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## Ternate's People Readiness in Facing the Eruption of Mount Gamalama

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### ABSTRACT

Mount Gamalama is located on Ternate Island, with the altitude 1,730 masl. This volcano often erupted, the last eruption occurred on October 4<sup>th</sup>, 2018. As its impact, activity and public health become disrupted. The purpose of this study is to analyze community preparedness in the face of the eruption Mt. Gamalama. The method applied in this study is quantitative, the population of this research is the head of the family who lives in the Dufa-Dufa Village, the respondents are chosen by purposive sampling. Research data collection techniques are observation, documentations and using questionnaire by *Google form*. The data analysis of this study used the preparedness index analysis from LIPI UNESCO/ISDR, 2006. The results of this study showed that people in Dufa-Dufa Village around the Togorara river was in category of almost ready to face the volcano eruption with an index value of 55.62%.

Keywords: Preparedness, Disasters, Volcano, Eruption

### 1. INTRODUCTION

From a geological point of view, the Ternate Island is one of the islands that has volcanoes, from the line of the “*strato vulcano active at south pacific*” which crosses in East Asia to Southeast Asia, from north to south, and one that is still active in the Islands of North Maluku is “Mount Gamalama” on Ternate Island with the altitude of 1,730 MASL (the Portuguese called it *Nostra Senora del Razio*). Topographically, Ternate Island is in the shape of a cone (*strato vulcano*) which is broadly diagonally from north to south along 13 kms and from west to east along 11 kms, with the circumference of the island is 55 kms, consisting of low land and slopes. Topographic characteristics of most of the terrain are mountainous and hilly areas, consisting of volcanic islands and coral islands (Rahman, 2010).

Report of *Badan Penanggulangan Bencana Daerah (BPBD)* Ternate City, the history of the Mt. Gamalama volcano eruption was recorded from 1538 to 2003 with the longest eruption interval of 50 years and the shortest interval of 1 year, this means that almost every year Mt. Gamalama experienced an eruption, the volcanic status of Mt. Gamalama since May 11, 2008 increased from normal (level I) to be wary (level II). The eruption of Mt. Gamalama generally took place almost magmatic, except the eruption that occurred in 1907 occurred on the eastern slope (side eruption).

In 2011, Mt. Gamalama experienced an eruption, based on the *BPBD* data of Ternate City there were at least 2,117 people who had to be evacuated to nine points of refuge. As a impact of a volcanic eruption can cause losses such as human casualties, environmental damage, property losses and psychological impacts, this condition is prepared for preparedness activities, early warning and disaster mitigation, so that community knowledge and understanding of disaster preparedness is needed to prevent this situation for greater disaster impact. In 2018 Mt. Gamalama erupted again. Based on the statement of *Badan Geologi Pusat Vulkanologi dan Mitigasi Bencana Geologi Ministry of Energy and Mineral Resources* eruption occurred at 11.52 East Indonesian Time on Thursday (10/04/2018) with an ash column reaching 250 meters from the top of the mountain. There were 8 times volcanic earthquakes recorded for one hour before the eruption occurred. The gas emitted by Mt. Gamalama is dominated by hydrothermal gas content. People are advised to remain calm, and people who live around rivers are reminded to be careful of cold lava flows during the rainy season

<https://news.detik.com/berita/d4242057/gunung-gamalama-erupsi>.

Dufa-Dufa Village, North Ternate District in Ternate City is one of the villages included in the list of prone areas to volcanic eruption (prone area I). According to the *Badan Penanggulangan Bencana Daerah (BPBD)* Ternate City the hazard-prone area I is a disaster-prone area to the flow of lava / flood and the possibility of expansion of hot clouds such as lava flows. Dufa-Dufa Village which is a river area is a channel for the flow of cold lava should make the community of Dufa-Dufa Village ready to face the catastrophic volcano eruption disaster. Data from the *Badan Penanggulangan Bencana Daerah (BPBD)* Ternate City, volcanic eruption that occurred in 2011 caused 2,711 people / 627 families to be evacuated. There were 9 points of refuge when the volcano eruption of Mt. Gamalama occurred, following the table of the point of displacement of the volcano eruption Mt. Gamalama (*Badan Penanggulangan Bencana Kota Ternate, 2011*).

**Table 1:** Data on Refugees of Mt. Gamalama  
Eruption Victims in 2011

No	Evacuation Site	Number of casualties	Number of victims (Family)
1	Ex Governor's office	974 souls	214 families
2	Persiter Mess	466 souls	54 families
3	SMK N 2 Hall	466 souls	96 families
4	Mushalla Dufa-Dufa	216 souls	47 families
5	Kedaton Ternate	55 souls	14 families
6	Togafo Village	391 souls	99 families
7	SMP 11 Taduma	366 souls	78 families
8	Dufa-Dufa Fisheries Office	39 souls	10 families
9	Fisheries Hall	55 souls	15 families
	<b>Total</b>	2.711	627 families

Source: *BPBD Ternate City (2011)*

Realization and awareness of the importance of community preparedness became very important when Indonesia experienced the tsunami disaster in Aceh in 2004 which shocked the international world. This very bitter experience teaches that the community must absolutely be involved in disaster preparedness activities (Hidayati, 2008). In some cases of disasters, some members of the community, because of psychological conditions and panic, did not take the initiative to take actions that could save and help victims. Some of them cannot help because they do not know what to do, therefore the community needs to gain knowledge because community participation is very important in tackling disaster management. Communities in disaster-prone areas, together with the authorities, become "subjects" or agents. One of the smallest scope of participation is self and family preparedness, while in a broader environment it includes community or people in community groups, (Hidayati, 2008).

People preparedness to anticipate natural disasters is developed using a participatory approach. According to LIPI-UNESCO / ISDR (2006), basically community preparedness includes 5 critical factors that become the variables of community preparedness studies to anticipate natural disasters, the preparedness variables include; knowledge and attitudes towards disaster risk, policies and guidelines, plans for disaster emergency, disaster warning systems, ability to mobilize resources. These five factors are used in the study of community preparedness in anticipating natural disasters. The five critical factors that become variables or parameters in the study of community preparedness in anticipating natural disasters are as follows, (Hidayati et al., 2006).

Preparedness intersects with both of these two areas, serving as a temporal connector between the pre-impact and post-impact phases of a disaster event. Preparedness is typically understood as consisting of measures that enable different units of analysis individuals, households, organizations, communities, and societies to respond effectively and recover more quickly when disasters strike. Preparedness efforts also aim at ensuring that the resources necessary for responding effectively in the event of a disaster are in place, and that those faced with having to respond know how to use those sources (Sutton & Tierney, 2006).

Communities with strong political, social, and financial capitals tended to fare better immediately following disasters, enabling longer term processes of transformation or recovery. In understanding how use and reliance on community capitals can lead to varied recovery success from different kinds of disasters, these findings can help prepare for future disasters (Cornel et al., 2018).

Knowledge of disaster risk, knowledge is the major factor that is the key to preparedness. The experience of disasters that have been experienced by the community provides very meaningful lessons on the importance of knowledge of natural disasters. Policies and guidelines, the policies and guidelines that become the second variable of preparedness relate to preparedness to anticipate natural disasters. Natural disaster preparedness policy becomes very important because it relates to concrete efforts based on natural disaster preparedness policies such as, public education, disaster warning systems and resource mobility as well as important facilities for disaster emergency conditions. Emergency response plan, emergency response plans become an important part of preparedness, especially related to evacuation, first aid and rescue so that disaster victims can be

minimized. This also requires knowledge and willingness of human resources to understand the emergency response plan.

Disaster preparedness activities also include things done after a disaster occurs, namely post-disaster recovery activities, such as research by (James et al., 2019), the evidence shows that many people affected by the disaster were not previously involved disaster preparedness, even when they receive training and have adequate resources. This is possible partly explained by the relationship between mental health symptoms and readiness; however, these components are usually not integrated in the intervention.

This research refers to research conducted by (Ardalan et al., 2019) about Household disaster preparedness in the Islamic Republic of Iran: 2015 estimation. The results of this study are the mean score of Household Disaster Preparedness (HDP) was estimated at 9.3 out of 100 (95% CI: 8.3–10.3). The multivariate analysis revealed slightly higher preparedness among rural households than urban households ( $P < 0.001$ ). Higher level of education was positively associated with a higher preparedness score ( $P < 0.001$ ). In this study, a high level of knowledge affects the preparedness of a community.

The type of disaster, gender and age also affect the preparedness of a community in negotiations such as research conducted by (Bronfman et al., 2019). The findings show that participants are significantly better prepared to face earthquakes than floods, which sends a serious warning to local authorities, given that floods have caused the greatest human and material losses in the region's recent history of natural disasters. Men claimed to be more prepared than women to face floods, something that the authors attribute to the particular characteristics of the main employment sectors for men and women in the region. The potential contribution of large companies on preparedness levels of communities in the areas in which they operate is discussed. The sociodemographic profile of individuals with the highest levels of preparedness in an environment with multiple natural hazards are people between 30 and 59 years of age, living with their partner and school-age children. The implications of the results pertaining to institutions responsible for developing disaster risk reduction plans, policies and programs in a multi-hazard environment are discussed

Disaster warning system, with the knowledge of the disaster warning system that available in these disaster-prone areas, the community can take appropriate actions to reduce risks from both casualties, disaster property and the environment. Resource mobilization, resource mobilization in community preparedness is the availability of human resources (HR), as well as funding and important infrastructure facilities for emergencies, which are potentials that can support or otherwise become obstacles in community preparedness. The paradigm shift from disaster response to disaster preparedness in anticipating disasters is crucial and important to do. For this reason, steps of disaster management measures are very important to be carried out, both before, after and during the disaster, in accordance with its main objective, which is to reduce and / exclude victims and losses that may arise. Activities undertaken prior to the occurrence of disasters are prevention activities and preparedness. The purpose of this research is to find out the preparedness of the Dufa-Dufa people in the North Ternate District of Ternate City in the face of the Mt. Gamalama eruption.

2. RESEARCH METHODS

This research uses quantitative analysis methods. The study population was all heads of family who lived in Dufa-Dufa Village, North Ternate District, especially those who lived around the Togorara River, that is, RW 01 RW 04. The total population of Dufa-Dufa was accompanied by BPS data in 2016 was 5865 souls with a total of 1,606 heads of family. Sampling in this study is using purposive sampling, researchers have determined the place or informant to be addressed because the informan must be someone who can provide clear information and can support research data. The information obtained in this study is that people who have been affected by the Mt. Gamalama eruption at some points determined by researchers based on field conditions. The sample in this study was 63 families as respondents that scattered around the Togorara River, Dufa-Dufa Village. While the data collection techniques in this study are the study of literature, a questionnaire distributed using Google forms and documentation. The filling in questionnaire was used to obtain information on the readiness of the community in facing the Mt. Gamalama volcano eruption disaster in Ternate City which was conducted in May 2019. The questionnaire includes variables from LIPI UNESCO/ISDR, 2006 explained the indicators of preparedness consisted of (1) knowledge and attitudes towards disaster risk, (2) policies and guidelines, (3) emergency response plans, (4) early warning systems, (5) ability to mobilize resources.



sumber : google earth

Figure 1. Research Location in the Village Dufa-dufa

Data analysis in this study used the preparedness index analysis from LIPI UNESCO / ISDR, 2006 to find out the preparedness of people in the Dufa-Dufa Village in facing the volcanic eruption disaster (Hidayati et al., 2006). Index figures in this study include each variable, as in the table below.

Table 2: Preparedness Variables

No	Preparedness Variables
1	Knowledge and attitude towards disaster risk
2	Policies and guidelines
3	Emergency response plan
4	Early warning system
5	Ability to mobilize resources

Source: LIPI UNESCO/ISDR (2006)

### 3. RESULTS AND DISCUSSION

#### 3.1 Mt. Gamalama Conditions

Mt. Gamalama is volcano that is one of the Active Mountains in North Maluku. Gamalama Volcano is Gamalama Volcano is one of the Active Mountains in North Maluku. Administratively it is located in Ternate City (Ternate Island) North Maluku Province, while Geographically it is located at 0°, 48° North Latitude and 127°, 19.3° East Longitude with the altitude of Mt. Gamalama 1,715 meters above sea level.

*Badan Penanggulangan Bencana Daerah (BPBD)* Ternate City in the Mt. Gamalama eruption disaster management report explained the Mt. Gamalama eruption interval, the longest interval of Mt. Gamalama eruption was 50 years and the fastest interval was 1-2 years, this would be a threat if the people who were in around the area of Mt. Gamalama is not equipped with knowledge of preparedness to anticipate damage and losses during a volcanic eruption disaster.

Mt. Gamalama has three vulnerable areas with different levels of risk. Dufa-Dufa Village is located in an area prone to the eruption of the Mt. Gamalama. Prone area I is an area that has the potential danger of mass flow in the form of lava / flood and expansion of hot clouds and lava flow. This condition should make the community ready for the catastrophic volcanic eruption that almost happens every year.

#### 3.2 People Preparedness

Preparedness is actions that enable governments, organizations, communities and individuals to be able to respond to a disaster situation quickly and efficiently. Individual disaster preparedness is shaped by a broad variety of psychological, socio-economic and cultural factors which interact in complex ways (Team, 2018). Included in preparedness measures are the preparation of disaster management plans, maintenance of resources, and training of personnel. Preparedness is an activity that is focused on developing plans quickly and effectively, LIPI-UNESCO / ISDR (2006).

Disaster preparedness initiatives are increasingly focused on building community resilience. (Adams et al., 2019). Preparedness is one part of the disaster management process, the importance of preparedness is an important element of proactive disaster risk management control activities, before a disaster occurs. Based on LIPI UNESCO/ISDR, 2006 explained the indicators of preparedness consisted of (1) knowledge and attitudes towards disaster risk, (2) policies and guidelines, (3) emergency response plans, (4) early warning systems, (5) ability to mobilize resources. These five indicators are used in determining disaster preparedness in people or a community. In this study the researchers used several parameters including indicators of preparedness such as (1) public knowledge about the general conditions around the Mt. Gamalama, (2) organization and socialization of hatred in the community, (3) preparedness supporting facilities such as (rescue buildings and evacuation routes). To find out the people preparedness index, LIPI-UNESCO / ISDR (2006) classified the community preparedness index into five preparedness index values using the following formula:

$$\text{Index} = \frac{\text{total real parameter score}}{\text{maximum parameter score}} \times 100$$

**Table 3:** Community Preparedness Index

No	Preparedness Index Value	Category
1	80-100	Very ready
2	65-79	Ready
3	55-64	Almost ready
4	40-54	Not ready enough
5	<40	Not ready

Source: LIPI UNESCO/ISDR (2006)

The results of questionnaires that have been spread out in May, 2019 in around Togorara River Dufa-Dufa Village that become lava flow of Mt. Gamalama in RW 01 and RW 04 based on preparedness variable of LIPI/UNESCO (2006) shows that the people of Dufa-Dufa Village is almost ready for facing the disaster that seen from index value of 55,62%. This value was gotten from result of questionnaire that have been filled by respondents and analyzed by using preparedness formula from LIPI -UNESCO/ISDR (2006). Community preparedness variable in facing volcano disaster are as follows.

**Table 4:** Knowledge and attitude level of people in the Dufa-Dufa Village in facing Mt. Gamalama eruption

Index Value	Category	f	%
80-100	Very ready	45	71
65-79	Ready	18	29
55-64	Almost ready	0	0
40-54	Not ready enough	0	0
<40	Not ready	0	0

Source: Research Data (2019)

Based on the result of table 4, the level of people’s knowledge that very ready is 71% and ready is 29%. On the result that have been spread out, almost all of people know about generally condition of Mt. Gamalama that experienced eruption every year, such as thundering sound from the mountain that become a sign for people to know volcano activity. Knowledge value here is just only the limit of community to know the signs of volcano will be eruption, but a lot of people are still confuse with the evacuation routes and save place for evacuation.

Education is the effective way for shaped people’s behavior in facing disaster(Suharini, 2013).Education knowledge is 71% (table 4) become the earlier step in preparing ready community and strong in facing disaster through others activities that focus on preparedness. The activity that can be do before disaster happen is the improvement of education disaster awarness, disaster drill training, preparation of disaster-proof technology, building social system of disaster and formulating disaster management policies. In disaster prone areas, routine outreach is needed provide information about disasters, with the hope that the community will know or be aware of



disasters that will befall them. Disaster education is related to disaster knowledge and will form an attitude of preparedness for disasters that will befall. (Setyowati & Rahman, 2015).

**Table 5:** Policies and guidelines level of people in the Dufa-Dufa Village in facing Mt. Gamalama eruption

Index Value	Category	f	%
80-100	Very ready	11	18
65-79	Ready	29	46
55-64	Almost ready	0	0
40-54	Not ready enough	23	36
<40	Not ready	0	0

*Source:* Research Data (2019)

From table 5 policies and guidelines aspects, the respondents that ready is 46% and who is not ready enough is 36% this case avowed the people that is lack of socialization and institutes involvement or organization of community that give the understanding through socialization immediately. Government is one of important variable in the preparedness of disaster that showed through policies. According to (Setyowati et al., 2012), role of government can be done through institution or non government organization and community for giving knowledge in efforts of tackling disaster is through the formal education institute and informal.

**Table 6:** Emergency response plan level of people in the Dufa-Dufa Village in facing Mt. Gamalama eruption

Index Value	Category	f	%
80-100	Very ready	0	0
65-79	Ready	25	40
55-64	Almost ready	0	0
40-54	Not ready enough	38	60
<40	Not ready	0	0

*Source:* Research Data (2019)

Table 6 is about emergency response plan that have been ready is 40% and that not ready enough is 60%. Emergency response plan that is not ready enough in community of Dufa-Dufa Village caused by people who did not know what must to do when disaster happens and the steps of rescue in emergency. Because of that, communication also the government collaboration through relate institutions have to keep up with the community, through training or simulation emergency response plan that produced preparedness like opinion of (Telfair LeBlanc et al., 2019) that collaboration is a key of community preparedness.

**Table 7:** The level of early warning system in Dufa-Dufa Village in the face of the eruption of the Mt. Gamalama

Index Value	Category	f	%
80-100	Very ready	5	8
65-79	Ready	36	58
55-64	Almost ready	0	0
40-54	Not ready enough	16	34
<40	Not ready	0	0

Source: Research Data (2019)

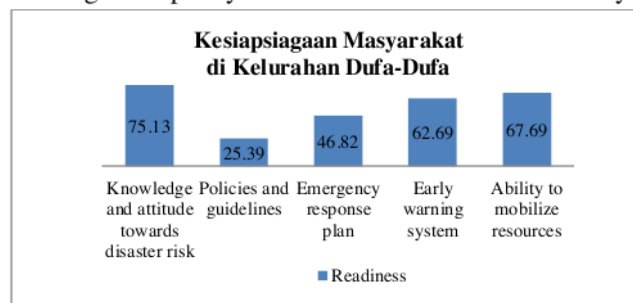
Based on table 7, it can be seen that the amount of people that is ready 58%, and not ready enough is 22% this thing caused by the use of alarm that indicate danger or disaster happens is known by people in Dufa-Dufa Village.

**Table 8:** The level of community resource mobilization in Dufa-Dufa Village in the face of the eruption of the Mt. Gamalama

Index Value	Category	f	%
80-100	Very ready	6	10
65-79	Ready	25	39
55-64	Almost ready	0	0
40-54	Not ready enough	35	51
<40	Not ready	0	0

Source: ResearchData (2019)

The results of the level of mobilization of Dufa-Dufa community resources in the face of the Mt. Gamalama eruption disaster showed that respondents were 39% ready and 51% not enough ready. Resource mobilization still needs to be improved, providing sustainable socialization is an important factor in increasing the capacity of human resources who are ready to face disasters.

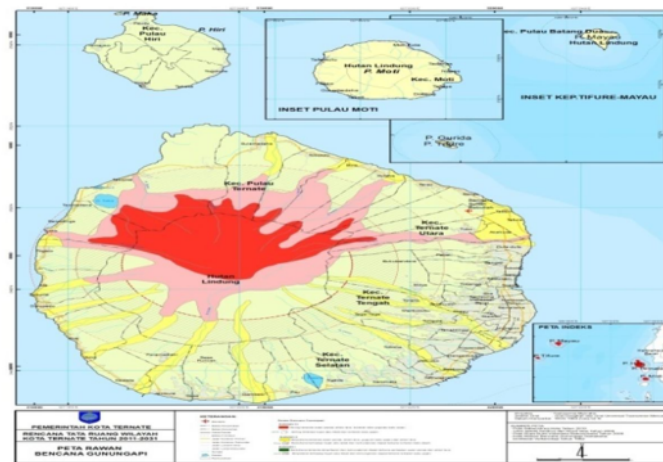


Source: Research Data (2019)

**Figure1.**Graph of Dufa-Dufa Village Community Preparedness in Dealing withMt. Gamalama Eruption

Based on figure 2, the community preparedness chart of Dufa-Dufa Village in facing the Mt. Gamalama eruption shows the overall results of community knowledge variables of 75.13%, policies and guidelines of 25.39%, emergency response plans of 46.82%, early warning systems of 62.69% and resource mobilization at 67.69%. The five variables that are indicators of community preparedness that have the highest index value are knowledge and attitudes and the lowest are policies and guidelines.

Based on writers' argument, this is because the eruption that always happens every year makes people know the early signs of volcanoes will experience an eruption such as a roar that is heard from the direction of the mountain or a small earthquake that causes people to assume that eruption of volcano happens. The high value of knowledge is caused by the experience of the community when evacuating, but some people are still confused about the use of evacuation routes and also the gathering point which is a safe point. The low index value of policies and guidelines is also caused by the absence of government involvement in socialization and simulation activities to the community so that people are confused in determining emergency response plans in the family.



Source: BPBD Ternate City (2019)

**Figure2.**Map of Vulnerable Areas

Figure 2 is a map of the disaster-prone areas of Ternate City that includes the Dufa-Dufa Village which is one of the prone zones through which cold lava passes.



Source : private document (2019)

**Figure3.**Condition of damaged community houses

Figure 3 shows the condition of community houses damaged by cold lava floods that occurred after the eruption of the Mt. Gamalama. Now the house is no longer inhabited by those who have it.

#### 4. CONCLUSION

The level of community preparedness in Dufa-Dufa Village is at an index value of 55.62%, which means that it is almost ready, the variable knowledge about the general condition of volcano, such as signs of volcano eruption and what actions are immediately taken, how to use the evacuation route is already understood by the community though not all of them. This requires more attention from the government related to increasing the preparedness of the Dufa-Dufa Village community.

The socialization carried out by *Badan Penanggulangan Bencana Daerah (BPBD)* must often be done because the community needs to be given continuous understanding, and continuous early warning, especially the people who live along the Togorara River which is a cold lava track. Community readiness in understanding makes the community more prepared and aware of the right and fast actions taken when disasters occur and after disasters occur. Actions of preparedness through all component variables must be carried out continuously because disasters always occur around us. Preparing a community to be ready to face a disaster can be done using local wisdom as part of disaster education. It can also be done by the local government and the community in preparing the community in facing disasters, such as research (Purnomo & Kurniawan, 2019) that the response of a community in facing a disaster is one of them is the perception of the community built based on knowledge, experience and also the legacy of its predecessor.

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