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Development Direction of Gunung Nona Tourism Area Based on Landslide Mitigation

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Abstract. Gunung Nona tourism area is one of the tourism areas in Enrekang Regency. As a tourism area in the mountain area, it cannot be denied that this area is vulnerable to disaster especially for landslide. This research aimed to: 1) identify the pattern of development of tourism facilities in the area of Gunung Nona. 2) identify the vulnerability level of landslide in Gunung Nona area. 3) establish regional development strategies of Gunung Nona tourism area based on the landslide mitigation. This research included descriptive qualitative and quantitative. Data analysis technique were observation, interview, documentation, and inventory of related agencies. The data analysis techniques used were qualitative and quantitative descriptive analysis, weighted scoring analysis, overlay and spatial mapping analysis. The results of this research were: 1) tourism facilities in the area of Gunung Nona are main facility as tourist attraction, accommodation and restaurant along with complementary facilities such as playground and photo spots. The pattern of development sector from a span of 1995 to 2012 kept following the pattern of main road and started extending to the east following the tourist attraction of Buttu Macca from 2013 to 2018. 2) Gunung Nona tourism area partially covers Mandette village and Bambapuang village. The area with medium level of vulnerability in Madatte village is 926,60 Ha while the whole vulnerable area is 681,21 Ha. Whereas for vulnerability level of Bambapuang village area is 1446,26 Ha and the whole vulnerable area is 915,92 Ha. 3) direction for tourism area is divided into two zones, for vulnerable zone is directed as restricted eco-tourism and can only perform disaster mitigation with environmental approach while vulnerable zone is directed as conditional eco-tourism and can be performed disaster mitigation approach with technical engineering

Keywords: tourism area, disaster mitigation, landslide, Gunung Nona

1. Introduction

Tourism sector becomes growing very rapidly, UNWTO (2015) notes that tourism has provided its coverage to world income by 9.2%, interest in the creation of U \$ 1.4 Billion of exports or 5% of the value of exports in the world. According to the law Number 10 of 2009, tourism is defined as any tourism activities supported by various facilities and services provided by community, businesspersons, government and regional governments. Tourism sector has always been a major driving force of social and economic growth of the world. Indonesia undoubtedly has many interesting types of tourist areas to visit and enjoy such as natural tourism, historical tourism, and cultural tourism. Along with the growth of the tourism sector, which has many benefits, community and government hand in hand initiated to develop and open tourism spots for business purpose in Indonesia. As the main driving force of social and economic growth, it is undeniable that tourism sector is a kind of industry that is vulnerable to disasters. Faulkner explained that disaster the real



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thing can be anticipation with planning good that can reduce or avoid disaster event. He added that study of natural disasters and change the environment in the island nation is less (Faulkner, 2003). Tourist area might be affected by disasters or might be the trigger of the disaster itself. Disaster risk reduction approach or in Indonesian language known as *Pendekatan pengurangan resiko bencana (PRB)* in disaster management is surely needed since disaster might occurs anytime. By seeing the fact that tourism industry is vulnerable to disaster, it is important to reduce the effect. Thus, plan and development of the approach are needed.

Enrekang is one of regions in South Sulawesi province, which is chosen as the place for tourism development. As a district located in mountain part, Enrekang Regency offers astonishing mountain panoramas that attract many tourists. However, as a mountainous area, which geographically consists of steep slopes, Enrekang district is vulnerable to disaster such us landslides. The dense contour lines indicate that Enrekang is a region with rather steep to very steep slopes. Therefore, it has high vulnerability to disaster, especially ground movements due to its topographical conditions. (Rasyid: 2012).

One of the main tourist attractions in Enrekang Regency is Nona Mountain tourist area. Based on Enrekang District Regulation No. 14 of 2011 about Spatial Planning for Enrekang Districts in 2011-2031, the Mount Nona tourism area is designated as a strategic district area from an environmental standpoint. As a tourist area, which attracts many tourists, Nona mountain is vulnerable to landslides. The construction of tourist facilities such as restaurants is often built on the edges of the slopes. The community builds the area in the purpose of getting the best spot to enjoy the panoramic view, however they did not consider about the mitigation aspects of the disaster. The development of tourism area, which brought the aspects of disaster mitigation are considered, is expected to minimize disaster risk and to support environmental conservation efforts for sustainable development.

The aims of this research are identifying the development pattern of tourist facilities in the tourist area of Nona mountain, determining the level of landslides vulnerability in the Nona mountain tourism area, and formulating the development instruction of Nona mountain tourist area based on the landslide mitigation.

2. Research Method

The research was conducted in Nona mountain tourist area, including part of Bambapuang and MandatteVilagges in Anggeraja District, Enrekang regency.

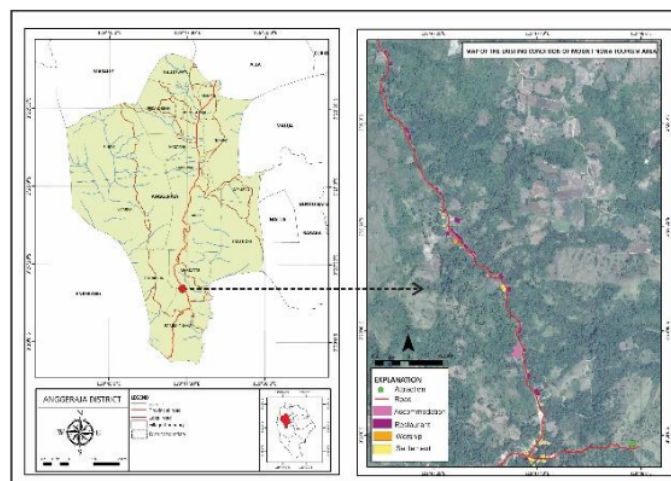


Figure 1 Research location Map

2.1 Methods of collecting data

The technique of primary data collection were obtained directly from observations, interviews, and documentation. Moreover, the secondary data were collected from literature-study and surveys of relevant agencies.

2.2 Methods of analysing data

The data were analysed using qualitative and quantitative approaches, scoring / weighting analysis and spatial overlay analysis by using Geographic Information System (GIS) technology. At very first, the identification of problem was done, which then followed by literature study. Descriptive analysis and time series maps were used to see the development pattern of tourism facilities. The landslide vulnerability level in the tourist area was analysed by scoring and weighting. Furthermore, the map overlay method used in ArcGIS 10.1. The first analysis step was creating thematic map based on the parameter which influence the landslide vulnerability level. The used parameters and the weighting are shown in this following table:

Table 1 The determination of score value and weight in the classification of area vulnerable to landslide

1. Parameter/weight	Quantity	Category	score
Human activities factor (30%)			
Land use 20%	Natural Forests	Very low	1
	Forests/Plantation	Low	2
	Shrub/grasses	Medium	3
	rice field/settlement	High	4
Infrastructure 10%	No road crossing the slopes	Very low	1
	Road crossing the slopes	High	4
Natural physical factor (70%)			
Annual rainfall (mm) 20%	< 1000	Very low	1
	1.000 – 1.499	low	2
	1.500 – 2.500	Medium	3
	> 2500	High	4
Slope 25 %	< 15	Very low	1
	15 - 24	low	2
	25 - 44	medium	3
	> 45	high	4
Fault line existence 10 %	Nothing	Very low	1
	Exist	High	4
Geology (soil/rock)15 %	Alluvial land	Very low	1
	calcareous hills	Low	2
	Sedimentary rock hills	Medium	3
	Volcanic rock hills	High	4

Source: Government decree No.22/PRT/M /2007 and Karnawtiin Rasyid (2012)

The equation used in analysing the landslide vulnerability level is as follows:

TOTAL SCORES: 20FPL + 10FI + 20FCH + 25FKL + 10FKS + 15FG

Description:

- FRL = Land use factor
- FI = Infrastructure factor
- FCH = Rainfall factor

FKL = Slope factor
FKS = Fault line factor)
FG = geological factor
25;20;15;10 = weighting value

The total scores are in the range of 130-340. The final overlay classification was conducted by using 3 class of landslide vulnerability, they are: not vulnerable, medium and vulnerable based on the total of the final score, the higher the score, the higher vulnerability level will be, by determination of interval:

$$\text{Interval score} = \frac{\text{Highest score} - \text{Lowest scoreh}}{\text{Highest score} - \text{Lowest score}}$$

3. Analysis and Discussion

Two landslide locations were found in Nona mountain tourist area. The first location is a settlement location where landslides occur almost twice a year since 2004. Based on the interview result, the serious condition landslides occur in 2004 to 2017. The effect in the 2004 landslide was that the four-story building was relocated. The effect in the 2017 landslide was that the building foundation built in that area. The landslides that happened in the location were rain pouring hard which filled the soil layers in the slope.



Figure 2 Landslide
Source: Documentation, 2018

This study began by identifying tourism facilities in Nona Mountain tourism area. The main facilities included tourist attractions such as Nona Mountain, Bambapuag Mountain, Buttu Macca, accommodations and restaurants. Meanwhile, the complementary facilities included game rides and spots for photos. These facilities are the variables to find out the development pattern of tourism facilities in Mount Nona tourist area.

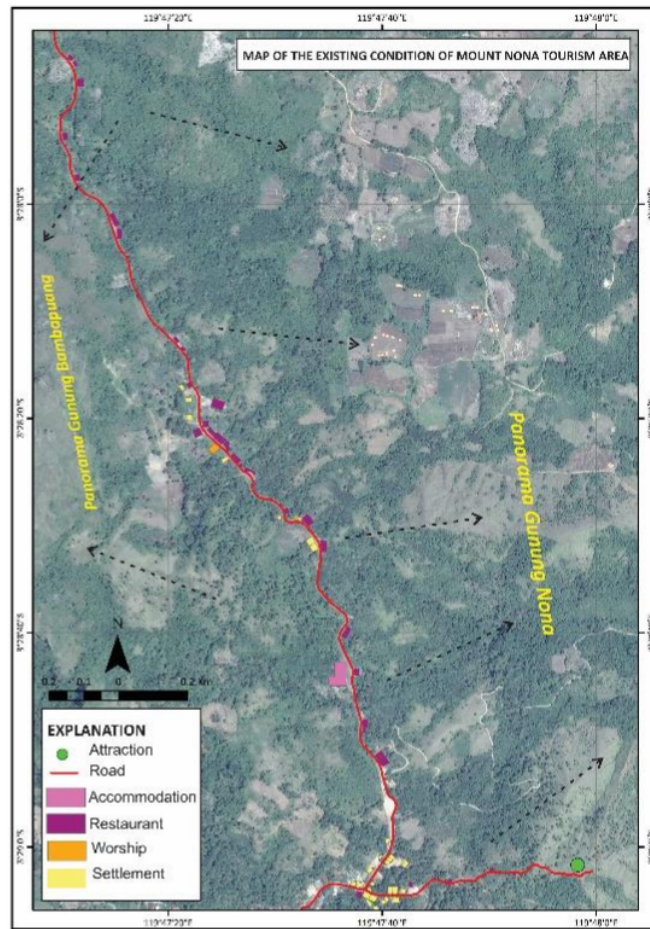


Figure 3 Map of the Existing Condition of Mount Nona Tourism Area

Time series analysis was done to find the development pattern of tourism facilities in Nona Mountain tourism area. The *time series* map of this study began from 1995 to 2018 with a span of 5 years. After mapping process every five years, the pattern of development and the number of buildings built in the span of time. From the analysis of this development pattern, it is found out that from 1995 to 2012 the tourism facilities developed only following the main road pattern. From 2013 to 2018, as a tourism attraction, Buttu Macca was built and indicated the pattern of development that initially only followed the main road pattern began to change following the new tourist attraction. As seen from the construction of new tourism facilities around Buttu Macca.

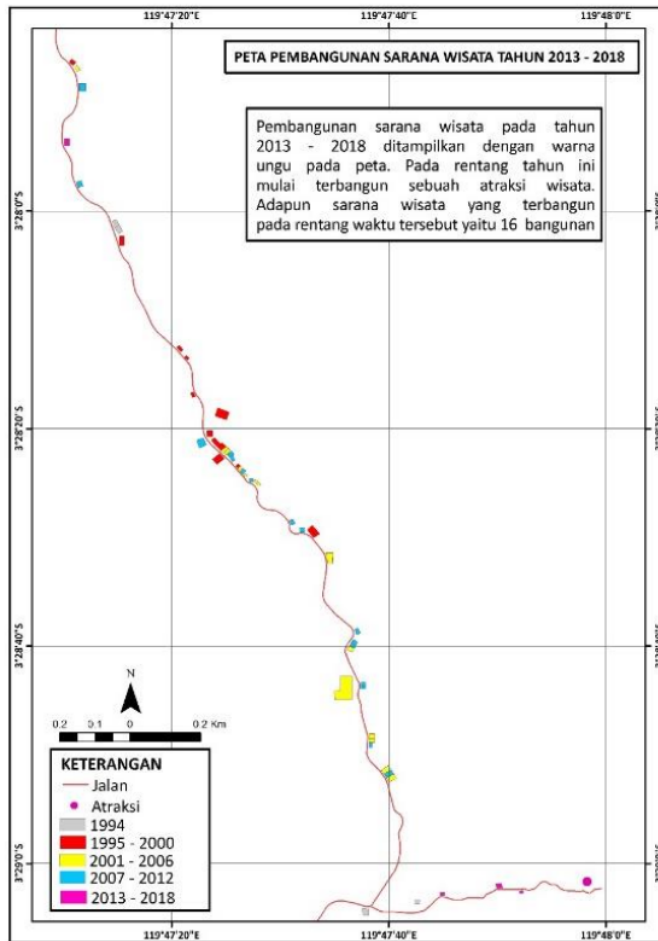


Figure 4 Map of Development tourist facilities

3.1 Analysis of Vulnerability Level of Landslide in Nona Mountain Tourist Area

Analysis of landslide vulnerability in one district was done to know the vulnerability level of landslide disaster in Nona Mountain tourist area. The data of vulnerability level from the analysis would be overlaid with tourist areas to get the result.

The parameter used in the analysis of landslide vulnerability level was divided into two factors: factor of human activity and factor of physical nature. Human activity factor had weight of 30% which included land use with 20% parameters and infrastructure 10%. Meanwhile physical nature factor had weight of 70% included rainfall 20%, slope 25%, existence of fault 10%, and geology 15%.

3.1.1 Land use

To find out the vulnerability level of landslide in Anggeraja Dsistrict, Land Use was divided into 5 criteria included natural forest, forest/plantation, rice fields/residential areas, and scrubs/grass. These criteria were grouped based on their level of effect on landslide. The result of the analysis on the land use map is shown in the following table:

Table 2 Extent of Land Use in Anggeraja District

No	Land Use	Extent (ha)	Percentage (%)
1	Natural forest	1.259,001	10,04
2	Forest/Plantation	8.594,74	68,54
3	Rice fields/residential areas	808,37	6,44
4	Scrubs/grass	1.876,48	14,96
	Total	12.538,59	100

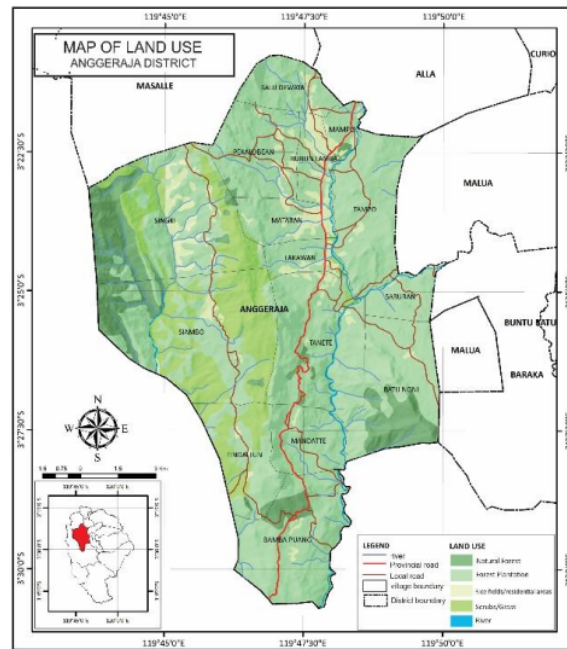


Figure 5 Land Use Map of Anggeraja District

3.1.2 Rainfall

Rainfall is one of the climate symptoms with its great influence on landslide. Rainfall has 20% out of 70% of physical nature factor. Infiltration of rainwater will fill the soil in the subsoil and weaken the slope-forming material so it will prompt landslide to happen. Rain with high intensity will be more dangerous for soil movement. The following is the table of rainfall classification in Anggeraja District;

Table 3 Extent of Rainfall Classification in Anggeraja District

No	Rainfall Classification (mm/year)	Extent (ha)	Percentage (%)
1	1500 - 2000	5.226,02	10,04
2	2000 - 2500	7541,98	68,54
	Total	12.768	6,44

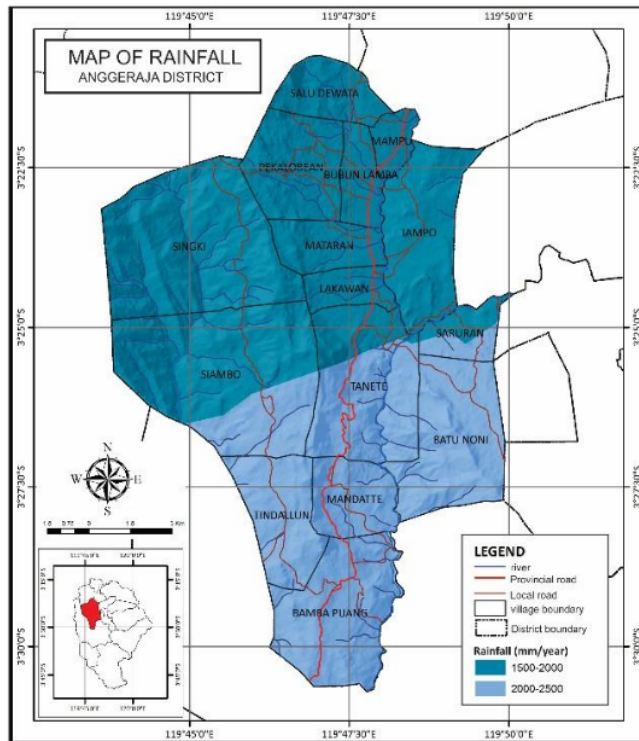


Figure 6 Map of Rainfall

3.1.3 Slope

Slope is the topographic element with the greatest impact on landslides. The parameter has an effect of 25% or more if compared with other parameters. The steeper the slope, the bigger and faster landslides might happen. Landslides often occur on slope with the tilt of >40%, particularly caused by gravity effect.

Table 4 Extent of Slope in Anggeraja District

No	Classification of Slope (%)	Extent (ha)	Percentage (%)
1	0 - 8	913,46	7,21
2	8 - 15	2.192,66	17,30
3	15 - 25	2.640,35	20,82
4	25 - 40	4.438,02	35,00
5	>40	2.493,49	19,66
	Total	12.677,98	100

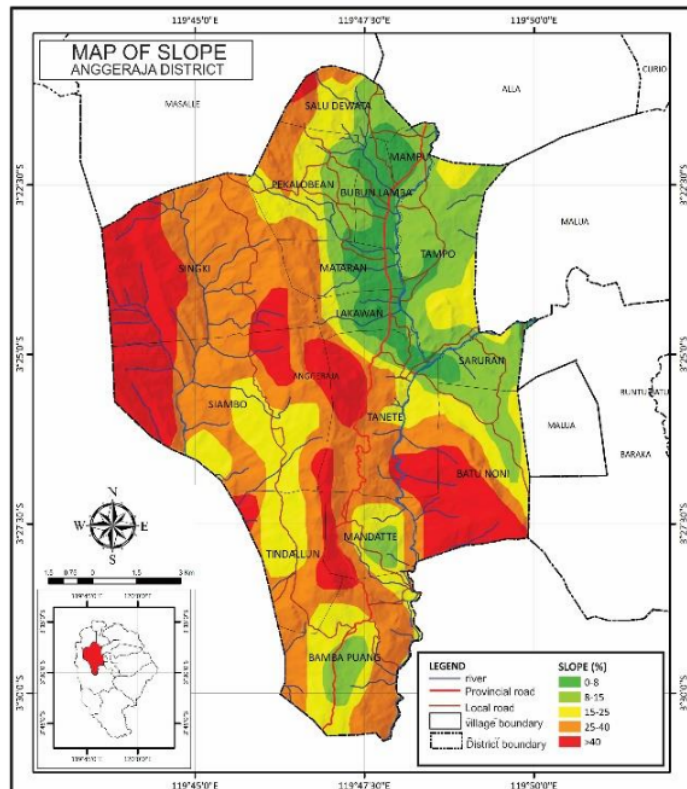


Figure 7 Map of Slope

3.1.4 Type of Soil and Fault Line

There are three types of soil in Anggeraja District, namely volcanic, sedimendan, and Alluvil. Each type of soil has different weight based on its level of influence on landslides.

Table 5 Extent of Type of Soil in Anggeraja District

No	Type of Soil	Extent (Ha)	Percentage(%)
1.	Volcanic	5.998,29	47,31
2.	Sediment	5.682,41	44,82
3.	Alluvial	997,28	7,86
	Total	12.677,98	100

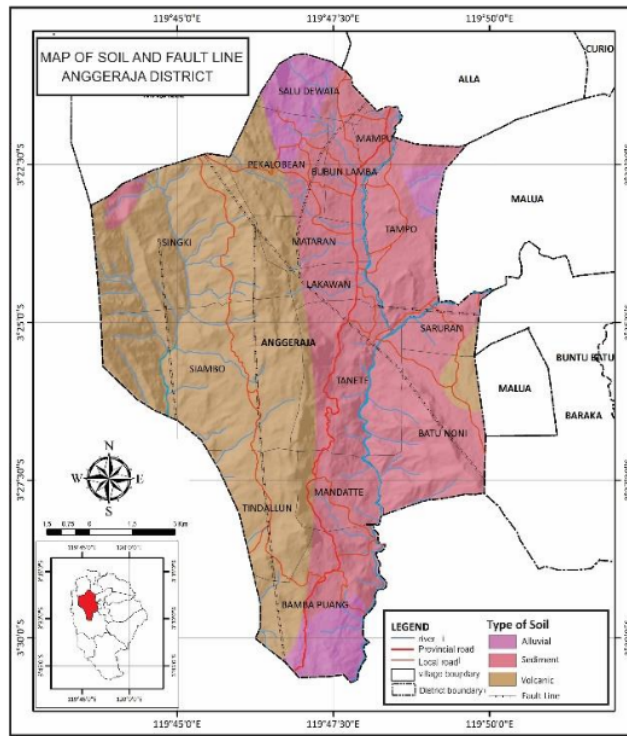


Figure 8 Map of Soil and Fault Line

3.2 Analysis of Vulnerability Level of Landslides

Special analysis on every parameter that cause landslides in Anggeraja District resulted in the outcome of landslide prone areas map with 3 classifications of landslide vulnerability, namely non-landslide-prone area, medium, and landslide-prone area. Details of the extent of landslide vulnerability classification are in this following table.

Table 7 Extent of Landslide Vulnerability Level in Anggeraja District

No	Vulnerability Level	Extent (Ha)	Percentage (%)
1.	Non landslide-prone area	291,30	2,29
2.	Medium	5.982,54	47,18
3.	Landslide-prone area	6.404,15	50,51
Total		12.678,01	100

Anggeraja district was dominated by landslide-prone areas with the percentage of 50,50%, meanwhile medium level 47,18%, and the rest is the non-landslide-prone areas. The following is landslide prone level map in Anggeraja District:

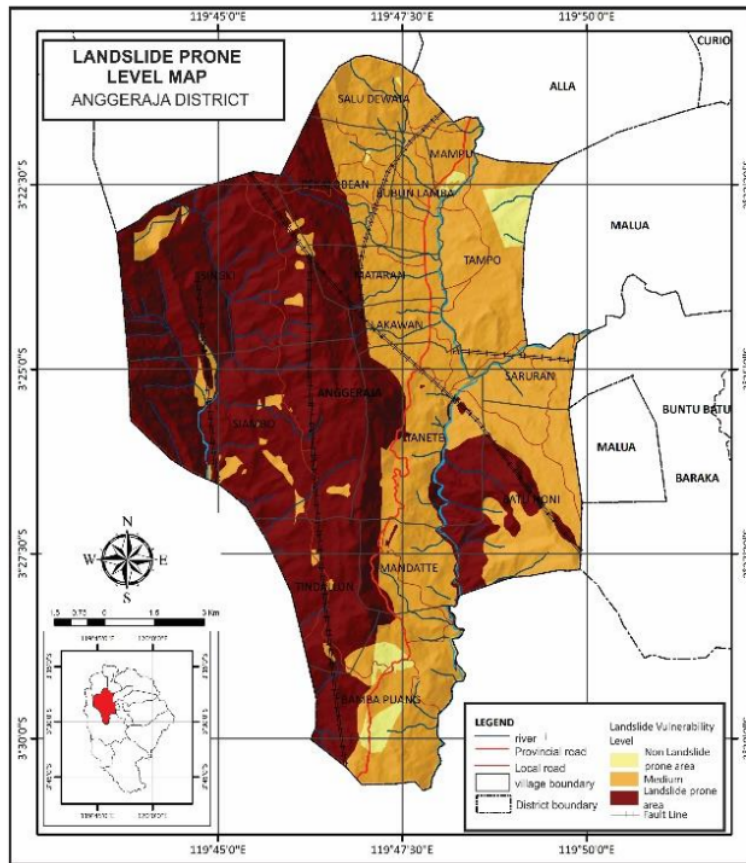


Figure 9 Landslide Prone Level Map

3.3 The Analysis of Vulnerability Level of Landslide in Nona Mountain Tourist Area

From the analysis of vulnerability level of landslide in Aggeraja District it immediately can be detected the vulnerability of Nona Mountain tourist area. The Nona mountain tourism area included the whole Mandette village, and also some part of Bambapuung village. As for the extent average of vulnerability in Mandatte is 926,66 Ha and the vulnerability range is 681,21 Ha. Meanwhile in Bambapuung the extent average level of vulnerability is 1446,26 Ha as wide as 915,92 Ha. Details of the Extent of Landslide Vulnerability Level of landslide-prone in Mount Nona Tourist Area as follow:

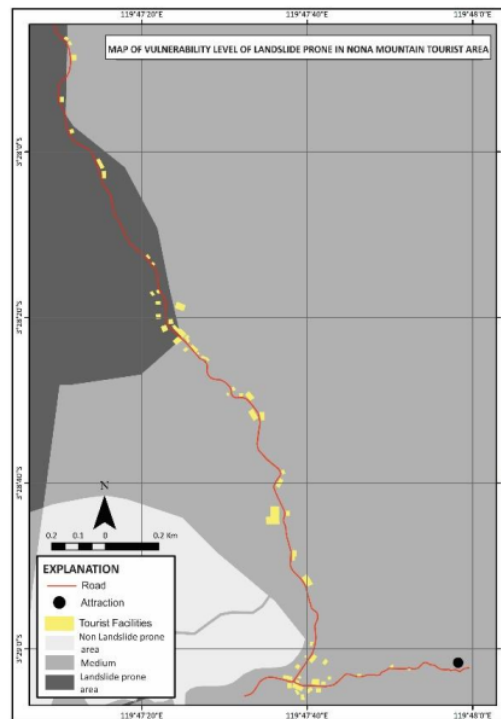


Figure 10 Map of Vulnerability Level of Landslide Prone in Nona Mountain Tourist Area

From the map of picture that showed above it can be noticed that some areas have different vulnerability level of landslide in this case it has a moderate and vulnerable level of vulnerability. In the great vulnerable area, the vulnerability level of landslide-prone can be found in the North of tourist area and the moderate level of vulnerability can be found in the South area. In the tourist area it is undeniable that there was no such category of invulnerability.

3.4 The Direction of Tourist Area Development Based on The Landslide Prone Mitigation

Before deciding the right instruction, it is reputedly important to divide the areas in a zoning category. Zoning is a process of dividing space of the areas becoming a few different segments. In this case, the areas can be done by doing a segment of allotment base on the areas of typology. Stated on Primer ministry PU No. 22/PRT/M/-2007, the Tourist Area of Nona Mountain divided into two types, there are first, Type A with the slope gradient $>40\%$ and Type B with a 25-40% of slope. In the previous explanation Type, A was in the class of high vulnerability and in Type B was in a medium class. Therefore, the determination of *zona* (zoning) area can be divided based on the vulnerability of landslide and the direction of its regional typology.

After deciding the area of *zones* based on the type of its regional then the determination of areas direction can be done based on the results of the *zones*. Both in Zone A and B it has a different direction that can be suited to

their space and remain based on the importance of landslide disaster mitigation and tourists needs. The following is a map of Nona Mountain tourism zoning and the characteristics of each zone based on the results of the analysis:

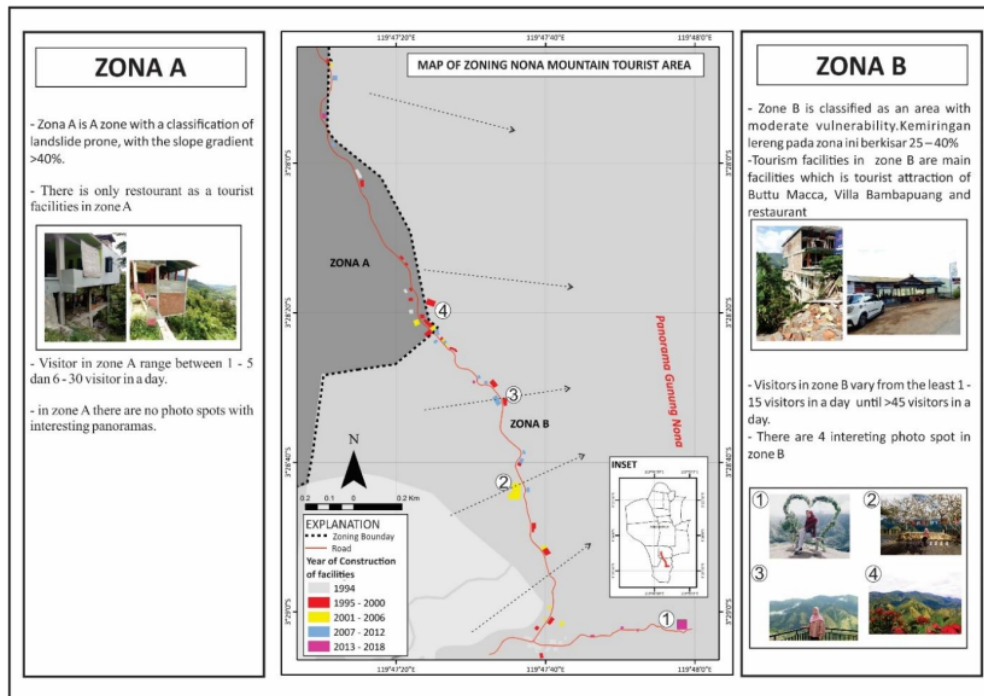


Figure 11 Map of Zoning Nona Mountain tourist area

3.5 The Direction of Zone A Development of Nona Mountain Tourist Area Based on The Mitigation Landslide

For the development of tourist areas, zone A is more directed as a limited tourist area by prioritizing tourist with such a concept of environmental adjustment. The construction of tourists' support to its facilities in this zone should be controlled and monitored closely. For tourism facilities that have been built are expected to directly returned to the original conditions and functions gradually.

Mitigation can be done in the form of its engineering natural conditions such as vegetation that can prevent landslides. One of the plants that can prevent landslides is coffee. This area is suitable for coffee plants because it is in the highlands. Coffee trees have layered canopy that can protect the soil from any damage of raindrops directly. In addition, coffee plants are also able to bind the soil because it has taproots that immediately can reach the ground to a depth of 3 meters. Planting coffee can be accompanied by any other plants that retrieve as a great patron. Other plants that can maintain slope stability and can be able to do planting in Zone A are vetiver plants. Vetiver plants are grasses that have many disease. Vetiver grass roots are fibrous and can reach a depth of 5.2 meters. The roots are able to hold soil particles so they can prevent soil erosion. The stem is stiff and hard, and any other good things from this Vetiver plant that they are resistant to water flow.

3.6 The Direction of Zone B Development of Nona Mountain Tourist Area Based on The Mitigation Landslide

Zone B is classified as an area with moderate vulnerability. The slope of the slope in this zone ranges from 25-40%. The slope of the slope in this area is lower compared to zone A. Although the condition of the level of the slope is moderate, this zone remains collapsed as a protected area and is not suitable for settlement. As for tourism activities, it is permissible to pay. Types of tourism that are

permitted are only types of natural tourism with businesses in the form of lodging tours, camping ground and mountain climbers.

The direction of mitigation disaster directives in zone B can be done with technical engineering, different from zone A which can only be done by environmental adjustment. As for the instruction that only recommended by doing technical engineering, it can be a reinforcement system on the slope with a restraining force. Construction that can be used in the form of a retaining wall, anchor, or shotcrete, using this kind of construction can maintain slope stability and resist ground motion. In addition to technical engineering mitigation is also directed to prioritize environmental suitability. The right selection of vegetation types and cropping patterns must be taken into consideration in increasing slope stability.

The development of tourist area in Zone B can be in the form of developing attractions. In this case, the addition of tourism objects such as flower tours that is directed to Zone B, in addition to adding aesthetics to the flower, tourist area can be a such nature that can attract tourist to do self-photos. Other tourist facilities that can be developed is *camping ground*. The great natural atmosphere and misty atmosphere also beautiful natural scenery is undeniable that it is going to make the tourist area suitable for camping location. Camping can be used as a place for tourists, the community and institutions and organizations that will carry out the campground in such a great outdoor-vibes.

4. Conclusion

- 1) The tourist facilities in the tourist area of Nona mountain include basic facilities in the form of Nona mountain tourism objects, Bambapuang mountain, Buttu Macca, accommodation and restaurants. Complementary tourism facilities there are game rides and photo spots. The pattern of regional development from the range of 1995 - 2012 continued to follow the pattern of the main road and began to develop towards the East following the Buttu Macca tourist attraction in the year of 2013 - 2018.
- 2) The vulnerability class of landslide in the Nona mountain tourism area is divided into two levels of vulnerability, which are vulnerable and moderate. Prone area is in the North and the vulnerable area is in the South. The slope factor is very influential in determining the level of vulnerability landslide in this study.
- 3) In the tourist area of Nona mountain can be divided into two zones based on the level of vulnerability to landslide-prone. Zone A is a vulnerable zone that is directed as a natural tourist area that is limited and can only do mitigation with the environmental adjustment approach. Whereas for zone B, it is a zone with medium prone class. Zone B can be directed as a conditional natural tourism area and a disaster mitigation approach can be carried out by means of technical engineering and environmental approaches.

References

- [1] Enrekang District Regulation No. 14 of 2011 about Spatial Planning for Enrekang Districts in 2011-2031
- [2] Faulkner, B., 2003, Towards a framework for tourism disaster management, *Managing Tourist Health and Safety in the New Millennium*, 155-176.
- [3] Rasyid, Rachman dkk. 2012. *Mitigasi Daerah Rentan Gerakan Tanah di Kabupaten Enrekang*. Universitas Hasanuddin
- [4] Undang-undang Nomor 10 Tahun 2009 Tentang Kepariwisataaan
- [5] UNWTO (2015). *Tourism Highlight 2015 Edition*. UNWTO. Madrid

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