# STUDY OF LANDSLIDE VULNARABLE REGION AND MITIGATION IN TANGGAMUS DISTRICT

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**ABSTRAK;**Bencana tanah longsor merupakan bencana hidrometeorologi yang sering terjadi di Kabupaten Tanggamus Lampung.Tujuan dari penelitian ini adalah untuk mengetahui tingkat kerawanan longsor di Kabupaten Tanggamus .Metode yang dilakukan adalah metode deskriptif dengan menggunakan variabel (parameter) Kelas kemiringan lereng, curah hujan,geologi dan penggunaan lahan. Analisis yang dilakukan dengan overlay menggunakan ARCGIS dari 4 variabel tersebut yang kemudian didapatkan satuan lahan dan satuan lahan itu lantas diberi pembobotan untuk mendapatkan tingkat kerawanan longsor dengan kelas,rendah,menengah,tinggi.Hasil penelitian menunjukkan bahwa wilayah dengan tingkat kerawanan rendah seluas 13,963 ha (4,89%), kerawanan menengah 175,297 ha (61,39%) dan tingkat kerawanan tinggi seluas 96,286 ha (33,72%).Variabel dominan penyebab longsor adalah curah hujan dan kemiringan lereng serta penggunaan lahan. Mitigasi bencana longsor yang dapat dilakukan adalah dengan memberikan informasi kepada masyarakat yang tinggal di Kabupaten Tanggamus akan wilayah-wilayah mana saja yang tinggi,menengah,rendah terjadinya longsor.Meningkatkan kesadaran masyarakat terhadap bahaya longsor di wilayahnya,kesiapsiagaan menghadapi longsor dengan cara memperhatikan kondisi ketika turun hujan dengan intensitas tinggi,maka untuk masyarakat yang tinggal di wilayah dengan kemiringan lereng curam dan sangat curam hendaknya berhati-hati dan selalu siaga menghindari bahaya longsor.Peningkatan kesadaran masyarakat juga untuk menggunakan lahan pertanian lahan kering untuk digunakan sesuai peruntukkannya,jangan ditanami tanaman-tanaman yang justru dapat menimbulkan resiko longsor lebih parah lagi.

Kata Kunci: Longsor, Kerawanan,Tanggamus

## 1. INTRODUCTION

A landslide is a geological event that occurs due to the movement of rock mass or soil whose movement falls down. In general, landslides are caused by 2 factors: driving factors and trigger factors. The driving factor is a factor that affects material conditions while the trigger factors are the factors that cause the material to move. Landslides, often hit the Tanggamus District of Lampung. Tanggamus Regency is located in the southern part of Lampung Province which borders the Sunda Strait. This region in 1883 had been affected by the tsunami due to the eruption of Mount Krakatau. In this region there are areas that have the potential for disaster. Geographically, the area of Tanggamus Regency is located at the position of 1040 18 "- 1050 12" East Longitude and between 50 05 '- 50 56' South Latitude. The area is mostly found in the southern part of Bukit Barisan. Tanggamus Regency has an area of 3,356.61 Km2 with regional morphology varying from lowland to highland. About 40% of all areas with elevation from sea level between 0 to 2115 m (Bappeda, 2005). Tanggamus Regency is based on 2013 data, included in the multi-threat disaster risk index per district in the Indonesian region in the high risk class category with a score of 201 ( BNPB, 2013). This shows that Tanggamus Regency is at risk of natural disaster threats, be it floods, tsunami, landslides, extreme weather, land and forest fires, volcanoes and others.

Based on research conducted by (Prawiradisastra, 2013), if you look at the area of landslide prone areas in Lampung Province, Tanggamus Regency is in the third place which has a high landslide-prone area, which is 168.07 sq km or 0.47 % of Lampung province's area. Landslides that occur are caused by high rainfall (3000-3500 mm / year) with a slope of more than 45% which is steep to steep and there is an active fault zone of Sumatra.

In October 2018, there were landslides in three sub-districts namely Limau District, Cukuhbalak District and East Agung City. Landslides are spread evenly, starting from Pekon Sukabanjar in the East Agung District District; Ketapang District, Tegineneng, Tanjung Jaya in Limau District; to Pekon Putih Doh in Cukuh Balak Subdistrict. As a result, material that hides the road body makes the vehicle unable to pass within a few hours, this can be seen in Figures 1 and 2

Figure 1. Landslide Event in the Provincial Road Section in Limau District
Source: Tribun Lampung.co.id (10/14/2018)

Figure 2. After three days covered with landslides, cross-district road access in the Cukuh Balak District area can already be crossed.
Source: Tribun Lampung.co.id (1/11/2018)

In the past three years several areas classified as vulnerable include Pematang Sawah, Semaka, Wonosobo, Ulu Belu, Kelumbayan landslides. one of them, which was quite large,

was a landslide in Sedayu Semaka, which had severed the western crossing road in 2009. The incident had cut off the Sumatran west (jalinbar) crossing, especially in the Sedayu incline. Landslides that occurred in Tanggamus Regency also caused by planting plants that are not in accordance with the conditions of the land. From the research study conducted by Nur (2007) on evaluating land suitability for superior plantation crops in Tanggamus Regency, it turned out that both coffee, cocoa, pepper, coconut, oil palm, rubber were included in plants that were not suitable for planting in Tanggamus Regency, even though these plants become mainstay plants. This incompatibility is caused because these plants are planted throughout the Tanggamus Regency, without regard to physical aspects, such as slope aspects and soil type, so this type of planting of plants can also cause the occurrence of landslides. The occurrence of this landslide is certainly very detrimental to both the economic, social and environmental aspects. Therefore identification of landslide-prone areas in full in Tanggamus Regency is very necessary in the effort of sustainable development management and targeted landslide mitigation efforts.

## 2. LITERATURE REVIEW AND DEVELOPMENT OF HYPOTHESIS

According to Arsyad (1989), landslides (landslides) are a form of erosion which transports or transfers the land at a time in large volumes. So it can be said that landslides are one of soil erosion, but in landslides the transport of land occurs at once. Landslides occur as a result of the sliding of a volume of soil above a rather impermeable layer of water saturated water. The layer consists of clay or contains high levels of clay which after saturating water acts as a sliding field (Sukri, 2013). Disaster mitigation is a series of efforts to reduce disaster risk, both through physical development and awareness and capacity building to deal with disaster threats (Article 1 paragraph 6 PP No. 21 of 2008 concerning the Implementation of Disaster Management).

The hypothesis that can be designed in this study is that the occurrence of landslides in the Tanggamus Regency is caused by high rainfall and steep slope to steep slopes so that there is a need for disaster mitigation.

## 3. RESEARCH METHODS

The method that will be used in conducting this research is descriptive method by looking at the influence of each variable to analyze landslide-prone areas where these variables are obtained through secondary data in the form of maps, namely land use maps, rainfall maps, geological maps, slope maps and administrative map of Tanggamus Regency. The maps are then overlaid by using ARCGIS to obtain a land unit map, which is then scaled to the land unit map for the classification of the level of prone landslides in the Tanggamus Regency of Lampung. The value of the score of landslide vulnerability classification using puslitanak and BPPT, 2004, can be seen in table 1. The classification of landslide vulnerability is divided into 3, namely high vulnerability, moderate vulnerability and low vulnerability.

Table 1. Score Indicator for Landslide Hazard Maps

| No | Variabel | Kriteria | Nilai Harkat |
|---|---|---|---|
| 1. | Kemiringan Lereng (%) | - > 45<br>- 30 - 40<br>- 15 – 30<br>- 8 – 15<br>- < 8 | 5<br>4<br>3<br>2<br>1 |
| 2. | Geologi | - batuan vulkanik (tuf, pasir)<br>- batuan sedimen (lempung, napal)<br>- batuan aluvial | 3<br>2<br>1 |
| 3. | Curah hujan (mm/tahun) | - sangat basah (> 3000)<br>- basah (2501 – 3000)<br>- sedang/lembab (2001 – 2500)<br>- kering (1501 – 2500)<br>- sangat kering (< 1500) | 5<br>4<br>3<br>2<br>1 |
| 4. | Penggunaan Lahan | - tergalan, sawah<br>- semak belukar<br>- hutan, perkebunan<br>- kota, permukiman, bandara dll<br>- tambak, waduk, perairan | 5<br>4<br>3<br>2<br>1 |

Source: puslitanak and BPPT, 2004

Table 2. Criteria For Assessing Landslide Vulnerability

| Landslide vulnerability | criteria Number of scores |
|---|---|
| High vulnerability | ≥ 14 |
| Medium vulnerability | 9-13 |
| Low vulnerability | 4-8 |

Source: Data processing

## 4. DISCUSSION AND ANALYSIS OF RESULTS

The physical condition of Tanggamus Regency based on the four variables used in this study can be shown in each map as follows:

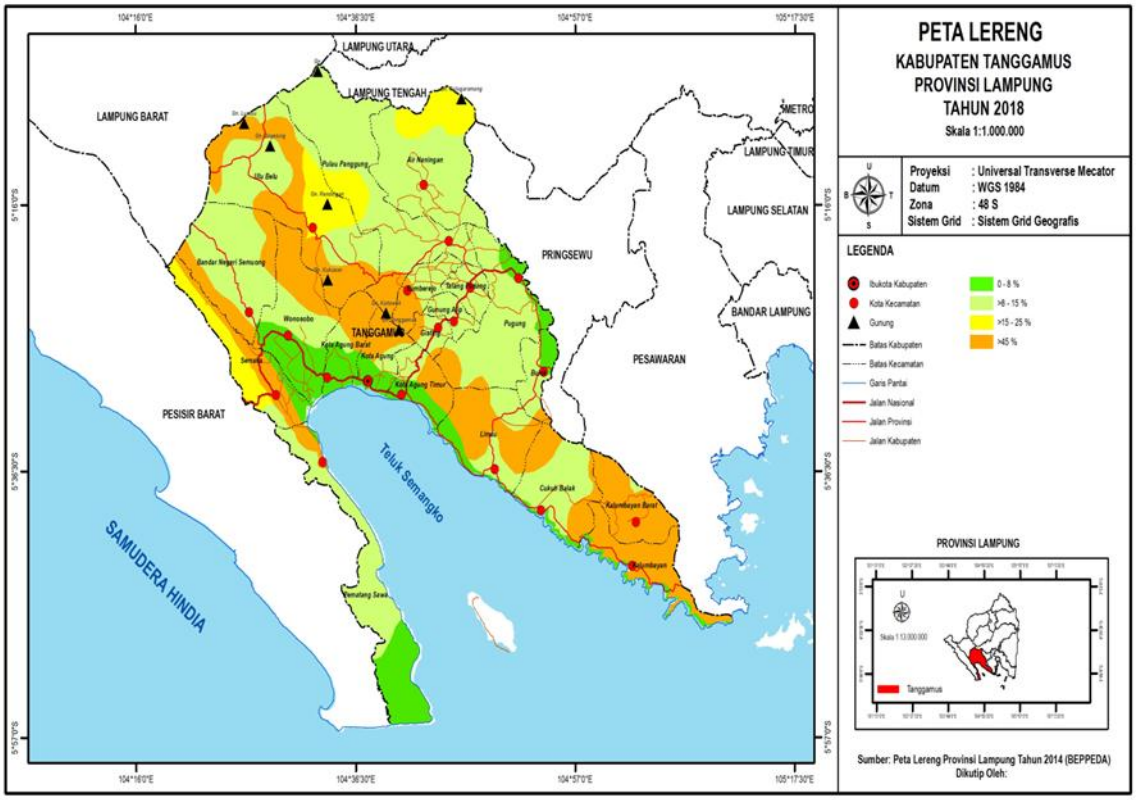
1. Physical Slope Conditions
the physical condition of the slopes of Tanggamus Regency is classified into 4 slope slopes, namely flat, sloping, rather steep, very steep. The classification can be seen in the table below.

Table 3. Classification of Slope Slope Based on Van Zuidam, 1985

| No | Slope (%) | Slope Class | Morphological unit |
|---|---|---|---|
| 1 | 0-8 | Flat | Plain |
| 2 | >8-15 | Hill | Ramps are finely lubricated |
| 3 | 15-25 | It is rather steep | The hills are medium sized |
| 4 | >45 | Very steep | hills are very rough bereft |

Source: Van Zuidam, 1985

From the results of data processing using ARCGIS, the distribution of slope classification in Tanggamus Regency is obtained as shown in map 3.




The flat slope class is marked by dark green, in parts of Wonosobo Subdistrict, Kota Agung, Kota Agung Timur, Pematang Sawa, Pugung, Semaka and Bulok with an area of 34,665 ha (12.14%). light green color is in part of Pugung Subdistrict, Alip Mountain, Talang Padang, Sumberejo, Cukuh Balak, Naningan Water, Pulau Panggung, Ulu Belu, Bandar Negeri Semuong, Wonosobo with an area of 145,978 ha (51.12%). The grade of the slope is rather steep marked by yellow, located in the District of Ulu Belu, Semaka, Naningan Water with an area of 84.437 ha (29.57%). The grade of the very steep slope is in the areas of Semaka, Ulu Belu, Wonosobo, Agung Barat City, Agung Timur Limau City and West Kalumbayan with an area of 20,466 ha (7.17%).

2. Rainfall

Rainfall in Tanggamus Regency ranges from less than 1500-3500 mm / year. This rainfall is included in the classification of low, medium, high. Rainfall low in figure 4. given light green (less than 1500 mm / year), moderate rainfall is given a light blue color (2500-3000 mm / th) and high rainfall is given a blue color (3000-3500 mm / year).

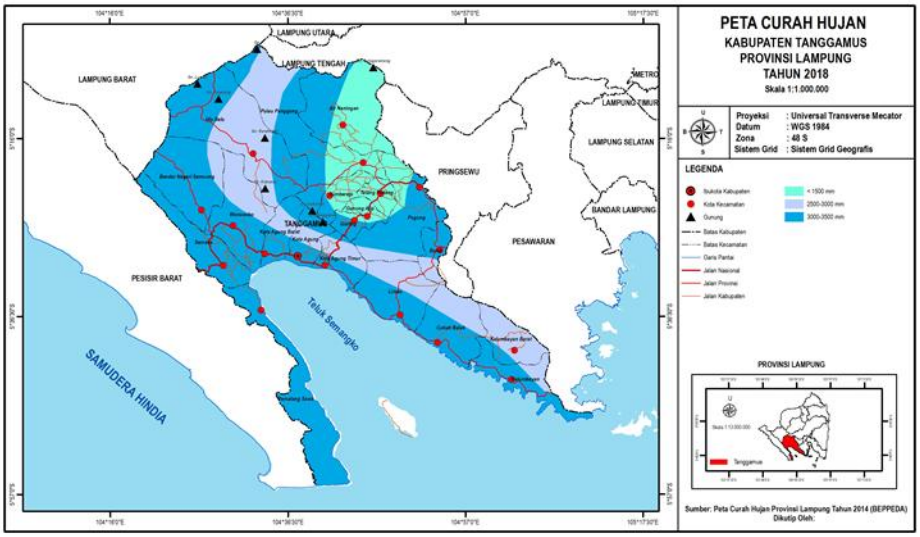



Figure 4. Rainfall Distribution Map Based on Differences in Rain Intensity

From the map it is known that the sub-district of Naningan water, Talangpadang, Sumberejo, Mount Alip are sub-districts with low rainfall intensity. While the island island sub-district, Ulu Belu and West Kelumbayan have moderate rainfall. For sub-districts that have high rainfall are in Pulopanggung sub-district, Gistingbulok, Ulu Belu, Semuong airport, all of them, Pematang Sawa, Limes, Cukuh Balak, Kelumbayan.

3. Land Use

For land use, most of the land is used for dry land mixed with bushes and plantations. For more details, see the map in Figure 4 below.

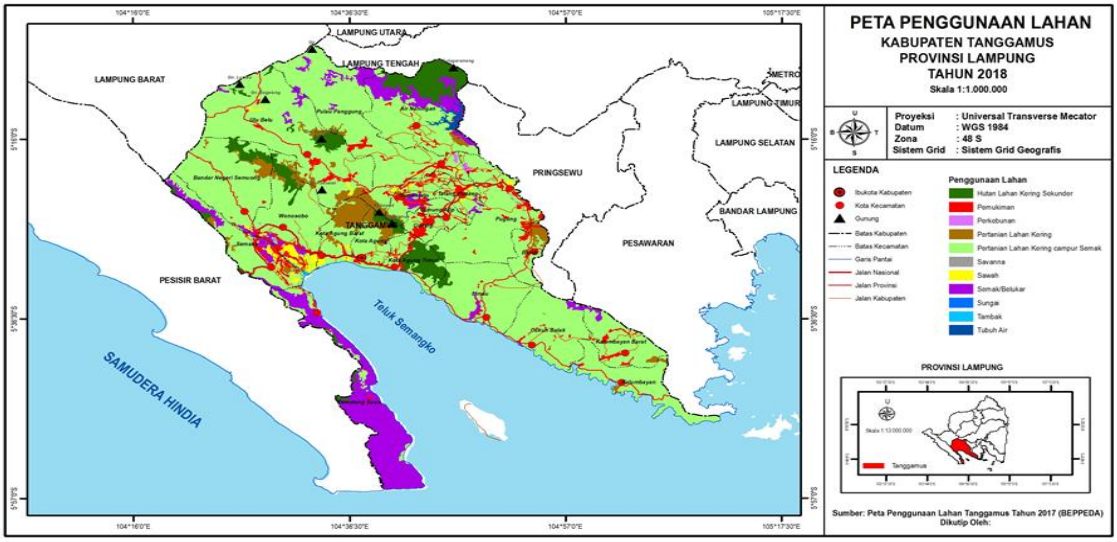



Figure 5. Map of Land Use in Tanggamus Regency

4. Geology

The geological conditions in Tanggamus Regency are mostly dominated by the Hulusimpang Formation, Bal Formation, old and young quaternary volcanic rocks. It can be seen on map map 5.

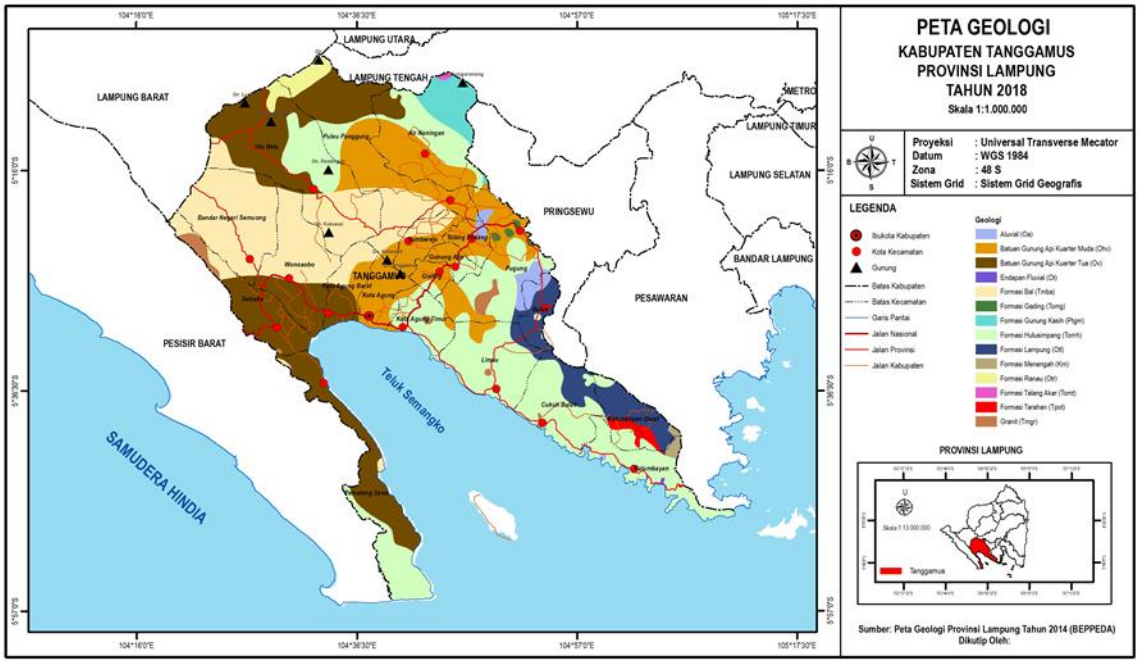



Figure 6. Geological Map of Tanggamus Regency

5. Landslide Prone Areas

Based on the landslide vulnerability map in Tanggamus Regency (figure 6), there were three landslide vulnerability classes namely green for low grade vulnerability classes, yellow for medium landslide vulnerability and pink for high landslide vulnerability.

For areas with low vulnerability (green), located in Air Naningan District, part of Talang Padang, Mount Alip. For regions with medium vulnerability (yellow), they are located in most areas of Pulau Panggung Subdistrict, Ulu Belu, Pugung, Bulok, Wonosobo, Bandar Negeri and Cukuh Balak. While for areas with a high level of vulnerability (red) are in the area of Semaka, Limau, and in the central part of Tanggamus District which is spread along Mount Tanggamus.

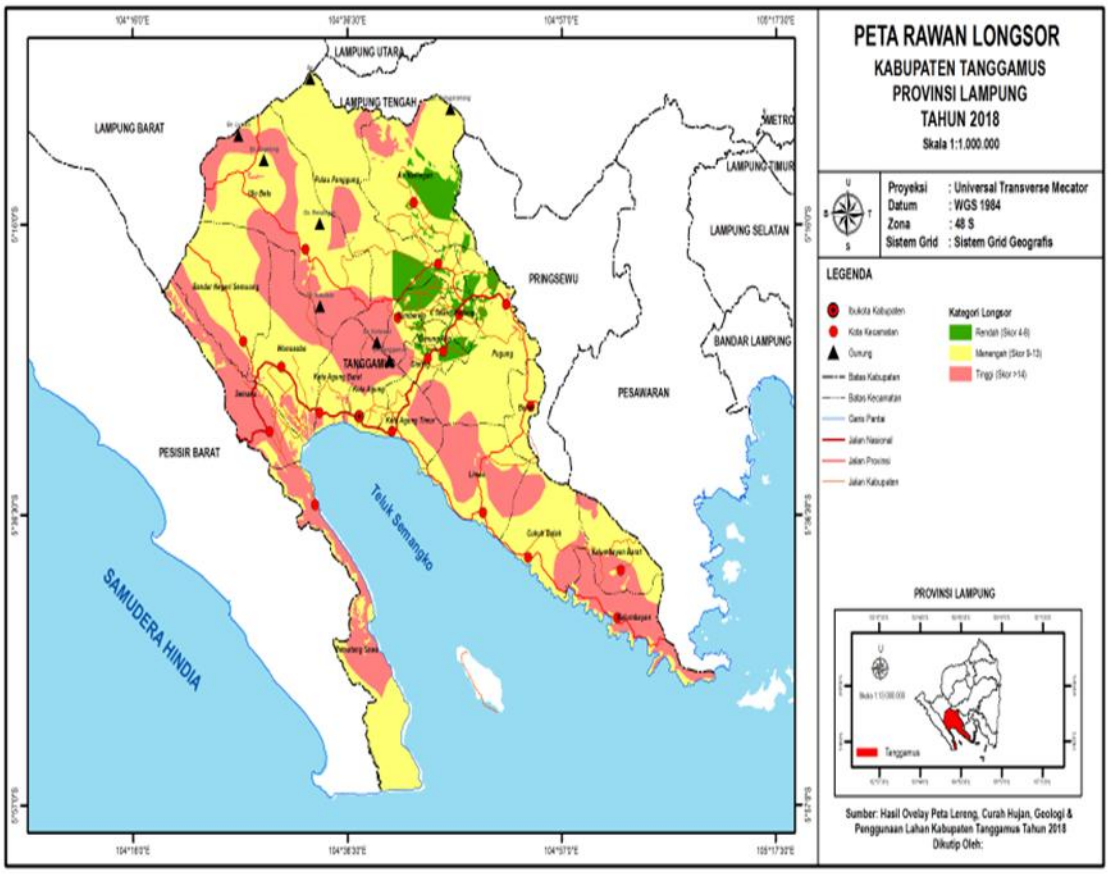



Figure 7. Landslide Prone Classification Map in Tanggamus District

Based on the map, that the area is prone to low landslides, is an area that generally has a low potential for landslides with an area of 13.963 ha (4.89%). Regions with intermediate landslide prone classifications have medium potential for large or small landslides and spread over an area of 175,297 ha (61.39%). Regions with a high classification of prone landslides have high potential for landslides which are spread over an area of 96,286 ha (33.72%) of the area of Tanggamus Regency. The area based on the landslide category can be seen in table 4.

Table 4. Landslide Vulnerability Categories Based on the Area in Tanggamus Regency

| No | Category | Area (ha) | percent |
|---|---|---|---|
| 1 | Low | 13,963 | 4,89 |
| 2 | Intermediate | 175,297 | 61,39 |
| 3 | Height | 96,286 | 33,72 |

Source: Data processing

Distribution of sub-districts based on differences in low, medium, high vulnerability to landslides can be seen in table 5 below.

Table 5. Distribution of District Based Landslide Prone Areas Category in Tanggamus Regency

| No | District | Low vulnerable landslide | Midle vulnerable landslide | Hight vulnerable landslide |
|---|---|---|---|---|
| 1 | Air Naningan | | | |
| 2 | Bandar negeri Semuong | | | |
| 3 | Bulok | | | |
| 4 | Cukuh Balak | | | |
| 5 | Gisting | | | |
| 6 | Gunung Alip | | | |
| 7 | Kalumbayan | | | |
| 8 | Kalumbayan Barat | | | |
| 9 | Kota Agung | | | |
| 10 | Kota Agung Barat | | | |
| 11 | Kota Agung Timur | | | |
| 12 | Limau | | | |
| 13 | Pematang Sawa | | | |
| 14 | Pugung | | | |
| 15 | Pulau Panggung | | | |
| 16 | Semaka | | | |
| 17 | Sumberejo | | | |
| 18 | Talang padang | | | |
| 19 | Ulu Belu | | | |
| 20 | Wonosobo | | | |

The landslide prone areas found are generally in areas that have very steep slope (more than 45%), high rainfall (3000-3500 mm / year), geological conditions, are in the oligo miocene age range consisting of andesite-basaltic lava, tuff-breccia breccia with mixed-use dryland agricultural land use. Such conditions are certainly very vulnerable to landslides.

6. Landslide Disaster Mitigation

Landslides that have occurred in Tanggamus Regency must receive serious attention from the community, regional government, and the central government. Because if not, it will be detrimental to both social, economic and environmental conditions. The anticipatory steps that can be taken immediately are by mitigating landslides. Its mitigation includes:

1. Mapping.

This mapping was carried out to determine the level of vulnerability of landslides, and this was done so that people could find out which area was included in which landslide category, whether low, medium or high.

2. Information Dissemination

The dissemination of this information is conveyed or given to the community, as well as the district government to the sub-districts and villages of each region. Submission of this information can be done by counseling residents about landslide hazards through representatives of RT / RW, Distribution of brochures installed in each house.

3. Disaster Simulation
Landslide simulation activities are carried out nearing the rainy season involving government and community officials and NGOs.

4. Determination of evacuation routes
The right evacuation route affects the process of rescuing residents quickly.

5. Monitoring
Monitoring is carried out in disaster-prone areas, in strategic areas in the economy and services, so that the level of danger is recognized early by the community.

6. Establishment of Disaster Response Community Groups (PKMTB)
It is a community organization that aims to monitor and implement activities related to landslide disasters at the village level (Nugroho, 2013).

## 5. CONCLUSION

Tanggamus Regency based on four landslide parameters, namely rainfall, slope, land use and geology has a classification of landslide vulnerability levels ranging from low, medium and high where the dominant factor is influenced by rainfall and slope. For this reason, it is necessary to mitigate landslides by mapping, disseminating information, simulating disasters, establishing evacuation routes, monitoring and establishing disaster response community groups.

## 6. ACKNOWLEDGMENTS

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