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MAPPING OF LANDSLIDE-PRONE AREAS BASED ON REMOTE SENSING WITH GEOGRAPHIC INFORMATION SYSTEMS IN TANAH DATAR REGENCY, WEST SUMATRA

* Nadyya 'Azima Muarif[1], dan Febriandi, S.Pd. M.Si[2]

[1]D3 Remote Sensing Technology Study Program Student, Universitas Negeri Padang, [2]Lecturer Study Program D3 Remote Sensing Technology, Universitas Negeri Padang
Email: nadyyaazimamuarif17@gmail.com

ABSTRACT: The aims of this study were 1) to determine the classification of landslide-prone levels in Tanah Datar Regency, 2) to and find out the causal factors for Tanah Datar Regency to be categorized as landslide-prone areas. The research method used in this study is the overlay method in the form of a combination of the results of 5 classifications (slope, rainfall, land use, geological structure, and, soil type). The type of research used is quantitative research in the form of surveys and questionnaires, statistical data sets, interviews, and, observations. The results of this study are 1) the area of Tanah Datar Regency is divided into 4 classifications of landslide-prone levels, namely low, medium, high, and very high. The landslide-prone level at the low classification level is in Pariangan District, Ten Koto District, Salimpaung District, and Sungayang District. The medium-level classification is in Batipuh District, Lima Kaum District, and Tanjung Emas District. High-level classification is in the South Batipuh District, Rembatan District, Tanjung Emas District, Padang Ganting District, Lintau Buo District, and North Lintau Buo District. Very high-level classification is in Betipuh Selatan District, Rbatan District, Tanjung Emas District, Padang Ganting District, and Lintau Buo District. Of the 14 districts dominated areas are prone to moderate landslides. This is due to the condition of the vegetation which is still very good at overcoming landslides on slopes; 2) the area of Tanah Datar Regency is included in the area prone to landslides characterized by the causal factors, namely the area with hills, excessive natural exploitation The medium level classification is in Batipuh District, Lima Kaum District, and Tanjung Emas District. High-level classification is in the South Batipuh District, Rembatan District, Tanjung Emas District, Padang Ganting District, Lintau Buo District, and North Lintau Buo District. Very high-level classification is in Betipuh Selatan District, Rbatan District, Tanjung Emas District, Padang Ganting District, and Lintau Buo District. Of the 14 districts dominated areas are prone to moderate landslides. This is due to the condition of the vegetation which is still very good at overcoming landslides on slopes; This is due to the condition of the vegetation which is still very good at overcoming landslides on slopes; 2) the area of Tanah Datar Regency is included in the area prone to landslides characterized by the causal factors, namely the area with hills, excessive natural exploitation Very high-level classification is in Betipuh Selatan District, Rbatan District, Tanjung Emas District, Padang Ganting District, and Lintau Buo District. Of the 14 districts dominated areas are prone to moderate landslides. This is due to the condition of the vegetation which is still very good at overcoming landslides on slopes; 2) the area of Tanah Datar Regency is included in the area prone to landslides characterized by the causal factors, namely the area with hills, excessive natural exploitation characterized by illegal mining, excessive extraction of wood from nature aimed at preventing landslides around slopes, infrastructure development that is not by geographical conditions, and conversion of land functions from forest areas to agricultural areas.

Keywords: Disaster, Landslide Prone, Overlay, Mapping

1. INTRODUCTION

According to the National Disaster Mitigation Agency (BNPB), landslides can be interpreted as a type of mass movement of soil or rock by mixing the two down or out of the slope due to disruption of the stability of the soil or rock making up the slope. According to Sitorus (2006), landslides can be interpreted as a form of erosion in which the transport or displacement of the soil occurs at a relatively short moment in a very large volume (amount).Heavy rains can also cause landslides. The cause of landslides is heavy rain that comes suddenly, so the soil is unable to hold large volumes of rainwater. When water seeps into the soil it will increase its weight of the soil and if it penetrates the impermeable layer as a slip surface, the soil becomes slippery and the soil above it will experience movement following the slope. Several main factors cause and slides, namely: rainfall intensity, earthquakes, rock conditions and land use arrangements that are not by the characteristics of the land (Sutikno, 1994).

IRSAJ
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2. THE METHOD

This type of research used is quantitative research. According to A. Muri Yusuf (2005:50) "Quantitative type research can be used if the data collected is in the form of quantitative data or other types of data that can be quantified and processed using statistical techniques." The research method used to map landslide-prone areas in Tanah Datar District is the method of weighting and overlaying between the constituent parameters. The weighting method for mapping landslide threats is based on Permen PU No. 22/PRT/M/2007.
This research requires the equipment used to collect data, analyze data, and present data as follows:

Table 1. Research Tools

No	Tool	Utility
1	Laptop	processing container data
2	Software ArcGIS10.8	Data analysis
3	Google earth	Envi 5.3
4	Software ENVI	Radiometric Correction and Atmospheric
5	GPS	For determining the coordinates of the test pointaccuracy And result point confirmation data analysis
6	Camera	Documentation field

Source: *Research Tools (2021)*

The materials used in this study are as follows:

Table 2. Research Materials

No	Name	Year	Source
1	Administration map Regency	-	BPBD
2	Data bulkdistrict rain Flat Land	2021	CHIRPS
3	Image Sentinel	2021	Esa Opernicus
4	DEM image	-	ASTER GDEM
5	Map RBI District Geology Flat Land	-	Inageoportal
6	Data type Regency land Flat Land	-	Geo Network FAO
7	Data field	2022	survey

Source: *Research Materials (2021)*

To support the purposes of this research, researchers need several supporting data that come from within or outside. The data collection techniques carried out are adjusted to the type of data taken as follows:

Table 3. Literature Study

No	Data Type	Data Source
1	Bulk conditions Rain	CHIRPS
2	Condition geology	RBI Map (Digits)
3	Condition type land	FAO Geo Networks
4	Conditions of use land	Sentinel image
5	Tilt conditions slope	GDEM daisies

Source:*Author 2021*

Secondary data is data obtained indirectly which includes rainfall data and data obtained from the required institutions or agencies including:

IRSAJ
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Vol 3 No 1 | June 2022

1) Shp from rainfall data.
2) Land use data from shp.
3) Landslide disaster data (BPBD) form of information.
4) Shp shape geological structure map.
5) Shp shape Slope Map.
6) Shp shape soil type map.
7) DEM image at Aster GDEM and sentinel image obtained at Esa Copernicus.

overlay method using scores. To do this, scoring must first be done for these polygons. Determination of the value of the score in this study is formulated as:

$$Skor = (20\% X\ faktor\ kelas\ geologi) + (15\% X\ faktor\ kelas\ lereng)(30\% X\ faktor\ kelas\ hujan) + (15\% X\ faktor\ penggunaan\ lahan) + (20\% X\ faktor\ kelas\ jenis\ tanah)$$

The cumulative score obtained will be grouped into four classes, with categories namely: low, medium, high, and very high based on the total final score. The greater the number of scores, the higher the level of vulnerability by determining the score interval. To determine the classification of landslide vulnerability can be seen in the formula below:

$$\frac{Skor\ Tertinggi - Skor\ Terendah}{Jumlah\ Kelas\ Klasifikasi}$$

3. RESULT AND DISCUSSION

1. Rainfall Map

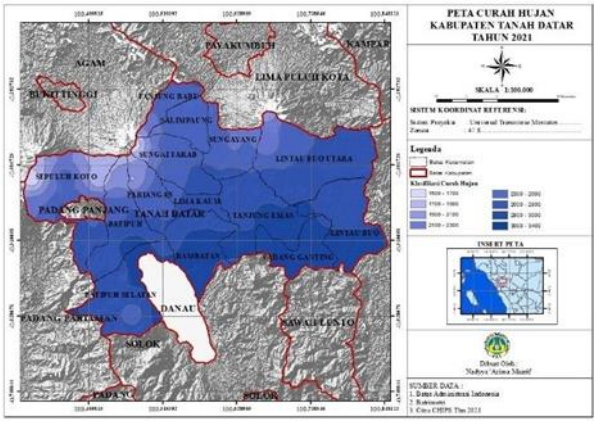

Fig. 1 Rainfall Map

Table 4. Area of Rainfall Classification of Tanah Datar Regency

Class	Rainfall Rain	Area (Ha)	dignity	Information
1	<1500	644,655,347	1	Rain Very Light
2	1700-1900	3,791,202,811	2	Rain Light
3	1900-2100	5,648,542,425	2	Rain Light
4	2100-2300	9,510..442,211	3	Rain Normal
5	2300-2600	29,943,929,905	3	Rain Normal
6	2600-2800	52,953,333,267	4	Heavy rain
7	2800-3000	28,993,031,668	5	Rain Very Heavy
8	3000-3400	21,375,319	5	RainVery Heavy

Source :Results of Secondary Data Processing (2021)

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Vol 3 No 1 | June 2022

2. Soil Type Map

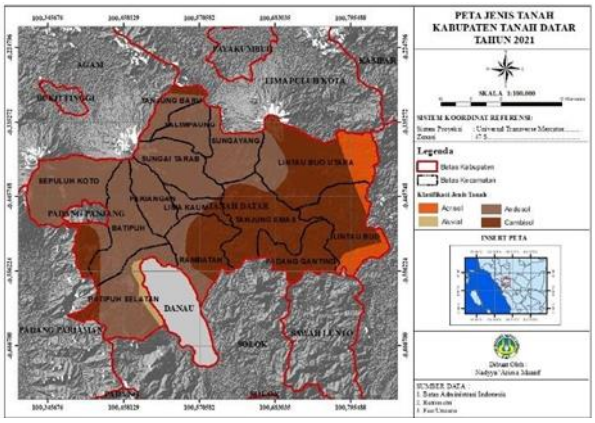

Fig. 2 Soil Type Map

Table 5. Area of Classification of Land Types in Tanah Datar Regency

No	Parameter	Class	Area (Ha)	Dignity
1	Land	Acrisol	73,785,240	4
2		Cambisol	51,494,427	3
3		Andosol	71,084,181	1
4		alluvial	15,493,803	4

Source :*Results of Secondary Data Processing (2021)*

3. Land Use Map

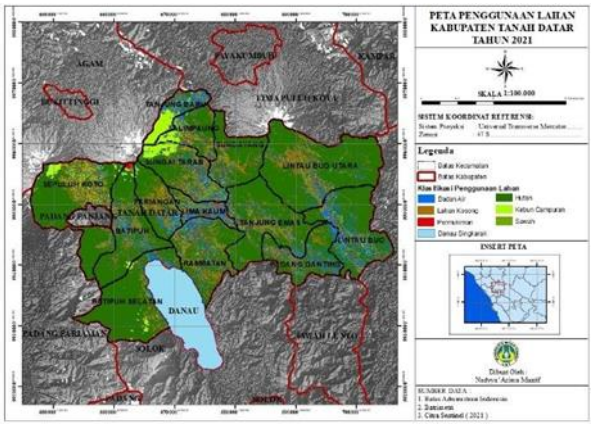

Fig. 3 .Land Use map

Table 6. Area of Land Use Classification of Tanah Datar Regency

Class	Use Land	Area (Ha)	dignity
1	Forest	80,476,142,898	1
2	Waterbody	15,823,306,446	1
3	Garden Mixture	5,703,467,158	2
4	Ricefield	8,405,549,826	3
5	Settlement	3,123,998,104	4
6	Empty land	17,969,867,739	5

Source :*Results of Secondary Data Processing (2021)*

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4. Geological Structure Map

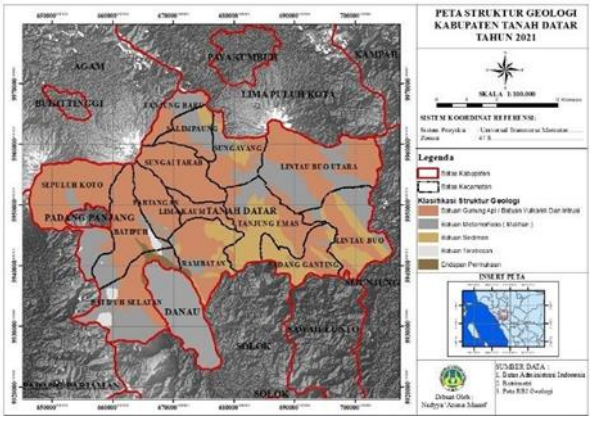

Fig. 4 Geological Structure Map

Table 7. Area of Geological Structure Classification of Tanah Datar Regency

No	Parameter	Class	Area (Ha)	dignity
1	Geological Structure	Rockvolcanoes/volcanic rocks and intrusion	77,887,001,104	3
2		Rock metamorphosis(instead)	32,254,685,122	2
3		Sedimentary rock	1,898,057,288	2
4		Breakthrough rock	1,461,943,218	3
5		precipitate surface	1,370,779,223	1

Source :Results of Secondary Data Processing (2021)

5. Slope Map

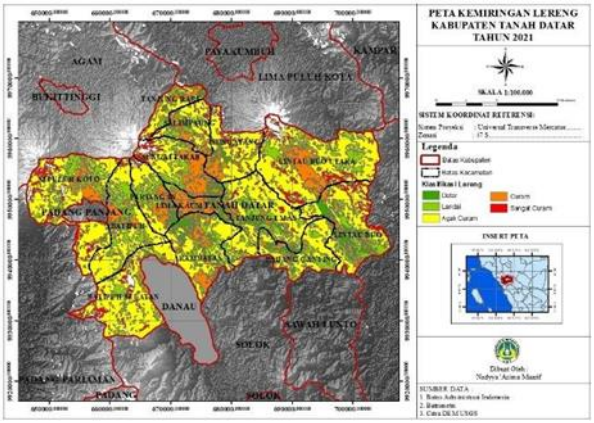

Fig. slope Map

Table 8. Area of Slope Classification of Tanah Datar Regency

No	Class TiltSlope (%)	Area (Ha)	dignity	Information
1	0-6	8,073,601,313	1	Flat
2	6-13	20,485,965,247	2	Sloping
3	13-25	26,652,711,737	3	Rather steep
4	25-55	64,506,019,273	4	Steep
5	>55	9,353,715,005	5	Very steep

Source :Results of Secondary Data Processing (2021)

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Vol 3 No 1 | June 2022

6. Landslide Prone Area Map

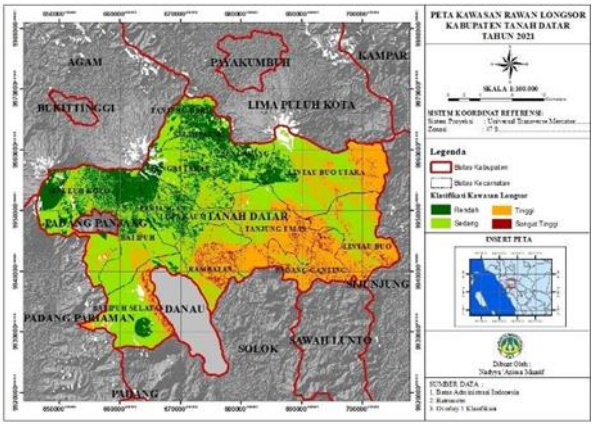

Fig. 6 Landslide Prone Area Map

Classification of landslide-prone areas:
1. 1.7 – 2.375 (Low)
2. 2.375 – 3.05 (Moderate)
3. 3.05 – 3.725 (High)
4. 3.725 – 4.4 (Very High)

So the division of the classification of landslide-prone areas in this study resulted in 4 classifications, namely Low, Medium, High and Very High classes.

This research was conducted in mapping landslide-prone areas in Tanah Datar Regency based on the 2021 BPBD data recapitulation reference for landslides in Tanah Datar Regency using remote sensing and geographic information systems. A landslide or often called ground movement is a geological event that occurs due to the movement of rock or soil masses of various types and types such as the fall of rocks or large lumps of soil. The Tanah Datar district is an area at risk of landslides because it is dominated by hilly areas.

The areas identified as landslide-prone areas are 7 sub-districts which are included in landslide-prone areas. Batipuh District consists of 4 villages namely Gunung Rajo Village, Bunga Tanjung Village, Batipuh Baruah Village, and Tanjung Barulak Village. Batipuh Selatan District consists of 3 villages namely Sumpur Village, Padang Laweh Malalo Village, and Guguak Malalo Village. Rembatan District consists of 5 villages namely III Koto Village, Simawang Village, Balimbing Village, Padang Magek Village, and Rembatan Village. Tanjung Emas sub-district consists of 4 villages namely Pagaruyung Village, Desa Saruaso, Tanjung Barulak Village, and Koto Tangah Village. Lintau Buo District consists of 4 villages namely Pangian Village, Buo Village, Tigo Jangko Village, and Taluak Village. Lintau Buo Utara District consists of 4 villages namely Lubuak Jantan Village, Tepi Selo Village, Tanjung Bonai Village, and Balai Tangah Village. Padang Ganting District consists of 2 villages namely Padang Ganting Village and Atar Village.

4. CONCLUSION

Based on the results of a study regarding the Mapping of Landslide Prone Areas Based on Remote Sensing with the Geographic Information System of Tanah Datar District, West Sumatra Province, several things can be concluded, including the following:

1. 1.The area of Tanah Datar Regency is divided into 4 classifications of landslide-prone levels, namely low, medium, high and very high. The landslide-prone level at the low classification level is in Pariangan District, Ten Koto District, Salimpaung District, and Sungayang District. Medium-level classification is in Batipuh District, Lima Kaum District, and Tanjung Emas district. High-level classification is in the South Batipuh District, Rembatan District, Tanjung Emas District, Padang Ganting District, Lintau Buo District, and North Lintau Buo District. Very high-level classification is in Betipuh Selatan District, Rbatan District, Tanjung Emas District, Padang Ganting District, and Lintau Buo District. Of the 14 districts dominated areas are prone to moderate landslides. This is due to the condition of the vegetation which is still very good at overcoming landslides on the slopes.
2. The Tanah Datar Regency area is a landslide-prone area marked by its causal factors, namely areas with hills, excessive natural exploitation marked by illegal mining, excessive extraction of wood from nature which aims

to prevent soil from landslides around the slopes, infrastructure development that is not by the conditions. geographical area, and land conversion from forest areas to agricultural areas.

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