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Analysis of the Level of Landslide Susceptibility in the Sakuli Latambaga Area, Southeast Sulawesi

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ABSTRACT

The vulnerability of landslides that occur in the Sakuli area, Kolaka Regency is related to topographic conditions which are dominated by mountains and hills, for this reason, research is needed as an effort to determine the level of vulnerability and determine disaster mitigation efforts against the danger of landslides. This type of research is quantitative descriptive by looking at the influence of each variable to analyze landslide-prone areas. The method used in this research is experimental analysis with direct observation in the field. From the research results, the vulnerability level value for the slope parameter was 0.83; with soil texture 0.408; for faults 0.86; value for regolith 0.363; with geological conditions 0.628; with a rainfall value of 0.3 and land use of 0.6, the accumulated value is that the research area is at a very vulnerable level with a value of 3.989. Therefore, this area really needs structural and non-structural mitigation to be able to protect and reduce the potential for landslides.

Keyword: vulnerability level; landslide; disaster mitigation; Sakuli; Kolaka.

INTRODUCTION

Landslides are categorized as one of the causes of natural disasters, alongside earthquakes, floods and hurricanes, etc. The danger of landslides has a major impact on the continuity of human life and always threatens human safety. In Indonesia, landslides have resulted in large losses, for example loss of human life, property damage and disruption of natural ecosystems. From data from Bakornas Disaster Management, from 1998 to mid-2003, 647 disaster events were recorded in Indonesia, of which 85% of these disasters were floods and landslides (Mubekti, and Fauziah Alhasanah, 2008).

Thornbury (1969) in Nasiah and Ichsan Invanni. (2014), defines land landslides as mass movements of rock debris whose type of movement is sliding or sliding (slipping), rotating (rotational) caused by gravitational forces so that the movement is faster and the water content is less. Directorate of Geology and Environmental Management Landslides are a product of disturbances in slope balance that cause masses of soil and rock to move to lower areas. This movement can occur in soil/rock where the resistance is smaller than the weight of the soil/rock mass itself. Based on data compiled by the Directorate of Volcanology and Geological Disaster Mitigation, Directorate General of Geology and Mineral Resources, every year several regions in Indonesia experience land landslides. The landslide caused material loss and also casualties. Landslide events are generally small scale, not as severe as earthquakes, volcanic eruptions and tsunamis, so there is less attention to this problem and even less attention is paid to it in development planning (Nasiah and Ichsan Invanni, 2014). A cliff of land more than five meters high collapsed, almost hitting residents' houses. However, the cliff is prone to further landslides, considering the intensity of the rain is still high. The landslide section of the cliff almost hit seven residents' houses, and one house was on the cliff (Sultrakini, 2022). Landslides hit a number of houses in Sakuli Village, Latambaga District, Kolaka Regency, Southeast Sulawesi (Sultra), Friday (27/05/2022) morning. As a result, eight residents'

houses were badly damaged, some of the houses were even destroyed. The Kolaka Regional Disaster Management Agency (BPBD) helped evacuate the victims' valuables to a safer place. According to Bhabinkamtibmas Sakuli, Aiptu Surdin, the landslide occurred after pouring rain since Thursday (26/5/2022) evening. Luckily, this incident did not result in any casualties. "This landslide started with heavy rain since last night which hit the Kolaka Regency area, so that in the morning, a landslide suddenly occurred," said Surdin (Asdar Lantoro, 2022). The high level of loss experienced by the community due to landslides is caused by the lack of information obtained by the community regarding the possibility of disasters occurring in their surroundings, so that public awareness of disaster response is very minimal. Therefore, initial information regarding the potential and risk of disasters is one of the information media that can be used as basic disaster education for the community (Damanik & Restu, 2012). The aim of this research is to analyze the level of vulnerability to landslide hazards that occur in the research area.

Good soil conditions to prevent landslides are determined by several key factors. First, soil compactness is very important because dense soil has high shear strength, being able to withstand loads without shifting. Water content also plays a significant role, because soil with the right water content, not too wet or dry, has optimal bearing capacity. Soil type affects its stability. Coarse-grained soils such as sand and gravel have good drainage and greater stability than fine-grained soils. Clay soil can be stable if properly consolidated, although it tends to expand and contract due to changes in water content. Soil containing large rocks is generally more stable because these rocks add strength to the soil (Triyanto T et.al, 2020; Satriadi I, 2021).

A well-graded soil structure, with a mixture of different particle sizes, provides better stability. Small particles fill the gaps between large particles, increasing the density and strength of the soil. Excessive organic matter in the soil can reduce strength because it decomposes easily and changes volume with changes in humidity. Geotechnical conditions are also crucial. The friction angle in the soil indicates the soil's ability to withstand shear forces; The higher this angle, the more resistant the soil is to landslides. Soil cohesion, or the forces of attraction between particles, also adds stability (Zainudin SM, Namara I, 2016; Nugroho SA et.al, 2021; Farodhiyah SN, 2016).

The surrounding environment influences soil stability. The slope of the land, for example, determines the risk of landslides; Soil on steep slopes is more vulnerable than flat surfaces. Vegetation helps stabilize the soil through roots that strengthen the soil structure and absorb excess water. Soil strengthening techniques are also important to prevent landslides. Installing geotextiles can increase soil stability by preventing the movement of soil particles. Retaining walls are effective in preventing soil movement on steep slopes. A good drainage system regulates water levels in the soil, preventing saturation which can cause landslides (Syamsul A, Feril H, 2020; Aminda RS, 2024).

RESEARCH METHODS

The method used in this research is quantitative descriptive by looking at the influence of each variable to analyze landslide-prone areas in North Kolaka Regency based on scoring. Primary data is data obtained directly from sources that are observed and recorded for the first time through field studies. Field studies are used to determine field conditions such as weather, area size that can be used for research, and geographical and administrative conditions. Meanwhile, literature studies are used to determine the geological structure of the research area both online and offline. Primary data is also obtained from interviews and direct observations in the field. Secondary data is data relating to the general conditions at the research location obtained from literature studies, related institutions or agencies. Secondary data used in the research consists of administrative boundary maps, topographic maps and geological maps.

RESULT AND DISCUSSION

In this research, based on environmental geological aspects, the researchers added 2 new variables so that there are 7 variables for determining landslide-prone areas which refer to the Center for Standardization of Disaster Resilience and Climate Change Instruments (Pustandpi) of the Environmental and Forestry Instrument Standardization Agency of the Ministry of Environment and Forestry. In general, there are additions made specifically to rainfall data where scoring is used using

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the Directorate of Volcanology and Geological Disaster Mitigation/DVMBG (2004). Which will be explained as follows:

Slope/Slope Conditions

Judging from the physical condition of North Kolaka Regency, the topography of North Kolaka Regency which can be seen in Appendix 2, this area is at an elevation of 0 - 100 meters above sea level (masl), with varying levels ranging from coastal areas, coastal plains, sloping, undulating , hills, to mountains. Meanwhile, if you look at the slope of the slopes, Kolaka Regency has slope levels ranging from flat to very steep. Specifically, the research area has a slope of 5-8o with a percentage of 7-15% (Van Zuidam, 1985).

Soil texture

Based on analysis of soil samples in Kolaka, it was found that there were three types of soil texture at the research location, namely clay, dusty clay, sandy clay. Meanwhile, in the research area with the characteristics we can feel the sand content when holding the soil, it tends to be looser and scattered with a little clay and smoothness, has a lighter color, such as light brown or light gray so it can be concluded that the research area has a texture sandy loam soil (Armiselin Ch.Salawangi, 2020). For more details, see Figure 1.

Figure 1. Soil texture conditions at the research location (Source: Researcher 2023)

Type of soil

The area of Kolaka Regency according to soil type consists of 4 types of soil, namely the largest sequence is red yellow podzolic soil, lithosol soil, wide red Mediterranean soil, gray brown latosol soil. The research location has a type of soil with the characteristics of moderate to non-existent organic matter, humus has begun to decrease, red, gray to brassy in color, easily absorbs water so it is easily released and washed, formed from the weathering of sedimentary and metamorphic rocks, The texture is clay and has layers of soil (EditorUMSU, 2022) so it can be determined that the soil type is Latosol where the distribution of this Litosol soil is in areas that have high rainfall and high humidity.

Regolith The condition of rock material resulting from weathering which causes very hard rock to change into softer material or finer grains. Based on Figure 2, it is clear that the grains of the rock weathering material in the study area are still clearly visible.

Figure 2. Soil texture conditions at the research location (Source: Researcher 2023)

Land use

Currently, land use in Kolaka Regency is still dominated by natural forests, plantations and settlements. Meanwhile, the land use research locations are settlements and plantations. For more details, see Figure 3.

Figure 3. Land Use at the research location (Source: Researcher 2023)

Geological conditions and geological structure

An overview of the geological conditions in the Kolaka Regency area, in this case seen based on geomorphological units, rock-forming units and geological structures. Where the rocks that make up the research area are metamorphic rocks with physical characteristics, fresh brown, weathered blackish gray, lepidoblastic texture with a foliation structure. Meanwhile, the morphological condition is steep with the type of structure found in the form of folds, thus identifying that in the study area there are faults that are still active (Figure 4).

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Figure 4. Geological conditions and fold structures at the research location (Source: Researcher **2023)**

Rainfall

Kolaka experiences extreme seasonal variation in monthly rainfall. Rain falls throughout the year in Kolaka. The month with the most rain in Kolaka is April, with an average rainfall of 210 millimeters. The month with the least rainfall in Kolaka is September, with an average rainfall of 56 millimeters.

Results of data analysis on the level of vulnerability to landslides in the research area (Table 1):

Table 1. Results of scoring the level of vulnerability of the research area

NO	Parameter	Classification	Scoring	Weight	Vulnerability
1	Slope	8-15%	2	0.415	0.83
2	Soil Texture	Currently	3	0.136	0.408
3	Fault	There is	5	0.172	0.86
4	Regolith	Currently	3	0.121	0.363
5	Geological Conditions	Sediment	4	0.157	0.628
6	Rainfall	<1000mm/yr	1	0.3	0.3
7	Land Use	Settlement	4	0.15	0.6
Vulnerability Level Value					**3.989**

Source: Data processing results, researcher 2023

Based on the results of the weighting carried out, it can be concluded that the Landslide Disaster Classification research location is Very Vulnerable with a weight value of > 3,918. Areas with a high level of vulnerability with a weight value >3,918 so that the research location is an area that has a high potential for landslides. Currently, rainfall is in the high category with an intensity of >200 mm/Th which occurs at the beginning of each year. Factors that cause a high level of vulnerability are high rainfall, the slope of the slope is dominated by steep slopes with a slope of 30-50o, and the soil texture is dominated by clay and sand, as well as the use of residential and plantation land and the presence of folds which are characteristic of active geological structures. in the form of a fault that gives the highest honor.

CONCLUSION

Based on the results of the analysis that has been carried out, it can be concluded that the level of vulnerability at the research location is very vulnerable with an interval of >3,918. Areas with a very

vulnerable level of vulnerability are areas that have a high potential for landslides. Especially at this time, rainfall is in the high category which occurs at the beginning of every year.

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