SPATIAL ANALYSIS OF LANDSLIDE HAZARD POTENTIAL FOR DISASTER MITIGATION-BASED SPATIAL PLANNING IN THE CITY OF SABANG

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Abstract

The geology and topography of Sabang City has the characteristics of areas that have the potential for landslides. This study analyzes the potential for landslide hazard to spatial planning as a disaster mitigation effort. Identification of potential landslide hazards using a geographic information system (GIS), based on the assessment and weighting of the factors that cause and trigger landslides. The results of the analysis of the level of landslide hazard potential are prepared by a landslide hazard map based on the influence of each parameter that causes landslides. The results of the analysis show that the area with a high landslide hazard potential of 8.98% or 1,114.60 Ha in Suka Jaya District. The area of moderate landslide hazard potential is 85.73% or 10,639.88 Ha covering Suka Jaya and Suka Karya Districts. The results of a comparison of high landslide hazard potential with spatial patterns show that high landslide hazard potential is found in spatial patterns of dense settlements of 23%. Mixed plantation area 13%, protected forest 12%, tourist area 12%, residential area 11%, industrial area 7%. The results of the research are expected to be taken into consideration in the spatial planning of Sabang City, to apply the Regulation of the Minister of Public Works Number 22/PRT/M/2007 concerning Guidelines for Spatial Planning for Landslide Disaster Areas in Areas with High potential for landslide hazard. industrial area 7%. The results of the research are expected to be taken into consideration in the spatial planning of Sabang City, to apply the Regulation of the Minister of Public Works Number 22/PRT/M/2007 concerning Guidelines for Spatial Planning for Landslide Disaster Areas in Areas with High potential for landslide hazard. industrial area 7%. The results of the research are expected to be taken into consideration in the spatial planning of Sabang City, to apply the Regulation of the Minister of Public Works Number 22/PRT/M/2007 concerning Guidelines for Spatial Planning for Landslide Disaster Areas in Areas with High potential for landslide hazard.

Keywords : Landslide, Hazard, Geographic Information System, Spatial Planning.

1. INTRODUCTION

Landslides are one of the disasters that often occur in Indonesia, especially in hilly and mountainous areas (Leulalem Shano, et al, 2020). This landslide-prone area is along Bukit Barisan, Aceh to Lampung. Floods, landslides and tornadoes still dominate disaster events in Indonesia from 2009 to 2019. During the January - June period in 2020 the number of natural disasters that occurred in Aceh was 505 disasters, the intensity of landslides was also still high, with 36 incidents recorded with total predicted loss of IDR 1,120,000,000. (bpba.acehprov.go.id). Report of the Regional Disaster Management Agency (BPBD) of Sabang City, in 2018 there were 5 landslides in two sub-districts in Sabang City (Sabang City in figures, 2019). The landslide incident that occurred on the Gampong Iboih crossroad leading to Gampong Batee Shok, Sukajaya District on December 18 2018, the landslide which was triggered by heavy rain had cut off access to the Iboih - Kota cross road or vice versa, due to landslide material in the form of large boulders covering the road. The causeway is access to get to the location of the Iboih beach tourist attraction.

Landslide events are the movement of soil or rock masses caused by disturbances of slope stability (ASM mean Kamal, et al, 2021). There are two important factors that trigger landslides,

namely natural factors such as morphology, geological structure, land use, soil type, geological structure, climatology (rainfall) and seismicity (Rohan Kumar, et al, 2015). The Ministry of Energy and Mineral Resources (2018) explains the main factors that cause landslides, namely: steep slopes, less dense and thick soil, high rainfall, type of land use, vibration, stockpiled material on cliffs, old landslide marks, deforestation forests, and landfill areas. Uncontrolled land use change caused by an increasing population resulting in land development for residential, economic and infrastructure activities can increase the risk of landslides. (Priyono & Priyana, 2006). The city of Sabang consists of five islands, namely Weh Island (Sabang), Rondo Island, Rubiah Island, Seulako Island and Klah Island. The geological condition of Sabang City is that almost all of its land (ie 98.6%) is in the form of rock, both volcanic rock and alluvial rock, with mountainous and hilly topographic contours with steep slopes. This condition causes the City of Sabang to have the potential for landslides. namely Weh Island (Sabang), Rondo Island, Rubiah Island, Seulako Island and Klah Island. The geological condition of Sabang City is that almost all of its land (ie 98.6%) is in the form of rock, both volcanic rock and alluvial rock, with mountainous and hilly topographic contours with steep slopes. This condition causes the City of Sabang to have the potential for landslides. namely Weh Island (Sabang), Rondo Island, Rubiah Island, Seulako Island and Klah Island. The geological condition of Sabang City is that almost all of its land (ie 98.6%) is in the form of rock, both volcanic rock and alluvial rock, with mountainous and hilly topographic contours with steep slopes. This condition causes the City of Sabang to have the potential for landslides.

Some studies that have been carried out are to determine the level of vulnerability of landslides and the main factors that cause landslides. One of the studies that analyzed landslide vulnerability as a basis for mitigation in Banjarnegara Regency (Susanti, et al 2017). In her research, Susanti, et al., (2017) attempted to determine the level of vulnerability of landslides in Banjarnegara by using the overlay method of predetermined parameters and weighting. The overlay results show 5 classes of landslide susceptibility, as well as the dominant parameters that affect landslides.

Mustafa, et al., (2019) conducted another study with different locations in Southeast Aceh District, (2019) with the aim of knowing the main factors causing the greatest landslide vulnerability using the AHP method and knowing the distribution of landslide vulnerability in Southeast Aceh with spatial modeling using a geographic information system. (GIS). This research has resulted in a spatial distribution of landslide susceptibility with a distribution of low vulnerability levels of 49%, medium vulnerability of 37% and high vulnerability of 13%.

In article 2 of the General Provisions of government regulation in lieu of law (PERPU) No 2 of 2000 concerning the Free Trade Area and Free Port of Sabang, it is stated that activities for the development of the economic sector such as trade, services, industry, mining and energy, transportation, maritime and fisheries , telecommunications, insurance banking, tourism and other fields. The development of the Sabang Free Trade Area must be supported by spatial planning based on data and information on the use of areas with the potential for landslides as an effort to mitigate the impact of future disasters.

To realize spatial planning plans for provincial and district/city areas that can provide protection to the public from the threat of landslides, the government through the Minister of Public Works issued guidelines for spatial planning for landslide-prone areas in the form of Regulation of the Minister of Public Works Number: 22/PRT/M/2007. The scope of this Ministerial Regulation includes arrangements regarding spatial planning, spatial utilization, control of spatial use, and management of spatial planning in areas prone to landslides.

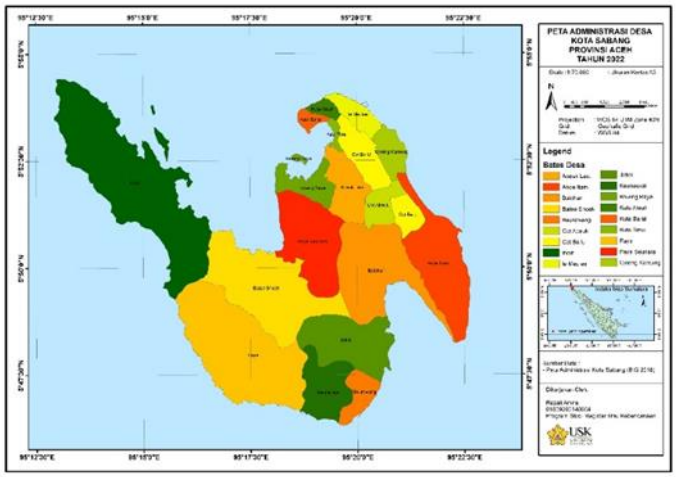
Identification of areas that have the potential for landslides with wide area coverage can be carried out using a Geographic Information System (GIS), which is a spatial study technique that is widely used today to analyze natural disasters and also other analyzes related to space

(KrzysztofGaidzik, et al, 2020). The development of GIS can provide accurate geospatial data information and explain accurate analysis systems. So that there are mitigation efforts to prevent risks that have the potential to become disasters or minimize losses from disasters that occur (Faizana, Nugraha, & Yuwono, 2015).

Government Regulation No. 21 of 2008 article 15, research activities regarding the spatial study of the potential for landslide hazard in Sabang City are intended as one of the preparedness activities to reduce the risk of impacts that will be caused by landslides on the community or other public facilities located in areas with the potential for landslides. To meet the information needs of landslide potential, it is necessary to carry out a spatial study to map areas that have the potential for landslide hazard for spatial planning of landslide prone areas. Inappropriate land use and increased land use change as a result of increasing population has resulted in a high hazard in the landslide disaster area.

2. RESEARCH METHOD

This research was conducted in Sabang City which is located in the western part of Aceh Province, has a land area of 12,213.97 hectares, which consists of two sub-districts with 18 gampongs. Astronomically, Sabang City is located between 05°46'28" - 05°54'28" North Latitude and 95°13'13'02", 95°22'36" East Longitude. Based on geographical position, Sabang City has boundaries: North – Malacca Strait, Andaman Sea; South – Indian Ocean; West - Indian Ocean; East – Malacca Strait.



Picture 1 Research Location Map

Spatial analysis of landslide hazard potential for disaster mitigation-based spatial planning in Sabang City is carried out using the spatial data overlay method, in the form of vector data in geographic information systems. This overlay aims to produce a map that has information from combining several maps, then it is analyzed to obtain new information for the classifier at the weighting and scoring stages. The potential landslide hazard value/index in an area is obtained from the classification results in each landslide potential area for each of its constituent parameters (Tilahun Mersha, et al, 2020). The index value will have a unique value to be represented using the GIS application which can then be analyzed to determine the spatial distribution and distribution of potential landslide hazards. Based on the landslide susceptibility formula (Paimin et.al., 2006), the parameters used to determine the level of landslide vulnerability are natural factors that make up the formula, namely cumulative daily rain for 3 consecutive days (25%), land slopes (15%) , geology/rock (10%), presence of faults/faults/scarf (5%), soil depth to impermeable layer (5%); while management factors include land use (20%), infrastructure (15%), and residential density (5%).

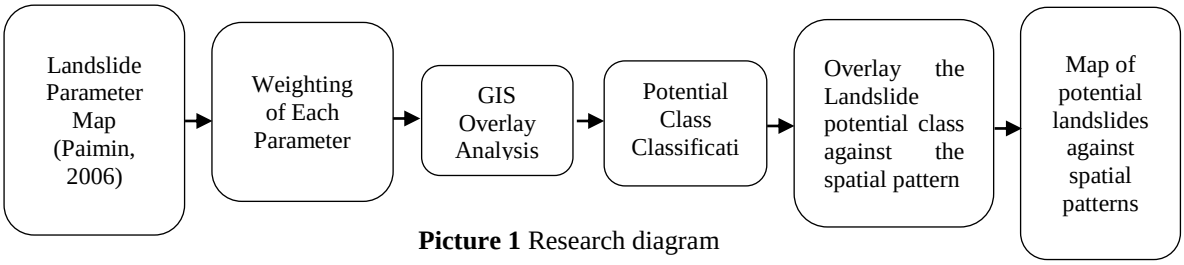
The results of the sum of all the parameters that cause landslides are classified according to the total score obtained so that the category/level of landslide vulnerability in Sabang City is obtained based on Table 1.

Table 1 Landslide Potential Class and Category

No	Class/Category	Mark	Weight (100%)	Score
1.	Tall	3	100	1.0000
2.	Currently	2		0.6666
3.	Low	1		0.3333

Source: Perka BNPB. No. 2 of 2012

Based on the parameter map in Table 1, the landslide hazard areas can be determined. All of these parameters are classified based on scores and then weighted according to their respective contributions and then the data is analyzed. Based on the results of the analysis of 7 parameters of landslide hazard in Perka BNPB Number 2 of 2012, 3 criteria for landslide vulnerability were obtained, namely High, Medium and Low. To analyze the results of mapping the landslide hazard locations, an overlay was then carried out between the 2012 – 2032 RTRW map of Sabang City and the landslide hazard map. Figure 2 shows the flowchart of this study.



Picture 1 Research diagram

3. RESEARCH RESULTSANDDISCUSSION

3.1 Rainfall Factor

One of the parameters for estimating the cause of landslides is rainfall. The City of Sabang has one rainfall measuring station, namely, Maimunsaleh Station with a high rainfall rate of 360 mm/year. This value is obtained based on rainfall data for the last 10 years and is selected from the cumulative rainfall of three consecutive days. The auxiliary station's rainfall data is taken from satellite data, by making two auxiliary rainfall station points. The rainfall rate in Sabang City can be seen in the table. Based on the table it is known that rainfall is relatively higher covering the areas of Gampong Iboih, Anoe Itam, Batee Shoek, Paya Seunara, Aneuk Laot, Cot Bak U with rainfall values between 260 – 360 mm/year with scores given 4 and 5.

Table 2 Rainfall Rate of Sabang City

No.	**Rainfall (mm/yr)**	**Score**	**Area (ha)**	**Wide (%)**
1.	360	5	7180.47	59,62
2.	300	4	1983,7	16,47
3.	315	2	1721.52	14,29
4.	260	2	1158.91	9,62
	Amount		12044.60	100

Source: BMKG Rainfall Data

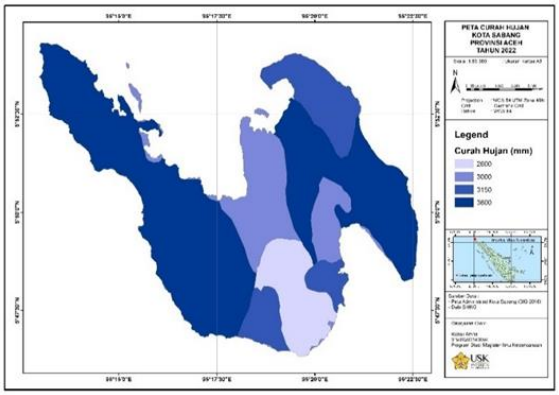


Figure 2 Rainfall Map of Sabang City

3.2 Slope Factor

The slope of the slope is the factor that most influences the occurrence of landslides in an area. The slope of the slope in the study is secondary data obtained from DEMNAS data processing. The city of Sabang has different topography/slope slopes, areas with hilly contours have a high degree of slope with the most dominant slope being 26-44% with an area of 4,651 ha.

Table 3 Slope Level of Sabang City

No.	Slope Percentage (%)	Score	Area (ha)	Wide (%)
1.	>85	5	636	5,23
2.	65-85	4	1877	15,42
3.	45-64	3	3,420	28,10
4.	26-44	2	4,651	38,21
5.	<25	1	1,587	13.04
	Amount		12044.60	100

Slope data is divided into five classes based on the slope level, namely, flat, sloping, rather steep, steep and very steep as shown in the table. Landslide events in general are strongly influenced by steep slopes with a high percentage of slope which can result in landslides. This is in accordance with the opinion of Sumiyatinah and Yohanes (2000), who state that landslides can generally occur on slopes. The higher the slope of the land, the greater the potential for landslides.

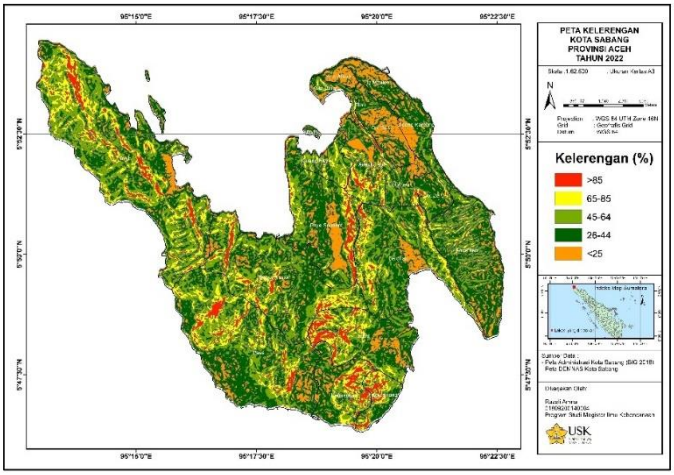


Figure 3 Slope Map of Sabang City

Based on the data in the table above, it shows that areas with topographical conditions <25% have an area of 1587ha or 13%. Meanwhile, an area with a slope > 85% has an area of 636 ha or 5.23%. In general, the area of Sabang City is dominated by the slope class of 26 – 44% with an area of 4,651 or 38.21%.

3.3 Land Cover Factors

Land cover factors have an influence on the causes of landslides. Land cover that occurs in Sabang City is influenced by natural factors and non-natural factors caused by human activities. Naturally, the factors that affect land use in Sabang City include slope, soil type, rainfall, groundwater content and so on, while non-natural factors that affect land use are activities that occur in the community, livelihoods, population and population distribution. Currently, land use in the City of Sabang can be broadly classified into built-up land and non-built-up land. Undeveloped land includes shrubs, natural forest and plantation forest. Built-up land includes residential land, urban facilities and infrastructure and buildings.

Table 4 Sabang City Land Cover Level

No.	Land Closure	Score	Area (ha)	Wide (%)
1.	Rice fields/Settlements	5	730.52	5.96
2.	Moor/Field	4	200.4	1.64
3.	Forest/Plantation	3	6595,14	53.85
4.	Natural Forest	2	3781.5	30.88
5.	Shrubs/Grass	1	939.3	7,67
	Amount		12044.60	100

The table of results of analysis of land use data in Sabang City shows that land use for cultivation is larger than land use for protection functions. Land use for cultivation areas includes land use for settlements, rice fields, buildings, fields, gardens, identified fields with a percentage of 61.45% which is dominated by plantation land use, settlements and rice fields, overall land use for cultivation areas in Sabang City reaches 7,526 .06 ha, of the total area of Sabang City. The grouping results for each land use are; Paddy fields/settlements were 5.96% with an area of 730.52 ha, use of dry land/fields of 1.64% with 200.4 ha, use of plantation land of 53.85% with an area of 6,595.14 ha. While the land cover for protective functions is still mostly natural forest of 30.88% covering an area of 3,781.5 ha and also shrubs or grass of 7.61% with an area of 939.3 ha. The land cover map can be seen in the figure.

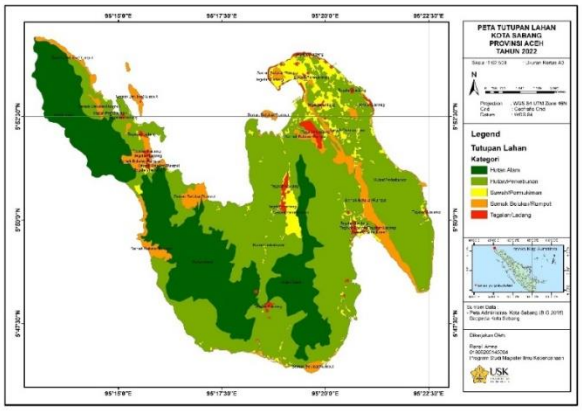


Figure 4 Land Cover Map of Sabang City

3.4 F Soil type actor

The classification of soil type parameters in the city of Sabang used to become secondary data from the Janis soil map with a scale of 1; 250,000 obtained from the ministry of agriculture in 2018. The scale of this soil type map is very small so the level of accuracy of data and information about soil types is still very general. . Based on the image of the soil type map for the City of Sabang, there are 4 types of soil in the area and the area of each type of soil is stated in table 4.4.

Table 5 Soil Type in Sabang City

No.	Type of soil		Wide (Ha)	Wide (%)
1.	Grumosol		2,695	22%
2.	Andosol		4,857	40%
3.	Litosol		880.3	7.2%
4.	Podzolic		3,607	29%
	Amount		12044.60	100

Based on Table 5, it shows that the soil types in Sabang City have a wide variety of soil types, which are dominated by Andosol soil types with the largest percentage, namely 40%, which are spread over the Suka Jaya and Suka Karya sub-districts, including Gampong Krueng Raya, Balohan, Keuneukai, Batee Shoek and Jaboi with an area of 4,857 ha. For the Grumosul soil type, 22% is found in the village of Iboih with an area of 2,695 ha.

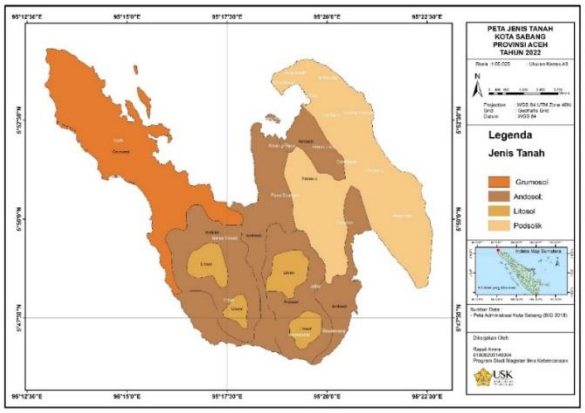


Figure 5 Map of Soil Types of Sabang City

For podzolic soil types, they are found in the Ujung Kareung, Anoe Itam, Balohan, Ie Meulee and Kuta Ateuh areas with a total of 29% with an area of 3,607 ha. The map of soil types in Sabang City can be seen in Figure 6.

3.5 Geological Factors/Rock Type

Geological factors or rock types in an area are also a cause of landslides. In general, the types of constituent rocks in Sabang City consist of three types, namely Sedimentary Rocks, Alluvial Plains and limestone hills. The limestone hills are composed of Iboih Lava, Kulam Lava. Labu Ba'U Lava, Leumo Mate Lava, Pawang Lava, Semeureugoh Lava, Weh Lava, Pyroplastic Kulam and Piru Plastik Weh, these limestone hills cover almost the entire city of Sabang or by 80%.

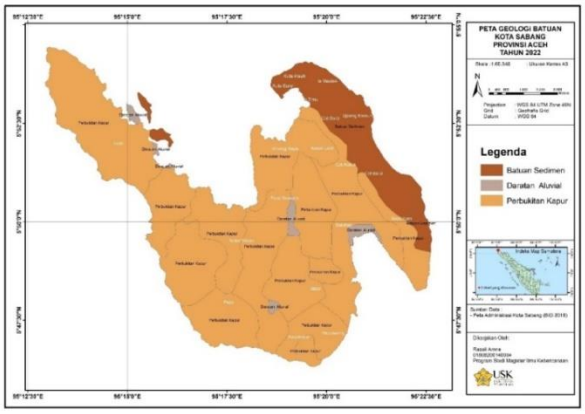


Figure 6 Rock Geology Map of Sabang City

In addition, the City of Sabang is composed of 2% alluvial rock types or alluvial land or an area of 210.49 ha. Sedimentary rock consisting of tuffaceous sandstone and reef limestone by 10% with an area of 1,711.39ha, covering the areas of Anoe Itam, Cot bak U, Ujong Kareung, Ie Meule and Kuta Ateu. Figure 7 shows a map of the distribution of rock types in Sabang City.

3.6 Settlement Factor

Other factors that cause potential landslide hazards are settlements, the area of settlements and the distribution of population are factors that will affect the level of susceptibility of an area to landslide hazards. Based on the report from the Sabang City Statistics Center, the population distribution in Sabang City is <2500/Km, this indicates that the settlement factor has a low score or 1 on the effect of the level of landslide vulnerability. The map of settlement distribution in Sabang City can be seen in Figure 4.6.

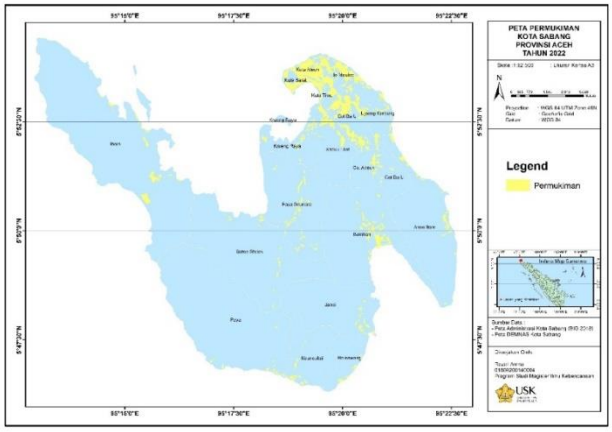


Figure 8 Sabang City Residential Map

3.7 Infrastructure Factor

The existence of infrastructure development in an area has the potential to cause disturbances to the soil structure. One of the factors causing landslides is the disruption or cutting of slopes caused by infrastructure development such as roads and bridges. Road construction in the city of Sabang in many places where slopes are cut, this can be one of the factors causing landslides along roads that cut the slopes. The distribution of road construction infrastructure that cuts the slopes in the City of Sabang can be seen in Figure 9.

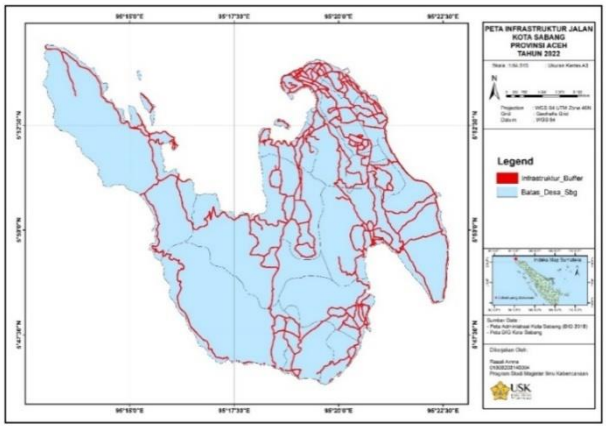


Figure 9 Road Infrastructure Map of Sabang City

3.8 Making a Landslide Potential Map

In order to get a map of the potential level of landslide hazard in Sabang City, an overlay is performed which functions to combine the parameter maps that cause landslides and produce a map of landslide potential. Overlay is done by adding up the rainfall map, slope, land use, soil type, geology, population density/settlements and infrastructure. Based on the landslide susceptibility formula (Paimin et.al., 2006) the parameters used to determine landslide susceptibility are rainfall (25%), gelology/rock (10%), presence of faults (5%) soil layer/soil type (5 %), slope (15%) as a natural factor. While management factors include land use (20%), infrastructure (15%) and settlement density (5%).

Table 6 Landslide Potential Class and Category

No	Class/Category	Mark	Weight (100%)	Score
1.	Tall	3	100	1.0000
2.	Currently	2		0.6666
3.	Low	1		0.3333

Source; Perka BNPB. No. 2 of 2012

Based on the map parameters above, landslide prone areas can be determined. All of these parameters are classified based on scores and then weighted according to their respective contributions and then the data is analyzed. Based on the results of the analysis of 7 parameters of landslide vulnerability based on Perka BNPB Number 2 of 2012, 3 criteria for landslide vulnerability were obtained, namely High, Medium and Low. In accordance with Paimin's opinion, the rainfall factor is the factor with the greatest weight to the occurrence of landslides when compared to other factors, such as soil type, land slope and land cover type. The results of the analysis of the total score are the sum of each parameter which is the factor that triggers the occurrence of landslides in the research location, a classification or category of potential landslides for each class will be obtained which has been determined based on the weighting of each parameter. After an analysis was carried out to obtain a classification of the landslide hazard map in the study area, a map of the potential for landslides in Sabang City was obtained as shown in Figure 10.

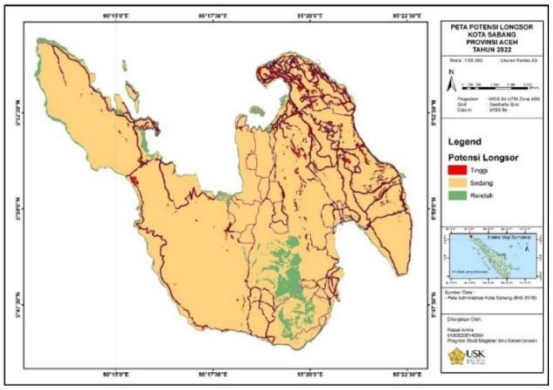


Figure 10 Landslide Potential Map of Sabang City

Based on the map of the level of vulnerability of landslides in Sabang City, it is known that the research area has the potential for landslides which are dominated by moderate to high levels of vulnerability. This correlates with rainfall and the slope of the slopes in several areas of Sabang City and the types of rock that are dominated by volcanic and sedimentary rocks, of course these two rocks are easily eroded. Table 6 below describes the area of each class of landslide potential at the Sabang City location.

Table 7 Class of Potential Landslide Disaster in Sabang City

Class	Area (ha)	Percentage (%)
Low	656,13	5,29
Currently	10,639.88	85,73
Tall	1114.60	8.98
Total	**12,410.62**	

Based on the table above, it can be seen that the City of Sabang has moderate potential for landslides to occur. The potential for landslides with a high class has a total area of 1,114 ha. For potential landslides, the medium class has an area of 10,639 ha and for low potential, it has the smallest area, namely 656.13 ha. The difference in the area of areas that have the potential for landslides in Sabang City is influenced by several parameters used, namely the parameters of rainfall, slope, soil type, land use, geological infrastructure/settlements and the presence of faults. The influence of each parameter for each area in Sabang City is different, but in general landslides in Sabang City are influenced by rainfall intensity, in areas with steep slopes.

Table 8 Wide Distribution and Potential Landslide Hazards in Sabang City

No	Subdistrict	Class	Area (ha)	Percentage (%)
1	Like Jaya	Low	427.96	6,38
2		Currentl y	5,612.94	83,70
3		Tall	664.96	9,92
Sub Total Like Jaya			***6705.85***	***54.03***
4	Like Work	Low	228,17	4.00
5		Currentl y	5026.95	88,12
6		Tall	449,64	7.88

Sub Total Like Work	***5,704.76***	***45.97***
Total	**12,410.62**	

3.9 Spatial Pattern Analysis of Landslide Potential

The distribution of landslide hazard potential in Sabang City consists of low, medium and high, the potential for landslides is spread throughout the City of Sabang. Based on the results of data processing that has been carried out, Sabang City has a moderate landslide hazard category, with an area of 10,639.88ha or 85.73%, and spread over two sub-districts. The potential for high landslide hazard reaches 1,114.60 ha or 8.98%, the potential for high landslide hazard is also found in two sub-districts in Sabang City. The results of the overlay between the potential landslide hazard map and the spatial pattern map of Sabang City show that the existing spatial pattern development plans are still in areas with high landslide potential, as shown in the following figure;

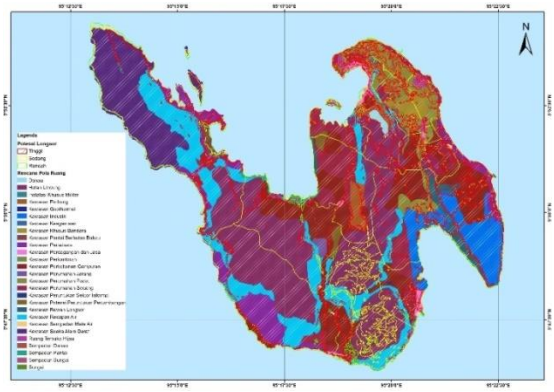


Figure 11 Landslide Potential Distribution Map to Spatial Patterns

Figure 11 shows that each class of landslide potential for the spatial pattern of Sabang City has a different area and percentage. The broad distribution of each class of landslide hazard potential can be seen in Figure 11.

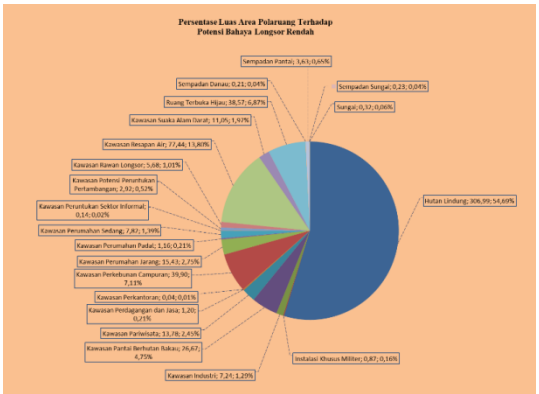


Figure 12 Graph of the percentage of the spatial pattern area against low landslide potential

Figure 12 shows the percentage area of each spatial pattern against low landslide hazard potential. The total percentage of areas with low landslide hazard potential in Sabang City is 5.29%, or 656.13ha, the largest area is in the protected forest spatial pattern of 55%. The second percentage of the area with low landslide potential is found in the spatial pattern of water catchment areas by 14%, and the third percentage is found in the spatial pattern type of mixed plantation area by 7% which is the same as the total percentage in the type of green open space

pattern. The low potential area is found in the spatial pattern of mangrove forested coastal areas. As for other types of spatial patterns, they have an area of between 3% and 2%.

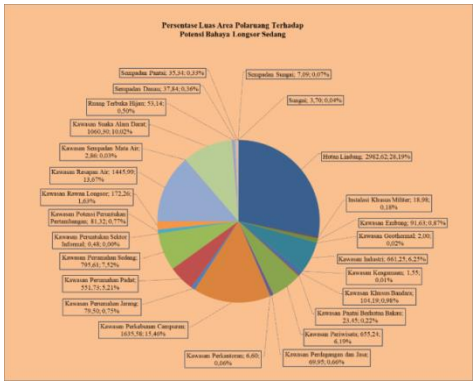


Figure 13 Graph of the percentage area of the spatial pattern against the potential for moderate landslides

Figure 13 shows the percentage of the area of the spatial pattern against the moderate landslide hazard potential. The percentage of area of moderate landslide hazard potential in Sabang City is the widest area, namely 85.73% or 10,639.88 ha. This moderate landslide hazard potential is found in every spatial pattern in the spatial planning of Sabang City. The percentage of moderate landslide hazard potential is found in the protected forest spatial pattern of 28%, mixed plantation area spatial pattern has a moderate landslide hazard potential of 15%, water catchment area is 14%. The residential spatial pattern area has a medium landslide hazard potential of 7%, then the tourism spatial pattern area has a moderate landslide hazard potential area of 6%.

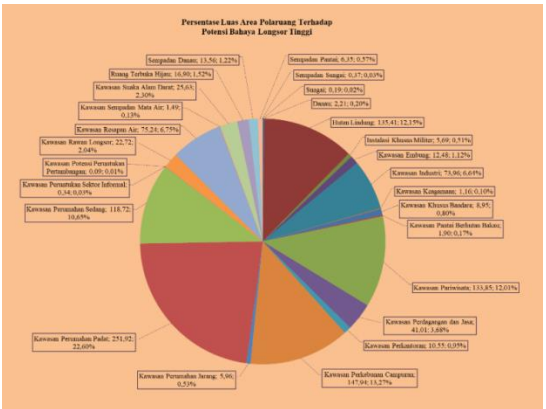


Figure 14 Graph of the percentage of the spatial pattern area against high landslide potential

Figure 14 shows the percentage of the spatial pattern area against the class of high landslide hazard potential in Sabang City. The total percentage of the area of Sabang City that has a high landslide potential is 1,114 ha or 8.9%, and most of it is in the Suka Jaya sub-district. Based on the results of the overlap between the spatial pattern map and the landslide hazard potential, the result is that the largest percentage of high landslide hazard potential is in the spatial pattern of dense housing areas, namely 23%. Mixed plantation area 13%, protected forest 12%, tourism area 12%, residential area 11%, industrial area 7% and water catchment area 7%. As for other types of spatial patterns, it ranges from 0.01% to 2%.

4. CONCLUSION

Based on the results of the research that has been done, it can be concluded that Sabang City can be categorized as an area with moderate landslide hazard potential with a percentage of 85.7% or 10,639.88 ha, 8.98% or 1,114.60 ha with high potential and 5.29% or 656 ,13ha has low potential. The wide distribution of potential landslide hazard areas to the types of spatial patterns that exist shows that most residential areas in Sabang City have the potential for landslides as well as tourism areas. The results of overlaying the landslide hazard potential map with spatial patterns show that the spatial pattern of dense residential areas, medium residential areas and tourism areas are in areas with high landslide hazard potential. Government attention and synergy with the community are needed in efforts to mitigate disasters, especially around areas that have a high level of landslide hazard potential. The development and development of the City of Sabang must consider the potential for landslide hazard, by applying the mechanism for developing areas that have the potential for landslides in accordance with Regulation of the Minister of Public Works No. 22/PRT/M/2007 concerning Guidelines for Spatial Planning for Landslide Disaster Areas.

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