https://doi.org/10.23960/JIPS/v3i2.133-142

Mapping Of Potential Land Disasters Using GIS (Geographic Information System) In Tanggamus District

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Abstract

Tanggamus Regency is one area that has the potential for landslides because it's passed over by mountains and hills. This study aims to determine the level of potential landslides and to determine the distribution of areas with potential landslides in Tanggamus Regency.
This study aims to determine the level of potential landslides and to determine the distribution of areas with potential landslides in Tanggamus Regency.

This study uses descriptive research methods conducted in Tanggamus Regency. The population of this research is all land units in Tanggamus Regency. Determination of the sample in this study using stratified random sampling technique. Data collection tehniques such as observation and documentation. Spatial analysis was performend with geographic information system (GIS) using Arcmap 10.3 software with scoring and overlay methods.

The results of the research that have been obtained sahow that the level of potential landslides in Tanggamus Regency consists of four classes, namely non potential (492,31 ha or 0,17%), low potential (161.269,73 ha or 54,48%), moderate potential (124,555,24 ha or 42,84%), and high potential (4.403,53 ha or 1,51%). The distribution of landslide potential areas in the non potential class are spread in Air Naningan Suddistric, Kota Agung Suddistric, Pematang Sawa Suddistric, Semaka Suddistric, Ulu Belu Suddistric, and Wonosobo Suddistric.

Potential landslides in the low class are scattered hroughout Tanggamus Regency. The dominant area is scattered in the areas of Ulu Belu Subdistrict. Potential landslides in the moderate class are scattered hroughout Tanggamus Regency. The dominant area is scattered in the areas of Ulu Belu Subdistrict. The high potential class landslides are spread in Kota Agung Suddistrict, Kota Agung Timur Suddistric, Kota Agung Barat Suddistric, Pematang Sawa Suddistric, and Ulu Belu Suddistric.

Keywords: *Mapping, Potential Landslides, Geographic Information Systems.*

Abstrak

Kabupaten Tanggamus merupakan salah satu daerah yang berpotensi longsor karena dilalui oleh pegunungan dan perbukitan. Penelitian ini bertujuan untuk mengetahui tingkat potensi longsor dan mengetahui sebaran wilayah yang berpotensi longsor di Kabupaten Tanggamus.
Penelitian ini bertujuan untuk mengetahui tingkat potensi longsor dan mengetahui sebaran wilayah yang berpotensi longsor di Kabupaten Tanggamus.

Penelitian ini menggunakan metode penelitian deskriptif yang dilakukan di Kabupaten Tanggamus. Populasi penelitian ini adalah seluruh satuan lahan yang ada di Kabupaten Tanggamus. Penentuan sampel dalam penelitian ini menggunakan teknik stratified random

sampling. Teknik pengumpulan data berupa observasi dan dokumentasi. Analisis spasial dilakukan dengan sistem informasi geografis (SIG) menggunakan software Arcmap 10.3 dengan metode scoring dan overlay.
Hasil penelitian yang diperoleh menunjukkan bahwa tingkat potensi longsor di Kabupaten Tanggamus terdiri dari empat kelas yaitu non potensial (492,31 ha atau 0,17%), potensi rendah (161.269,73 ha atau 54,48%). %), potensi sedang (124.555,24 ha atau 42,84%), dan potensi tinggi (4.403,53 ha atau 1,51%). Sebaran daerah potensi longsor pada kelas non potensial tersebar di Kecamatan Air Naningan, Kecamatan Kota Agung, Kecamatan Pematang Sawa, Kecamatan Semaka, Kecamatan Ulu Belu, dan Kecamatan Wonosobo. Potensi longsor kelas rendah tersebar di seluruh Kabupaten Tanggamus. Wilayah yang dominan tersebar di wilayah Kecamatan Ulu Belu. Potensi longsor dengan kelas sedang tersebar di seluruh Kabupaten Tanggamus. Wilayah yang dominan tersebar di wilayah Kecamatan Ulu Belu. Kelas potensi longsor tinggi tersebar di Kecamatan Kota Agung, Kecamatan Kota Agung Timur, Kecamatan Kota Agung Barat, Kecamatan Pematang Sawa, dan Kecamatan Ulu Belu.

Kata Kunci : *Pemetaan, Potensi Longsor, Sistem Informasi Geografis*

INTRODUCTION

Indonesia is one of the countries that often experience various types of disasters. The disaster is caused by natural and non-natural factors. The number of such disasters, due to the territory of Indonesia is the place where the three large plates of the world meet, namely: the Indo-Australian, Eurasian, and Pacific plates. The process of plate dynamics that are quite intensive has formed a typical and varied relief of the earth's surface, from sloping areas along the coast with the potential threat of flooding, soil decline, and tsunami to mountainous areas with steep slopes and as if implying a high landslide potential (Sadisun, 2005).
Disasters can be distinguished into three types, namely natural factors, non-natural factors, and social factors (humans). In general, the risk of disasters caused by natural factors include, disasters due to geological factors, disasters due to hydrometeorology, disasters due to biological factors. Non-natural factors include, technological failure, while disasters caused by human actions are related to human conflicts due to limited resource struggles, ideological, religious, and political reasons.
Disasters caused by natural factors that often occur in Indonesia are hydrometeorological disasters. Hydrometeo-rological disasters are one type of disaster that can be triggered by climate change. Types of hydrometeorological disasters include floods, droughts, typhoons, and landslides. In addition to flood disasters, landslides often occur also in Indonesia. A landslide is the mass movement of rocks or soil on a slope due to the influence of gravitational forces. The movement of rock or soil mass occurs due to a disturbance in the balance between resisting force and driving force working on a slope.
A landslide is the mass movement of rocks or soil on a slope due to the influence of gravitational forces. The movement of rock or soil mass occurs due to a disturbance in the balance between resisting force and driving force working on a slope. This force imbalance is due to the force from

outside the slope which causes the size of the launcher force on a slope to be greater than the retaining force (Karnawati, 2004). Regionally Lampung Province shows the appearance of hilly nature with an intensive erosion process. Arifin, et al (2006) added that Lampung Province has a fairly diverse marbles ranging from flat (0 to 3%) up to a very steep one (over 75%). So lampung province has the potential of landslide disasters that are generally located on the slopes of hills or mountains.

Landslide disasters have a very detrimental impact on the community. One of the landslide disasters that suffered losses occurred in Tanggamus Regency. The amount of losses suffered by the community caused by the landslide disaster is due to the lack of information obtained. This indicates a lack of vigilance and readiness in the face of disasters (Iswoyo, 2017).

One way to reduce and prevent landslides is to know and estimate the spread of landslide-prone areas in the region. By knowing the distribution of landslide-potential areas in tanggamus district, it can minimize losses caused by the disaster. To know the distribution of potential landslide areas, there needs to be mapping and action to manage the risk of landslides.

Identification of potential landslide disasters can be used by Geographic Information System (GIS). Geographic Information System (GIS) is able to predict or identify landslide potential areas at a specific location determined by several parameters consisting of factors causing landslides. So the information obtained from mapping the potential of landslide disasters will be very helpful in the process of disaster mitigation efforts that can reduce the risk of landslide disasters.

Seeing the number of landslide disaster events in Tanggamus Regency, it is necessary to conduct research to analyze landslide disaster prone areas in Tanggamus Regency, using the implementation of Geographic Information System (GIS) data to determine the distribution of areas that have the potential for landslide disasters.

RESEARCH METHOD

In this study, the method to be used is descriptive research method. According to Sugiyono (2017:11) that descriptive research method is research conducted to know the value of variables either one variable or more (independent) without making comparisons or relationships with other variables. The population in this study is the entire unit of land within the scope of the administrative area of Tanggamus Regency. Land units are used as analysis units and mapping units. Samples were taken as much as 15% of the population of land units in Tanggamus District which is 34 units of land. Sampling using stratified random sampling techniques.

Data collection techniques using observation and documentation techniques. Data analysis techniques use overlays and scoring. The results of the overlay will show different land conditions in accordance with the score that has been given and to show the distribution of areas that have the potential for landslides. after doing the next overlay scoring. Scoring is based on the small influence of variable supporting levels of potential landslides in the research area. The score of each parameter can be seen in Table 1

Table 1. Avalanche Potential Parameter Score

No	Variabel Indikator Longsor	Kelas Variabel Indikator Longsor	Skor
1	Curah Hujan	Sangat rendah (<1000)	1
		Rendah (1000-2000)	2
		Sedang (2000-2500)	3
		Tinggi (2500-3000)	4
		Sangat tinggi (>3000)	5
2	Kemiringan Lereng	Datar (<8%)	1
		Landai (8-15%)	2
		Agak curam (15-25%)	3
		Curam (25-45%)	4
		Sangat curam (>45%)	5
3	Jenis Tanah	Alluvial, Gleisol, Planosol, Hidomorf kelabu, Laterik Air Tanah	1
		Latosol	2
		Brown Forest Soil, Non Calcic Brown, Mediteranian	3
		Andosol, Laterik, Grumosol, Podsol, Podsolik	4
		Regosol, Latosol, Renzina	5
4	Geologi	Bahan Alluvial	1
		Bahan Vulkanik 1	2
		Bahan Sedimen 1	3
		Bahan Sedimen 2 dan Vulkanik 2	4
5	Penggunaan Lahan	Hutan/vegetasi dan bahan air	1
		Kebun dan campuran semak belukar	2
		Perkebunan dan sawah irigasi	3
		Kawasan industry dan pemukiman	4
		Lahan-lahan kosong	5

Source : DVMBG (2004)

RESULTS AND DISCUSSION

A. Overview of Research Sites

1. Location, Area, and Boundaries of Research Area

The research area in this study is Tanggamus Regency of Lampung Province. According to data BPS (Central Statistics Agency) Tanggamus District (2019) the astronomical location of Tanggamus Regency is located between 104º18'00'-105º12'00' East Longitude and 5º05'00'- 5º56'00' South Latitude with an area of 4.654,96 Km2. This area consists of a land area of 2.855,46 Km2 and added with an area of sea area of 1.799,5 Km2.

Based on its geographical position, Tanggamus Regency has territorial boundaries with other regions, as follows:

1. North : Regency of West Lampung and Central Lampung
2. South : Indonesian Ocean
3. West : Regency of West Lampung
4. East : Pringsewu County

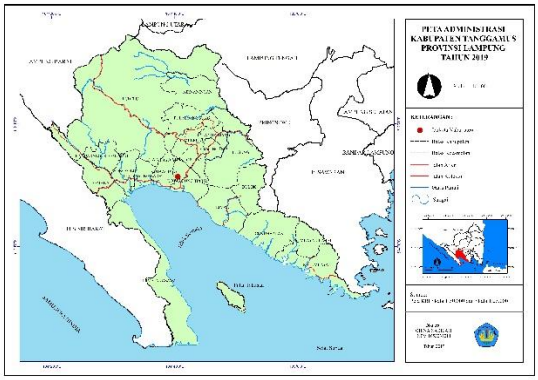

Image 1. Tanggamus District Administration Map

2. Physical Condition of Research Area

Tanggamus regency has a topography that is at an altitude of 0 to 2,115 meters above sea level. More than 50% of Tanggamus district has a hilly and mountainous area with a slope of more than 40%.

Rainfall in Tanggamus regency is quite high ranging from 1,750 mm per year to 3000 mm per year (BPS Tanggamus Regency, 2019).

Tanggamus district has a type B climate that has wet climate conditions. Air temperature temparatur ranges on average between 26ºC to 30ºC at an altitude of 20-60 meters above sea level. The average wind speed is 5.83 km/h, with high humidity of 80%-88%.

The type of land contained in Tanggamus Regency is based on the classification of USDA (United States Dept. Of Agriculture) includes alluvial, latosol, andosol, regosol and gray hydromorph soil types.

3. Population Conditions of Research Area

The population of Tanggamus Regency is based on the projected population in 2018 of 586,624 people consisting of 305,594 male residents and 281,030

female residents. While the number of sex ratio in Tanggamus district according to BPS (Central Statistics Agency) in 2018 is 108,64. So that the distribution of residents in Tanggamus district is uneven in each sub-district

B. Analysis of Landslide Cause Parameters

1. Rainfall

Rainfall is one of the largest elements of the climate to the landslide event. Tanggamus district is divided into four classes of rainfall. Rainfall with an intensity of 2500-3000 mm / year is the intensity of rainfall that has the most dominant area of 185.092,17 ha. Rainfall with an intensity of 2000-2500 mm / year has an area of 74.470,58 ha which is the intensity of rainfall that has the second largest area. Rainfall with an intensity of 1000-1500 mm / year is included in the low rainfall class which has an area of 30.322,48 ha. Districts with very high rainfall intensity of >3000 mm / year are found in Ulu Belu Subdistrict with an area of 385.58 ha.

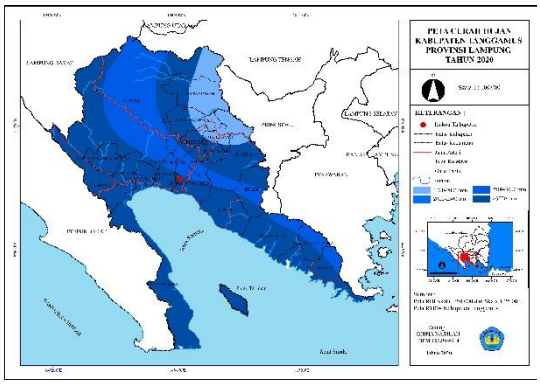

Image 2. Rainfall Map

2. Geology

Based on the results of overlay between the research location map and the geological map of Tanggamus Regency is known to have variations of various geological formations with different constituents. Rock formations in Tanggamus Regency consist of 4 types of rocks, namely Alluvial Material, Volcanic Material 1, SedimentAry Material 1, Volcanic Material 2 and SedimentAry Material 2.

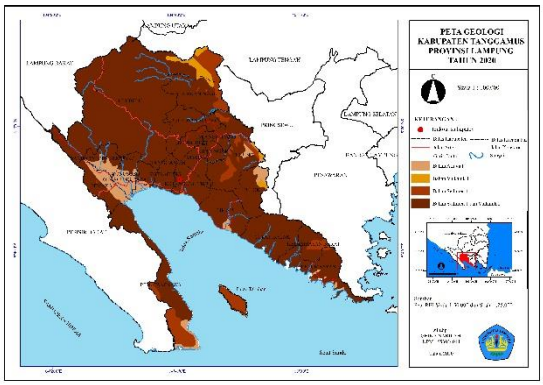

Image 3. Geology Map

3. Soil Type

Based on the results of the analysis of the land type map of Tanggamus Regency, it can be known that Tanggamus Regency has 5 types of land, namely alluvial, latosol, regosol, andosol, and podsolic. Soil conditions greatly influence the sensitivity of the land to erosion and movement of soil. The higher the sensitivity of soil type, the more potential for landslides in an area.

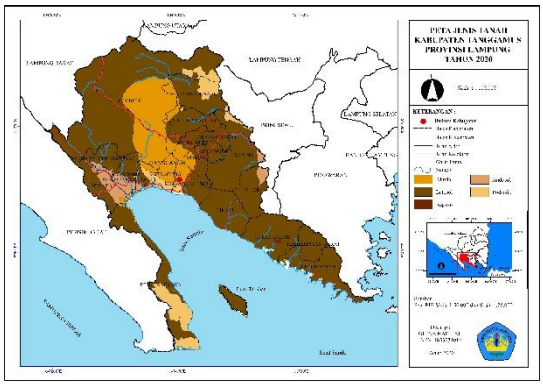

Image 4. Soil Type Map

4. Slope

Based on the results of the analysis of the land type map of Tanggamus Regency, it can be known that Tanggamus Regency has a slope that varies considerably from to steep with slope classes such as 8-15% (Ramps), 15-25% (somewhat steep), and 25-45% (steep). The potential for landslides on the slope parameters is very influential if the steeper the slope, the more potential for landslides in an area.

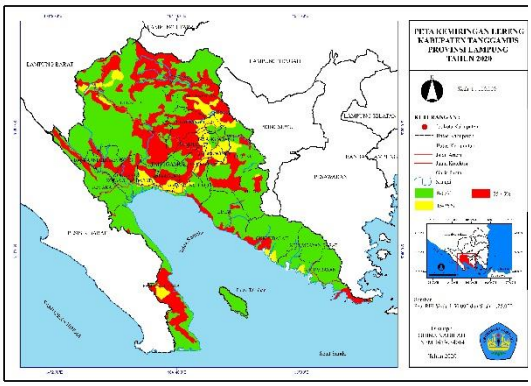

Image 5. Slope Map

5. Land Use

Land use in Tanggamus Regency from the land use map is divided into six types, namely forests, plantations, settlements, rice fields, shrubs, and water bodies / water materials.

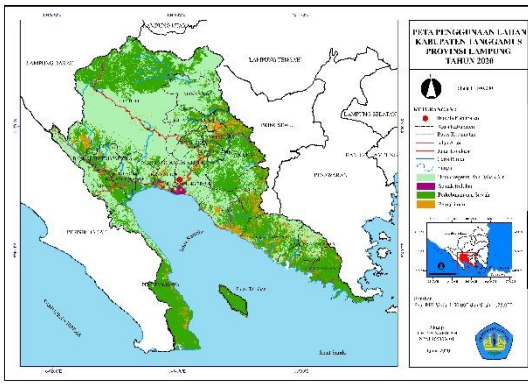

Image 6. Land Use Map

C. Analysis of Landslide Potential In Tanggamus District

1. Class Not Potentially Landslide

The potential for landslides in this class is not found the potential for landslide disasters. This class of landslide potential has an area of 492.31 ha or about 0.17%. Land units located at the class level are ht-fl-fl-i, kb-fl-i, sb-fl-i, tg-fl-i, sw-fl-i, and ar-fl-i. Judging from the slope characteristics of the slope that this class has a slope of 8-15% so it has a topography of ramps. Rainfall conditions are known to vary greatly from 1000-2000 and 2000-25000 mm/year which fall into the low to moderate category. This type of soil in this class is alluvial soil that has a low sensitivity to landslides.

Geological formations in this class are found in the form of Alluvial materials that fall into a very low category. The most dominant land use in Tanggamus Regency in this potential class is the body of water, namely ponds.

2. Low Potential Landslide Class

The potential for landslides in this class has a low scale for landslide disasters. From the result of scoring calculation of landslide parameters of 10-14 included in the class of low landslide potential. This class of landslide potential has an area of 161,269.73 ha or about 54.48%. Land units in the low landslide potential class are Pm-Fl-I, Kb-Vl-I, Tg-Vl-I, Sb-Vl-I, Kb-Dn-II, Sb-Dn-II, Tg-Dn-II, Ht-Vl-II, Ar-Vl-II, and Kb-Vl-II. Judging from the slope characteristics of the slope that this class has a slope of 8-15% so it has a topography of ramps. Rainfall conditions are known to vary greatly from 1000-2000 and 2000-25000 mm/year which fall into the low to moderate category. This type of soil in this class is dominated by Alluvial soils

and Latosol soils that have a low sensitivity to landslides.

Geological formations in this class are found in the form of Alluvial material and Volcanic material 1 which belongs to the category of very low to low. The most dominant land use in Tanggamus Regency in this potential class is plantations, rice fields, and forests.

3. Medium Potential Landslide Class

The potential for landslides in this class has a medium scale to the potential for landslide disasters. From the result of scoring calculation of landslide parameters of 15-19 included in the class of medium lonsor potential level. This potential class has an area of 124,555.24 ha or about 42.84%. Land units in the low landslide potential class are Kb-Vl-II, Sw-Vl-II, Pm-Vl-II, Ht-Vl-III, Ar-St-III, Ar-Vl-III, Kb-Vl-III, Sb-Vl-III, Sb-St-III, and Tg-Vl-III. Judging from the characteristic slope of the slope in this class has a slope of 15-25% which belongs to the category of rather steep with hilly topography. The average rainfall per year is 2500-3000 mm/year. This can trigger for the occurrence of landslide disasters that generally have a fairly high average rainfall. The types of soil contained in this class are Latosol soil, Regosol soil, and Andosol soil that has low to high landslide sensitivity.

Geological formations are dominated by Sedimentary material 1. Sedimentary rocks consist of units of tertiary rock and limestone. This rock has a sensitivity to moderate landslides. Land use encountered are forests, plantations, rice fields, settlements, bodies of water.

4. High Potential Landslide Class

The potential for landslides in this class is an area that has the potential for landslide disasters. From the results of scoring calculation of landslide parameters of 20-24 included in the class of high potential lonsor. This potential class has an area of 492.31 ha or about 1.51%. Land units contained in the low landslide potential class are Sw-Vl-III, Kb-Vl-III, and Pm-Vl-III. Judging from the characteristic slope of the slope in this class has a slope of 25-45% which belongs to the category of steep with hilly topography. The average rainfall per year is >3000 mm/year. This can trigger landslides that generally have a high average rainfall over a long period of time. The type of soil contained in this class is Podsolic soil that has a high sensitivity to landslides. Geological formations are dominated by Sedimentary material 2 and volcanic 2. Sedimentary rocks consist of units of tertiary rock and limestone. These rocks have high landslide sensitivity properties. The land use encountered in this class is settlement.

D. Analysis of Landslide Distribution In Tanggamus District

1. Class Not Potentially Landslide

The potential of landslides with this category is spread in several sub-districts in Tanggamus, namely Naningan Water District, Kota Agung Barat Subdistrict, Pematang Sawa Subdistrict, Semaka Subdistrict, Kecamatan, Ulu Belu, and Wonosobo Subdistrict. The most dominant area in this class is in the northern part of Ulu Belu Subdistrict covering an area of 440.28 ha. For the area that has the smallest area in this category is in the western part of the District of Kota Agung Barat which is an area of 0.37

ha. Areas in this class are possible landslides because this area has factors that cause indicated not potential to landslides.

2. Low Potential Landslide Class

Landslide potential with low category spread evenly throughout the sub-district in Tanggamus. The most dominant area in this class is in the northern part of Ulu Belu Subdistrict covering an area of 70,325.05 ha. For the area that has the smallest area in this category is in the eastern part of The District of Mount Alip which is an area of 681.64 ha. The possibility of landslides in this region exists, although usually in small dimensions with relatively stable slopes.

3. Medium Potential Landslide Class

Landslide potential with the category is being spread evenly throughout the sub-districts in Tanggamus. The most dominant area in this category is the northern part of Ulu Belu Subdistrict covering an area of 33,292.68 ha. For the area that has the smallest area in this category is in the eastern part of Talang Padang Subdistrict covering an area of 428.69 ha. The area in this class is possible for landslides because it has a slope slope with a category of ramps up to a bit steep and high rainfall.

4. High Potential Landslide Class

Landslide potential with high category is only spread in a small part of Tanggamus Regency. The area included in this category is in the southern part of pematang sawa district with an area of 3,393.52 ha. The area that has the smallest area in this category is in the northern part of Ulu Belu Subdistrict covering an area of 69.12 ha. Areas in this class are possible landslides because this area has a steep slope and high rainfall and geological control. In addition, in general, areas that have a high landslide potential are found in mountainous areas. The distribution of high landslide potential areas in Tanggamus Regency is also in the area that contains the Tanggamus Mountains and bukit barisan.

Based on the results of the analysis of the spread of landslide potential areas in Tanggamus District for more details can be seen in Image 2.

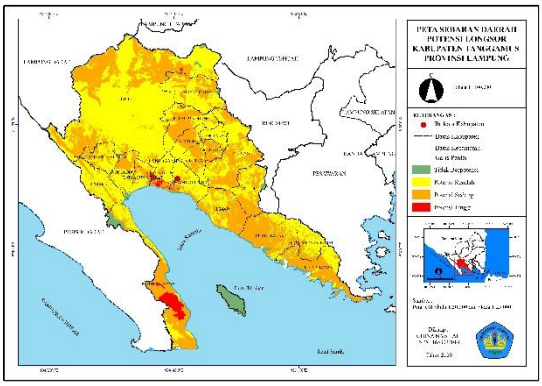

Image 7. Landslide Potential Area Distribution Map

CONCLUSION

Based on the results and analysis of research that has been done, it can be concluded as follows:

1. The landslide potential level in Tanggamus Regency has 4 classes, namely no potential, low potential, medium potential, and high potential. Overall landslide potential in tanggamus district is the most dominant including low and medium potential class which has a dominant area, namely 161.269,73 ha with presentations of 54.48% and 124.555,24 ha with presentations of 42,84%.
2. The distribution of landslide potential areas in Tanggamus District varies. Areas that fall into the category of

landslide potential are not potentially scattered in Naningan Water District, Kota Agung Barat, Pematang Sawa, Semaka, Ulu Belu, and Wonosobo Areas are not potential landslides with a dominant area located in the northern part located in Ulu Belu Subdistrict. Areas belonging to the low potential category are scattered throughout Tanggamus Regency. The area of low landslide potential with the dominant area is in the northern part located in Ulu Belu Subdistrict. Areas that belong to the category of potential are being spread throughout Tanggamus Regency. The area of medium landslide potential with a dominant area is in the northern part of Ulu Belu Subdistrict. While the areas that belong to the category of high potential are spread in The District of Kota Agung, Kota Agung Timur, Kota Agung Barat, Pematang Sawa, and Ulu Belu. The area of high landslide potential with a dominant area is in the southern part of Pematang Sawa Subdistrict.

ACKNOWLEDGMENTS

Some efforts that can be made to reduce or minimize the occurrence of potential landslides in Tanggamus District are as follows:

1. It is necessary to plant plants that have strong rooting in accordance with the physical condition of the region, so that it can hold the soil and bind water in case of rain
2. It is necessary to socialize about areas that have the potential for landslide disasters to the community and related agencies, so that the community is more vigilant.
3. There needs to be a firm policy from the government in the management of areas that have the potential to landslide disasters such as relocation of settlements that are in areas with high landslide potential.

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