

Analysis of the Impact of Flash Floods and Cold Lava Floods on Mount Marapi, West Sumatra 2024

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ABSTRACT

The areas affected by flash floods and cold lava floods from Mount Marapi are Agam Regency, Tanah Datar Regency, Padang Panjang City, and Padang Pariaman Regency which occurred on Saturday, May 11 2024. This flood has caused significant material and non-material losses for the local community. This research aims to obtain information about the affected areas, find out the causes and solutions. The cause of flash floods and cold lava floods on Mount Marapi occurred due to moderate to very heavy rain in the local area. Material losses have reached Rp. 516 billion more, 63 people died, 50 people were injured and 10 people were declared missing. It was recorded that 1,210 houses, 1,102 irrigation facilities and 53 roads were damaged and destroyed. Apart from the loss of life and houses, other damage impacts were 232 trading units, 39 houses of worship, 886,793 hectares of agricultural land and rice fields, 15 units of educational facilities, 54 units of bridges, 15,168 heads of livestock (cows, buffaloes, goats, chickens, ducks) and dozens of thousand tons of fish. The solution to this flood is that the government can plan to relocate affected houses, repair transportation routes and also operate Weather Modification Technology.

Keywords: *Flash floods, cold lava floods, impacts, causes, solutions.*

1. INTRODUCTION

The territory of Indonesia, in addition to its natural beauty, is also a country prone to disasters, both natural disasters and disasters caused by human actions itself. Most of Indonesia is at high risk of natural disasters. The risk is apparently caused by several factors, including first, Indonesia is traversed by the Pacific Circumference or Pacific Ring of Fire which is at risk or prone to earthquakes, volcanoes and others due to volcanic activity. The second factor is that Indonesia is an Alpid Belt region, meaning a seismic belt formed from the meeting of the Eurasian plates, the India Plate and the Australia Plate. This makes the Alpid belt the second most earthquake-prone region in the world. And the last factor is that Indonesia is in the Tropics (equator) which can be at risk of storms, typhoons, and also tropical cyclones, landslides, and floods (BNPB, 2020).

West Sumatra is a province in Indonesia located on the island of Sumatra with the capital city of Padang. West Sumatra Province is located along the west coast of central Sumatra, the Bukit Barisan plateau to the east, and a number of islands off its coast such as the Mentawai Islands. From north to south, the province with an area of 42,012.89 km² borders four provinces, namely North Sumatra, Riau, Jambi, and Bengkulu. Like other regions in Indonesia, the climate of West Sumatra is generally tropical with a fairly high air temperature, which is between 22.6 °C to 31.5 °C. This province is also traversed by the Equator, precisely in Bonjol, Pasaman. In this province, there are a number of large rivers that drain into the east coast of Sumatra such as Batang Hari, Siak, Inderagiri (referred to as Batang Kuantan in the upstream part), and Kampar. Meanwhile, the rivers that drain into the west coast are Batang Anai, Batang Arau, and Batang Tarusan.

Coordinating Minister for Human Development and Culture Muhadjir Effendy said that West Sumatra (West Sumatra) is a disaster-prone area. He continues to coordinate with relevant parties to find permanent solutions to floods and landslides in West Sumatra. West Sumatra is the province with the highest risk among other provinces in Indonesia, because in 2023 alone, of the 5,400 disaster events in Indonesia, 460 of them occurred in West Sumatra (Sanjaya 2024). Based on the disaster profile of West Sumatra Province for the period 2014 – 2022, there have been 6,274 natural disasters spread across 6 (six) types of natural disasters (other than earthquakes and tsunamis) that

always occur repeatedly every year in the territory of West Sumatra Province, with the composition; strong winds 3,505 incidents (55.9%), landslides 1,161 incidents (19.5%), floods 853 incidents (13.6%), forest and land fires 609 incidents (9.7%), flash floods 107 incidents (1.7%), and coastal aberration 39 incidents (0.6%). In the period of January – October 2023, based on provisional data from the West Sumatra Provincial PB Pusdalops, there have been 364 disaster events in all regencies/cities with the highest frequency still being strong wind disasters with 202 incidents, then landslides 61 incidents and floods 53 incidents (BPBD West Sumatra Province, 2023).

2. LITERATURE REVIEW

Disaster is an event or series of events that threaten and disrupt people's lives and livelihoods caused by, either natural and/or non-natural factors or human factors resulting in human casualties, environmental damage, property losses and psychological impacts (Law No. 24 of 2007). Floods are one of the disasters that often occur in Indonesia due to human actions themselves. There are still many Indonesia people who do not pay attention to the surrounding environment, such as illegal logging of forests and littering.

In the RBI (Indonesia Disaster Risk) book on page 40 Flooding is defined as a drastic increase in the flow of rivers, ponds, lakes, and others where the excess flow inundates out of the water body (Smith & Ward 1998). If an event of submersion in water in an area threatens and disrupts people's lives and livelihoods, resulting in human casualties, environmental damage, property losses, and psychological impacts, the flood can be called a Flood Disaster (Reed 1995).

Flash flooding is the flow of sediment masses (sand, gravel, rocks and water) in a single unit at high speed. It occurs because the static equilibrium between the shear forces induced by the flow is greater than the shear forces of the sediment masses that hold it. Because this flowing mass has an acceleration, its height and speed will always increase, and at a certain limit the situation becomes unstable so that the sediment mass rises rapidly which causes flash floods. (Maryono A., 2005). The areas affected by the flash flood disaster include Agam Regency, Tanah Datar Regency, Padang Panjang City and Padang Pariaman Regency. These floods have caused significant material and non-material losses to the local community. This impact has disrupted socio-economic activities, destroying infrastructure and public facilities.

Cold lava floods are a type of natural disaster caused by volcanic activity (Nasarudin, 2022). This phenomenon occurs when a volcano erupts, producing lava flows that trigger the release of volcanic material such as ash, sand, and large rocks. The materials are then dragged by lava flows, which under certain conditions can create a very dangerous mud mixture. Cold lava forms when rainwater mixes with volcanic material, resulting in mud flows that can move quickly down the mountainside. This process is often characterized by unexpected movements, which can destroy everything in its path and drastically change the landscape. Cold lava floods have the potential to cause major damage to infrastructure, settlements, and agricultural land, as well as threaten the safety of people living around vulnerable areas. In addition, environmental pollution due to volcanic materials carried along with cold lava can also have long-term impacts on human health and ecosystems. Therefore, a deep understanding of the characteristics and causes of cold lava floods is essential to improve mitigation and mitigation efforts for this natural disaster.

3. METHODS

The research method used is a qualitative research method. This research was conducted in the province of West Sumatra based on analysis, observation or observation of flash floods and cold lava floods of Mount Merapi. The author makes indirect observations through social media such as Instagram, Tiktok, Youtube and others. In this analysis, the researcher obtained data obtained from various sources, including data from the National Disaster Management Agency (BNPB) and the West Sumatra Regional Disaster Management Agency (BPBD). The purpose of this study is to identify the affected areas and analyze the factors that cause flash floods and cold lava floods of Mount Merapi. Another purpose is to find out the impact and losses caused by this flood, both material and non-material

4. RESULTS AND DISCUSSION

Flood-prone areas are areas that have a high risk of flooding which can cause various negative impacts such as casualties and injuries, property damage, economic losses, environmental damage, and clean water crises (Sugandhi et al., 2023). Prevention and preparedness are critical in mitigating

the impact of floods, including early warning, flood infrastructure development, community education, and weather monitoring. Floods are natural disasters that often cause adverse impacts and can affect human life, the economy, and the environment, so appropriate mitigation and adaptation efforts are needed to protect people and their assets (Rakuasa et al., 2023).

Areas affected by the flash flood and cold lava flood of Mount Marapi in West Sumatra Province include Agam Regency, Tanah Datar Regency, Padang Panjang City, and Padang Pariaman Regency which occurred on Saturday, May 11, 2024. Flood This occurred due to several factors, including moderate to very heavy rain in the upstream area of Mount Marapi, piles of fallen tree material in the Batang Anai river valley which forms a natural dam, and the impact of the Mount Marapi volcanic earthquake. Material losses have reached more than Rp. 516 billion, 63 people have died, and 10 people have been declared missing. It was recorded that 1,210 houses were damaged, 1,102 irrigated, and 53 roads were destroyed. In addition to casualties and houses, other impacts were 232 trading units, 39 houses of worship, 886,793 hectares of agricultural land and rice fields, 15 units of educational facilities, 54 units of bridges, 15,168 livestock (cows, buffaloes, goats, chickens, ducks) and tens of thousands of tons of fish.

4.1 Agam Regency

Agam Regency was hit by flash floods and landslides that were quite severe throughout Saturday, May 11, 2024, as many as 6 sub-districts were recorded, including IV Koto District, Canduang District, Sungai Pua District, and Ampek Angkek District. The total number of victims in Agam Regency is 285 people, including 24 dead, 22 injured, and 239 displaced (BPBD West Sumatra).



Figure 1. Post-Flood Conditions in Agam Regency

4.2 Tanah Datar Regency

Flash floods and cold lava floods of Mount Marapi hit five sub-districts in Tanah Datar Regency, including X Koto District, Batipuh District, Pariangan District, Lima Kaum District, and Sungai Tarab District. The total number of victims in Tanah Datar is 3,093 people, of which 32 died, 21 were injured, 10 were missing and 3,030 people were displaced (BPBD West Sumatra).



Figure 2. Post-Flood Conditions in Tanah Datar Regency

4.3 Padang Panjang City

Flash floods and cold lava floods of Mount Marapi hit two sub-districts in Padang Panjang City, including West Padang Panjang District, and East Padang Panjang District. The total number of victims in Tanah Datar was 201 people, including 2 dead, 1 injured, and 198 people displaced (BPBD West Sumatra).



Figure 3. Post-Flood Conditions in Padang Panjang City

4.4 Padang Pariaman Regency

Flash floods and cold lava floods of Mount Marapi resulted in 35 families in Padang Pariaman Regency being evacuated (BPBD West Sumatra).

4.5 Efforts made after the flood

The search process for flash flood victims in West Sumatra took place from May 12 to June 9, 2024, involving various agencies and volunteers who worked in a coordinated manner. A joint SAR team consisting of the TNI, the Regional Disaster Management Agency (BPBD), and volunteer personnel, was deployed to conduct search and evacuation in the affected areas. In carrying out its duties, this team faced various challenges, including difficult terrain and uncertain weather, but remained committed to reaching every point suspected of being the location of the victim.

BNPB continues to conduct regular data reviews and updates to ensure that all up-to-date information regarding the location and condition of victims can be managed properly. These efforts include collecting information from the community, monitoring through technology, and

collaborating with various parties who have expertise in disaster management. In addition, BNPB also seeks to strengthen communication and coordination between the SAR team and local volunteers so that every search step can be carried out effectively and efficiently.

In this process, many volunteers showed extraordinary enthusiasm, assisting the SAR team in various tasks, such as searching in hard-to-access locations, providing logistics, to psychological support for the victims' families. Their existence means a lot in easing the burden on the team and providing hope for families who are still waiting for news about their loved ones. With all the efforts made, the hope of finding survivors remains, while the evacuation process also continues for those who need immediate assistance.

After the occurrence of cold lava floods, there are several impacts of flooding. For this reason, the government has taken steps to help farmers whose land was destroyed by the cold lava flood of Mount Marapi in West Sumatra, including the Ministry of Agriculture to prepare alternative fertilizers and seeds for agricultural land that failed to harvest. "There is a puso of 450 ha. We change the fertilizer and seeds for the puso. We are increasing agricultural machinery tools. We will check the field directly today," said Minister of Agriculture Andi Amran Sulaiman after giving a public lecture at Padang State University, Saturday (18/5/2024).

The government also plans to relocate houses along the river, which are most affected. "Regarding the relocation, we are assessing, we have given recommendations at the transition stage of reconstruction rehabilitation whether there is relocation, if there is relocation, the local government will prepare the land and the central government will then build. If it is not relocated, we will prepare other alternatives, such as repairs," said TNI Lieutenant General Suharyanto. For damaged houses, they will also receive government assistance, namely IDR 15 million for light damage, IDR 30 million for moderate damage, and IDR 60 million for severe damage.

Solution

Flash floods and cold lava floods caused by the activities of Mount Merapi have caused quite destructive impacts, both in terms of material and non-material, for the local community. The losses experienced by residents are not only limited to the loss of property, but also include the loss of very precious human lives, which of course leaves deep grief for the families left behind. In addition, this disaster disrupts socio-economic activities which are the backbone of people's lives, thereby worsening the condition of the local economy which is already vulnerable. Infrastructure that supports daily life, such as roads, bridges, and other public facilities, has been severely damaged, hindering people's mobility and access to basic services.

In this context, it is important to emphasize the need for comprehensive flood planning and mitigation, which includes proper risk assessments in order to predict and mitigate the impact of these disasters. One of the strategic steps that can be taken is the development of better infrastructure and in accordance with the characteristics of disaster-prone areas. The infrastructure must be designed not only to withstand the effects of disasters, but also to facilitate quick and safe evacuations for people. In addition, raising public awareness about the dangers posed by flash floods and cold lava is crucial. Education on the steps that need to be taken before, during, and after a disaster is very important to minimize the risk of sustainable negative impacts, as well as increase disaster management capacity by building an early warning system and a better disaster management system.

5. CONCLUSION

The flash floods and cold lava floods of Mount Marapi that occurred in Agam Regency, Tanah Datar Regency, Padang Panjang City, and Padang Pariaman Regency, West Sumatra on May 11, 2024, have caused significant material and non-material losses to the community. Material losses have reached more than Rp. 516 billion, 63 people died, 50 people were injured and 10 people were declared missing. It was recorded that 1,210 houses were damaged, 1,102 irrigated, and 53 roads were destroyed. In addition to casualties and houses, other impacts were 232 trading units, 39 houses of worship, 886,793 hectares of agricultural land and rice fields, 15 units of educational facilities, 54 units of bridges, 15,168 livestock (cows, buffaloes, goats, chickens, ducks) and tens of thousands of tons of fish.

Flash floods and cold lava floods in West Sumatra occurred due to several factors, including moderate to very heavy rain in the upstream area of Mount Marapi, piles of fallen tree material in the Batang Anai river valley that forms natural dams, and the impact of the Mount Marapi volcanic earthquake. Flash floods and cold lava floods of Mount Marapi have disrupted socio-economic activities, destroying infrastructure and public facilities. To reduce the impact of flash floods, the

government must take appropriate steps, such as building better infrastructure, increasing public awareness about the dangers of flash floods, the government must help victims by providing material and non-material assistance, such as houses, infrastructure, and public facilities, and the government must increase disaster management capacity by building an early warning system and a better disaster management system good.

Public education should include knowledge of ways to deal with floods, as well as training to deal with emergency situations. In this case, support for disaster victims must also be a priority, by providing the necessary material and non-material assistance so that they can recover immediately and continue their lives. In addition, there is a need to increase disaster management capacity through the development of an early warning system and a more effective disaster management system. This system will allow the public to get accurate and timely information about potential threats, so that they can take the necessary preventive measures. With these measures, it is hoped that the impact of disasters can be minimized, and community resilience to disasters can be significantly improved.

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