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Science and technology for the Alert Group Disaster "Tumik Singgalang" East Malalak Nagari, Malalak District, Agam Regency, West Sumatra

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Abstract. In the implementation of devotion in Jorong Saskand obtained a commitment on the part of districts, villages and ellipse as a service area. The commitment is obtained based on some identification problems faced by people who are important to be solved collectively. Society needs an explanation in terms of the academic science related to the potential danger to human settlements that are prone to landslides. The survey was conducted using a test to determine the type of layer geoelectric lithology / rock. Based on the results of the interpretation of electrical resistivity tomography. Wenner configuration showed layers of clay and pumice tuff at this track. Scientific analysis is translated in simple language to convey to the public. The solution to the problems facing society is the improvement of information systems at the community level while considering the potential and local wisdom. Public understanding of scientific terms that are directly involved in the technical processes related to geological conditions in disaster areas and this becomes the basis for an early warning system to collect and effective mitigation mechanisms to do. Improvement of early warning information system for landslides that involve elements that exist in society. To strengthen the information system related to early warning, then the required agreement among participants so that generated Mechanism of Landslide Mitigation Participative Approach. This method is outlined in the form of Standard Operating Procedures (SOP) early warning system for landslides Jorong Saskand, East Malalak, Agam Regency.

1. Introduction

Jorong Saskand, East Malalak Nagari, Malalak District is one part of Agam district. The geographical conditions of Agam Regency consist of flat areas, wavy flat areas, wavy and wavy flat areas and mountainous hills. The flat area owned by Agam Regency is at a slope between 0^0 – 3^0 with 662 Km^2. While the wavy flat area which has a slope between 3^0 – 8^0 has a total area of 8o 153 Km^2 [1]. This region is also located between two mountains, namely Mount Singgalang with an altitude of 2,877 meters and Mount Tandikat. The location of the study can be seen from Figure 1.

Figure 1. The location of study East Malalak district

To see the condition and record of events that have occurred can be known according to the Indonesian Disaster Data and Information (DIBI). The official information system issued by the National Disaster Management Agency (Badan Nasional Penanggulangan Bencana (2012), recorded 10 times landslides in the last 10 years in Agam District, which also occurred in several Malalak sub-districts [2].

Therefore, to reduce the risk of landslides, an early warning is needed. An early warning system is a series of systems to notify of the occurrence of natural events, can be disasters or other natural signs. Early warning to the community on disasters is an act of providing information in a language that is easily digested by the community. The ultimate goal of early warning is that the community can live and move safely in an area and the order of an area.

Geologically, the Jorong Saskand region, East Malalak Nagari is located under a steep hill, located in geological alignment, with loose lithology which has the potential to occur in landslides [3]. Based on the experience of the community that there was once a landslide accompanied by rocks which in the local language was called galodo. In addition to causing environmental damage, loss of property, the galodo also caused casualties. The galodo incident originates from a hill that landslides in an area about 200 m from the settlement. But now what people are worried about is the hill in their area of residence. According to observations the field has experienced *fractures* due to the earthquake that occurred in previous years.

From the results of a survey in early January 2012 at Jorong Saskand, the research team identified that the community in Jorong Saskand through the Disaster Preparedness Group (KSB) formed by an NGO had tried to make a document about the vulnerability analysis known as the *Hazard Vulnerability Capacity Assessment.* The results of the document show that the level of vulnerability and disaster risk is quite high [4]. This conclusion was obtained from the study and analysis regarding the economic, social and knowledge conditions of the community in the face of a landslide that threatened Jorong Saskand. Another important concern is because the people living in vulnerable areas have nearly 500 people and have farming livelihoods around the hills which are categorized as prone to landslides.

While the evacuation route and the safe route for the local community are insufficient. This is because access to open and safe areas is constrained by river flows that are likely to be the main stream if landslides accompanied by rocks (galodo) occur. So that the isolation of the area becomes the worst condition experienced by the people in Jorong Saskand if a landslide disaster (galodo) occurs.

According to information from the KSB members, as long as community assistance in improving preparedness for landslide hazards carried out by an NGO has not touched the landslide disaster early warning system and mechanism. The information obtained is only limited to knowledge about preparedness and testing (simulation) of events based on the tasks and functions of the group itself.

Therefore, based on the elaboration of the situation and the conditions above, it can be concluded that the community in Jorong Saskand, East Malalak Nagari, Agam Regency experienced quite complex and dilemma problems. But with the research program to be conducted in Jorong Saskand, East Malalak Nagari, Malalak District, Agam Regency is expected to be able to obtain a method of integration of early warning systems and landslide mitigation mechanisms.

2. Research Methods

2.1. Method of approach

Approach and direct assistance to the community in a participatory manner is a method for solving problems during program implementation. The community will be asked to participate directly in the implementation later through a series of agreed activities.

To carry out the initial steps in addition to field survey / mapping, it was carried out as well as the screening of commitments with the government, nagari leaders and other parties who would be involved during the implementation of the program. The research team with a background in geology and civil science will conduct a survey / mapping of the geological conditions of the area to determine the geological structure, rock, landslide fields and sampling to further analyse the development of models / estimates of landslide fields for vulnerable areas and affected assets. The results of the research team will be synchronized with the system and mechanism of the early warning tools that BPPT has made.

To carry out the integration method of the early warning system and the landslide mitigation mechanism that will be developed by the research team demands the role of the community involved in the program. Communities that know the area, try to agree together on disaster mitigation and especially implement and ensure the sustainability of existing systems and mechanisms. While the team is only an intermediary and researcher to ensure the condition scientifically and recommend systems and mechanisms for early warning and landslide mitigation to partners / KSB "Tumik Singgalang".

2.2. Plan of Activities

Plans for activities in solving problems faced by KSB "Tumik Singgalang" are the initial steps to provide counselling to explain as completely as possible the technical problems related to regional geological conditions and scientific disaster. After this group correctly understands the problem, the research team explains the stages of implementing the integration method of the early warning system and the landslide mitigation mechanism.[5]

The stages of mapping the condition of the area are the first step to know and understand the geology of the real conditions of the threat and the modelling / analysis of the affected areas while trying to understand the concept of early warning tools with partners. The next stage is mentoring by the research team as well as collective and participatory community agreement on the method of integration of early warning systems and landslide disaster mitigation mechanisms [6]. After the two stages above are carried out properly, the next stage is the agreed stage of testing / implementation of the system simulation. If the achievement of the test results is not maximized, improvements will be made until the early warning system can be implemented and understood by all levels of society.

The success of this research program needs support from many parties including the active participation of the Disaster Preparedness Group (KSB) "Tumik Singgalang" as the main partner of this research program. The forms of participation of partners that have been supported include providing access to the research team such as providing a separate place / room, access to information and the widest opportunity for the research team to come at any time in the process of identifying problems, dismantling, replacing and reassembling and landslide early warning system testing. With such broad access support, the community research team can freely express their ideas in a broad, complete, optimal and responsible manner. With the beam diagram the solution to solving the problems faced by the "Tumik Singgalang" Disaster Preparedness Group can be seen in the appendix.

3. Result and Discussion

Geographically, Jorong Sasai Kandang borders Jorong Subarang, the length of the North, South borders Jorong Toboh, on the east borders on Mount Singgalang, and on the west borders on Jorong Limo Badak. Jorong in the hilly area, as seen in Figure 2, generally has a potential danger that threatens the people living in the area.

Figure 2. General topography of the Saskand region

Based on Figure 2, it can be seen that the Sasai Kandang area is near the line of structural alignment. Geographically, Jorong Sasai Kandang borders on Jorong Subarang, the length on the North, South borders on Jorong Toboh, on the east borders on Mount Singgalang, and on the west borders on Jorong Limo Badak. Jorong in the hilly area as seen in the picture generally has a potential danger that threatens the people living in the area. The land contour is in the form of hills, this makes the Sasai cage area the most potential area for landslides (in regional terms is galodo). The results of recording these events can be seen in table 1 below;

Table 1. Historical events in Jorong Saskand and impacts

Year	Disaster events	Impact
1926	Earthquake	Houses damaged
1979	Galodo	4 people died, houses damaged, bridges got washed away
2006	Earthquake	Home damaged, damaged rice field
2007	Earthquake	12 houses damaged, 19 homes were damaged, facility public (schools and mosques) damaged
2008	Galodo	5 destroyed houses, 6 people died, bridges broken, farm land damaged 30 ha
2009	Earthquake	13 houses badly damaged, 9 medium damaged houses, mosques and mushalla damaged, hills cracking

From the historical plot of Jorong Saskand we can see a series of events disaster that has hit this area. the characteristics of the disaster that hit Jorong Saskand were the earthquake and galodo, but the biggest threat to the Saskand community was Galodo, because from the field survey and mapping several locations had been found which had cracked on the hillsides surrounding Jorong Saskand which would eventually break and cause landslides / banjir bandang / galodo, moreover rainfall in the area is quite high. The Malalak area is the most vulnerable to earthquakes, because this area is an area traversed by the earthquake fault line, as evidenced by the 2009 West Sumatra earthquake, Malalak was one of the worst affected areas. One of the drivers in the Malalak sub-district is Jorong Saskand who has felt the impact.

Jorong Sasai enclosure is located in a high degree of slope so it also has a very high threat of landslides. A number of landslides occur several times, affecting physical, property and life losses. At present the threat of landslides is still haunting the people of Jorong Sasai Kandang. As a result of the 2009 West Sumatra earthquake there were cracks at several points in the slopes of Mount Singgalang which at times could threaten the people of the Jorong Sasai cage especially in conditions of very high rainfall. From the historical path of Jorong Saskand disaster we can see a series of disasters who had hit this area. characteristics the disaster that hit Jorong Saskand was earthquake and galodo, but it became the heaviest threat to the people of Saskand is Galodo, because of the survey and field mapping obtained several locations who had cracked the slope the hills surrounding Jorong Saskand which one day will break and cause landslide / flash flood / galodo, let alone bulk rain in the area is quite high. Area Malalak is the most vulnerable area against earthquake, because of the area this is the area passed by the lane earthquake fault, proven in the earthquake 2009 West Sumatra earth, malalak is one of the worst affected areas. One of the drivers in this Malalak sub-district is Jorong Saskand who feels it the impact.

Jorong Sasai Kandang area located at a high degree of slope so that also has a very landslide threat high. Several landslides have occurred, impact on physical loss, property and soul. Currently the threat of landslides is still on haunt the people of Jorong Sasai Kandang. As a result of the 2009 West Sumatra earthquake occurred cracks on several points of the mountain slope Singgalang can at any time threatening the people of Jorong Sasai cage especially in very heavy rainfall conditions high.

Figure 3. Illustration of lithology and geological problems in Jorong Saskand

Signs of landslides in this area have been studied and known simply by the Saskand community. It is characterized by shrinking river water when it rains with high rainfall and a very loud thud. At this time the community was asked to stand by. However, early warning according to local wisdom needs to be refined by developing a systematic early warning system.

The following are the results of identification of community problems in the Sasai Kandang in a participatory manner in assessing vulnerabilities and capacities in their area. Assessment of these vulnerabilities is done using the PRA (Participatory Rural Assessment) method. The PRA tool used in assessing the vulnerability and capacity of the Sasai Kandang drive includes, transects, disaster maps, season calendars, varnish diagrams, historical flows, and the daily schedule of the community.

1) **Physical Vulnerability.** Among the physical vulnerabilities possessed by Jorong Saskand are:
   a. Residential settlements are on hillsides.
   b. Residential settlements near the river flow
   c. Many forest conditions are deforested
   d. Hills many cracks (fractures)
   e. Evacuation paths are inadequate Evacuation
   f. locations do not yet exist
2) **Social Vulnerability.** Among the social vulnerabilities possessed by jorong sankand are:
   a. Lack of population knowledge about how to deal with and disaster management
   b. Lack of youth living in the village
   c. Lack of Ulama
3) **Economic Vulnerability**. Among the economic vulnerabilities possessed by jorong sankand are:
   a. Sources of livelihoods (field rice fields) on the hillside
   b. There are no alternative jobs
   c. Many families that are less able
   d. The planting season is not simultaneous
   e. Prices of agricultural products often fall on the market
   f. Far from urban
   g. Transportation inadequate
   h. Erratic weather, which affects agricultural yields and planting patterns
   i. Plant pests (rats, pigs)
   j. Scarcity of Fertilizers

In addition to having many vulnerabilities, the Jorong Saskand community also has the capacity to reduce disaster risk. With the existing capacity if realized and maximized, of course the risk that will be caused by the disaster will decrease. Among these capacities are physical, social and economic capacity.

1) **Physical Capacity**
   a. The existence of a mosque as a temporary evacuation site for
   b. smooth irrigation channels
2) **Social capacity**
   a. Disaster Preparedness Groups (KSB)
   b. Strong relationships between institutions
   c. There is a concern of migrants to their home villages
   d. People know the signs of a disaster High
   e. solidarity and public awareness
3) **Economic Capacity**
   a. existence of farmer groups and Gapoktan
   b. Presence of Water User Farmers Association (P3A)
   c. The existence of nagari-level BMTs
   d. There isSPP of
   e. Sufficient Agricultural Products

Identification of vulnerability issues and capacities that have been carried out needs to be supported by hazard assessment so that the magnitude of the threat risks is identified. Through the PRA method, a general overview of maps based on HVC (Hazard, Vulnerability, Capacity) is obtained. 80% of the area jorong Sasai Kandang is a disaster-prone area, the disaster in question is landslides and flash

floods. The red shaded area above is the area around the hillsides and river flow. Whereas the pattern of residential settlement of 60% is on hillsides and follows the river flow.

There are 3 points of vulnerability which are hilly cracks which can threaten people's lives and livelihoods at any time with landslides. From the map, it was also illustrated that only one road used as an evacuation route was in a disaster-prone area because it followed the river flow.

The evacuation area of the Sasai Kandang jorong is centered in the open area of Jorong Lomo rhinos, and temporary evacuation at the Sasai Kandang mosque. To take the two evacuation sites, you can only pass one road, the jorong road, Sasai Kandang. The capacity of the main evacuation site can accommodate approximately 300 people, while the temporary evacuation site in Saskand Jorong mosque can accommodate 100 people.

3.1 Coordination for screening commitments

Initial coordination of the activities is carried out after obtaining a letter issued by LP2M UNP. Research permit is given to the sub-district, nagari and jorong. At the time of coordination, a persuasion approach was carried out with stakeholders and policies in the Sub-Districts, Nagari and Jorong. When the initial coordination was obtained agreement and support in the implementation of the activities later. This is because the activities carried out are needed by the community. The condition of vulnerable areas and the condition of the community that requires attention related to disaster risk reduction efforts.

3.2 Geological survey of the area

The research area and its surroundings are plain and hilly areas with steep slope. Morphology in the eastern part (upstream) of the research area is hills which are composed of deposited material in the form of lumps of tuff, which is easily released due to weathering. Morphology in the western part (downstream) of the study area is a plain area.

The Ampera hill area in Jorong Saskand which has the potential for landslides has a variety of slope angles, namely slopes with an angle of ± 30º found in the middle to the foothills and slopes with angles of ± 35º-40 ° found in the middle to the top of the hill. The middle area of the hill that has the potential for landslides with soil thickness reaches ± 20-30 meters. Analysis of the data was obtained from more detailed mapping based on the geological map of the Malalak area as seen in Figure 4.

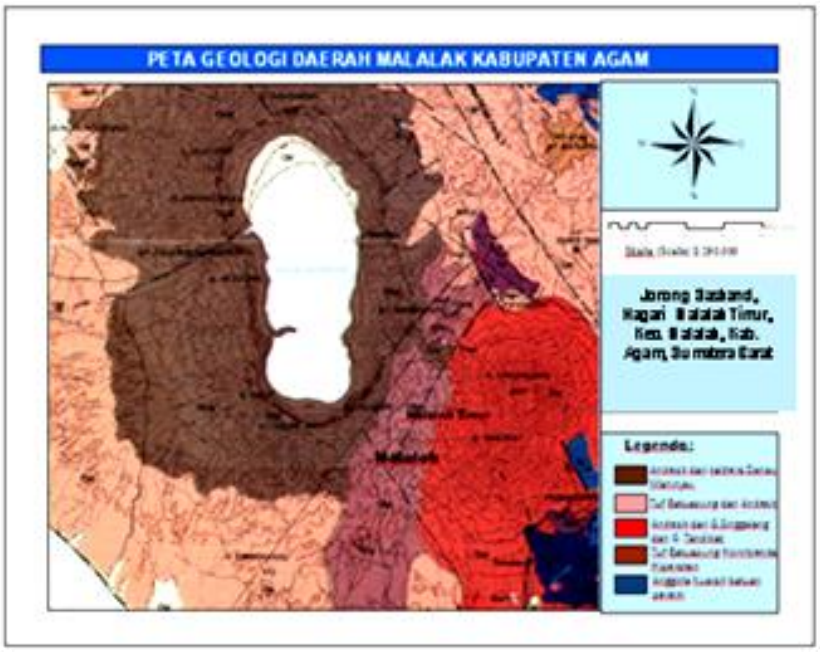

Figure 4. Malalak geological map of land Use

Land use in the middle area of potentially landslide hills in the form of shrubs and at the foot of hill settlements and rice fields. The condition of paddy fields is always planted with seasonal plants such as rice, corn and crops. Water that continues to be held in the middle of the hill due to soil cracks results in increasing the intensity of the water entering the soil. This condition will reduce soil shear strength significantly and increase slope load.

The sloping morphology of the study area leads to a vertical force that pulls rocks downward higher, this supports the occurrence of landslides in the study area. The river in the study area occupies the southern part of the research area, at the foot of the hill which has the potential for landslides there is a small channel used to drain water to the rice fields. This causes the water to seep into the soil continuously. This event accelerates avalanches in the research area as shown in Figure 5.

Figure 5. Survey location and field data collection points field

Based on observations this area consists of volcanic material from the Maninjau caldera eruption in the form of hiperstin hornstone tufa (Qhpt) (purple) which is entirely in the form of 2-10 cm lapilli stone containing horblenda and hiperstin or biotite, rather compact white or grayish yellow for fresh and brown ingredients from decaying and pumice and andesite (Qpt) (pink) in the form of fibers glass 5-80% white pumice fragments measuring 1-20 cm, rather compact. The description of the lithology that appears in the field can be seen in Figure 6.

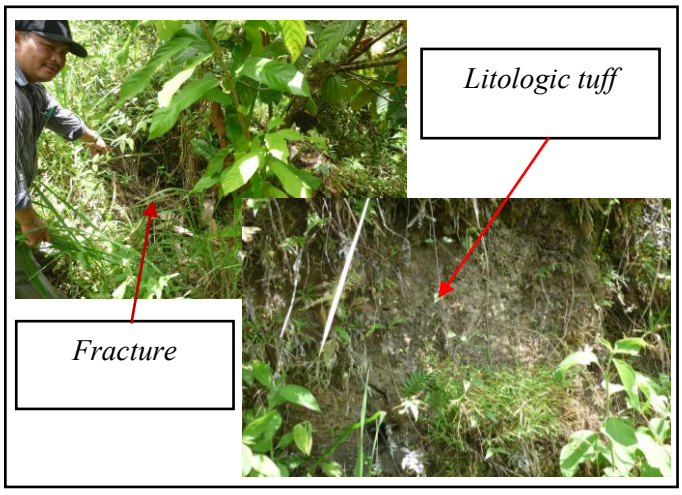

Figure 6. Lithological appearance that can cause landslides

Based on the results of the survey and lithological sightings which have several cracks, it can be concluded that the hill above the settlement has a high potential for landslides.

3.3 Analysis of the results of the field survey

Processing the results of the analysis of the geoelectric survey carried out can be seen from the 3 generated trajectories namely:

Track 1.

This track is located 26˚ from the north of the measurement location, at the coordinates S 00˚ 23' 17.2" and E 100˚ 17' 01.3". Based on the results of electrical resistivity tomography, the Wesner configuration shows the presence of colloidal deposits and pumice tuffs on this track. The clay (colivium deposits) occupy the top of the track and the pumice tufa is located at the bottom of this track with varying thicknesses.

Track 2.

This track is parallel to line 1 on the coordinates S 00˚ 23' 17.3" and E 100˚ 17' 01.0". Based on the results of electrical resistivity tomography, the Wesner configuration shows the presence of colloidal deposits and pumice tuffs on this track. The clay (colluvium deposits) occupy the top of the track and the pumice tufa is located at the bottom of this track with varying thicknesses.

Track 3.

This track is located 48˚ from the north of the measurement location in the coordinates 00˚ 23' 17.3" and E 100˚ 17' 00.9". Based on the results of electrical resistivity tomography, the Wesner configuration shows the presence of colloidal deposits and pumice tuffs on this track. The clay (colluvium deposits) occupy the top of the track and the pumice tufa is located at the bottom of this track with varying thicknesses. The track is a test sample to find out more in detail the lithology of the area. To see more clearly through trajectory mapping can be seen in Figure 7.

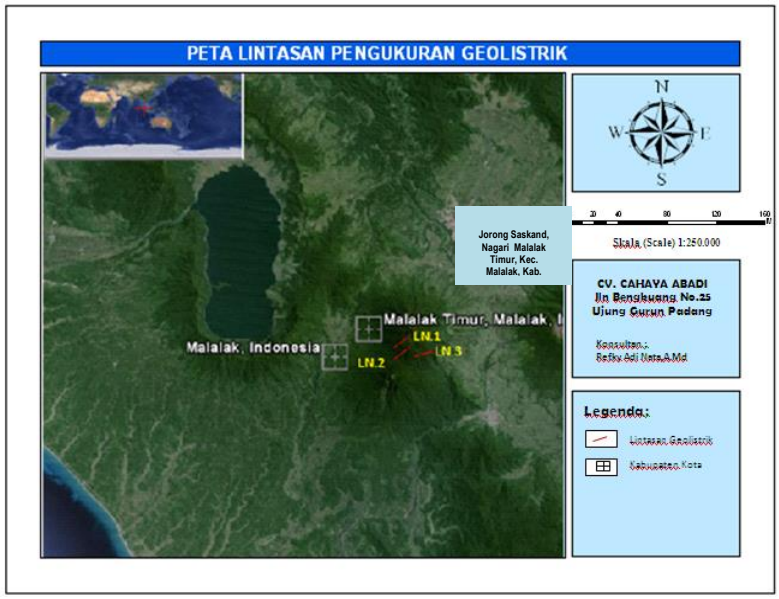

Figure 7. Geoelectric measurement path map in Jorong Saskand

Based on the picture above, testing has been done by producing several things related to the lithology of the area. The results of mapping and testing will be the basic material in conducting socialization and assistance to the community.

3.4 Dissemination of the results of regional mapping

After the mapping results were obtained, a meeting was held with community groups incorporated in the KSB. This is done in order to provide basic knowledge in terms of science related to regional conditions. Submission of information from the mapping survey needs to be done so that people can understand what the research team has done.

In general, the delivery of information to the public is more fundamental in understanding the potential of landslides. To make it easier for the public to understand, the research team made a simple description of the condition of the hill as a landslide point as shown in the following figure;

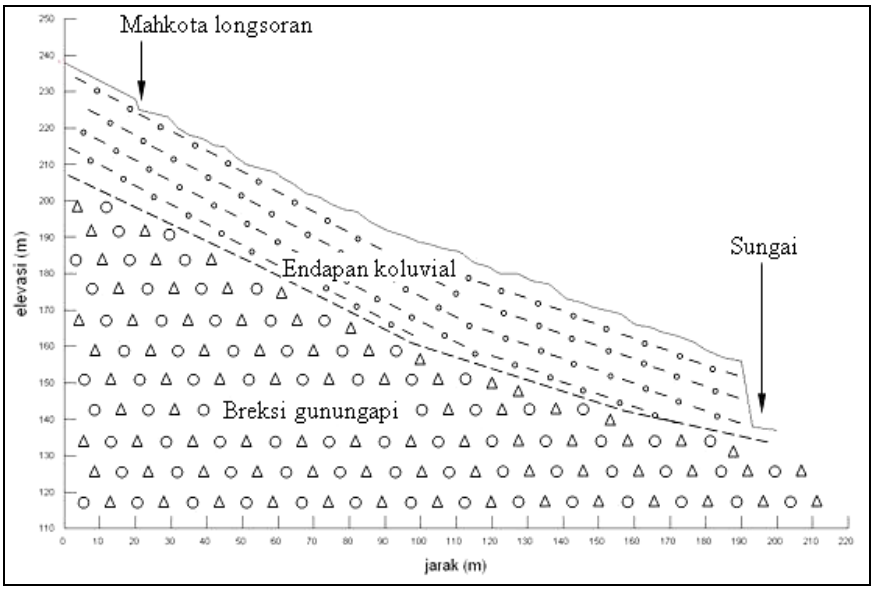

Figure 8. The results of a simple analysis based on geoelectric testing based on geoelectric testing

Socialization to the community in providing an explanation of the picture above has been done. Communities belonging to the KSB tumik Singgalang will pass on the knowledge provided by the research team to another general public. The role of KSB is more empowered as a group that has been formed in an effort to reduce disaster risk, especially landslides.

3.5 Focus Group Discussion (FGD) the role of the community in mitigation and prevention

Before entering into the FGD activities material was provided as an introduction to the FGD activities. First, the Implementation Team explained that Risk is the most important thing in a disaster, namely the risk of losing lives and assets. Therefore, the most important action that must be taken is to minimize the risk of small risks if we can face vulnerability and sponsored hazards. Provision of material prone to landslides in Jorong Saskand, East Malalak Nagari, Malalak District when rainfall is more than standard especially in the watershed. In particular this activity focuses on landslides. This is inseparable from the frequent frequency of landslides that occur in East Malalak District.

One that is needed by disaster-prone communities is the early warning system (EWS). This is absolutely necessary in order to create a society that is ready, alert and fast in facing disasters. In landslide-prone areas, such as in Jorong Saskand, East Malalak District is the most important part of disaster management. With the application of good and true will be able to protect and save the public from the threat of disaster.

The community can make various efforts to save lives and property. Early warning (EWS) is the key to effective risk reduction. It will be effective if it involves the participation of all components of society, besides that it can be understood and reaches all levels of society and must be followed by a systematic Standard Operating Procedure (SOP). Therefore. The IbM Program Implementation Team

"Singgalang Tumik Disaster" Group Faced Landslide Disaster, Jorong Saskand, East Malalak Nagari, Agam District Organized a Focus Group Discussion (FGD) on an appropriate method to integrate early warning systems with optimal landslide mitigation mechanisms, efficiency and agreed upon by the community in a participatory manner. The active involvement of the community is highly demanded to produce a method that is simple and easy to implement by the community.

4. Testing and monitoring of community systems and mechanisms in landslide handling

Anticipating the high risk of landslides in East Malalak Nagari, Malalak District, Agam Regency, which is between two mountains, namely Singgalang Mountain with an altitude of 2,877 meters and Mount Tandikat, Disaster Preparedness Group "Singgalang Tumik", In Jorong Saskand, East Malalak Nagari, Malalak Subdistrict, trials and monitoring of systems and mechanisms of the community in handling landslides. One of them is a landslide handling simulation that is centered in the local village field. In addition to these activities, to anticipate and handle the disaster, the role of the "Tumik Singgalang" Disaster Group was also increased.

"Tumik Singgalang" Disaster Preparedness Group has a community-based disaster management function. Starting from pre or disaster mitigation, emergency response, and recovery after a disaster. The "Tumik Singgalang" Disaster Preparedness Group not only moves to one village area but can also help surrounding villages within a sub-district. The formation of the "Tumik Singgalang" Disaster Alert Group is equipped with various disaster management facilities such as social barns for logistics, shelter, tents and other equipment. After empowerment, development is then carried out with the preparation of a roadmap (vulnerability map), disaster management SOP, and need assessment.

"This simulation is for SOP trials. With the "Tumik Singgalang" Disaster Preparedness Group equipped with logistics, they can move on their own, not depending on the government especially if there is a disaster when the office holidays are closed, they can independently move on their own. The Chairman of the "Tumik Singgalang" Disaster Preparedness Group, Jorong Saskand, Nurwan St Mangkudun said that before the simulation of the Lonsor land handling, his party had made sponsored anticipation efforts by draining the cracks of the land and fixing the trenches. The "Tumik Singgalang" Disaster Preparedness Group has 60 members consisting of the rapid reaction team (TRC) division, shelter, evacuation, public kitchen, communication and transportation. "With this simulation it is very positive, so that in the future we can anticipate and handle all possible disasters. The Jorong Saskand area, East Malalak, Agam Regency because of the form of cliffs so that it is very likely to occur landslides.

5. Conclusion

Based on the activities carried out in the Science and Technology program for the Community in Jorong Saskand, several conclusions and suggestions were obtained. These results are conclusions from several processes that have been running so the results are in the form of;

1. Mapping
   Presents visual information about the level of vulnerability of geological natural disasters in an area, as input to the community and / or district / city and provincial governments as basic data to carry out regional development in order to avoid disasters.
2. Examinations
   Conduct investigations during and after a disaster, so can know the causes and ways of controlling it.
3. Monitoring
   Monitoring is carried out in disaster-prone areas, in strategic areas economically and services, so that the danger level can be identified early, by users and the people who live in the area.
4. Socialization
   Provides understanding to the general public, about natural disasters of landslides and their consequences. Dissemination is carried out in various ways including sending posters, booklets, and leaflets or can be directly to the public and government officials

5. Landslide disaster inspection
   Aims to learn the causes, processes, disaster conditions and disaster management procedures in an area affected by a landslide
6. Community role Focus Group Discussion (FGD)
   Provide understanding to participants (KSB) about the importance of an early warning system, know what equipment is important in a landslide early warning system, and know what steps should be taken in the early warning system, even though not well conceptualized.
7. follow-up plan will be made public
   presence of repair / strengthen early warning information system landslide disasters, the required agreements between the public / participants KSB thus produced Procedures (SOP) early warning system for landslides Jorong Saskand
8. Tests and monitoring system
   In order to anticipate the and handle all possible disasters

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