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ANALYSIS OF THE EFFECT OF NATURAL FACTORS ON THE POTENTIAL OF FLOOD AND LANDSLIDE IN THE EAST JEMBER

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Abstract

Natural phenomena of floods and landslides are natural phenomena that often occur anywhere and anytime, with these phenomena certainly having negative impacts such as on health and socio-economic conditions. The purpose of this study was to determine the effect of natural factors on the potential for flooding and landslides in the eastern part of Jember. The method used in this study is a qualitative descriptive method because in this study it is based on map and image interpretation techniques (Surface Analysis) while the qualitative method itself is carried out using interpretation elements such as patterns, textures, associations, hues, and also shapes. land. The parameters used in determining the factors prone to flooding and landslides, The research was conducted in several sub-districts, namely Sumberjambe District, Ledokombo District, Silo District, Mayang District, Mumbulsari District and Tempurejo District. In the eastern part of Jember, if seen from the morphology, it is dominated by highlands because in some of these areas it is part of the area at the foot of Mount Raung so that there is a lot of volcanic land, besides that in the eastern part of Jember, it is also dominated by flat land so that it is very possible for natural phenomena to occur. floods and landslides. Geologically, the eastern part of Jember is dominated by lava breccia, tuff and tuff sandstones, lava, volcanic breccias, claystone with siltstone inserts, and sandstone whose ages range from quarter to tertiary age. Silo District, Mayang District, Mumbulsari District and Tempurejo District. In the eastern part of Jember, if seen from the morphology, it is dominated by highlands because in some parts of this area it is part of the area at the foot of Mount Raung so that there is a lot of volcanic land, besides that in the eastern part of Jember, it is also dominated by flat land so that it is very possible for natural phenomena to occur. floods and landslides. Geologically, the eastern part of Jember is dominated by lava breccia rocks, tuff and tuff sandstones, lava, volcanic breccias, claystone with siltstone inserts, and sandstone whose ages range from quarter to tertiary age. Silo District, Mayang District, Mumbulsari District and Tempurejo District. In the eastern part of Jember, if seen from the morphology, it is dominated by highlands because in some parts of this area it is part of the area at the foot of Mount Raung so that there is a lot of volcanic land, besides that in the eastern part of Jember, it is also dominated by flat land so that it is very possible for natural phenomena to occur. floods and landslides. Geologically, the eastern part of Jember is dominated by lava breccia rocks, tuff and tuff sandstones, lava, volcanic breccias, claystone with siltstone inserts, and sandstone whose ages range from quarter to tertiary age. In the eastern part of Jember, if seen from the morphology, it is dominated by highlands because in some parts of this area it is part of the area at the foot of Mount Raung

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Keywords: Natural Phenomena; Flood Disasters; Landslide Disasters; Driving Factors

1. introduction

Natural disaster is a phenomenon that often occurs anywhere and anytime. One of the natural phenomena that often occurs in various regions is natural phenomena in the form of floods and landslides. (Hutomo et al., 2016) The natural phenomenon of landslides is a natural phenomenon in the form of erosion accompanied by movements or shifts that occur in the soil on the earth's surface, resulting in the displacement of rock or soil material with a fairly large or high intensity. (Sitepu et al., 2017) The speed of soil movement is certainly influenced by several factors such as rock type, soil, topography, land use, and rainfall, where these parameters are parameters that play a very large role in the occurrence of natural phenomena of landslides in an area. region. (Rahmadani et al., 2017) While the natural phenomenon of flooding itself is a natural phenomenon that often occurs during the rainy season this occurs due to the inability of the river to accommodate surface flow discharge with very high intensity which is not in accordance with the capacity or ability of the river in accommodate the amount of incoming water discharge. This is certainly influenced by the cross-sectional dimensions of the river and also the speed of river flow. The speed of the river flow itself is influenced by the slope of the land in the area and also the level of intensity of the rain that falls. (Musa et al., 2020) The existence of natural phenomena in the form of floods and landslides in an area will certainly have a negative impact on health and conditions. socioeconomic status of the surrounding community. 2017) While the natural

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According to research conducted by Baco et al., (2017) states that the potential for flooding and landslides in the Southeast Sulawesi Province is caused by several natural factors, natural factors that affect the potential for flooding in Southeast Sulawesi Province are influenced by land form, meandering, and also the slope of the existing slopes in the area. Meanwhile, natural factors that affect the potential for landslides in Southeast Sulawesi Province are influenced by the intensity of rain in the area, slope slope, geology or land-forming rocks, the presence of faults, land use and also the density of settlements in the area. Risk et al., (2019) states that the potential for natural disasters of floods and landslides in Purworejo Regency is 42% influenced by the slope of the existing slopes in the area, besides that it is also influenced by rainfall with a rainfall intensity of 8.85 mm/hour. The intensity of rainfall, soil moisture, is an integrated indicator of the danger of landslides triggered by rainfall.(Stanley et al., 2020) In addition, landslides are often found in Italy in areas with Vulcan land, of course this is triggered by high rainfall, earthquakes and propagation of fault episodes.(Barbano, Pappalardo, Pirrotta, & Mineo, 2014) Indeed, displacement along active faults creates steep slopes and rock fractures, which are factors for the mass movement.(Disaster & Ecology, 2019).

Liu et al., (2018) stated that a higher population density with the help of a higher degree of topography is a key factor causing a higher risk of banjir bandang. The results of his research show that human activities cause severe disturbances to the earth's surface environment and climate change, and are therefore the main reason for flash floods. Setiawan et al.,

According to research conducted by Seto et al., (2020) stated that the level of vulnerability of the natural phenomenon of landslides to debris flow in the Mount Merapi area is strongly influenced by the slope of the slope. The results showed that the greater the slope, the faster the rain caused debris flow to occur. Sukajaya et al., (2020) stated that there were several causes for the natural phenomenon of landslides in Sukajaya District, Bogor Regency influenced by several factors such as morphology and slope, soil and rock formation in the area (geology), land use, drainage, rainfall intensity and human activities. Yuniarta et al. (2015) said that Ponorogo Regency is an area that has the potential to experience landslides because many of its morphological forms are hills with steep slopes. The data is obtained from GIS analysis using many parameters which are overlaid and then weighted (score). The results of this study indicate that Ponorogo Regency can be categorized as an area with landslide conditions belonging to the vulnerable category in hilly and mountainous areas, while in the lowlands it is included in the category of somewhat prone to landslide phenomena. The data is obtained from GIS analysis using many parameters which are overlaid and then weighted (score). The results of this study indicate that Ponorogo Regency can be categorized as an area with landslide conditions belonging to the vulnerable category in hilly and mountainous areas, while in the lowlands it is included in the category of somewhat prone to landslide phenomena. The data is obtained from GIS analysis using many parameters which are overlaid and then weighted (score). The results of this study indicate that Ponorogo Regency can be categorized as an area with landslide conditions belonging to the vulnerable category in hilly and mountainous areas, while in the lowlands it is included in the category of somewhat prone to landslide phenomena.

Setyawan et al., 2020 stated that the potential for landslides that had occurred in Banyumatic District, Semarang City was dominated by the slope factor that existed in the area and was a very important factor in the process of landslides. Zones that have slopes that are included in the steep category are dominated by vegetation in the form of grass, as well as high rainfall intensity which has a very high potential for landslides.Sri et al., 2019 stated that Ponorogo Regency, East Java Province has a fairly high level of vulnerability to landslides, the background for this is due to several main factors that influence landslide disasters such

as very steep slopes, volcanic breccia rocks that are prone to landslides. forming very thick weathered soil, conversion of land to horticultural plants that require efforts to loosen the soil and disrupt slope stability, and high rainfall.

From the research that has been done by previous researchers, that from several researchers the factors that cause potential floods and landslides only focus on certain parameters such as slope factors, topography, and also rainfall as one of the factors that affect the potential for flooding and soil. Avalanche. And there is limited research related to land use factors, the geology of an area, elevation, contours, slope direction and also the shape of the relief. Where these parameters also have a major influence on the potential for flooding and landslides in an area. Therefore, this study focuses on natural factors that affect the potential for flooding and landslides in an area that is viewed from several parameters such as land use factors, altitude,

2. Method

2.1 Research Site

The research was conducted onThe eastern part of Jember consists of Sumberjambe District, Ledokombo District, Silo District, Mayang District, Mumbulsari District and Tempurejo District. In the eastern part of Jember, if seen from the morphology, it is dominated by highlands because in some of these areas it is part of the area at the foot of Mount Raung so that there is a lot of volcanic land, besides that in the eastern part of Jember, it is also dominated by flat land so that it is very possible for natural phenomena to occur. floods and landslides. Geologically, the eastern part of Jember is dominated by lava breccia, tuff and tuff sandstones, lava, volcanic breccias, claystone with siltstone inserts, and sandstone whose ages range from quarter to tertiary age.

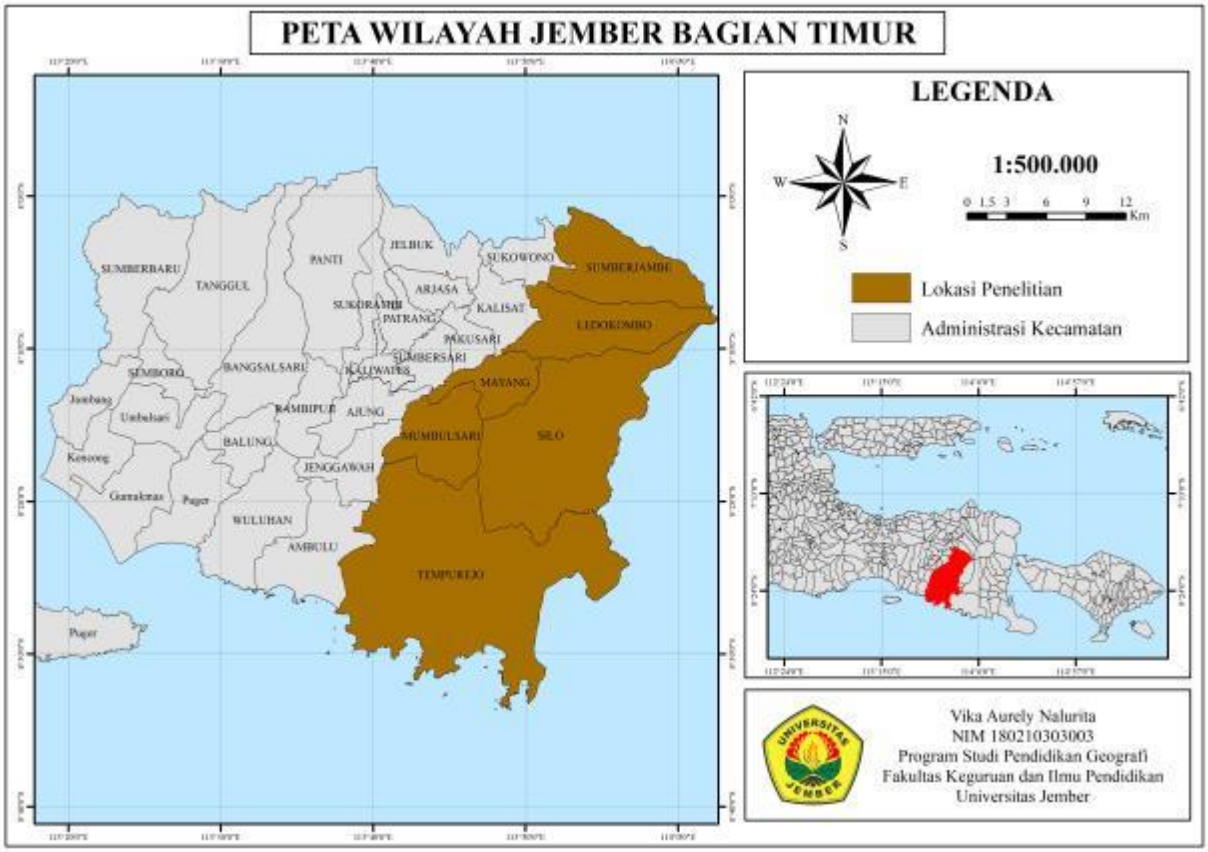

Figure 1. Research Location

2.2 Materials and Data

Materials and data used in the research to determine factors that have the potential for flooding and landslides in the eastern part of Jemeber include; ArcGIS 10.4 application, slope map, land use map, slope direction map, contour map, relief map and radiometric corrected SRTM data.

2.3 Research Method

In this study, a qualitative descriptive method was used because in this study it was based on map interpretation techniques and also images (Surface Analysis) while the qualitative method itself is carried out by using elements of interpretation such as patterns, textures, associations, hues, and also land forms. The parameters used in determining the flood and landslide-prone factors include; slope factor, slope height, land use, slope direction, contour and relief. Where from the map results are then described to determine the level of vulnerability to flooding and landslides using predetermined factors.

3. Results and Discussion

The topography of an area allows gravity to act on rock masses, moving along major slope gradients or creating unstable situations. In addition, by controlling the source of water

flow, the direction of water flow and soil moisture, the surface topography is an important factor affecting the density and spatial area of landslides.(Abdallah & Faour, 2017)

3.1 The Effect of Land Use on Potential Floods and Landslides

Liu et al., (2018) stated that a higher population density with the help of a higher degree of topography is a key factor causing a higher risk of banjir bandang. The results of his research show that human activities cause severe disturbances to the earth's surface environment and climate change, and are therefore the main reason for flash floods. In addition, an increase in human activities that takes place continuously without regard to environmental conservation will result in environmental degradation because this is related to the neglect of conservation practices in the long term, so that it can contribute to an increase in the potential for disasters.(Debortoli, Camarinha, Marengo, & Rodrigues, 2017)

In the Brazilian region, results are more intensively affected by natural disasters of a hydrometeorological nature, due to its location in the tropics, where high temperatures and high evaporation potential facilitate high rainfall, causing the geodynamic features of the soil to be more vulnerable to hazards.(Jun, 2015)Continuous rainfall or additional water from confluence of branch rivers raises the water level of barrier lakes. Once the water level is higher than the landslide dam, overflow flooding occurs and can result in water erosion and dam failure. Of course, each stage has a different movement mechanism and has a complex relationship with other stages.(W. Liu & He, 2018)

The map (Figure 2) shows that the eastern part of Jember is dominated by land use in the form of rice fields and also settlements so that during the rainy season this area will become an area prone to potential flooding because the land form is filled with flat land and lack of water absorption in the area. This means that when it rains with high intensity it is very possible for surface runoff which results in erosion and then triggers the occurrence of natural phenomena in the form of flooding. Because basically the more water infiltration places in an area it will minimize the occurrence of flooding, besides that good vegetation in an area will also minimize the occurrence of flooding because when it rains the water will not fall directly to the ground but still through the trees, leaves and tree branches. Increased irrigated areas can result in local irrigation systems being often not well maintained, leading to build-up of sediment deposits and reduced water-holding capacity. This has an additional negative impact on the hydrological characteristics of the catchment. (Keil, Saint-Macary, & Zeller, 2013)

Floodplain areas are usually areas close to watersheds but also have a very sloping and relatively flat level of elevation. The presence of sufficient vegetation will certainly have a positive impact on the environment because with good vegetation in an area such as protected forest land and plantations in an area it will minimize the occurrence of surface runoff during the rainy season so as to minimize flooding. This can happen because when it rains the water does not fall directly and is absorbed by the soil but still through trees, leaves and twigs so that the process of water infiltration in the soil can run optimally and minimize surface runoff which can trigger natural phenomena to occur.

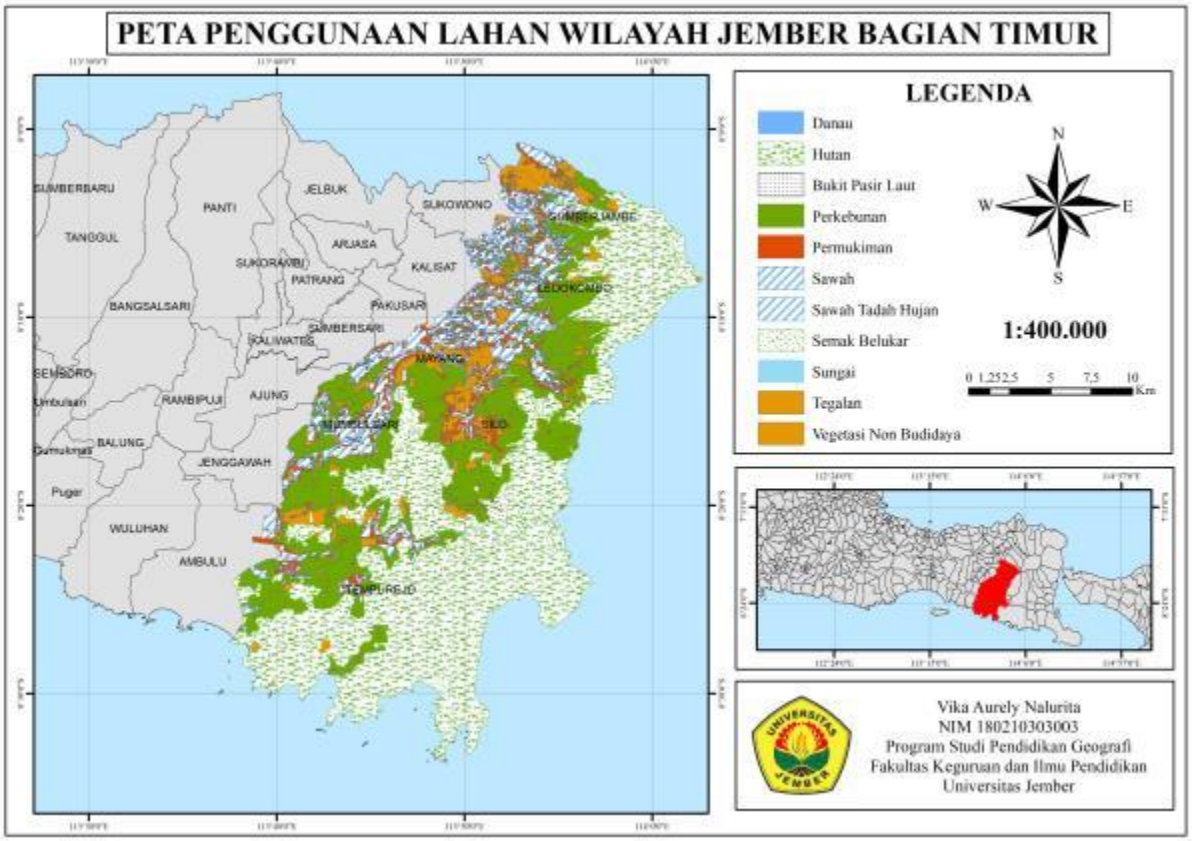

Figure 2. Map of East Jember Land Use

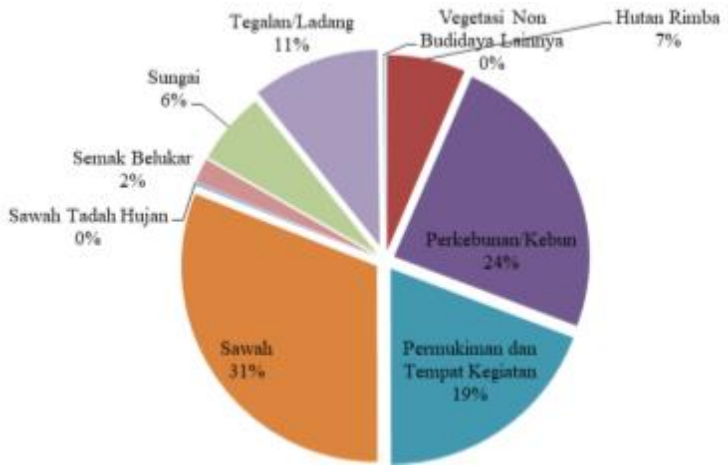

Diagram 1. Land Use of the East Jember Area

In the Jember Regency area, especially in the eastern part of Jember, it has a tropical climate where in this area the rainfall intensity is high so that natural phenomena of floods and landslides often occur in this area. One of the factors that cause natural phenomena in the eastern part of Jember is during the rainy season, sea water and river water will become high tides so that if this area does not have sufficient water catchment areas, it will cause natural phenomena in the form of erosion which can cause flooding. and also landslides occurred in this area. Land use in an area of course also affects the potential for natural disasters to occur such as floods and landslides,(Chae, Park, Catani, Simoni, & Berti, 2017)

3.2 The Effect of Contours on Potential Floods and Landslides

The river morphology of the valley between the Dhoban and Jagat Settlement (1246 mdpl) (Appendix 4) depicts a well-developed water level (1.4 m here) and paleoflood levels ranging between 3 m and 3.4 m. Consequently, the arithmetic mean of 3.2 m represents the paleoflood stage. Then observed the shape of the winding channel. At the end of this valley, the meandering process of formation stops, and the valley becomes narrower, which raises the water level in this short river's reach. In addition, the relief results in the form of rocks that have accumulated at the bottom of the river on the right side of the river transitioning to this narrow valley. As a result, this process builds natural dams that can block the flow of water

In the south the settlement of Macha Khola meanders and a wide floodplain along Buri Gandaki is investigated. This meandering, pond-riffle and floodplain pattern is dependent on the high frequency of fluvial discharge and sedimentation changes, reflecting the high water dynamics of this river range. During high-water events, most of which occur

during the rainy season, the river's water level rises. As a result, the floodplain at the border became submerged.(Tombrink, 2017)

Contour analysis conducted in the eastern part of Jember is also one of the determining factors for the occurrence of potential floods and landslides because the closer a contour is, it indicates that the area is a relatively steep plain and can potentially occur natural phenomena in the form of landslides, while in The loose contours indicate that the area is a flat area that has the potential for flooding because in general water flows from high-lying areas and then empties into low-lying areas so that this causes potential flooding to occur in low-lying areas.

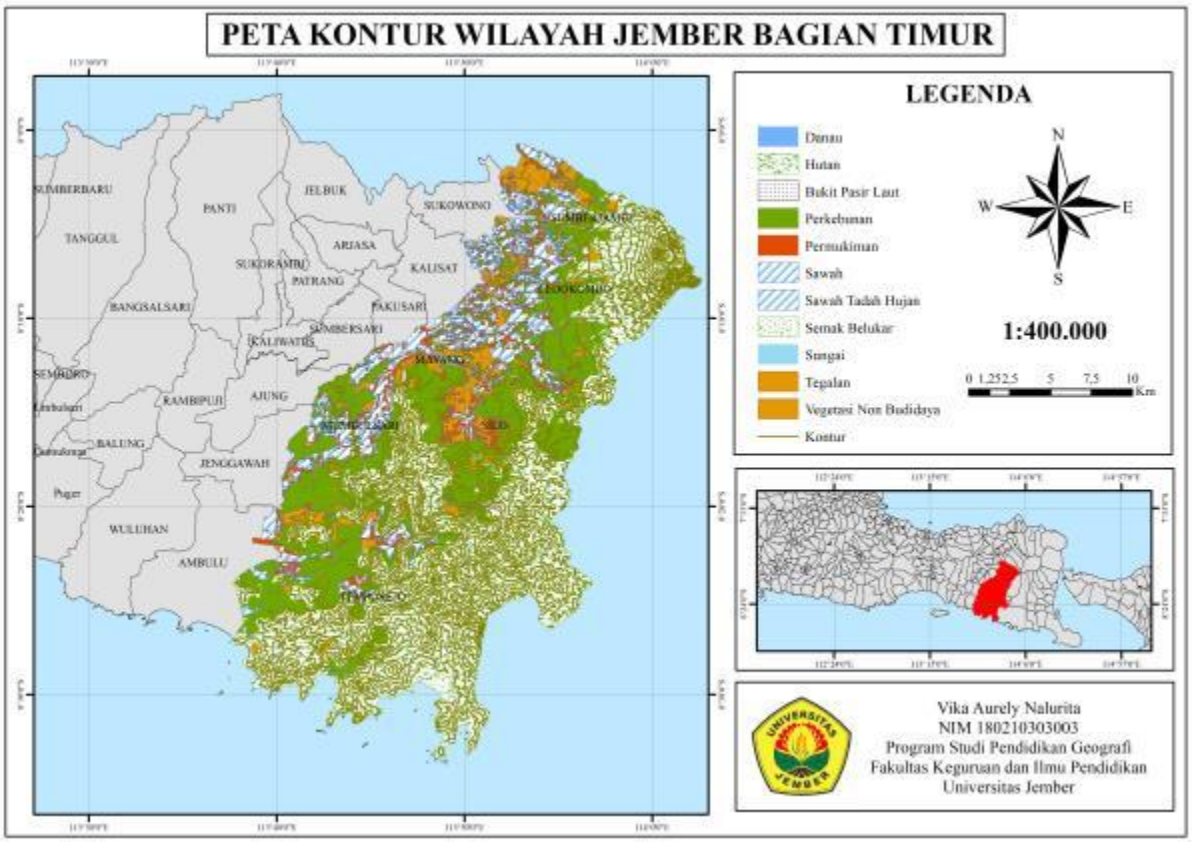

Figure 3. Contour Map of East Jember Region

3.3 Effect of Slope Slope on Potential Floods and Landslides

In the Pico de Orizaba volcano area, Mexico, the level of vulnerability to landslides and flooding is influenced by the value of elevation, slope, flow direction, land use, lithology, and terrain curvature which are the most significant factors in driving slope movement in the region.(Legorreta Paulín, Bursik, Hubp, Mejía, & Aceves Quesada, 2014)The slope of the slope in an area that exceeds 27 °. included in the area that must be wary of because it is an

area that is classified as prone to landslides. Because the higher the angle in a region, the greater the shear component of the force acting on the potential surface. On a local scale, the slope of the slope affects moisture concentration and pore pressure levels and is often useful for dealing with detailed instability patterns, while on a larger scale, it controls hydraulic continuity.(Abdallah & Faour, 2017)

Topographical conditions in an area can affect the potential for natural phenomena to occur such as topography with steep slopes that can trigger natural phenomena in the form of landslides, while in sloping to flat areas, there are areas that have the potential for natural phenomena such as flooding and erosion. In (Figure 4), a slope analysis is carried out to facilitate the clustering of areas prone to landslides and floods using five color categories on the map, namely the red color indicating an area whose slope level belongs to the very steep category which is an area that has the potential for landslides and includes areas that are prone to landslides. safe for flooding, the orange area also indicates an area that is classified as steep so that the area is still an area prone to landslides and can be said to be a safe area for flooding, the yellow area indicates a rather steep area while the light green to green area The old age indicates the existence of a sloping to flat area in the area where this area is an area that is very vulnerable to the occurrence of other phenomena in the form of flooding. In the Jember Regency area, the area that has the potential for landslides is in the eastern part of the Jember region, precisely at the foot of Mount Raung, while the area with the potential for flooding is located in the western part of the foot of Mount Raung.

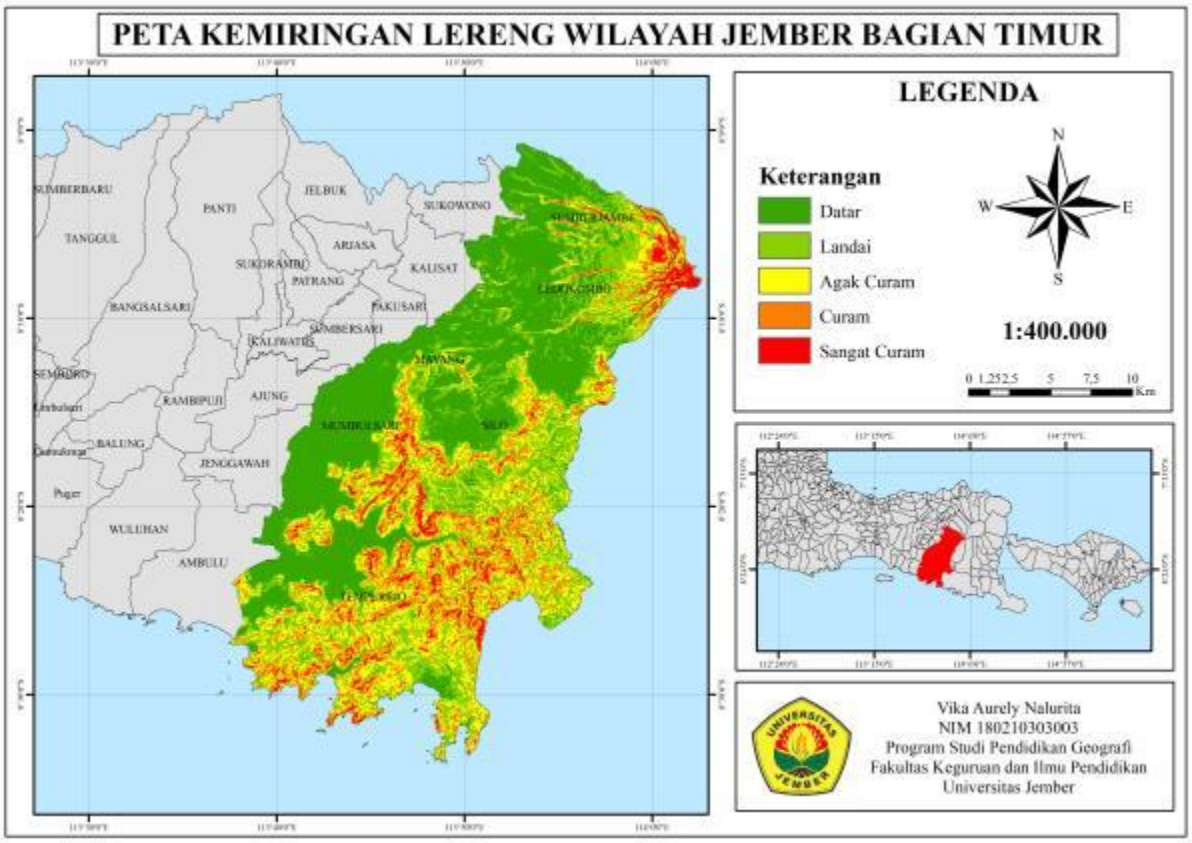

Figure 4. Slope Map of East Jember Region

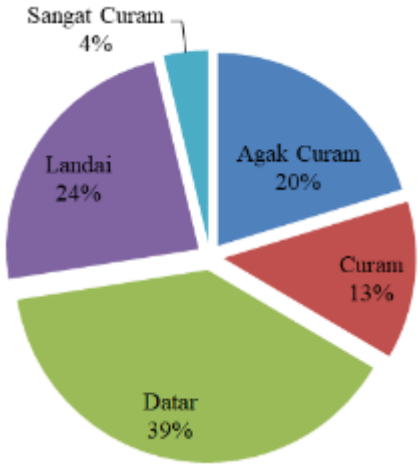

Diagram 2. Use of the Slope of the East Jember Region

3.4 The Influence of Slope Direction on Potential Floods and Landslides

In April 2000, the Yigong River was dammed by a large-scale landslide that occurred in Tibet at a temperature of 30° 1003900N, 94° 5602500E, which formed a vast barrier lake. With the continuously increasing water volume in the barrier lake, the flood overflow occurred after 62 days and caused a topographic catastrophic burst flood. There are three post-event dimensions of the Yigong disaster chain. The landslide area can be divided into three zones, namely the source zone, motion amplification, and deposition where the slope

angle and height factors are the first trigger factors for natural phenomena in the area.(W. Liu & He, 2018)

Map analysis using Aspect is used for the direction of the slope in the eastern part of Jember Regency. Most of the slopes in Jember Regency are found in the eastern area of the foot of Mount Raung. In this aspect analysis, it is represented by various colors. One of its functions is to identify the location facing the rising sun for the application of vegetation growth estimation. In the eastern part of Jember, the direction of the slope extends from the east to the west.

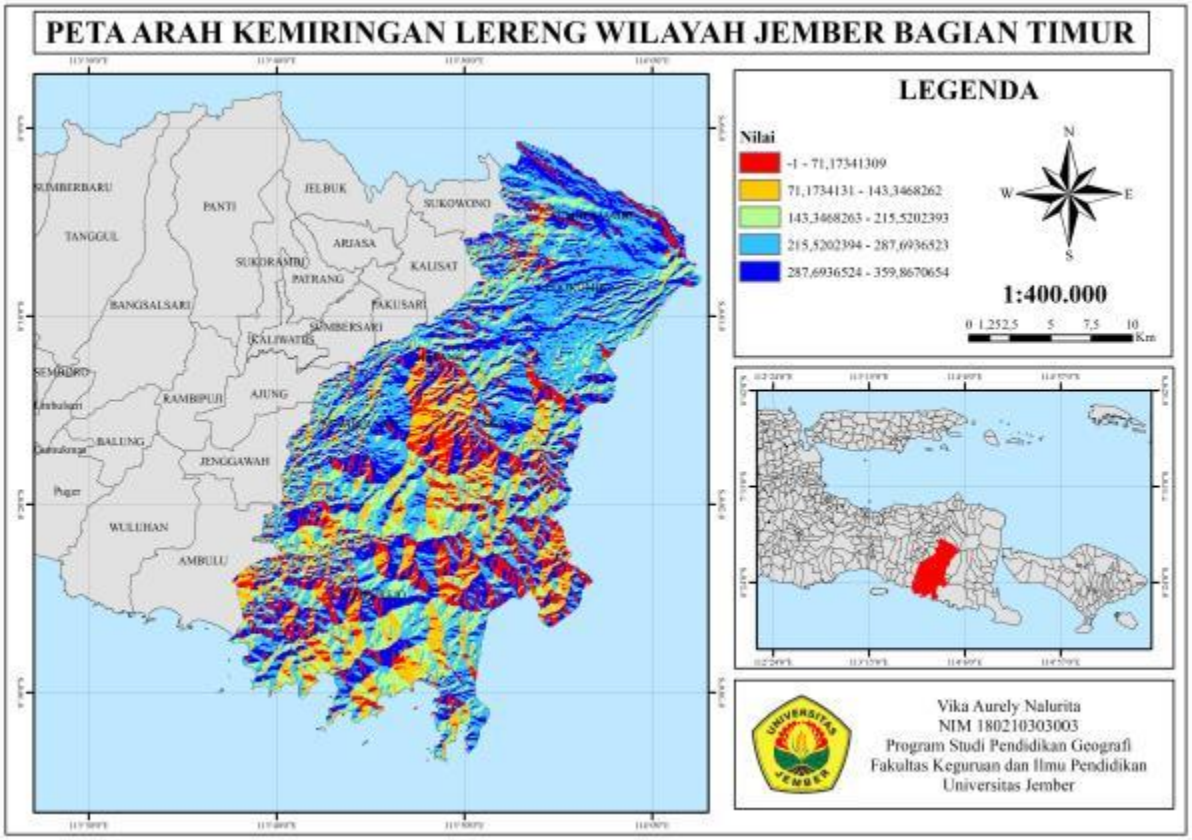

Figure 5. Map of the Slope Direction of the East Jember Region

3.5 Effect of Relief on Potential Floods and Landslides

In the Brazilian region, landslides have often been found which are influenced by the large number of highlands, especially in the state of Rio de Janeiro in 2011 which caused landslides and floods which caused 90 deaths and caused around 35,000 people. lost his home.(Fiorillo, Diodato, Meo, & Pagnozzi, 2018)In contrast to the upper reaches, signs of lower flood levels, higher river cross-sectional width with depth, and a well-developed floodplain were observed in the lower valley between 1710 and 780 m elevation. However, high flood levels can still be achieved in the middle of certain short river sections with

narrow gorges, as the river reaches the upper part of the Dhoban settlement just downstream in a meandering pattern.(Tombrink, 2017)

Analysis of the area of Jember Regency using Hilshade results in various reliefs ranging from reliefs with rough surfaces indicating steep areas, while smooth reliefs indicating flat areas. In the eastern part of Jember, more precisely, the Sumberjambe and Ledokombo areas are also classified as steep areas because the eastern part of Jember is part of the foothills of the Raung mountains so that the area is still included in the category of steep areas.

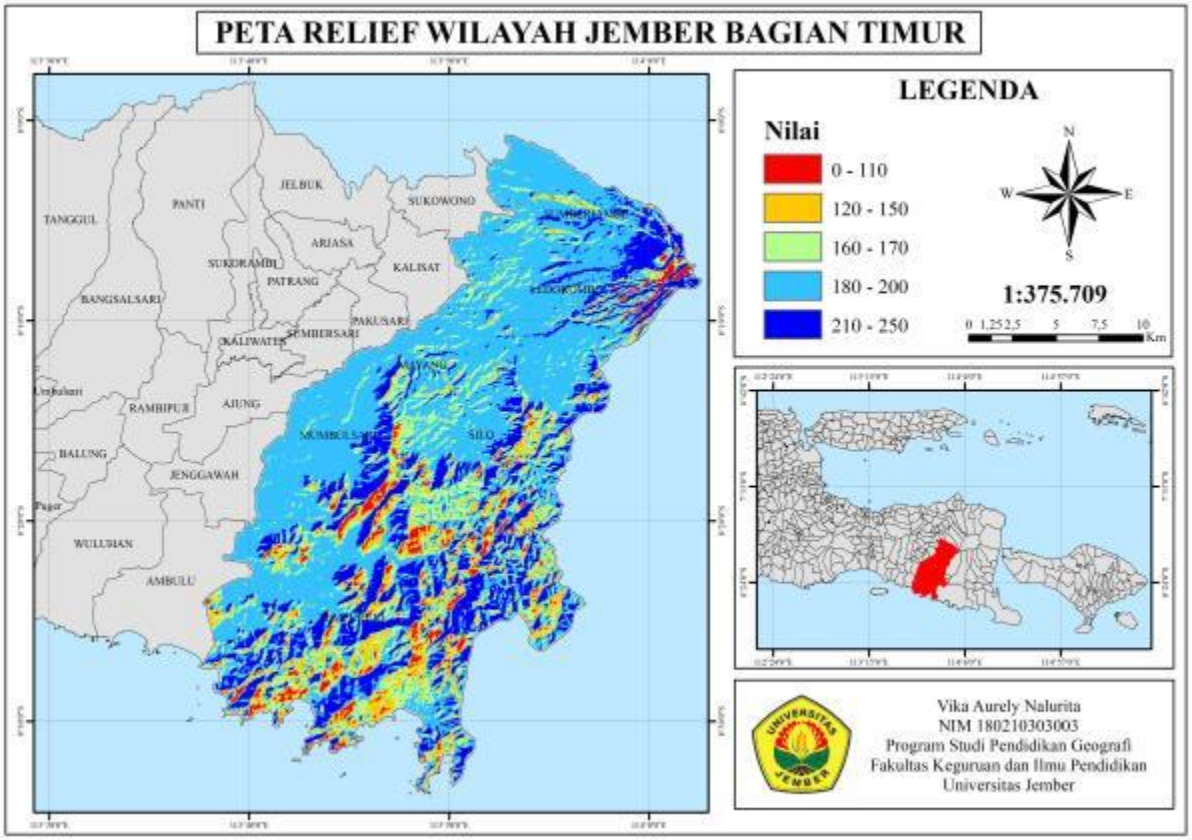

Figure 6. Relief Map of the East Jember Region

3.6 The Effect of Geology on Potential Floods and Landslides

Java Island has a volcanic structure with a high density, resulting in fertile soil and productive agricultural land, especially in volcanic areas. However, landslides often disturb the agricultural land. For example, landslides pose a threat to the Cleft Quaternary volcanic system and the Menoreh Tertiary volcanic-structural system, where the agricultural sector in the region serves as the main livelihood for civil society and supports national food security.(Noviyanto, Sartohadi, & Purwanto, 2020) In general, geological factors greatly influence the occurrence of landslides, because variations in lithology and structure and soil texture often cause differences in the strength and permeability of rocks and soil.(Abdallah &

Faour, 2017). Soil type affects the results of rainfall runoff and meeting processes, and the standard of soil texture classification.(Y. Liu, Yang, Huang, & Liu, 2018) Worldwide, it is stated that volcanic areas that have experienced weathering and the presence of sediments caused by volcanic activity are classified as high risk in triggering landslides, so it has been determined that geological conditions in an area are the biggest driving factor for landslides.(Legorreta Paulín et al., 2014)It has been proven that the Honduran capital, Tegucigalpa, experiences destructive landslides every year. During the rainy season, damage to infrastructure as well as injuries, fatalities. One of the reasons behind this is the existence of critical soil conditions, Central America has ideal geological and climatic conditions and has also been indicated by the geological unit that urban areas have experienced moderate levels of weathering and many of them are very vulnerable, so that the presence of These factors are capable of causing landslide potential in the area.(Garcia-Urquia & Axelsson, 2014)

Landslides commonly occur in mountainous and hilly areas with thick soil or weathered rock, and in volcanic landscapes in the humid tropics. Landslides in volcanic landscapes occur due to the weakening of mountain topography due to volcanic parent rocks exposed to hydrothermal alteration processes.(Noviyanto et al., 2020)

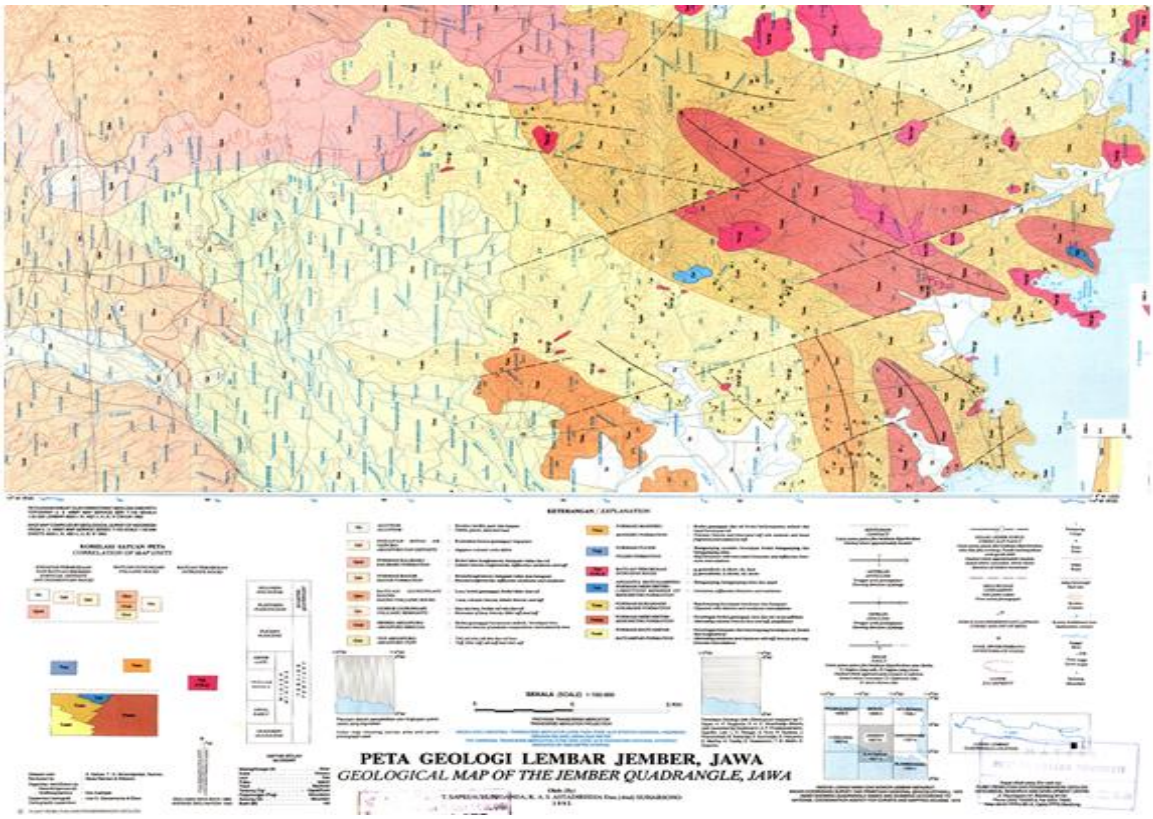

Figure 7. Geological Map of Jember

4. Conclusion

Natural phenomena of floods and landslides are natural disasters that often occur in every region, in the eastern part of Jember including areas that are prone to the occurrence of these phenomena where natural disasters are influenced by various natural factors such as the level of slope, the height of a blood, geology, land use, feeling, contour, and slope direction where these parameters play a major role in the potential for flooding and landslides. It is necessary to analyze the influence of natural factors on the potential for floods and landslides in order to determine the factors that play a dominant role in the occurrence of potential floods and landslides so as to minimize the negative impact on the area.

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