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TYPOLOGY OF SPATIAL BASED LANDSLIDE DISASTER CONTROL IN PAREPARE CITY SOUTH SULAWESI

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ABSTRACT

Typology of spatial based landslide disaster management in the context of regional planning needs to be assessed and considered, especially in the City of Parepare. The city of Parepare, which is a strategic area in the province of South Sulawesi, occupies most of the hilly area and has a physical condition of the area that is vulnerable to geological disasters, with the limitation of research on landslides. The physical conditions are: the level of land use change is relatively high, physiographic aspects, hydrogeology, and geological conditions. In addition, the local government has not paid attention to this aspect seriously. This condition is the background for the need for an analysis of landslide geological disaster management in the framework of regional planning.

This study aims to determine the form of landslide control, as a basis for direction in regional planning and spatial use. The objectives of this research are: analyzing the level of hazard, vulnerability and risk of geological disasters, land use analysis in *spatial planning in relation to geological disaster management, and the formation of typology of geological disasters, as a basis for recommendations on the physical form of handling of geological disasters especially landslides in the City of Parepare.*

This study examines the level of hazard, vulnerability, capacity and risk, and the determination of geological disaster typologies using spatial-based analysis methods with GIS tools. Furthermore, determining the typology of geological disasters, by overlaying the analysis of the level of risk hazard with the spatial pattern plan contained in the Parepare City *Regional Spatial Plan 2012. From the results of the analysis obtained 11 landslide typologies in Parepare City, which will be used as a basis for preparing physical countermeasures. The final product of this study is expected to be a useful direction for planners and policy makers in regional planning, in preventing preventive and curative measures, in the framework of developing the integrated Parepare City area, and as a direction for the use of the Parepare City area in the micro context as well as macro.*

Key words: Hazard, Vulnerability, Risk, Typology, Landslide

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1. INTRODUCTION

1.1. Background

Parepare City is one of the cities in South Sulawesi Province which is located in the North region. In terms of natural conditions (meteorological and geophysical) and geological conditions, the City of Parepare has the potential to be hit by various threats of disasters, especially geological disasters. Several types of potential geological disasters have been identified based on their history, including landslides. Based on the history of disaster events and the conditions of the regional landscape, Landslides are geological disasters that often hit South Sulawesi in general, including the City of Parepare and its surroundings.

Based on data from the National Disaster Management Agency (BNPB), there were 850 landslide incidents that were included in the national disaster which spread throughout Indonesia from 2002-2015, including the South Sulawesi Region (BNPB. 2015). In addition, it was also recorded that 85% of the 647 disasters in Indonesia were landslides (WALHI 2003).

On the other hand, disaster management policies in the urban planning of the city of Parepare have not included detailed and systematic geological disaster parameters, especially landslides. This condition is the background for researchers to make an analysis of the Typology of Spatial-Based Landslide Control in the City of Parepare, South Sulawesi Province.

With the various potential geological disasters that exist, the Regional Government of Parepare City needs to increase its disaster management capacity so that the risks that may occur can be reduced. Law No.24 of 2007 on disaster management mandates that all local governments prepare Disaster Management Plans (RPB) including the Regional Government of Parepare City. This is also regulated in Government Regulation no. 21 of 2008 concerning Disaster Management. The typology of spatial-based landslide disaster control in the City of Parepare will be a basis that can be used and integrated in the sustainable development planning process, according to the roles and authorities of each stakeholder.

1.2. Objectives and Goals

This study aims to determine the form of geological landslide disaster control and mitigation, as a basis for direction in area planning for spatial use. The objectives of this research include;

- Analyze the level of hazard, vulnerability, capacity and risk of landslide geological disasters in the City of Parepare
- Analyzing landuse in regional spatial planning for geological landslide disaster control and mitigation in the City of Parepare.
- Creating a geological landslide disaster management typology, as a basis for recommendations on the form of disaster control and management in the City of Parepare.

1.3. Significance of Research

The final product of this research is expected to be an input for planners and policy makers. The benefits of this research are expected to be:

- Input for the basis of sectoral policies for handling and controlling landslide geological disasters, both preventive and curative in various types of land use in the City of Parepare
- Recommendations for regional/city governments in an integrated manner in controlling the implementation of sustainable development
- Recommendations for spatial use of the City of Parepare in a micro and macro context.

1.4. Research Site

The research is located in Parepare, South Sulawesi. About 154 km to the north of Makassar. Parepare is located between 3º57'39"-4º04'49" South Latitude and 119º36'24"-119º43'40" East Longitude, bordering Pinrang Regency in the north, Sidrap Regency in the east, Barru Regency in the east south, and the Makassar Strait to the west (Figure 1. Research Location Map). The total area ofParepare is 99.33 km^2; covering 4 sub-districts (Bacukiki, West Bacukiki, Ujung, and Soreang) and 22 villages. Bacukiki sub-district is the widest sub-district with an area of around 66.70 km^2 or 67.15 percent of Parepare [4].

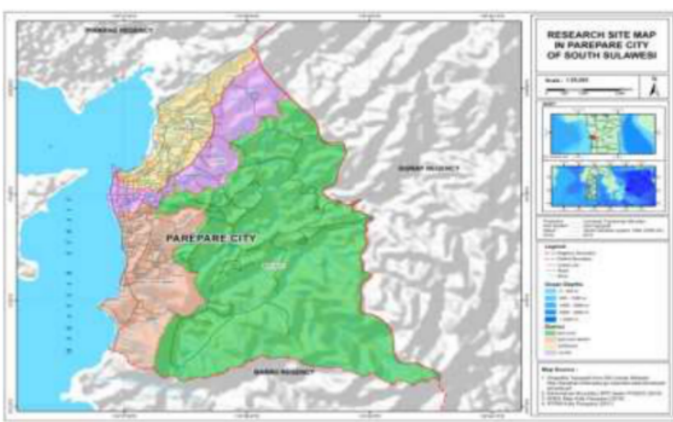

Figure 1. Research Site Map.

2. MATERIALS & EXPERIMENTAL PROCEDURES

2.1. Materials

2.1.1. Definition

The motion of soil/ rock mass is process of moving the slope construction materials which is sliding or falling towards the foot slope due to Earth's gravity control [5]; [6]. According to [7], the term landslide is one of mass or rock mass motion type, or a mixture of both, down or out of a slope due to disruption of soil stability or slope construction materials. According [8]; [9], the slope construction materials which consist of rock exposed to the surface will experience weathering, although it is very slow but greatly affects the rock engineering properties.

The results of soil/ rock mass motions can be divided into controlling factors and motion trigger process. Controlling factors are factors that make the condition of a slope vulnerable or ready to move including morphological conditions, stratigraphy (rock type and its connection with other rocks around it), geological structure, geohydrology and land use. The motion trigger processesare the processes that change a slope from a vulnerable or ready to move condition to a critical condition and finally move. Generally the processes include the process of rain infiltration, earthquake vibrations or vehicles / heavy equipment, as well as human activities that causes the changes in load or land use on the slopes [6]; [10] stated that the motion trigger process of soil/ rock mass are generally factors from outside the slope. [11]; [6] asserted that factors originating from inside the slope, such as weakening rock strength due to weathering, can be a motion trigger process. [12]; [6] explained that the triggering factors of a motion are the process that initiate a motion that is the change in conditions on the slope from the marginal stable (marginally stable) to an unstable.

Landslides often occur in Indonesia resulting in loss of lives and property. For this reason, it is necessary to improve preparedness in facing this type of disaster. Judging from the patterns and characteristics of disasters, taking into account the effectiveness of disaster management plans, landslides are classified into two as follows [3]:

- Slope failure and
- Large-scale landslides, including deep-seatedland slide

Most of the past landslide disasters were slope failures that occured along the road and on land built for housing mainly due to poor excavation and drainage systems. As these landslides caused the road system and human misery, it is important to prepare an accurate and practical hazard map. On the other hand, large-scale landslide occurred mostly in mountainous areas with less population. Landslide hazard map is made with a scale of 1: 50,000. The hazard map is assumed using topographic and geological slopes, and is expected to be improved so that it can present potential landslide hazards in an area.

2.1.2. Landslide Characteristics and Causes

According to the Directorate of Environmental Geology, the land motion that occurs generally is a type of landslide of rubble material, slump, and creep, while the motion of rock collapses is rarely found. Landslides of rubble material move on slide fields that are more or less flat or bumpy ramps. The movingmass is generally out from the original ground level position. Slump moves rotationally on curved upwards slide field. The slump is characterized by a horseshoe shape on the upper slope; land subsidence occured that can turn into a small lake if it contains water, and the upper surface of the land is generally tilted towards the back of the slope; characterized by trees leaning towards the back slope. After the motion occurs, the easing force will be reduced and decreased, causing the motion to stop moving. Rock collapses move more through the air, free fall, jump or roll. Collapse usually occurs on very steep slopes to straight, due to slope cutting, excavation, weathering or abrasion of sea waves, so that the bottom of the slope loses its buffer.

Landslides generally occur through these mechanisms:

- The increasing of force causes motions on the slope, for example due to the absorption of rainwater which triggers an increase in pore pressure rise in the slope,
- The reduction in the retaining force of movement on the slope,
- Combination of both mechanisms.

The landslide-prone areas generally have these following characteristics:

- *Rainfall Level*: High (> 3000 mm/th).
- *Topography*: Slope> 25^{o}In volcanic areas; Slope>15° in sediment areas, clay stone; Rough relief; Old landslidesshaped like horseshoe; and the upstream / water spring areas.
- *Geology*:Smooth tuff rock with thick weathering; sedimentary rock; clay stone; Limestone;and the border area between clay stone and volcanic rock.
- *Geological structure areas (fault, fold, fracture)*: The areas with slope layer in a line with slope; and Unified quarterly sedimentary areas (around active volcanoes).
- *Vegetation*: Areas with dense vegetation, large and tall trees, shallow rooting, and deforestation areas.
- *Human Activities*: Around the excavation/mining areas; Wet agricultural areas; and Areas with active lateral erosion

Landslide Triggers are:

- Continual heavy rain with intensity >100 mm /3 days for volcanic areas;
- Continual heavy rain with intensity > 50 mm/ 3 days in claystone sedimentary rocks areas;
- Earthquake with richter scale > 6;
- Contain water from the channel above the slope; excavations that do not take into account the stability of the slope, at the bottom of the slope; and
- Load addition.

Among those triggers, water isone of the dominant factorwhich can cause landslide to happen. Thereforein identifying landslide prone areas hydrogeological conditions of an area need to be studied, especiallyrelated tosurface water, ground water and spring water.

2.1.3. Disaster Risk Analysis

Disaster Risk ReductionApproach (DRR)is an approachto showthe negative effects caused bydisasterin an exposed area. Negative effectsare calculated based onvulnerability and capacityin the area. Thus negative effects are includedtotal populationand constructionswhich may be affectedand ecomony effectsand areaswhich may be affected by disaster. According to [3], Disaster Risk Reduction Approach (DRR)can be done usingdisaster math approach, as in the following formulation:

Disaster Risk $\approx \boldsymbol{HxV}/\boldsymbol{C}$

Note: DR = Disaster Risk; H = Hazard; V = Vulnerability; C = Capacity

Disaster risk study came from indexand data similar to the one that used to develop disastare risk map. The difference is only in the order of use of each index. This order can be changed because the population cannot be assessed by number. Accordingly, threat level which is included in exposed population index becomes the basis to calculate hazard and capacity level. Hazard level integration and capacity level are disaster risk level.

2.2. Methods

Typology of Spatial-Based Landslide Control in the City of Parepare, is compiled based on a disaster risk assessment, then a typology is determined as the basis for control and mitigation directions. This analysis of landslide risk and typology will be the basis for making policies related to landslide disaster management in the City of Parepare. In making landslide disaster management policies, it is carried out through several processes, including identification, classification, and evaluation of risks used in risk analysis. The process is carried out in the following steps:

- Hazard Assessment; Hazard assessment is defined as a way to understand the elements of threats that pose a risk to the region and society. The types of hazard are different for each region and society. The hazard character assessment is carried out according to the level required by identifying the elements at risk from each threat in a particular location.
- Vulnerability Assessment; Vulnerability assessment can be carried out by analyzing the conditions and characteristics of a community and their activities to determine factors that can reduce the community's ability to deal with disasters. Vulnerability can be determined by assessing the security aspects of the location of their activities or the conditions caused by physical, socio-economic and environmental factors or processes that can increase the vulnerability of a community to threats and impacts of disasters.
- Capacity Assessment; Capacity assessments are carried out by identifying the status of individual, community, government or non-governmental capacity and other factors in dealing with threats with the available resources to take preventive measures, mitigate and prepare for emergency response, as well as address existing vulnerabilities with the capacity of the community.
- Risk Assessment; Risk assessment is the packaging of the results of an assessment of the threat, vulnerability and capacity / resilience of an area to disasters to determine the priority scale of action made in the form of work plans and recommendations to minimize disaster risk.

2.2.1. Geological Disaster Risk Analysis

Disaster risk assessment, produces disaster risk assessment documents and risk maps for each disaster in an area. Disaster risk assessment becomes the basis for regions to formulate disaster management policies. At the community level, the results of the assessment can be used as a basis for disaster risk reduction efforts. The preparation of this risk assessment has 3 component parameters, namely: danger / threat, vulnerability and capacity. From the measurement of this parameter, the level of disaster risk in an area will be obtained, by calculating the potential for exposed lives, property losses and environmental damage.

a. General Term

In the regional disaster risk assessment, 2 outputs will be produced, namely a disaster risk map and a disaster risk assessment document. The results of both studies must meet the following general prerequisites:

- Based on detailed analysis standards (the depth of analysis at the national level at least to the district, the depth of analysis at the provincial level at the minimum to the sub-district, the depth of analysis at the district level at least to the village/sub-distric).
- The minimum map scale is 1: 250,000 for the Regency; maps with a scale of 1: 50,000 for Districts on the islands of Sumatra, Kalimantan and Sulawesi; map with a scale of 1: 25,000 for the Districts on the Island of Java and Nusa Tenggara.
- Able to count the number of people exposed to the disaster (in souls).
- Able to calculate the value of property losses and environmental damage (in rupiah).
- Using 3 classes of risk level intervals, namely the level of high, medium and low risk.
- Using GIS with Grid Analysis (30 x 30 m) in disaster risk mapping.

b. General Method

In general, disaster risk assessment is carried out using the method as shown in the following figure.

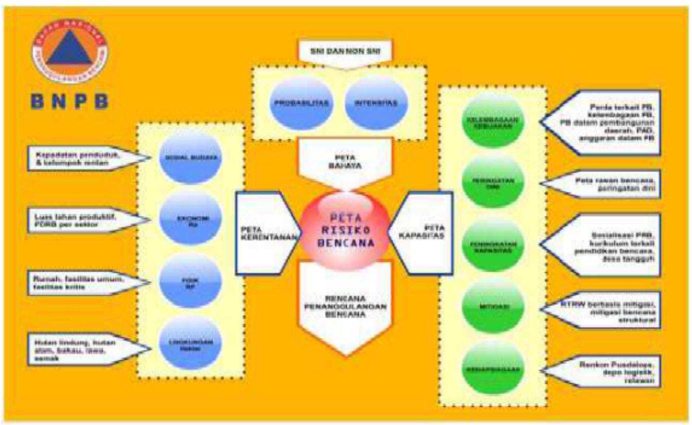

Figure 2 Disaster Risk Analysis Methods (Perka BNPB No. 02 TAHUN 2012).

From the picture above, it can be seen that the result of the disaster risk assessment is a disaster risk map. Furthermore, a disaster risk assessment is made in a document to produce a disaster management policy that is prepared based on the components of the hazard / hazard, vulnerability and capacity parameters. Hazard parameter components are arranged based on parameters of intensity and probability of occurrence. The components of vulnerability parameters are arranged based on socio-cultural, economic, physical and environmental parameters. The components of the capacity parameters are prepared based on the parameters of regulatory capacity, institutions, warning systems, skills training education, mitigation, and preparedness systems.

The mapping method and risk analysis for landslide geological disasters can be seen in figure 3, which shows that Disaster Risk analysis is an overlay of Hazard Maps, Vulnerability Maps and Capacity Maps. The maps are obtained from various indexes calculated from separate data and calculation methods. It is important to know that a Disaster Risk Map is created for each type of disaster threat that exists in an area. The calculation methods and data required to calculate the various indexes will differ for each type of threat.

2.2.2. Typology of Landslide Geological Disaster Control

Typology of Landslide Geological Disaster Control in this study, namely creating a typology of landslide risk, which is the basis for direction in the control plan. The basis of the analysis method carried out is still guided by the Technical Guidelines for the Preparation of Hazard and Disaster Risk Maps for the District / City Level, BNPB and JICA, 2015. As for the methodology flow, the researcher develops an analysis, which aims to create a typology of geological disaster risk based on the Pattern Plan. The space contained in the Parepare City RTRW. It is hoped that the development of the methodology carried out in this research can be a more complementative direction and serve as a guide in the use of space in the City of Parepare.

As explained in the introduction, the limitation of this research is Typology of Spatial Based Landslide Disaster Control. Thus, the analysis method used is to determine the typology of landslide risk, which will be the direction of control and mitigation. As for the analysis method referred to, it can be seen in the following figure.

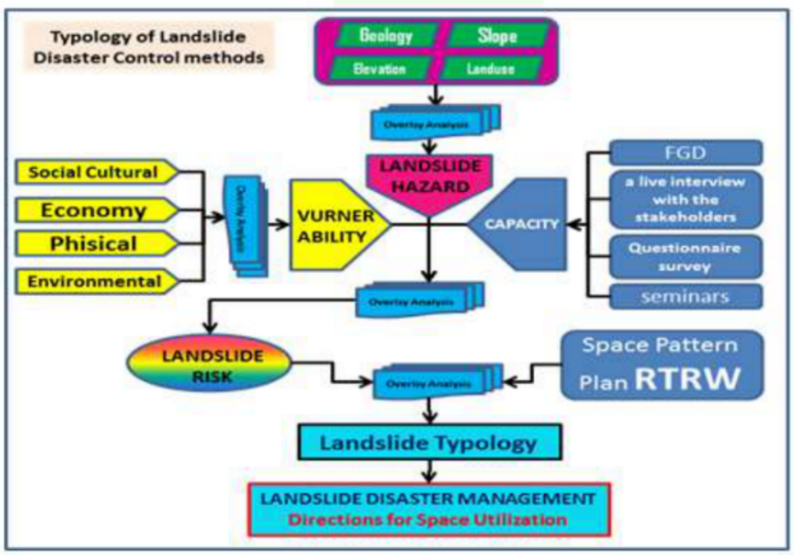

Figure 3 Development of typology methods for landslide disaster control.

3. RESULTS AND DISCUSSION

3.1. Identifying Landslide Hazard Level in Parepare

To obtain the description of landslide hazard level in Parepare, thus this research used some steps which determined geology map, elevation map, slope map, and landuse map. The overlay results of the maps obtained landslide hazard map.

Figure 4. Geology Map of Parepare.

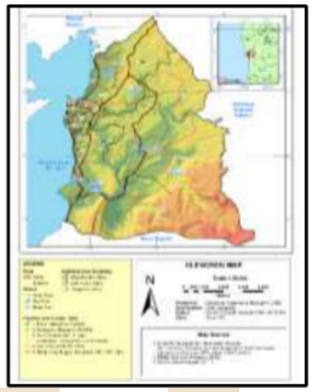

Figure 5. Elevation Map of Parepare.

Figure 6. Slope Map of Parepare.

Figure 7. Landuse Map of Parepare.

Figure 8. Landslide Hazard Map of Parepare.

3.2. Identifying Landslide Vulnerability Level in Parepare

Identifying vulnerability level used population density data from each village, whereas identifying landslide resistance level used quetionnaire/ FGD had been obtained and then calculated the default lueto determine vulnerability and resistance indexin the areasif landslide occurs. Then the level of vulnerability and resilience level was determined in each village to determine which areas had very low to very high levels of vulnerability and resilience.

Table 1 Vulnerability Indicator Value.

Village	Social Components	Economic Components	Physical Components	Environmental Components
Lemope	33.30	1.00	0.67	0.33
Lempoe	53.28	1.00	0.73	0.33
Galung Maloang	53.28	1.00	0.73	0.33
Watang Bacukiki	33.30	1.00	0.67	0.33
Kampung Baru	73.32	0.33	0.53	0.00
Lumpue	53.28	0.33	0.67	0.00
Tiro Sompe	76.65	1.00	0.60	0.33
Sumpang Minangae	73.32	0.33	0.67	0.00
Bumi Harapan	53.28	1.00	0.60	0.33
Cappagalung	76.65	1.00	0.67	0.33
Bukit Harapan	53.28	1.00	0.67	0.33
Kampung Pisang	73.32	0.67	0.93	0.33
Ujung Baru	73.32	1.00	0.67	0.33
Watang Soreang	73.32	1.00	0.60	0.33
Lakessi	73.32	0.67	0.60	0.33
Bukit Indah	73.32	1.00	0.53	0.33
Ujung Lare	73.32	0.33	0.60	0.00
Ujung Bulu	73.32	0.67	0.80	0.33
Labukkang	73.32	0.33	0.80	0.00
Ujung Subbang	73.32	0.67	0.93	0.33
Mallusetasi	73.32	0.33	0.80	0.00
Lapadde	53.28	1.00	0.73	0.33

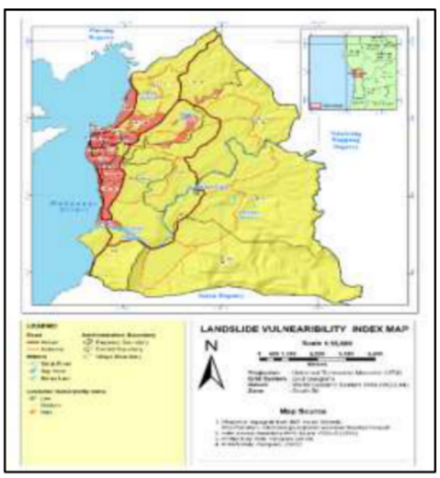

Figure 9. Landslide Vulnerability Index Map in Parepare.

3.3. Capacity Level Index in Parepare

Capacity level was discovered from the combination of threat level and capacity index. Index capacity was determined based on vulnerability level in area sthrough stakeholders questionnaires in Parepare. Capacity assessment is based on the Head [14] about Capacity Assessment of Disaster Risk Management Policy. The institutions involved in filling out the questionnaire consisted of BPBD Parepare, Indonesian Army, Indonesian National Police, village chief, subdistrict head, Department of Food Security, Department of Agriculture, Private Companies, Office of Communication and Information, TRC, Disaster Resilient Villages, Transportation Department, Health Department, etc. The results of the resilience study in Parepare can be seen in the following table:

Table 2. Resilience Study Results in Parepare.

Indicator Description	Priority Value	Level
Ensuring that disaster risk reduction becomes a national and local priority with a strong institutional basis for implementation.	40.63	3
Identify, assess and monitor disaster risks and improve early warning systems to reduce disaster risks.	25.57	2
The realization of the use of knowledge, innovation and education to build capacity and a safe culture from disasters at all levels.	17.05	1
Reducing basic risk factors.	27.27	2
Strengthen disaster preparedness for effective responses at all levels.	41.19	3
Total priority value	30.34	
Regional endurance level		

The tables hows that on the whole of resilience areas in Parepare in facing the potential for disaster at level 2 with a total priority value was 30.34. Achieving this level meant that the City of Parepare had implemented several disaster risk reduction measures with achievements that were still sporadic due to the lack of institutional commitment and/or systematic policy.

Achievement level in Parepare which was included in the low category of course required efforts to be improved. Resilience areas in Parepare at the very least needed to be improved in order to achieve the next level in implementation of disaster management in the area. Government commitment and several communities related to disaster risk reductionhad been achieved and supported with systematic policy, requires commitment and policies that were considered comprehensive so that they were meaningful enough to reduce the negative impacts of disasters.

3.4. Landslide Risk Level Analysis

The steps that had been done in analyzing landslide risk level were as follows:

- Determining factors and indicators landslide risk level. Landslide risk identificationin Parepare done based on 3 factors, landslide incidents history, geology, and topography.
- Calculating the standardization of indicator values to obtain default value, by conducting weighting of each parameter entered into the calculation.
- Calculating landslide risk level form factors affecting (hazard factor, vulnerability factor. Then divided it into several classifications according to their level. In this research, determining the number of levels was divided into 3, high, moderate, and low. The division of levels used the data classification feature in Arc GIS 9.1.
- Forming landslide risk map.

Landslide risk map was overlapping from hazard map, vulnerability and capacity. Those maps were developed based on some index calculated from each data and method. The results ofthe calculations showed that area with very high risk of landslide was located in Cappagalung. Whereas for area with moderate risk of landslides was in Lemoe. For more details can be seen in the following table and map.

Figure 10 Landslide Risk Map Parepare.

3.5. Typology of Control

3.5.1. Analysis of Regional Spatial Plans and Spatial Patterns

Based on the 2011 Parepare City Spatial Planning (RTRW), which is further detailed in the Parepare City Spatial Plan, there are 24 types of land use plan areas. The types of land use plan areas are: Industrial Estates, Port Areas, Trading Areas, Mining Areas, Protected Forest Areas, Tourism Areas, Religious Areas, Fisheries Areas, Residential Areas, Green Open Space Areas (RTH), Food Plant Areas, Areas provide protection under it, rivers, other agency areas, health areas, education areas, office areas, security defense areas, reclamation areas, terminal areas, landfills (TPA), horticultural areas, plantation areas and livestock areas.

In implementing the development of the City of Parepare, the regional development plan has been regulated in the Parepare City Spatial Plan (RTRW) 2001. The land use plan in the RTRW consists of cultivation areas and protected areas. Potential disasters according to RTRW are areas that provide protection underneath, protected forests and green open spaces. The limitation aspect of landslide geological disaster is not included as a factor. Meanwhile, the reality shows that the City of Parepare has a moderate to high risk of landslides throughout the City of Parepare (Analysis result). In areas with moderate to high landslide risk, landuse has been planned in a spatial pattern map, as in the following figure.

Figure 11 Regional Spatial Pattern Plan Map (Spatial Plan/RTRW, 2011) Parepare Ciity.

3.5.2. Typology of Landslide Geological Disaster

The determination of the geological landslide typology is made based on the level, with the spatial pattern plan contained in the regional spatial plan (RTRW) of Parepare City. Landslide risk contains categories of high and low levels of danger and risk. In the RTRW for the City of Parepare, a development area has been determined which is broadly divided into protected and cultivated areas, while in the Spatial Plan there are 24 types of land use.

For analysis purposes, the 24 types of land use in the spatial pattern plan are simplified into 4 groups of land use areas, namely:

- Industrial estate, consisting of: industrial area, port area, trading area and mining area.
- Protected areas, consisting of: protected forest areas, tourism areas, port areas, religious areas, fisheries areas, some residential areas, green open areas, food crop areas, areas that provide protection under them, and river areas.
- Settlement areas, consisting of: residential areas, office areas, religious areas, health areas, other institutional areas, tourism areas, education areas, reclamation areas, terminal areas, landfill areas and security defense areas.
- Agricultural Area and Food Crops; consists of: hortuicultural area, fishery area, plantation area, livestock area, and food crop area.

For more details abouth the result of the analysis of the spasial pattern area and the regional spatial planning (RSP) for the Citry of Parepare, can be seen in the following figure.

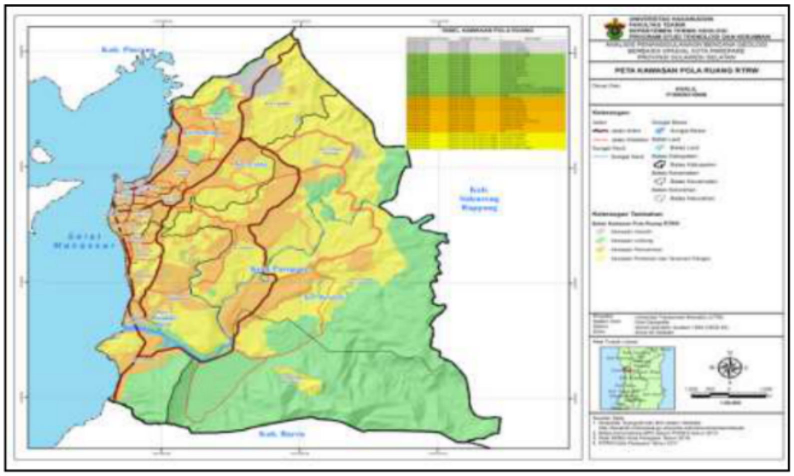

Figure 12. Spasil Pattern Map/RTRW in Parepare City**.**

In the analysis results obtained 3 types of landslide risk level categories. Meanwhile, in the spatial pattern area of the RTRW there are also 4 types of utilization as described in the Parepare City RTRW Spatial Pattern Area Map. From the four categories and types of land use, the respective geological risks of landslides are compiled with 3 risk categories, namely (low, medium and high) and earthquakes with two categories, namely (moderate and high).

Based on these data, then by using a "differentiation" overlay analysis, a substitution is made between the risk factors for landslides and the spatial pattern area / RTRW. From the results of the substitution, 11 types of typology were obtained. To find out about the type of each typology, the number of villages and sub-districts included in the typology, and the spatial description of landslide typology can be seen in the following table and figure.

Table 3 Typology of Landslide Risk Control in the City of Parepare

No.	Pattern Space Area	Landslide Risk	Tipology
1.	Industrial Area	Medum	A2
2.	Industrial Area	High	A3
3.	Protected Area	Loe	B1
4.	Protected Area	Medium	B2
5.	Protected Area	High	B3
6.	Residential Area	Low	C1
7.	Residential Area	Medium	C2
8.	Residential Area	High	C3
9.	Agricultural and Food Crops Area	Low	D1
10.	Agricultural and Food Crops Area	Medium	D2
11.	Agricultural and Food Crops Area	High	D3

Table 4 Landslide tipology in Ha.

Kecamatan	Kelurahan	A2	A3	B1	B2	B3	C1	C2	C3	D1	D2	D3	Grand Total
Kec. Bacukiki	Galung Maloang	16.53		7.41	159.26		0.69	221.85	14.68	16.05	667.43	0.77	1104.66
	Lemoe	0.12	0.48	6.84	921.98	1.87	1.73	316.49	31.27	2.97	612.50	0.78	1897.02
	Lompoe			1.99	6.93	0.24	0.61	238.10	48.76	5.61	256.65	28.59	587.48
	WatangBacukiki			0.18	1935.16	6.44		28.60	6.05		134.57	0.26	2111.25
Kec. Bacukiki Total		16.64	0.48	16.41	3023.32	8.54	3.03	805.03	100.76	24.63	1671.15	30.41	5700.41
Kec. Bacukiki Barat	Bumi Harapan				47.18	0.40		198.92	57.46		297.74	26.06	627.77
	Cappagalung				0.32	0.04		47.23	8.00		5.31	27.00	87.90
	Kampung Baru				0.27			35.93	2.00		2.63	4.75	45.58
	Lumpue	0.14			260.15	1.94		144.79	26.63		46.20	23.71	503.56
	Sumpang Minangae	0.86			15.59	3.41		36.34	0.94		0.07	0.01	57.23
	Tiro Sompe							27.75	6.54		2.36	12.71	49.35
Kec. Bacukiki Barat Total		1.01			323.53	5.79		490.96	101.56		354.32	94.23	1371.38
Kec. Soreang	Bukit Harapan	52.41	11.29		63.71			195.08	1.26		158.10	27.92	509.76
	Bukit Indah				0.10	0.02		84.31	30.31		0.20	0.04	114.97
	Kampung Pisang	13.44						0.72					14.16
	Lakessi	15.92			0.03			1.61					17.55
	Ujung Baru	1.40			0.49	0.00		36.85	5.27				44.00
	Ujung Lare	0.99						25.30	0.07				26.35
	WatangSoreang	40.86	3.69		0.86	0.34		19.32	14.85		0.06		79.98
Kec. Soreang Total		125.01	14.98		65.18	0.36		363.20	51.75		158.35	27.96	806.79
Kec. Ujung	Labukkang	1.55			0.96			28.27	0.28		2.51	3.61	37.17
	Lapadde	42.02	14.92		2.22	0.06		156.96	62.21		390.05	160.07	828.52
	Mallusetasi	2.77			1.78			25.23	0.06				29.83
	Ujung Bulu	0.22			0.16			30.07	0.22		1.78	1.87	34.32
	Ujung Sabbang	17.01	0.04		1.78			12.79					31.62
Kec. Ujung Total		63.58	14.97		6.89	0.06		253.32	62.77		394.34	165.55	961.47
Grand Total		206.24	30.43	16.41	3418.92	14.75	3.03	1912.50	316.84	24.63	2578.16	318.14	8840.05

Figure 13 Landslide Tipology Map in Parepare City.

4. CONCLUSION

Based on the results of the analysis and discussion carried out, several conclusions can be drawn as the research findings, as well as the direction of the space utilization plan in the City of Parepare, as follows:

- Most of the City of Parepare has a high landslide hazard level. The results of the analysis show that the area with a high hazard level reaches 17,424 Ha or about 50.83% of the total area.
- Based on the analysis, the level of landslide risk in the City of Parepare which is in the high category reaches 680.16 hectares or about 7.69% of the total area. Meanwhile, the level of risk in the medium category reached 8,115.82 hectares or around 91.8% of the area of the city of Parepare.
- Based on the level of landslide risk with a spatial pattern plan (RTRW, 2001) obtained 11 types of landslide typologies. Of the 11 types of typology, one of them is not found

in the City of Parepare, namely Type A1. Typology A1 is a category of low landslide risk in industrial estates.

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