IOSR Journal of Environmental Science, Toxicology and Food Technology (IOSR-JESTFT)
e-ISSN: 2319-2402,p- ISSN: 2319-2399.Volume 16, Issue 10 Ser. II (October 2022), PP 01-04
www.iosrjournals.org

Inventory of Lanslide Prone Area in Karaja Watershed (Maros Regency, Indonesia)

Andi Nurul Mukhlisa[1],*, Andi Khairil A Samsu[1], Andi Ariadi[2]
[1]*(Department of Forestry, Faculty of Agriculture, Animal Husbandry and Forestry, University of Muslim Maros, Indonesia)*
[2]*(Magister Student in Department of Forestry, Faculty of Forestry, Hasanuddin University, Indonesia)*

Abstract:
Background*: Mapping area of landslide proe is the activity of making a map that present the negative impacts that can arise in the form of material and non-material losses in an area in the event of a disaster. This study aims to obtain information related to landslide prone areas of Karaja Watershed in Maros Regency, Indonesia.*
Materials and Methods*: This research was conducted with initial landslide prone data obtained by merging Landsat image bands. Furthermore, spatial analysis is carried out by performing an overlapping technique (overlay) on the influencing factors. The data entry process is carried out through a set of computers with mapping software. Analysis of landslide prone maps is carried out after thematic maps, namely rainfall maps, soil type maps, geological maps, slope maps, land cover, slopes, elevations and soil types are available and ready in the form of digital maps. The next stage is classification based on scores and giving weights to each parameter.*
Results*: The results of the weighting show that the karaja sub-watershed is an area that has a high level of vulnerability to landslides.*
Conclusion:*Karaja Sub-watershed has area with a high level of vulnerability to landslides is more than 50%.*
Key Word*:Inventory; Landslide Prone; Watershed; Disaster; Maros Regency.*

Date of Submission: 08-10-2022 Date of Acceptance: 23-10-2022

I. Introduction

Based on the landslide prone index issued by the BNPD, Maros Regency is included in the high-prone class, as well as the flood-prone index. In Maros Regency, flooding occurs because the condition of the Maros river is no longer able to accommodate the discharge and volume of water due to the influence of upstream sediment transport. This is because the condition of the forest ecosystem around the upstream which is the catchment area no longer functions as a reservoir. As a result, the bond of the earth that is no longer strong flows along as mud[1].The high level of losses experienced by the community due to natural disasters is due to the lack of information obtained by the community about the possibilities of disasters that occur around them, so that public awareness of disaster response is very minimal. Therefore, initial information about the potential and risk of disasters is one of the information media that can be used as basic education for disaster response for the community[7,8]. Minimizing the effects of disasters can be done early if the community is prepared enough[2.] Several things can be done, such as identifying disaster-prone areas[2,3] and then mapping the disaster areas[2]. This step is a form of inventory of the disaster area as an effort to prevent the potential risk of becoming a disaster or reduce the effects after the disaster occurs[2,4]. Disaster Risk Mapping is a map-making activity that presents negative impacts that can arise in the form of material and non-material losses in an area in the event of a disaster. Valid data is needed for the risk mapping process so that it can present the actual conditions in the field[5,6].

II. Material And Methods

Study Design: Inventory landslide prone study
Study Time and Location: The study was conducted in early 2022 in an area that includes the Karaja River Basin (Karaja Sub-watershed) in Maros Regency, South Sulawesi, Indonesia.

Data Analysis: The delineation of the research area was carried out by cropping the image in the karaja sub-watershed of Maros Regency. Then the initial disaster-prone data was obtained by merging the Landsat image bands. Furthermore, spatial analysis is carried out by performing an overlapping technique (overlay) on the influencing factors. The data entry process is carried out through a set of computers using Mapping software

10.6 software. Analysis of disaster-prone maps is carried out after thematic maps, namely rainfall maps, soil type maps, geological maps, slope maps, land cover, slopes, elevations and soil types are available and ready in the form of digital maps. The next stage is classification based on scores and giving weights to each parameter.

III. Result & Discussion

Area Delinated: The process of delineating the Karaja sub-basin uses Digital Elevation Model (DEM) data by following the step

1. Download raster data on DEMNAS via the link https://tanahair.indonesia.go.id/demnas/
2. Merge DEM data mosaics and perform coordinate system projectionMelakukan analisis spatial dengan menggunakan mapping software (spatial analisis tools->hidrology->fill)

   The map data that we get must be processed using feature fills to fill in data that has sinks that may exist in the map. Sink is an area that has its own water flow, this water does not flow out. In the real world, sinks can be lakes, ponds, etc. or holes due to poor data processing. To analyze the catchment area, the fill process on the DEM map must be carried out so that the water flow can be analyzed.

3. Perform spatial analysis using mapping software (spatial analysis tools->hydrology->flow direction).

   This step is carried out to determine the direction of flow from the surface which is represented from the cells in our DEM map. This is important so that we can know the flow direction of each cell which will be used to obtain surface water flow patterns in the next stage.

4. Perform spatial analysis using mapping software (spatial analysis tools->hydrology->flow accumulation)

   Flow accumulation is the next stage which aims to determine the flow pattern of the river with the highest flow value cell formed from the Flow Direction information data. The highest cell value represents the downstream flow that receives the flow from each cell upstreamMelakukan analisis spasial dengan menggunakan mapping software (spatial analisis tools ->conditional-con)

5. Perform spatial analysis using mapping software (spatial analisis tools->hidrology->stream order)
6. Perform spatial analysis using mapping software (spatial analisis tools->hidrology->stream feature)
7. Perform definition query
8. Perform spatial analysis using mapping software (spatial analisis tools->hidrology->basin)
9. Perform Convertion raster to polygon

The selection of the Karaja sub-watershed is a consideration for research with areas that have road access and environmental conditions that can be reached during the research process. After delineating the sub-watershed it is known that the Karaja Sub-watershed has an area of 14532.2 ha spread over 6 sub-districts (figure 1), namely Bantimurung District (11.71%), Cenrana District (17.66%), Simbang District (61.42%) %), Tanralili District (0.66%), Tompobulu District (8.38%) and Turikale District (0.17%). The information related to the total area in the 6 districts can be seen in table 1.

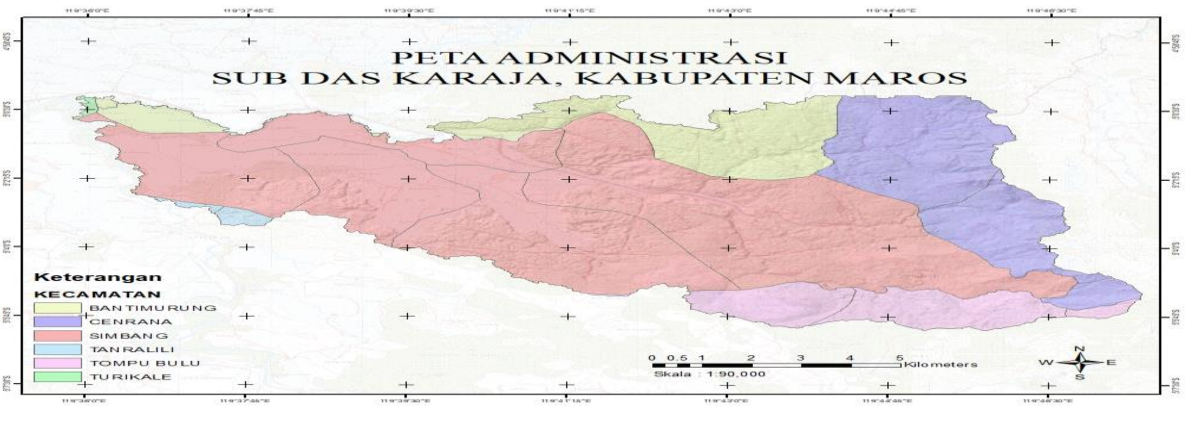

Figure 1. Adiministrative Map of Karaja Sub Watershed

Disaster-prone level (landslide)

Analysis of landslide hazard in the Karaja sub-watershed uses scoring and weighting techniques. The parameters used in this study are annual rainfall, rock type (geology), soil type, slope and land use in the Karaja sub-watershed. The analysis process was carried out using ArcGIS 10.6 based on the 2016 RBI weighting reference and PVMBG, 2004. In this scoring and weighting value, the researcher made modifications by adjusting the data and current conditions for the research area. The weighting technique used is shown in table 1.

Table 1. Weighting to get landslide prone areas

Parameter	Quantity	Skore	Weight
Annual rainfall (mm/year)	> 3000	5	30%
	2501-3000	4	
	2001-2500	3	
	1500-2000	2	
	<1500	1	
geology	Volcanic	3	20%
	sedimentary	2	
	Alluvial	1	
Soil	regosol, litosol, organoso;	5	10%
	andosol, laterit, grumosol	4	
	brown forest soil, mediterian	3	
	latosol	2	
	aluvial, planosol, hidromorf	1	
Slope	>45%	5	20%
	25-45%	4	
	15-25%	3	
	8-15%	2	
	<8%	1	
Landuse	moor, paddy field	5	20%
	shrubs	4	
	forest and plantation	3	
	city/residential/airport	2	
	ponds, reservoirs, waters	1	

Annual Rainfall. The stages in making rainfall are by presenting annual rainfall data. Annual rainfall data is obtained from https://www.chc.ucsb.edu/data/chirps. This is the choice of researchers because the displayed resolution is 0.05o x 0.05o or about 5.5 km. Figure 1 presents a rainfall map in the Karaja sub-watershed which shows an average annual rainfall that occurs above 3000 mm/year, this provides information that the Karaja sub-watershed has high rainfall intensity.

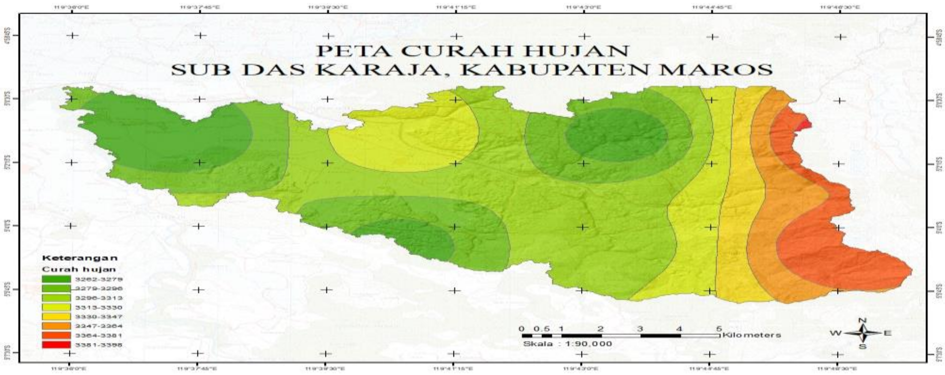

Figure 2. Annual Rainfall Map of Karaja Sub Watershed

Classification of rainfall class researchers divide into 8 classes to make it easier to see the highest rainfall class. The area for each class of rainfall is shown in table 2.

Table 2. Annual Rainfall of Karaja Sub Watershed

No	Class of Annual Rainfall	Area (ha)	%	Skore	Weight
1	3262-3279	2054.93	14.14	5	20
2	3279-3296	2850.64	19.62	5	20
3	3296-3313	4450.32	30.62	5	20
4	3313-3330	2151.20	14.80	5	20
5	3330-3347	879.74	6.05	5	20
6	3347-3364	1008.61	6.94	5	20
7	3364-3381	1121.29	7.72	5	20
8	3381-3398	15.50	0.11	5	20
Total		**14532.22**	**100**		

(Data Analysis, 2022)

Based on the analysis carried out, it can be seen in table 3 that the highest annual rainfall CH is in the range of 3381-3398 mm/year, namely in Labuaja Village, Cenrana District with an area affected is 15.5 ha. The lowest annual rainfall is in the range of 3262-3279 mm/year, which is spread over Bantimurung District, Cerana District and Labuaja District with the affected area covering 2054.93 ha. High rainfall is very influential in landslide disasters.

Rock Type. Based on existing data, rock types in the Karaja sub-watershed are classified into 3 types, including: volcanic rock, sedimentary rock and alluvial rock. The rock class classification obtained is adjusted to the data obtained by converting according to the weighting class rules.

The Karaja sub-watershed is dominated by limestone rock types, namely 6169.38 ha or 42.45% of the Karaja sub-watershed. This type of limestone rock is spread in Bantimurung District, Cenrana District, Simbang District, Tanralili District and Tompobulu District. Volcanic rocks have a structure that is susceptible to landslides.

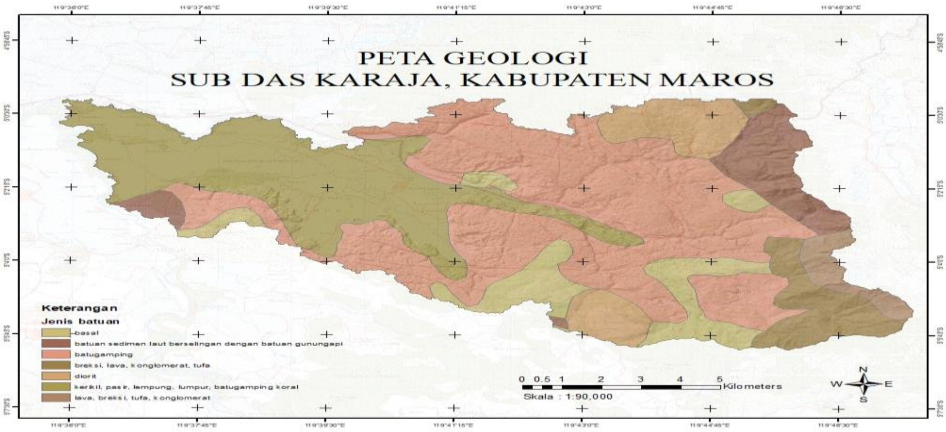

Figure 3. Rock type Map of Karaja Sub Watershed

Table 3. Rock type Map of Karaja Sub Watershed

No	Rock type	Classification	Area (ha)	%	Skore	Weight
1	Basal	volcanic rocks	1370.12	9.43	3	20
2	Marine sedimentary rocks interspersed with volcanic rocks	sedimentary rocks	1001.34	6.89	2	16.33
3	Limestone	sedimentary rocks	6169.38	42.45	2	16.33
4	Breksi, lava, konglomerat, tufa	sedimentary rocks	850.44	5.85	2	16.33
5	Diorit	sedimentary rocks	1073.72	7.39	2	16.33
6	Gravel, sand, clay, silt, coral limestone	sedimentary rocks	3710.99	25.54	2	16.33
7	Lava, breksi, tufa, konglomerat	sedimentary rocks	356.24	2.45	2	16.33
Total			**14532.22**	**100**		

Type of soil. The type of soil also influences the level of landslide susceptibility.

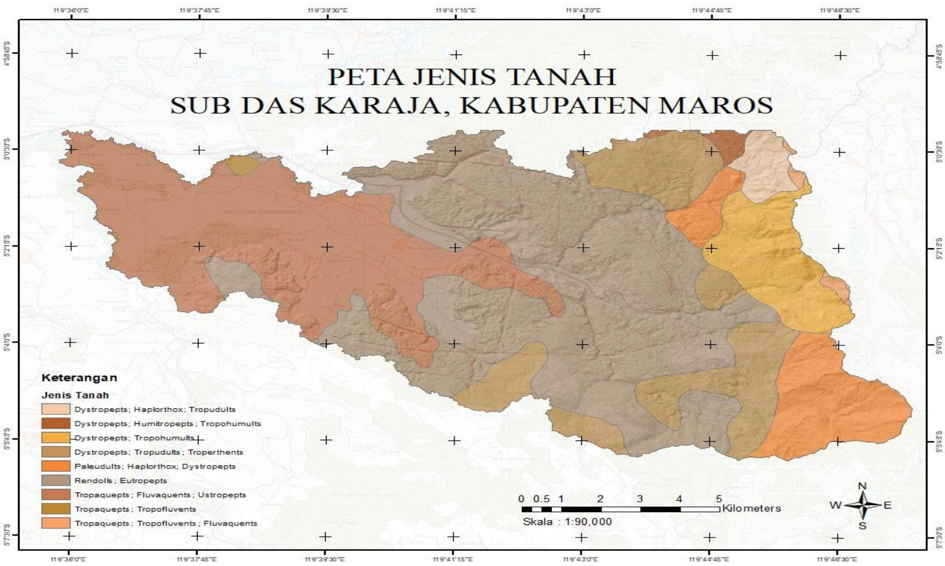

Figure 4. Soil Map of Karaja Sub Watershed

Tabel 1. Jenis tanah Sub Das Karaja

No	Kelas Tanah	Luas area (ha)	Skore	Bobot
1	Dystropepts; Haplorthox; Tropudults	259.68	2	4
2	Dystropepts; Humitropepts; Tropohumults	88.16	3	6
3	Dystropepts; Tropohumults	967.22	3	6
4	Dystropepts; Tropudults; Troperthents	1985.03	2	4
5	Paleudults; Haplorthox; Dystropepts	1212.13	4	8
6	Rendolls; Eutropepts	5943.25	5	10
7	Tropaquepts; Fluvaquents; Ustropepts	3970.34	1	2
8	Tropaquepts; Tropofluvents	41.64	1	2
9	Tropaquepts; Tropofluvents; Fluvaquents	64.77	1	2
Total		**14532.22**		

Slopes. The slope of the slopes in the Karaja sub-watershed varies greatly, from flat to very steep slopes. Areas that have a slope of <8% are sloping areas and are spread over Bantimurung District, Cenrana District, Simbang District, Tanralili District, Tompobulu District and Turikale District. Areas with slopes of > 45% are categorized as very steep and have a high risk of natural disasters. The areas with slopes > 45% are scattered in Bantimurung District, Cenrana District, Simbang District, Tanralili District and Tompobulu District.

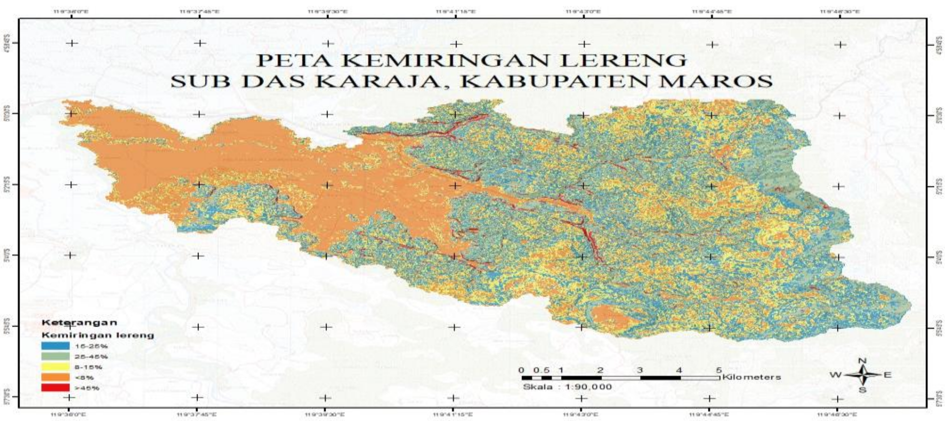

Figure 5. Slopes Map of Karaja Sub Watershed

Table 4. Slope of Karaja Sub Watershed

No	Slopes	Area (ha)	%	Skore	Weight
1	<8%	4940.54	34.00	1	4
2	8-15%	3601.26	24.78	2	8
3	15-25%	3472.15	23.89	3	12
4	25-45%	2289.52	15.75	4	16
5	>45%	228.75	1.57	5	20
Total		**14532.22**	**100.00**		

Land Closure. The Karaja Sub-Das has 7 categories of land cover. Secondary dryland forest is the most extensive land cover, which is more than 50%. The distribution of land cover in several districts is as follows:

1. Secondary land forests are scattered in Bantimurung District, Cenrana District, Simbang District, Tanralili District and Tompobulu District
2. Plantation forests are scattered in Cenrana District and Tompobulu District
3. Settlements are located in Bantimurung District and Simbang District. This is because the scope of the research is the Karaja sub-watershed area
4. Dry land agriculture mixed with shrubs is spread in Bantimurung District, Cenrana District, Simbang

District, Tanralili District, Tompobulu District and Turikale District

5. Rice fields are located in Bantimurung District, Cenrana District, Simbang District, Tanralili District, Tompobulu District and Turikale District
6. Shrubs are found in Cenrana District, Simbang District, Tanralili District and Tompobulu District
7. The body of water in the Karaja sub-watershed area flows in the Simbang District.

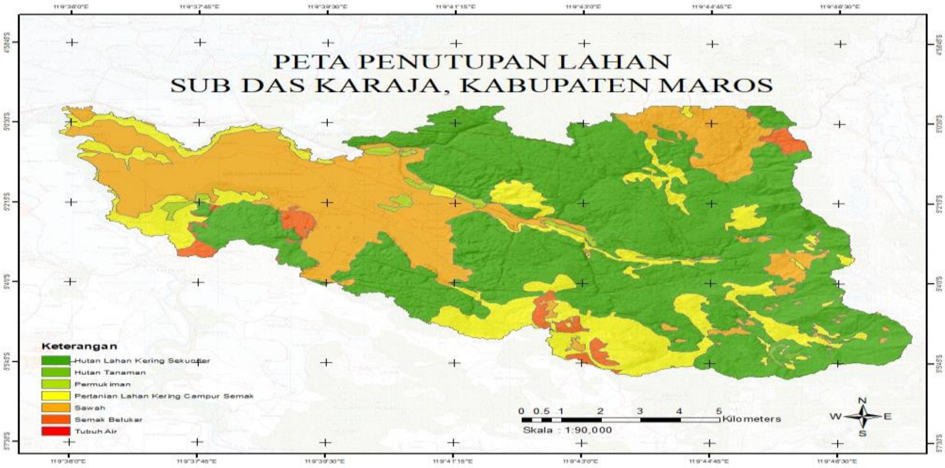

Figure 6. Land Closure Map of Karaja Sub Watershed

Table 5. Land Closure of Karaja Sub Watershed

No	Land Closure	Area	%	Skore	Weight
1	Secondary Dryland Forest	7883.26	54.25	3	12
2	Plantation Forest	20.90	0.14	3	12
3	Settlement	165.59	1.14	2	8
4	Shrub Mixed Dryland Agriculture	2318.97	15.96	3	12
5	Ricefield	3802.07	26.16	5	20
6	Shrubs	341.39	2.35	4	16
7	Water flow	0.04	0.00	1	4
Total		**14532.22**	**100**		

Disaster hazard map (landslide prode)

Determination of the level of vulnerability to landslides is based on the results of the cumulative score obtained from all parameters. The results of the total weighting are then converted at several levels as needed. In this study, 3 classes of vulnerability were used, namely low, medium and high. Classification for high vulnerability to landslides uses the lower limit, namely slope and soil type with a score of 3, land cover with a score of 4 and geology with a score of 2. This is because rainfall in the Karaja Sub-Das area is very high, which only has a score of 5. Classification of the class of moderate vulnerability has a lower class limit with the criteria: Slope and geology with a score of 2, Soil type and land cover with a score of 3 and Rainfall with a score of 5. Apart from the criteria previously mentioned, it is classified as a low vulnerability class. The area for each class and the total weighting can be seen in table 6.

Table 6. Classification of landslide prone classes

No	Vulnerability	Total of Weight	Area (ha)
1	Low	<69	1574.235
2	Moderate	69-77	4383.618
3	High	>77	8574.37
Total			**14532.22**

(Data Analysis, 2022)

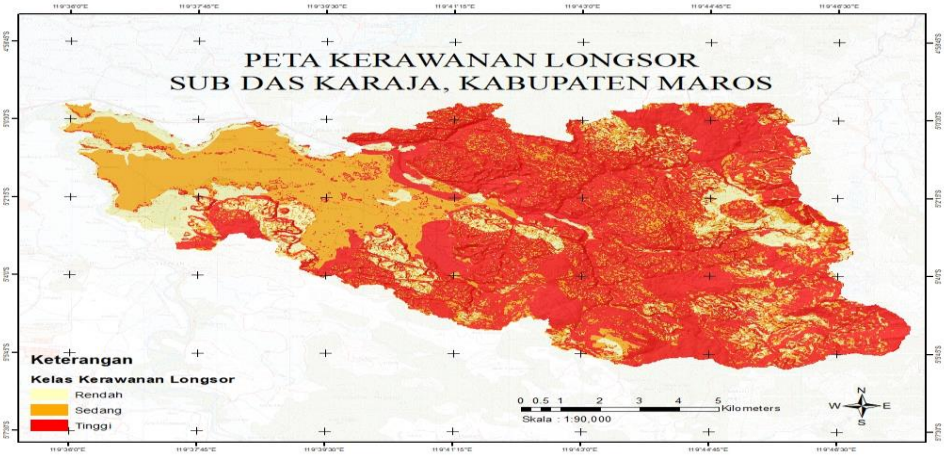

Figure 7. Landslide prone of Karaja Sub Watershed

Based on the analysis carried out, each sub-district that is covered in the Karaja Sub-Das needs to have a level of alertness against landslides.

IV. Conclusion

The area with a high level of vulnerability to landslides is 8574.37ha (>50%).

Suggestion: Further research needs to be done using geophysical methods such as microtremor so that it can be correlated between the results of microzonation data processing and GIS scoring processing data

References

[1]. Amir. 2014, "Uji Karakteristik Curah Hujan dan debit Pengaliran Sungai Maros Kab. Maros Sulawesi Selatan". Jurnal Forum bangunan: Vol 12 Nomor 2.

[2]. Suaib dan A. Qashlim, 2016, "Sistem Inventarisasi Daerah Rawan Bencana Berbasis GIS (Studi Kasus: Kecamatan Tapalang, Sulawesi Barat)

[3]. Nasiah dan Invanni I, 2014, Identifikasi Daerah Rawan Bencana Lahan Sebagai Upaya Penanggulangan Bencana di Kabupaten Sinjai, Jurnal Sainsmat, Hal. 109-121 Vol. III, ISSN 2086- 6755 http://ojs.unm.ac.id/index.php/sainsmat

[4]. Nugroho, J.A., Sukojo, B.M., Sari, I.L, 2011, Pemetaan Daerah Rawan Dengan Penginderaan Jauh Dan Sistem Informasi Geografis (Studi Kasus Hutan Lindung Kabupaten Mojokerto), Program Studi Teknik Geomatika, FTSP, ITS - Sukolilo, Surabaya, LAPAN (Lembaga Penerbangan dan Antariksa Nasional), Jakarta.

[5]. A. L. Nugraha. 2018, "Peningkatan Akurasi dan Presisi Analisa Spasial Pemodelan Banjir Kota Semarang Menggunakan Kombinasi Sistem Informasi Geografis Dan Metode Logika Fuzzy," Teknik, vol. 39, no. 1, hal. 16–24.

[6]. F. Faizana, A. L. Nugraha, dan B. D. Yuwono. 2015, "PEMETAAN RISIKO BENCANA TANAH LONGSOR KOTA SEMARANG," J. Geod. Undip, vol. 4, no. 1, hal. 223.

[7]. R. Rahmad, Suib dan A. Nurman. 2018, "Aplikasi SIG untuk pemetaan tingkat ancaman longsor di Kecamatan Sibolangit, Kabupaten Deli Serdang, Sumatera Utara. Majalah Geografi Indonesia, Vol.32, No.1, ISSN 0125-1790.

[8]. Damanik, M. R. S., & Restu, R. (2012). Pemetaan Tingkat Risiko Banjir dan Longsor Sumatera Utara Berbasis Sistem Informasi Geografis. JURNAL GEOGRAFI, 4(1), 29-42.

[9]. Muhtar. 2015, Pemanfaatan Citra Topografi Menggunakan Transformasi Watershed pada DAS yang Rawan Bencana Alam. Media Teknik Sipil, ISSN 1693-3095, hal 64-68.

[10]. S. Hettiarachchi, C. Wasko, dan A. Sharma. 2018, "Increase in flood risk resulting from climate change in a developed urban watershed- the role of storm temporal patterns". Hydrology and Earth System Sciences., 22, 2041-2056.

[11]. S. Doocy, A. Daniels, S. Murray, S., dan T. Kirsch. 2013, "The Human impact of floods: a historical review of events 1980-2009 and systematic literature review". PLOS Current Disasters, 5, 1-29.

[12]. T. G. Mamo. 2015, Evaluation of The Potential Impact of Rainfall Intensity Variation due to Climate Change on Existing Drainage Inrastructure. J. Irrig.Drain. Eng., 141, 1-7.

[13]. B. Laurensz, F. Lawalata dan S. Y. J. Prasetyo. 2019, Potensi Resiko Banjir dengan Citra Satelit (studi kasus: Kota Manado, Provinsi Sulawesi utara). Indonesian Journal of Computing and Modeling, e-ISSN:2598-9421, 17-24.

[14]. Nirmayanti, Rahmaniah, dan Sri Zelviani. 2017, "Identifikasi daerah Rawan longsor di kecamatan camba Kabupate Maros Menggunakan Mikrotremor". JFT.No.2, Vol.4, Desember 2017.

[15]. A.Y. Effendi dan T. Hariyanto. 2016, "Pembuatan Peta Daerah Rawan Bencana Tanah Longsor dengan Menggunakan Metode Fuzzy logic (Studi Kasus: kabupaten Probolinggo)". Jurnal Teknik ITS Vol. 5, No.2, ISSN:2337-3539.

[16]. A. A. Arbain dan Dodi Sudiana. 2015, "Deteksi daerah rawan longsor menggunakan data geospasial dan satelit berbasisi sistem informasi geografis (Studi kasus provinsi Banten, DKI Jakarta dan Jawa Barat). Departemen Teknik elektro uniersitas Indonesia.

[17]. G. Sitanggang. 2010, "Kajian Pemanfaatan Satelit Masa Depan : Sistem Penginderaan Jauh Satelit LDCM (Landsat-8)," Ber. Dirgant., vol. 11, no. 2, hal. 47– 58

Andi Nurul Mukhlisa, et. al. "Inventory of Lanslide Prone Area in Karaja Watershed (Maros Regency, Indonesia)."*IOSR Journal of Environmental Science, Toxicology and Food Technology (IOSR-JESTFT)*, 16(10), (2022): pp 01-04.