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Effect of Geological Characteristics on Landslides and Floods in Karangtengah

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Abstract

Bantul regency becomes an area that has a high potential for flooding in 2019 with each percentage of 27%, Bantul regency becomes an area that has a high potential for landslide disasters with a percentage of 43% or there has been a landslide as much as 220 times, landslide-prone points in Bantul districts are in some places there are 5 districts that are very vulnerable, one of the landslides and floods was in the Karangtengah village, research in this Karangtengah to see the most influential geological character as a trigger and cause of landslides and floods in the area of Karangtengah, The method used in this research is a field survey method assisted by GIS software, in field survey activities, by looking at the condition of the slopes, lithology on the slopes and structures that develop on the slopes, this analysis is carried out to determine the influence of geology on landslide disasters in the area. the upstream part which is the slope, while the analysis for the flood disaster is in the form of studies including infiltration at several points including residential areas and riverbanks and analysis of rainfall data, infiltration is carried out in the river boar area which is the downstream part, the geological aspects of landslides and floods in the Karangtengah area are quite dominant considering the results of the infiltration analysis, geomorphology and developing structures, besides the geological aspects of hydrometeorology and the use of a fairly large influence on the occurrence of the disaster.

Keywords: Geology, flood, Lanslide, Disaster

INTRODUCTION

Bantul Regency is one of the regencies with a high level of landslide and flood threat compared to other cities and regencies in the Special Region of Yogyakarta, from the results of direct observations in the field and Disaster Data and Information in Indonesia D.I Yogyakarta 2020 and 2019, in the latest DIBI (Disaster Data and Information in Indonesia D.I Yogyakarta 2019 and 2020), Bantul Regency has a percentage of 22% of the total landslide events in the DIY region which ranks second after Kulonprogo, while the 2018 flood incident in Bantul Regency became an area that has a high potential for flooding in 2019 with a percentage of 27%, the highest in the Special Region of Yogyakarta, one of the landslide and flood disasters in Bantul Regency, occurred in Karangtengah longosor Village in 2017 and floods 2019, Village Karangtengah is located in the south of the city of Yogyakarta with a distance of about 16 km, has acoordinates: -7.936294, 110.379671 this village is one of 8 villages in Imogiri sub-district prone to landslides and floods, landslides occurred in the tropical cyclone Cempaka 26 November 2017 causing moderate to heavy rainfall in the Bantul district, The Karangtengah area was also flooded due to the overflow of the Kaliceleng in 2019 with a height of overflowing puddles of water that entered the house of about 1.5 meters, the problems that arose were. From the results of observations made in July in the research area, it was found that 1. Residents live on the edge of the slope with a slope of 40^{o}, 2. residential areas located on the slopes standing on the weathered soil of volcanic breccia, 3. installation of landslide EWS is too sensitive so that sometimes it sounds for no reason other than the absence of flood EWS around Kaliceleng, 4. lack of knowledge residents about the characteristics of the threat of flooding and landslides, 5. lack of socialization of residents about the maintenance of EWS tools and other monitoring tools, resulting in damage

LITERATURE REVIEW

The research carried out is a study of geological factors that influence floods and landslides in the Karangtengah area, as for several studies and research that have been carried out. Some studies that have been carried out and used as references in this study include the following

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The research was conducted by Marcia Violetha Rikumahu, Master of Mining Engineering Program UPN "Veteran" Yogyakarta, with the title Analysis of Slope Stability Against Settlements in Pengkol Hamlet, Sriharjo Village, Imogiri District, Bantul Regency, DI Yogyakarta, 2016 the method used Data analysis method in the form of test laboratory of physical properties and shear strength test, for the calculation of slope stability in residential blood

Research conducted by Rokhmat Hidayat, SABO Research and Development Center, Ministry of Public Works and Public Housing, with the title Engineering Geological Conditions of Landslide Prone Areas, Karangkobar District, Banjarnegara in 2018, using geological investigation methods and slope stability modeling.

Research conducted by Sri Aminatun, Civil Engineering Study Program, Faculty of Civil Engineering and Planning, Islamic University of Indonesia, with the title The Effect of Tropical Storm Cempaka on Landslides in Bantul Regency, Yogyakarta in 2018, The method in this study is divided into two, namely methods for collecting data in the form of observation, FGD, secondary data collection and data analysis methods in the form of the relationship between rainfall and cyclone Cempaka

Research conducted by Liliya Dewi Susanawati, Faculty of Agricultural Technology, Universitas Brawijaya, with the title Determination of Infiltration Rate Using Double Ring Infiltrometer Measurements and Calculation of the Horton Model in Tangerine 55 (Citrus Reticulata) Orchards in Selorejo Village, Malang Regency in 2019, the method used is measurement of infiltration rate (constatnt-rate) and statistical analysis by t-test and calculation of Horton's infiltration model.

Based on the definition from the Multilingual Technical Dictionary on Irrigation and Drainage issued by the International Commission on Irrigation and Drainage (ICID), the definition of flood can be defined as the flow rate in a river that is relatively higher than usual; inundation that occurs on land; the rise, addition, and overflow of water that does not normally occur on land. In general, flooding is defined as an event in which water inundates land/land that should be dry, causing physical losses and having an impact on the social and economic fields. Floods can be classified based on: water source, mechanism, position and based on the aspect of the cause (Ferad Puturuhu 2015)

The causes of landslides stated (Varnes, 1978), can be interpreted as factors that make slopes vulnerable to collapse or landslides at certain locations and at certain times which includes geological factors, morphology and human activities. The causative factors can be referred to as the factors that cause the slope to experience structural failure, which then makes the slope unstable. A trigger is a single event that can eventually cause a landslide, while a trigger is the one that eventually causes a collapse/movement. Usually, the triggering factor is easy to determine after a landslide has occurred (although in general it is very difficult to determine with certainty the natural event that triggered it (the occurrence of a landslide from a collapse/movement event) (Muntohar, 2010).

RESEARCH METHODOLOGY

The method used in this study is to look at the condition of the slopes, lithology on the slopes and the structure that develops in the slope area, while the analysis for flood disasters is in the form of a comparison between infiltration and rainfall and the capacity of the Kaliceleng. The survey results from secondary data analysis using GIS software for variables such as slope conditions, land use, watershed width and other factors that cause landslides and floods. Surveys and measurements of engineering geology in the field with observed variables including slope geometry measurements, while data parameters for geometric measurements include slope orientation (stance and slope), slope height and slope (each level or total) and level width (berm). The width of the river, measurement of rainfall, and the ability of water absorption in the area. What are the main factors that then become the key to landslides and floods in Karangtengah?

FINDING AND DISCUSSION

Geological Conditions

Karangtengah village is dominated by young Merapi deposits and also alluvial deposits, on the slopes there is a ngelanggran formation and From the results of field observations carried out on March 2021, it was found that rock outcrops located at the top of the hill in the Karangtengah village area are breccias. volcanic rocks and rocks included in the Ngelanggran Formation, western Bada in a flatter area

there are rock outcrops in the form of limestone that enter the Wonosari Formation, the body of the slopes in the middle coral village is dominated by soil and weathered breccias, on the upper slopes are still found in the form of rocks the breccias are still fresh, while at the crown to the foot of the avalanche it is in the form of weathered breccias and quite thick soil,Conditions in the form of thick soil also affect the water absorption capacity around the slopes, which causes rainwater to not seep maximally so that the overflow of water from the slopes to the watershed, in this case Kaliceleng, is quite large. From the results of field observations conducted on July 23, 2021 obtained outcrop at coordinates x: 433281, y: 9122039 on the upper slopes, the outcrop obtained in the form of breccia with a light brown to dark color, large grains of crystal - krakal, corner, badly separated, open pack, the composition of fragments in the form of andesite-basalt and a minute of silica, Massiv Limestone outcrop at coordinates x: 432411, y: 9122783 on the lower slopes, the outcrop obtained in the form of limestone white to dark color, non-clastic sediment, dengan struktur masiv, komposisi mineral CaCo3

Figure 1. (Left) Lithology in the form of breccia of the ngalanggran formation on the slopes of the bag, (right) limestone of the Wonosari formation on the downstream housing

Geomorphology

The morphology of the Karangtengah area is dominated by structural hills and moderate undulating volcanic remnant hills that stretch from north to south, Karangtengah Village which is a hilly area on the east side with a slope of 15-50% (sloping-steep), The slope of the slope is a very important factor in the process of occurrence landslide. Slope conditions of more than 15% need attention to the possibility of landslide disasters, in Krangtengah village the 2017 landslide is on a slope area with a slope of 40^{o} (steep)

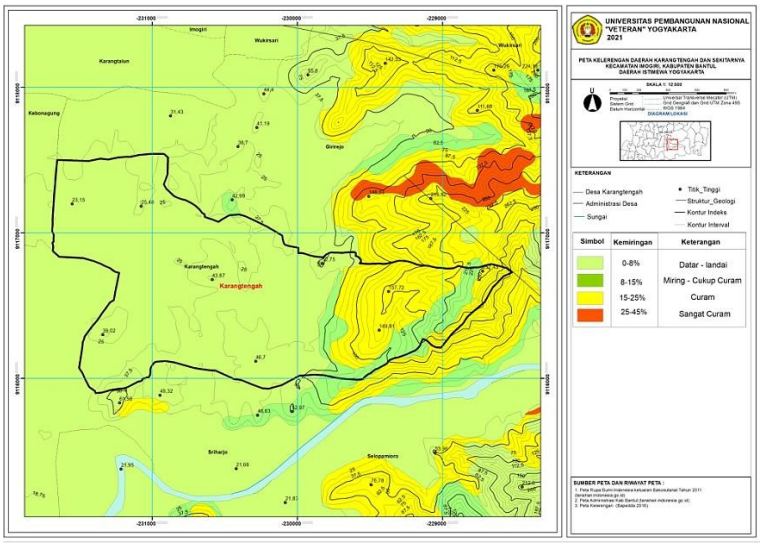

Figure 2. map of the slopes of the Karangtengah area

Structure

One of the factors that influence the occurrence of landslides is influenced by weak zones, including structural control, in the Karangtengah area the control structure that dominates in the form of joints in sandstone and breccias at the top and bottom of the slopes, this weak zone can cause further

damage. unstable slope because it can become a place that is saturated with water, The joint located in Karangtengah Village, besides being able to pass water and saturate it is thought to be associated with faults close to the research location, namely Opak Fault, general direction join in Karangtengah village N013^{0}E/51^0 and N249^{0}E/53^0

Figure 3. Joints formed in the landslide area

Infiltration

The infiltration test was carried out at three points, with the double ring inviltration method, this method used a double ring, which was then measured infiltration in each area tested, the first area was in the residential area of the residents with an average infiltration rate of 20 cm/hour in the fast category, while the second test was in a residential area but which was directly adjacent to the Kaliceleng, which obtained an infiltration rate of 24cm/hour in the fast category, and when the measurement was carried out on a slope area, an invitration rate of 6cm/hour was obtained with a medium category, classification referring to Uhland and O'Neal, 1951

Table 1. Classification of Infiltration rate

Kriteria	Laju Infiltrasi (cm/jam)
Sangat Cepat	> 25,4
Cepat	12,7 - 25,4
Agak Cepat	6,3 - 12,7
Sedang	2 - 6,3
Agak Lambat	0,5 – 2
Lambat	0,1 - 0,5
Sangat Lambat	< 0,1

Rainfall

Hydrometeorological factors are one of the factors that trigger floods and landslides, in 2017 the landslides that occurred were caused by cyclone Cempaka with very high rainfall around the slopes, rainfall in D.I Yogyakarta on November 28 2017, 286 mm/day, The rainfall that occurs is an extreme category of rainfall (> 150 mm/day). While the Cempaka cyclone incident in November the Bantul Regency area had rainfall of 101 - 500 mm/day, based on data from the Mlati Climatology Station. the flood event that inundated karangtengah village in March 2019, based on daily outpouring data summarized by several monitoring stations in the Special Region of Yogyakarta, the highest on 16th average rainfall of 24 mm / day - 177mm / day, while on the 18th with a clear daily rainfall of 138mm / day - 411mm / day, the extreme outpouring is one of the causes of the forgetn of the Kaliceleng. based on the results of infiltration analysis that the slope area had moderate infiltration according to the calculation of the invitation rate carried out , so that the water does not seep maximally and goes to the boar river which causes the downstream to overflow, although if you look at the rate of invasion of residential areas and riverbanks it is fast, however, the rainfall which is quite high is deposited on the slopes experiencing saturation of water, causing landslides, and the downstream has an increase in discharge due to slow absorption in the upstream part

Land Use

In addition to several geological and hydrometeorological factors, there are other factors beyond that, including in the upstream area, namely the hills around the imogiri area, many of which are already experts in the function of many new tours that inevitably make the function of the rain catchment area less and less, on the slopes of the Karangtengah Village area, it is widely used. as agricultural land but there is no control of surface water so that it burdens the slopes and can cause landslides, while the conversion of upstream land functions results in extreme rainfall such as 2017 and 2019 a lot of water runoff that leads directly to the Kaliceleng which results in additional water discharge downstream, so that floods downstream

Types of landslides that have occurred

The type of avalanche is in the form of debris flow. Debris flow tends to follow the direction of the slope. The flow of debris is a rapid mass movement consisting of soil, rock and often contains organic content mixed with water which then flows down the slope. The speed of this density movement can be very fast (56 km/hour), depending on the slope angle. The main trigger of this type of mass movement is the large volume of surface water flowing, the amount of water flowing in the aquifer, which then erodes and triggers the movement of material down the slope. The landslide event in Karangtengah Village was actually more influenced by the weather anomaly that occurred at the end of 2017.

Figure 3. Karangtengah avalanche which resulted in the destruction of houses

CONCLUSION AND FURTHER RESEARCH

The occurrence of floods and landslides in Karangtengah Village is influenced by several aspects including geological aspects (lithology, geomorphology and structure) rock lithology of slopes in Karangtengah Village, rock lithology is dominated by volcanic breccia Nglanggran formation which has begun to weather, then the slopes in Karangtengah Village include slopes Steep, this is a factor apart from lithology, there is also the influence of the structure in the form of a joint which makes several weak zones, from the inviltari test and rainfall data show that the upstream part of the slope in the village of Krangtengah has moderate invasion, which then affects the overflow of water that leads directly to settlements and sub-watersheds of the boar river which causes flooding,this was also reinforced by the extreme rainfall at that time due to the cempaka cyclone in 2017 and the peak of the rainy season in 2019, Further research (1) connected the impact of the development of tourist areas upstream to the occurrence of floods and landslides, (2) mapping of land use and development studies of riverbank areas.(3) development of early warning system of slopes and rivers and mapping areas prone to floods and landslides

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