

PEMETAAN DAERAH RAWAN PANGAN AKIBAT BANJIR BANDANG GALODO DI KABUPATEN TANAH DATAR

ANALYSIS OF FOOD-VURNERABLE AREAS DUE TO GALODO FLOOD I TANAH DATAR REGENCY

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ABSTRAK

Kabupaten Tanah Datar sebagai sentra produksi padi nasional mengalami dampak signifikan terhadap ketahanan pangan akibat banjir bandang (galodo) pada 11 Mei 2024. Bencana ini mengakibatkan kerusakan lahan pertanian dan gagal panen yang mengancam pasokan pangan. Penelitian ini bertujuan untuk memetakan zonasi wilayah rawan pangan pascabencana berdasarkan analisis spasial yang komprehensif. Penelitian menggunakan pendekatan Food Disaster Overlap Mapping (FDOM) dalam platform Sistem Informasi Geografis (SIG). Teknik ini menggabungkan tiga indikator utama: bahaya banjir, kerentanan sosial-ekonomi, dan kapasitas adaptif masyarakat. Analisis menghasilkan peta zonasi dengan tiga kategori kerawanan pangan: (1) Zona Sangat Rawan teridentifikasi di daerah dengan kerusakan irigasi parah dan gangguan distribusi pangan; (2) Zona Rawan Sedang berada pada lahan dengan kerusakan parsial; dan (3) Zona Rawan Rendah dicirikan oleh akses distribusi yang masih lancar. Secara kuantitatif, bencana merusak 511,521 hektar sawah dan menyebabkan gagal panen 2.900,32 ton yang berdampak pada 2.063 petani. Studi ini menyimpulkan bahwa pemulihan ketahanan pangan memerlukan intervensi strategis yang berfokus pada rehabilitasi infrastruktur irigasi, diversifikasi pangan, penguatan logistik, dan peningkatan kapasitas mitigasi komunitas di wilayah terdampak.

Kata kunci: Kerentanan, Sosial Ekonomi, Kapasitas Adaptif, dan Ketahanan

ABSTRACT

Tanah Datar Regency as a national rice production center experienced a significant impact on food security due to the flash flood (galodo) on May 11, 2024. This disaster resulted in damage to agricultural land and crop failures that threatened the food supply. This study aims to map the zoning of food-vulnerable areas after the disaster based on a comprehensive spatial analysis. The research uses the Food Disaster Overlap Mapping (FDOM) approach in the Geographic Information System (GIS) platform. The technique combines three key indicators: flood hazard, socio-economic vulnerability, and the adaptive capacity of communities. The analysis resulted in zoning maps with three categories of food insecurity: (1) Highly Prone Zones identified in areas with severe irrigation damage and food distribution disruptions; (2) Medium Prone Zone is located on land with partial damage; and (3) Low Vulnerability Zones are characterized by smooth distribution access. Quantitatively, the disaster damaged over 511 hectares of rice fields and caused a crop failure of 2,900 tons which impacted 2,063 farmers. The study concludes that restoring food security requires strategic interventions that focus on the rehabilitation of irrigation infrastructure, food diversification, strengthening logistics, and building community mitigation capacity in affected areas.

Keywords: Adaptive Capacity, and Food Security, Vulnerability, Socio-Economic, Zone

INTRODUCTION

The realization of food security can be achieved, through 4 pillars, namely: (1) Food availability (production and import); (2) Food reserves; (3) Diversification of consumption and food safety; and (4) Prevention and control of food insecurity (Danga et al., 2023). The second pillar of food security is food reserves, in this case the staple food in general for Indonesian people is rice.

According to Alfi (2024) West Sumatra Province is one of the largest rice-producing areas in Indonesia (Alfi et al., 2024). The issue of food security is still the main concern of the West Sumatra government related to the discovery of problems in the community that must be solved immediately. To see the condition of food security in an area, it can be seen whether there is still food insecurity in the area. According to Arifin and Juwita (2022), food insecurity can be distinguished into chronic or transient (temporary) conditions (F. N. Arifin & Juwita, 2022).

According to Tresnati et al (2022) chronic food insecurity is a long-term inability to meet minimum food needs and is usually related to structural and factors that do not change rapidly, such as local climate, soil type, local government system, public infrastructure, land ownership, income distribution, inter-tribal relations, education level, etc. (Tresnati et al., 2022). According to Prayitno et al (2022) Transient food insecurity is a short-term temporary inability to meet minimum food needs that is mostly related to dynamic factors that can change rapidly such as infectious diseases, natural disasters, displacement, changes in market function, debt levels, migration, etc. (Prayitno et al., 2022). Recurrent transient food insecurity can lead to livelihood insecurity in households, decreased survival and chronic food insecurity.

This makes regencies/cities in West Sumatra Province designated as the central rice-producing area, one of which is Tanah Datar Regency. Tanah Datar Regency is the highest rice productivity area in West

Sumatra Province. The availability of rice production in Tanah Datar Regency is influenced by production factors such as nature, climate, pests and diseases, soil type, rainfall, irrigation and agricultural infrastructure used. The success of farming is influenced by several factors, one of which is natural factors. Natural factors are closely related to agricultural cultivation such as natural disasters. Natural disasters according to law number 24 of 2007 are disasters caused by events or a series of events caused by nature, including earthquakes, tsunamis, volcanic eruptions, floods, droughts, hurricanes, and landslides (President of the Republic of Indonesia, 2007).

Cold lava flash flood disaster or *Gallodo* has become a threat in West Sumatra, especially in the Tanah Datar Regency area located at the foot of Mount Marapi. Galodo is a local term used by the Minangkabau people. Galodo according to the Minangkabau-Indonesian Dictionary (1985) published by the Center for Language Development and Development of the Ministry of Education and Culture, the term galodo means rocky land, landslide (Rusmali et al., 1985).

The phenomenon of flash floods occurs due to a combination of volcanic activity, high rainfall, and geomorphological factors that support the mobilization of materials from mountainsides to lowlands. According to Haldar et al (2021), recurrent and prolonged floods also affect local food security due to disruption of food resources and availability, especially in rural and urban areas with limited land (Haldar et al., 2021).

According to Arifin (2024) The high-intensity rain has triggered the depletion of deposits of volcanic material stored on the slopes. This material is then carried along with the water currents to form cold lava that flows downstream, knocking down anything it passes through (D. Arifin et al., 2024).

The cold lava flood (Galodo) originating from Gurung Marapi occurred on May 11, 2024 in the early hours of the

morning, causing access to major roads in West Sumatra Province to be disrupted. As a result of this cold lava flood, road access to and from the city of Padang (the capital of West Sumatra Province) was completely cut off. Road access to Tanah Datar Regency was also completely paralyzed due to flash floods, such as the Anai Valley road that connects (Tanah Datar Regency, Fifty Cities Regency, Bukittinggi City, and Padang Panjang City) to Padang City. Furthermore, the road from Tanah Datar Regency through Solok Regency where there was a landslide in the Sitinjau Lauik area causing access to Padang City to be cut off. Of course, this road problem hinders the distribution of goods and the production of agricultural commodities in Tanah Datar Regency.

The problem currently faced by paddy rice farmers in Tanah Datar Regency is the decrease in the area of productive agricultural land that can be used for farming due to the natural disaster of the flash flood (Galodo) that hit the rice production center area in West Sumatra Province. According to BPS West Sumatra (2023) Tanah Datar Regency is the largest rice crop productivity area in Prov. West Sumatra, along with horticulture as the backbone of the local economy (BPS) Central Statistics Agency of Prov. West Sumatra, 2023). When the galodo disaster occurred, the community immediately faced a threat to food security: rice supplies were depleted, food prices rose, and access to markets and staple foods was halted due to infrastructure damage and distribution barriers. This encourages an increase in the vulnerability of poor and vulnerable households in affected areas, as well as increases the risk of post-disaster food crises.

Before the galodo flash flood disaster, Tanah Datar Regency experienced a surplus of rice. This is because Tanah Datar Regency consists of 14 sub-districts, in general each sub-district has rice fields with a total rice harvest area of 54,139.20 hectares in 2023. The harvest area is accompanied by a total rice production of

306,969.30 tons in 2023. Thus, from the data on the harvest area and rice production of paddy fields, it was obtained that the productivity of paddy rice in 2023 was 5.67 Tons/Ha (BPS) Central Statistics Agency of Prov. West Sumatra, 2023).

After the occurrence of galodo, the area of rice fields affected by galodo was 511,521 hectares which were divided into 6 affected categories. The rice fields affected by the Galodo flash flood disaster could not be planted, thus affecting the amount of rice production in Tanah Datar Regency. If we refer to the data, there are 511,521 Ha and the productivity of paddy fields is 5.67 Tons/Ha, then it can be estimated that the amount of production that failed to harvest from rice fields affected by the Galodo flash flood disaster in Tanah Datar Regency is 2,900.32 tons.

Based on the data on land area and the amount of production that failed to harvest above, of course, it will cause disruption and loss of farmers' income. This also affects the state of farmers' households in fulfilling daily consumption, especially food consumption. The data of farmer groups affected by the galodo flash flood disaster in Tanah Datar Regency is as many as 50 farmer groups. Furthermore, the number of farmers affected by the galodo flash flood disaster in Tanah Datar Regency is 2,063 farmers.

Based on the above explanation, it is necessary to map which areas are affected by disasters so that the government can take policies in the future to minimize damage and overcome community losses caused by disasters. Wrong handling will have the potential to become a food-vulnerable area. So the purpose of this study is to map the areas affected by the Galodo Disaster which have the potential to become food vulnerable areas in Tanah Datar Regency.

RESEARCH METHODS

This study uses secondary data types. The secondary data used is cross section data, namely data on all sub-districts in Tanah Datar Regency in 2024. The collection of

research data was carried out using the data recapitulation and documentation method, where the data was obtained from several government agencies such as the Central Statistics Agency, the National Food Agency, the West Sumatra Provincial Food Service, the West Sumatra Provincial Social Service, the West Sumatra Provincial Bappeda, and the West Sumatra Provincial Health Office.

This study uses a spatial analysis approach based on Geographic Information System (GIS) to integrate the dimensions of galodo disaster risk and food insecurity in one analysis model. This approach was chosen because it was able to overcome the limitations of previous research that tended to discuss disaster and food security issues separately.

The analysis is carried out through the *Spatial Multi-Risk Overlay*, which is the combination of several layers of risk data by giving weight to each indicator. According to Pourhashemi et al (2025), the risk indicators used include three main components, namely: (1) hazards determined based on physical parameters such as rainfall, slope slope, and soil type; (2) vulnerability which includes social, economic, and food availability aspects of the community; and (3) capacity that represents the community's adaptability in dealing with disasters (Pourhashemi et al., 2025). Each indicator is given a numerical value according to its level of influence, then processed to produce priority zoning.

The data sources used are actual and contextual, obtained from various local agencies, including the Regional Disaster Management Agency (BPBD), the Agriculture Office, and the Central Statistics Agency (BPS). The use of local data sources aims to ensure validity, relevance, and direct connection to field conditions.

The novelty of the method in this study lies in the development of the Food Disaster Overlap Mapping (FDOM) approach, which is a mapping technique that specifically identifies areas with double pressure: the risk of galodo disaster and the

risk of food insecurity. According to Harpudiansyah & Apriyanti (2025), the implementation of FDOM often involves GIS to combine various layers of information such as agricultural land areas that overlap with flood-prone zones, droughts, or land conversions (Harpudiansyah & Apriyanti, 2025). In addition to mapping, this study also formulates a spatial-based adaptive strategy that integrates technical aspects with local values and Minangkabau cultural wisdom in the management of natural resources and food. This is intended so that the strategies offered are not only technically effective, but also acceptable and implemented by the community.

RESULT AND DISCUSSION

Affected Areas and Distribution of Food Insecurity

Tanah Datar Regency suffered heavy losses, with more than 500 hectares of agricultural land completely damaged and irrigation systems in a number of countries paralyzed. The affected areas are very severe, namely Nagari Pandai Sikek, Nagari Batipuah Baruah, Nagari Andaleh, Nagari Sungai Jambu, Nagari Sawah Tengah, Nagari Parambahan, Nagari Limo Kaum, Nagari Baringin, and Nagari Pasie Laweh where the main irrigation network is broken, causing the supply of clean water and rice fields to be disrupted. Based on data collection by the Agriculture Office of Tanah Datar Regency (2024), the impact zones are divided as follows:

- a. Category 1: About 60% of the land and more than 299 hectares are buried with boulder material and thick mud, almost impossible to recover in a short period of time;
- b. Category 2: About 130.7 hectares of rice fields buried with slightly thinner material, but still in need of intensive reclamation;
- c. Category 3: 80.98 hectares of rice fields suffered moderate to light damage (only buried in mud), potentially rehabilitated faster

(Agriculture Office of Tanah Datar Regency, 2024a).

The damage experienced in general, namely rice fields submerged in piles of flash flood materials in the form of sand, gravel, and wooden branches. Furthermore, in Nagari Pandai Sikek is the highest area and the closest to Mount Marapi. The damage to paddy fields in Nagari Pandai Sikek in addition to the failure of harvesting and rice production also has a collapse of connecting bridges between regions which causes the mobilization access of local communities to be disrupted. Furthermore, the decline in rice production also affects the food needs of the local community, for example, before the flash flood, rice production of 1 Ha, which is 5-6 tons, but after being affected by flash floods, it is reduced to 3-4 tons/ha.

Furthermore, the damage to paddy fields in Nagari Andaleh, in addition to crop failure and rice production, there was also a collapse of connecting bridges between regions which caused access to mobilization of local communities to be disrupted. Furthermore, the decrease in rice production also affects the food needs of the local community, for example, before the flash flood, rice production of 1 Ha, which is 6-7 tons, but after being affected by flash floods, it is reduced to 4-5 tons/ha. Furthermore, the damage to paddy fields in Nagari Batipuah Baruah in addition to crop failure and rice production was disrupted. Furthermore, the decline in rice production also affects the food needs of the local community, for example, before the flash flood, rice production of 1 Ha was 5-6 Tons, but after being affected by the flash flood, it was reduced to 4-5 Tons/Ha.

Furthermore, the damage to paddy fields in Nagari Sungai Jambu in addition to crop failure and rice production was disrupted, there were also rice fields around the river lip that were also carried away by flash floods and the collapse of connecting bridges that caused the isolation of the nagari from other areas. Furthermore, the decline in rice production also affects the

food needs of the local community, for example, before the flash flood, rice production of 1 Ha was 5-6 Tons, but after being affected by the flash flood, it was reduced to 3-4 Tons/Ha because farmers switched from rice to onion commodities. Furthermore, the damage to paddy fields in Nagari Sawah Tengah in addition to crop failure and rice production was disrupted, there were also rice fields around the river banks that were carried away by flash flood currents and heavy damage to irrigation flows which forced farmers to use pumping machines to drain water to the rice fields. Furthermore, the decline in rice production also affects the food needs of the local community, for example, before the flash flood, rice production of 1 Ha was 5-6 Tons, but after being affected by the flash flood, it was reduced to 4-5 Tons/Ha.

Furthermore, in Nagari Parambahan is the highest area in Limo Kaum District and is quite close to the foot of Mount Marapi. The damage to paddy fields in Nagari Parambahan in addition to the failure of harvesting and rice production also includes the collapse of connecting bridges between regions which causes access to local community mobilization to be disrupted. Furthermore, the decline in rice production also affects the food needs of the local community, for example, before the flash flood, rice production of 1 Ha, which is 5-6 tons, but after being affected by flash floods, it is reduced to 3-4 tons/ha. Furthermore, the damage to paddy fields in Nagari Limo Kaum is the worst land damage among the nagari (villages) in Tanah Datar Regency. This is because Nagari Limo Kaum is a lowland area which is the meeting point of flash flood flows from all directions coming from Mount Marapi. In addition to crop failures and rice production being disrupted, there are also rice fields around the river banks that are also carried away by flash floods and heavy damage to irrigation flows which force farmers to do other jobs and save daily expenses to survive. Furthermore, the decline in rice production also affects the food needs of the local

community, for example, before the flash flood, rice production of 1 Ha, which is 5-6 tons, but after being affected by flash floods, it is reduced to 3-4 tons/ha. Furthermore, the damage to paddy fields in Nagari Baringin in addition to crop failure and rice production also has a collapse of connecting bridges between regions which causes access to mobilization of local communities to be disrupted. Furthermore, the decline in rice production also affects the food needs of the local community, for example, before the flash flood, rice production of 1 Ha was 5-6 Tons, but after being affected by the flash flood, it was reduced to 4-5 Tons/Ha. In addition to farming, there are also livestock that lose money due to chicken farms whose cages are close to the river flow and are also carried away by *the galodo flash flood water current*.

Finally, in Nagari Pasie Laweh is the highest area in Sungai Tarab District and is an area that has been hit by *galodo flash floods* in the previous period. The damage to paddy fields in Nagari Pasie Laweh in addition to the failure of harvesting and rice production also has a collapse of connecting bridges between regions which causes the mobilization access of local communities to be disrupted. Furthermore, the decline in rice production also affects the food needs of the local community, for example, before the flash flood, rice production of 1 Ha, which is 5-6 tons, but after being affected by flash floods, it is reduced to 3-4 tons/ha. In addition to crop failures and rice production being disrupted, there are also rice fields around the river banks that are also carried away by flash floods and heavy damage to irrigation flows which force farmers to do other jobs and save daily expenses to survive. An alternative job that is widely engaged in by farmers in Nagari Pasie Laweh is the seller of impromptu building materials such as sand, gravel, and logs. As a result, through this alternative work, it can help ease the burden on farmers in meeting household needs while waiting for assistance from related stakeholders. Furthermore, the decline in rice production

also affects the food needs of the local community, for example, before the flash flood, rice production of 1 Ha, which is 5-6 tons, but after being affected by flash floods, it is reduced to 3-4 tons/ha.

Food vulnerability in Tanah Datar Regency is caused by many factors, such as damaged irrigation flows, rice fields collapsed by flood currents, and road access is cut off, so the distribution of food aid is constrained. A variety of logistical assistance (rice, sugar, cooking oil, and milk) was distributed to the main posts, but the difficulty of access to several areas caused the distribution of aid to be uneven in the early post-disaster periods. Farmers have suffered huge economic losses so that some are forced to go into debt or look for alternative jobs and expect assistance from the government to meet their daily needs and resume farming as usual.

Spatial Mapping of Potential Food-Infested Areas

Spatial analysis with field data resulted in the zoning of 3 main categories of food insecurity, namely very vulnerable (60% of the area directly affected by galodo, paralyzed irrigation), moderately vulnerable (open access but partially damaged land), and low vulnerability (good access and smooth distribution of aid). GIS-based spatial analysis results in risk classifications and food insecurity zones:

- a. Extremely Vulnerable Zone: Nagari on the banks of the main river, the upper reaches of the lava are cold, near the slopes of Marapi—the land is completely damaged, access is cut off, irrigation is dead, and aid is difficult to reach. Examples: Nagari Sungai Jambu, Nagari Limo Kaum, and Nagari Pasie Laweh;
- b. Vulnerable Zone: Areas with partially damaged facilities, food distribution available but limited, land can be rehabilitated in 6-7 months.
- c. Medium Vulnerable Zone: Areas with good access to food posts and

roads, but still affected by rising prices and partial crop failure.

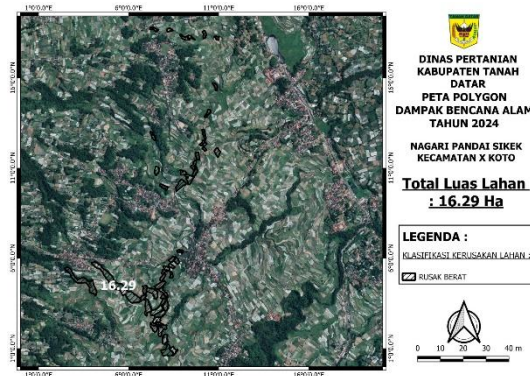
Very vulnerable locations are generally located in active watersheds and downstream small rivers bordering Mount Marapi. Furthermore, based on the affected areas, it can be classified based on the following table 1.

Table 1. Classification of Areas Affected by Galodo Flash Flood in Tanah Datar Regency

No.	Classification	Information
1	Category 1	Lots of boulders, very uneven
2	Category 2	Lots of boulders, flat conditions
3	Category 3	There are large rocks, uneven conditions
4	Category 4	There are large rocks, flat conditions
5	Category 5	There are small stones, uneven conditions
6	Category 6	There are small stones, flat conditions

Source: (Agriculture Office of Tanah Datar Regency, 2024c)

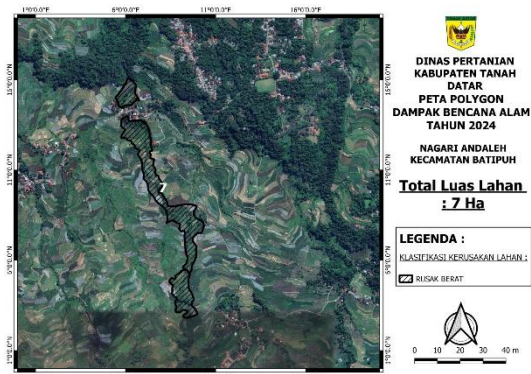
The classification of the affected area category is based on the category of affected areas ranging from many large and very uneven rocks to small stones and flat conditions. The average affected area in Tanah Datar Regency is in categories 1-2 that need immediate assistance. This condition is exacerbated by heavy rain weather that occurs from before the disaster occurs until 1 month after the disaster occurs. This makes it difficult for the government (BNPB, POLRI, and TNI) to reach isolated locations as well as see the state of the upstream waters of Mount Marapi. The following is a polygon map of areas affected by flash floods in Tanah Datar Regency.



Picture 1. Map of Polygon Nagari Pandai Sikek Affected by Galodo Flash Flood

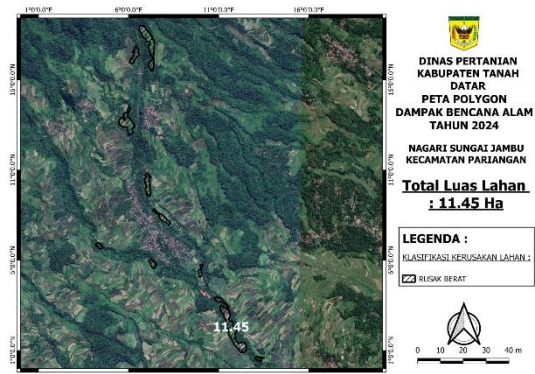
Source: (Agriculture Office of Tanah Datar Regency, 2024b)

From the map above, it can be seen that Nagari Pandai Sikek was affected by the flash flood disaster *Gallodo* covering an area of 16.29 hectares and has been dredging through land operations in December 2024 by the Ministry of Agriculture. Nagari Pandai sikek is a food producer (rice) and horticultural crops (red chili, mustard greens, tomatoes, celery, etc.) which is carried out with a rotating system in rice fields. This is done considering that the Pandai Sikek area is an area at the foot of Mount Marapi so that horticultural plant cultivation can also be carried out. This potential is certainly beneficial for the local community considering that the price of horticultural commodities, especially red chili, is quite promising compared to just cultivating paddy fields. For irrigation flows, there are indeed some that are clogged because they are buried by flash flood materials, but there are still other irrigation sources for the local community to use. Therefore, nagari Pandai Sikek is included in the area of moderate vulnerability because access to the location is mostly open but the land is partially damaged. Furthermore, Map of the Nagari Andaleh polygon affected by the galodo flash flood.



Picture 2. Map of Polygon Nagari Andaleh Affected by Galodo Flash Flood
Source: (Agriculture Office of Tanah Datar Regency, 2024b)

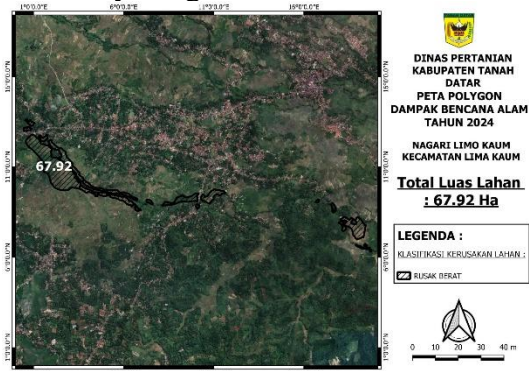
From the map above, it can be seen that Nagari Andaleh was affected by the *galodo flash flood disaster* covering an area of 7 hectares and land was dredged through land operations in November and December 2024 by the Ministry of Agriculture. Nagari Pandai sikek is a food producer (rice) and horticultural crops (red pepper, cayenne pepper, mustard greens, celery, etc.) which is carried out with a rotating system in rice fields. This is done considering that the Andaleh area is an area adjacent to Mount Marapi so that horticultural plant cultivation can also be carried out. This potential is certainly beneficial for the local community considering that the price of horticultural commodities, especially red chili and cayenne pepper, is quite promising compared to just cultivating rice fields. For irrigation flows, there are indeed some that are clogged because they are buried by flash flood materials, but there is a collective action of the community to carry out independent dredging by collecting donations. Therefore, Nagari Andaleh is included in the area that recovers the fastest compared to other areas and is classified as a moderately vulnerable area because access to the location is mostly open but the land is partially damaged. Furthermore, a polygon map of Nagari Sungai Jambu which was affected by the galodo flash flood.



Picture 3. Map of Polygon Nagari Sungai Jambu Affected by Galodo Flash Flood
Source: (Agriculture Office of Tanah Datar Regency, 2024b)

From the map above, it can be seen that Nagari Sungai Jambu was affected by the *galodo flash flood disaster* covering an area of 11.45 hectares and land was dredged through land operations in December 2024 by the Ministry of Agriculture. Nagari Sungai Jambu is a food producer (rice) and horticultural crops (shallots) which are carried out with a rotating system in rice fields. This is done considering that the Jambu River area is an area adjacent to Mount Marapi so that horticultural plant cultivation can also be carried out. This potential is certainly beneficial for the local community considering that the price of horticultural commodities, especially shallots, is enough to increase community income rather than just cultivating paddy fields. For irrigation flows, there are indeed some that are clogged because they are buried by flash flood materials, but there is a collective action of the community to carry out independent dredging by collecting donations. Therefore, the Jambu River is included in the slowest area compared to other areas and is classified as a very vulnerable area because access to the location is mostly difficult when affected by flash floods for up to 1-2 weeks, irrigation is paralyzed, and most of the rice fields adjacent to the river are carried away by the currents so that the rice field area is reduced and becomes a new watershed. Furthermore,

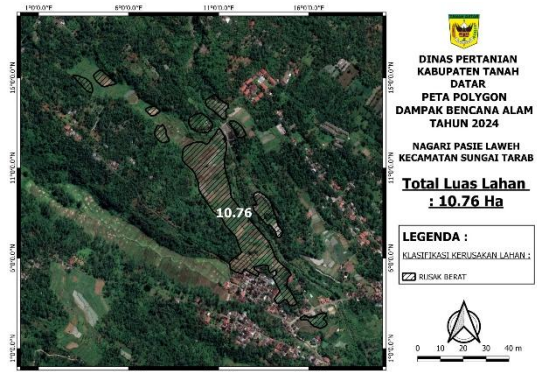
the map of the Nagari Limo Kaum polygon affected by the galodo flash flood.



Picture 4. Map of Polygon Nagari Limo Kaum Affected by Galodo Flash Flood

Source: (Agriculture Office of Tanah Datar Regency, 2024b)

From the map above, it can be seen that Nagari Limo Kaum was affected by the *galodo* flash flood disaster covering an area of 67.92 hectares and land dredging has been carried out through land operations in December 2024 by the Ministry of Agriculture. Nagari Limo Kaum is a food producer (*padi*). This is done considering that the Limo Kaum area is a lowland area. For irrigation flows, there are indeed some that are blocked because they are buried by flash flood materials because Nagari Limo Kaum is an area where flash flood water flows meet from all directions. Therefore, the Limo Kaum nagari is included in the most severely affected areas compared to other areas and is classified as a very vulnerable area, irrigation is paralyzed, and most of the rice fields adjacent to the river are carried away by the currents so that the rice field area is reduced and becomes a new watershed. Furthermore, the connecting bridge between Tanah Datar Regency and Padang Panjang City was cut off due to flash floods. This also exacerbates the mobilization of aid and daily needs for the residents of Nagari Limo Kaum and its surroundings. Furthermore, a map of the Nagari Pasie Laweh polygon affected by the *galodo* flash flood.



Picture 5. Map of Polygon Nagari Pasie Laweh Affected by Galodo Flash Flood

Source: (Agriculture Office of Tanah Datar Regency, 2024b)

From the map above, it can be seen that Nagari Pasie Laweh was affected by the *galodo* flash flood disaster covering an area of 10.76 Ha. Nagari Pasie Laweh is the most severely affected nagari compared to other nagari in Sungai Tarab District and has been dredging through land operations in December 2024 by the Ministry of Agriculture. Nagari Pasie Laweh is a food producing country (*padi*). For irrigation flows, there are indeed some that are clogged because they are buried by flash flood materials because Nagari Pasie Laweh is adjacent to the foot of Mount Marapi and has a flow of clean water that comes directly from Mount Marapi. Therefore, Pasie Laweh nagari is classified as a very vulnerable area, irrigation is paralyzed, and most of the rice fields adjacent to the river mouth are carried away by the current, so that the rice field area is reduced and becomes a new watershed. The response of farmers affected by the *galodo* flash flood in Nagari Pasie Laweh is not only waiting for the help of the government and related stakeholders. Affected farmers see impromptu business opportunities to become sellers of building materials such as sand, gravel, and logs. This happens because many materials are carried away by the flash flood currents that inhabit the rice fields they manage. As a result, becoming a seller of building materials can help meet the needs

of farmers' households and communities affected by flash floods.

From several areas affected by flash floods (*Gallup*) In Tanah Datar Regency, there was a 10-20% decrease in production from the previous rice production. This certainly has an impact on the shortage of rice and affects the amount of consumption of the people of Tanah Datar Regency. According to BPS (2024) The per capita consumption of the people of Tanah Datar district is 2,250 Kg/month/person (BPS West Sumatra, 2024). From the per capita consumption data, it means that the demand for rice in Tanah Datar Regency is 636,750 Kg/month. So, as much as 127,350 kg/month was lost when rice fields were submerged in the Galodo flash flood. This is certainly a serious concern for regional beautification and related stakeholders to formulate effective and efficient policies.

Policy Implications and Mitigation

The reduction in rice production has an effect on the reduction of the availability of rice as a staple food for the people of Tanah Datar Regency. This is certainly detrimental to the community and farmers, especially because farmers lose their main income due to being affected by flash floods (*galodo*). This phenomenon certainly needs to be observed together by FORKOPIMDA Tanah Datar Regency as a stakeholder to restore the loss of rice supply from the local area. The strategies that can be carried out by FORKOPIMDA Tanah Datar Regency, in this case the Tanah Datar Regency Agriculture Office, are:

- a. Rehabilitation of irrigation and agricultural production facilities
Rehabilitation of irrigation and agricultural production facilities is a crucial technical intervention in the sustainability of the agricultural sector in an era of climate change challenges and increasing food needs (Gamaliel & Suparno, 2023). Irrigation rehabilitation and agricultural production facilities are carried out because almost evenly damage to rice field irrigation flows in

Tanah Datar Regency. This makes the local government of Tanah Datar Regency coordinate with the local government of Prov. West Sumatra to ask for instructions to ask for assistance from the Ministry of Agriculture to dredge rice fields that were submerged in flash flood materials. Dredging of rice fields is carried out to remove flash flood materials such as sand, pebbles, and logs from the paddy field area so that farmers can farm again.

- b. Diversification of local food sources
According to Ainal (2022), food diversification is an effort to increase the consumption of a variety of foods with diverse, nutritious, and balanced principles (Ainal Ikram, 2022). According to Utami (2023), food diversification is not only to replace rice completely, but also to change and improve people's consumption patterns so that there are more diverse types of food with better nutritional quality (Utami, 2023). Thus, local food diversification is an effort to increase the types of staple foods and food ingredients consumed by the community by utilizing the wealth and potential of food in their own area, so that they do not depend on only one type of food such as rice. Of course, this is a bit difficult to do because the people of Tanah Datar Regency are used to making rice as a staple food. This is a challenge as well as an opportunity for the Tanah Datar Regency agriculture office related to staple foods other than rice, namely corn, sorghum, cassava, and others.
- c. Strengthening of emergency food logistics and distribution systems
The main connecting road between Tanah Datar Regency with Padang Panjang City and Padang City was cut off. This disrupts access to logistics mobilization and food distribution. The local government of Tanah Datar Regency is expected to have a comprehensive logistics distribution scheme, especially food, so that the community does not

experience hunger, especially affected farmers. This certainly needs coordination between sectors to ensure that the routes passed by the distribution party are safe and on time to arrive.

To facilitate the distribution of food aid during disaster emergency response, the author conveyed two alternatives for the placement of food reserves, namely: a) the local government builds a warehouse of food reserve stocks; b) Local governments build food networks through cooperation with existing private parties/retail distributors (Burtha et al., 2008).

d. Education and community capacity building in community-based galodo mitigation

According to Buchari and Ahmad (2020), education and community capacity building in community-based flash flood mitigation is an approach that emphasizes the active involvement of local communities, disaster education, training, and organizing to improve resilience and preparedness for wildfire disasters (Buchari & Ahmad, 2020). Synergy between the community, government, and related institutions is the key to the implementation of effective community-based mitigation, so that education and capacity building efforts are sustainable and connected to modern early warning systems.

e. Implementation of early warning system and technology-based periodic mapping

According to Tenda et al (2023), EWS and technology-based periodic mapping have a significant impact in accelerating detection, expanding dissemination, supporting decision-making, and improving community and government adaptation to disaster risk through innovation and integration of digital platforms (Tenda et al., 2023). The local government together with national and international partners installed the Multi Hazard Early Warning System

(MHEWS) to detect early galodo, flash floods, and the risk of cold lava due to the eruption of Mount Marapi. EWS, which has been implemented since 2024, uses sensors at several vulnerable points, monitors water level levels, rainfall intensity, and ground vibrations (microtremors), so that people can receive real-time alerts through siren sounds and coordination between communities. This system is data-based, directly connected to BMKG forecasts and the response of the disaster preparedness community at the state level, strengthening independent evacuation when the alarm sounds.

CONCLUSION

Disasters of any form, especially for landslides and floods, are inevitable and unpredictable. As a society that lives and makes a living around the source of disaster, this can be a blessing or a disaster. To minimize the losses that arise, there needs to be good cooperation from all stakeholders involved. Quantitatively, the disaster damaged 511,521 hectares of rice fields and caused a crop failure of 2,900.32 tons which impacted 2,063 farmers. The study concludes that restoring food security requires strategic interventions that focus on the rehabilitation of irrigation infrastructure, food diversification, strengthening logistics, and building community mitigation capacity in affected areas.

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