of Merapi eruption occurs repeatedly, the government should have provided the land used as shelters with the criteria that farmers can live as decent as a family and can continue to carry out farming activities at a safe distance from the disaster and reach the original village so that they are easily involved in restoring settlements and agricultural land in their home villages.

3.2. Utilization of Land on the Slopes of Merapi

As a result of the eruption of Volcano Merapi, it caused changes in both land resources and agricultural infrastructure around Volcano Merapi. Volcanic ash is essentially carrying many kinds of nutrients to increase soil fertility, but it takes time to decay and release the nutrients for plants. For the time being, volcanic ash covering the ground becomes hard like cement, so that if it rains it will increase surface runoff which encourages erosion, landslides and floods. Therefore, before fertilization efforts are carried out, first a good soil treatment is needed. In terms of land use use, the largest composition of land use around Gunung Merapi is for agriculture, both in the form of rice and non-rice farming. Eruption or eruption of Volcano Merapi indirectly affects the social life of the surrounding community, both in terms of settlement and livelihood. The livelihoods of the majority of the people use fertile land because there are many nutrients that are good for plants. As is well known, the area around the slopes of the volcano has good and fertile soil quality.

Table 1. Land Use of Cangkringan Subdistrict, Sleman Regency 2019

No	Village	Forest	Gardens	Settlement	Field
1	Umbul Harjo	182,25 ha	222,75 ha	444,5 ha	60,75 ha
2	Kepuh Harjo	333,7 ha	0	263 ha	0
3	Glagah Harjo	303,7 ha	0	344 ha	0
4	Argo Mulyo	0	20 ha	243 ha	425 ha
5	Wukir Sari	202,5 ha	30 ha	283,5 ha	1174,5 ha

Source: Results of Research Data Analysis, 2019

Agricultural land in the area affected by the eruption of Volcano Merapi is relatively fertile agricultural land. Use consists of dry fields, dry land agriculture, mixed gardens / gardens, and settlements. Each farmer is almost certain to plant one of the staple or intercropped food crops from several combinations such as the following: rice, corn, cassava, sweet potatoes and peanuts. Some seasonal crops that are considered to have high economic value planted by farmers include: chili, tomatoes, beans, cucumber, long beans, scallion and ginger. Many ginger plants are cultivated by i in Cangkringan Subdistrict, while chrysanthemum flowers have many plants in Pakem and Cangkringan sub-districts. Water resources in Sleman Regency consist of groundwater (aquifers) and springs and surface water.

The typical physical properties of Merapi ash are that when it falls to the surface of the soil it causes the ash to quickly harden and is difficult to penetrate by water either from above or from below the surface. The Merapi eruption caused the deaths of various types of livestock raised by the community which caused huge economic losses. Livestock deaths occur in beef cattle, dairy cows, goats, sheep and poultry, while

buffalo cattle are reported not to have died [4]. It can be seen that the mortality of cattle in Sleman Regency is far greater than in other regions. This is because when the eruption occurs clouds and hot lava movements move more towards Sleman Regency [7].

3.3. Mitigation and adaptation efforts carried out by farming communities in Sleman Regency

Damage to agricultural infrastructure is generally caused by cold lava flows, which damage dams, intakes, irrigation channels and agricultural land. Repairing the irrigation network is urgent to be done at the location of the location of the threat of the cold lava subsiding. Considering that the volcanic material deposits that have not dropped (still at the peak of Merapi) are quite large, in the river lanes prone to cold lava floods, irrigation network repairs are not urgent to do. Anticipation that can be done to fulfill water for agricultural and domestic needs is the need to identify alternative water resources and their exploitation technology. Survey_ investigation of water resources needs to be done both for surface water and deep groundwater. Water quality is not much affected by the Merapi eruption, except that the mud content is quite high on several large rivers so it is not suitable for drinking and bathing. ⁴

Efforts to increase community participation in natural disaster management (especially in the risk reduction of the Merapi Cangkringan Eruption disaster) have been made as a commitment of the nation. This condition is reflected in various programs and activities to improve community preparedness in disaster management that entered Cangkringan. These programs and activities include:

3.3.1. Disaster Alert Village

The Social Minister Regulation of the Republic of Indonesia Number 128 of 2011 concerning Disaster Alert Villages Article 1 point 1 explains that the Disaster Alert Village (KSB) is a community-based disaster management forum that is used as a disaster management area. In Cangkringan, a KSB was formed in the village of Umbulharjo. The Umbulharjo Cangkringan disaster standby village was inaugurated by the Minister of Social Affairs on Wednesday, December 12, 2011. It is hoped that disaster alert villages consisting of community elements can minimize casualties during natural disasters (Harianjogja.com, 2011). According to the Chief of KSB Umbulharjo: Umbulharjo village is the place for the jujagan (main destination) of the community in the process of rescue. As hosts, we must have readiness to entertain them, well ... at least drinking water. We are grateful that our village has been made as KSB. Umbulharjo already has social substations, and social barns. The social substation is a permanent building for the operationalization of the KSB secretariat, and the Social Barn is a permanent building as a place to store buffer stock and inventory of disaster preparedness goods. In the framework of optimizing activities in the disaster management of West Sumbawa supported by participant pillars such as: 1) Community Social Workers (PSM); 2) Youth Organization; 3) Social Organizations (Social Organization); 4) Disaster Preparedness Cadets (TAGANA). The pillar of the intended participants came from the local community who had received training and were facilitated by both the Ministry of Social Affairs and the local government.

3.3.2. Resilient Disaster Village (DTB)

Kepuharjo village and Wukirsari village have been ⁴ appointed by the Regional Disaster Management Agency (BPBD) of Sleman Regency as a DTB. Regulation of the Head of the National Disaster Management ⁴ Agency Number 1 of 2012 concerning General Guidelines for Resilient Village / Village Disasters. Tangguh Bencana Village / Village is a village / kelurahan that has an independent capacity to adapt and deal with potential disaster threats, as well as immediately recover from the adverse effects of disasters. Three villages have been designated in Sleman as Tangguh Bencana Village, namely Sindumartani Village, Ngemplak District, Kepuharjo Village and Wukirsari Village, Cangkringan District, Sindumartani Village. ⁵

⁷ 3.3. Youth Care for Disasters

Decree of the Minister of Health of the Republic of Indonesia number 406 / Menkes / SK / IV / 2008 concerning the Formation of Disaster Preparedness Youth (Dasipena). In this decree, it was explained that

Dasipena was a Youth component container established to support health efforts in disaster management in each region. The organizing system from Dasipena is carried out in stages from the center, the provinces to the districts. Communities involved as members are representatives of youth organizations that have been trained.

3.3.4. Disaster Preparedness School

Preparedness in overall disaster management, in Cangkringan has been supported by the Disaster Preparedness School. Based on the Circular of the Minister of National Education Number 70a / MPN / SE / 2010 on Mainstreaming Disaster Risk Reduction in Schools to Regional Heads, Education Offices, Regional Disaster Management Agencies (BPBD), and related agencies the Sleman District Government has appointed two schools namely Schools Muhammadiyah Cangkringan Vocational Middle School (SMK) and Cangkringan 2 Middle School as a Disaster Preparedness School. Activities that have been carried out by Cangkringan Muhammadiyah Vocational School include socialization of Disaster Risk Reduction (DRR), Training and preparation of DRR curriculum integrated into the school curriculum. Training for teachers and students in terms of the Indonesian Red Cross (PMI), Search and Rescue (SAR), First Aid for Accidents (first aid), Public Kitchen, and Communication. Preparation of contingency plans for the Merapi Volcano cold lava flood disaster and the Merapi volcanic rain / drone disaster simulation (Dishubkominfo DIY, 2014).

4. Conclusion

Impact of the Merapi eruption on community agricultural land in Sleman Regency. At the time of the Merapi disaster, there were at least three main factors faced by farmers, namely damaged housing conditions, damaged and non-productive business land and influencing household income and non-functioning business institutions. Therefore, efforts need to be made to deal with these three factors so that farmers suffer less. To be able to make efforts to reduce the risk, data and information are needed regarding the impact of the Merapi eruption on the socio-economic conditions of the population. Farmers realize that settling around Merapi will face an eruption disaster, but they think it is part of life because it gives blessings to fertilize the land that is part of life as a farmer, so that the slopes of Merapi are still crowded with settlements. History shows that it is impossible to relocate farmers from the slopes of Merapi. What can be done is to make efforts to minimize the risks faced by farmers. For this reason, the steps that can be taken are to build a system and provide infrastructure for an adequate evacuation and evacuation process by involving community participation around Merapi. These efforts continue to be carried out continuously in accordance with the behavior of the Merapi eruption.

Mitigation and adaptation efforts carried out by farming communities in Sleman Regency. Damage to agricultural infrastructure is generally caused by cold lava flows, which damage dams, intakes, irrigation channels and agricultural land. Repairing the irrigation network is urgent to be done at the location of the location of the threat of the cold lava subsiding. Considering that the volcanic material deposits that have not dropped (still at the peak of Merapi) are quite large, in the river lanes prone to cold lava floods, irrigation network repairs are not urgent to do. Anticipation that can be done to fulfill water for agricultural and domestic needs is the need to identify alternative water resources and their exploitation technology. Continue to review and update data to facilitate the development planning of the affected agricultural sector.

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