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Land Suitability Analysis for Settlement Areas in Tilamuta District, Boalemo Regency

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Abstract

Tilamuta Subdistrict which is the capital of Boalemo Regency is directed as a Regional Activity Center (PKW) which has a function as a government center, urban settlement area, education area and trade and service area, but only about 35 percent of the total area of Tilamuta Subdistrict can be maximized as a function. built area. The purpose of this study was to determine the suitability of land for urban settlement areas in Tilamuta District. The analytical technique used is the overlay method using a Geographic Information System (GIS) from slope data, rainfall, morphology, soil type, land use and spatial pattern planning directions in Tilamuta District, which is then scored to determine the classification of land suitability of the area. settlement. The results showed that there were 4 land suitability classifications, namely: suitable (402 ha), quite suitable (4202 ha), less suitable (5223 ha), not suitable 8831 ha.

Keywords: Land Suitability, Settlement, Geographic Information System

Introduction

The house/settlement is a primary human need, which has a function as a place of shelter and also a place for families to do their daily activities. The house also has a big role in shaping the character of the family (National Standardization Board, 2004). The need for houses/settlements/dwellings is increasing over time, so the provision of houses is an important thing that must be done. The increasing need for settlements, especially in urban areas, requires the preparation of plans for optimizing land use in urban areas.

Boalemo Regency in the Gorontalo Provincial Spatial Plan 2011-2031 is included in SWP III with the function of developing a certain area, and is centered in Tilamuta District. Tilamuta Subdistrict is directed as a Regional Activity Center (PKW) which has the following functions (1) An urban area located on the coast which has the function and potential to support the marine economy nationally. (2) Urban areas that have the function and potential to become centers of industrial and service activities serving the provincial and inter-district scales; (3) Urban areas that have the function and potential to become the second node of export-import activities and support PKN; (4) Urban areas that have the function and potential to become transportation nodes serving the provincial and inter-district scales.

A study on determining the location of settlements in urban areas, especially in Tilamuta District, needs to be carried out with the consideration that many residential/housing area developments are carried out without a good plan, especially in terms of physical and environmental aspects. The purpose of this study is to determine the suitability of land for settlements in Tilamuta District by conducting a spatial analysis so that results will be obtained in the form of suitable or suitable locations for development.

Theoretical Discussion

Branch (1995) in Pontoh et al. (2009), explains that, in fact urban areas have various elements and components, both physically visible such as public infrastructure and housing and those that are not visible in the form of legal and political forces and other activities that lead to urban activities. These urban elements interact with each other and simultaneously the city/urban area is seen as a complex system in the history of human civilization. Comprehensive urban area planning is needed to answer these challenges, making it possible for planners to provide recommendations with various interventions to develop urban areas that provide benefits for the people who live in them (Pontoh et al., 2009).

Jayadinata (1999) describes land use as a regulation. Land use does not only explain the use on land but also in the ocean. The word Tata has the meaning of rules or rules so that everything can be in accordance with the norms of life, while Land Use is all activities that occur on the ground in using and utilizing the land surface. The term land use means land regulations that are adapted to the desired land use arrangement (Mulyono, 2008). Regulation of the Minister of State for Agrarian Affairs / Head of the National Land Agency Number 1 of 1997 explains that the use of land in urban areas is a form of activity in using land where the use of land focuses on non-agricultural land parcels in a broad sense. The intended non-agricultural land parcels can be in the form of: (a) Residential Land is a residential group that has a house building as a place to live and has environmental supporting facilities and infrastructure; (b) Service Land are parcels of land used for a social and cultural service activity for the city community carried out by legal entities and/or community organizations, government or private which focuses on activities aimed at non-commercial services; (c) Industrial lands are fields used to support economic activities that have a commercial nature and/or as a place to conduct transactions of goods or services. Generally used by legal entities or government-owned enterprises; (d) Land No Building is parcels of land in urban areas whose conditions have not been or are not used for urban development; (e) Open Land are parcels of land that are not built and function as open spaces or plants; (f) Non-Urban Land is an area of land/plots of land within an urban area which is used for agricultural activities in a broad sense.

Land suitability has a classification quoted from FAO (1976) which is distinguished according to its level: order, class, subclass, and unit. Order is defined as a general suitability where at that level the classification is distinguished according to (Suitable = S) and not suitable (Not Suitable = N) (Adewole Osunade, 1988). In this case, the class is a level below the order (Suganda, 1988). Based on this, the land suitability class in detail is divided into: (1) The suitable order (S) is classified into three levels, namely very suitable (S1), moderately suitable (S2) and marginally suitable (S3) and the unsuitable order (N) is not classified into a certain level. This applies to the type of detailed scale mapping (1:25000 – 1:50000); (2) Further scale mapping (1:100000 – 1:250,000) classes are classified as suitable (S), conditionally suitable (CS) and not suitable (N) (Suprapto, 2016).

Table 1. Classification of Land Suitability Classes

Class	Classification	Information
S1	Very Appropriate	Land does not have a real or visible limiting factor when juxtaposed with sustainable land use, or there are limiting factors whose influence is not so significant that it will not reduce land productivity in a sustainable manner.
S2	Quite Appropriate	There are limiting factors that have quite an influence on land productivity and usually require additional inputs. These factors can generally still be overcome without changing the structure significantly

S3	Marginal as Per Marginal	There are severe limiting factors, and they have a great influence on productivity. It requires more input than the S2 classification, where large capital is needed and often intervention from the government or the private sector is needed because these factors are very difficult to overcome on their own.
N	Not Appropriate	The land is not suitable because there are limiting factors that are very difficult or even impossible to overcome.

Source: Module 5 Land Suitability Survey Basic Irrigation Planning Technical Training (Suprapto, 2016).

The criteria for determining the feasibility of land for settlements based on the guidelines for technical criteria for cultivated areas include:

Characteristics of location and land suitability; (1) Not located in an area that is prone to disasters (landslides, floods, erosion, abrasion); (2) It has a flat to undulating landscape (slope of the slope 0 - 25%); (3) Has good to moderate drainage; (4) There are water sources, both sourced from groundwater and water that have been treated by the organizers in sufficient quantities. For PDAM water, the water supply is between 60 liters/org/day - 100 liters/org/day; (5) Avoiding rice fields with a technical irrigation system; (6) Not in a protected forest area; (7) Not located in the border area of the coast / river / reservoir / spring / lake / irrigation channel / or railway and aviation safe area; (8) Not located in a buffer area / agricultural cultivation.

Methods

Research Approach Techniques

The research approach method used is from the physical and land use aspects to determine the ability and suitability of land in Tilamuta District. In general, this approach can be carried out with strategic proximity which includes a review of the policies of Tilamuta District in spatial and regional terms related to regional spatial plans, medium development plans, and detailed spatial plans that have direction for the function of each region.

Analytical Techniques

The analysis technique carried out is overlay or overlapping on land suitability variables, which are then scored to get a score for land suitability in the planning area.

Table 2. SKL Scoring Classification of Water Availability in Tilamuta District

Morphology	Score	Slope Slope	Score	Soil Type	Score
Plain	3	0 – 8%	4	Latosol, latosol	3
Hills	2	8 – 15%	3	- Latosol, lithosol - Mediteran Red Yellow - Brown Forest Soil	2
Mountains	1	15 – 25%	2	Mediteran Red Yellow	2
		>25 %	1	Podzolic Red Yellow	1

Table 3. Classification of SKL Scoring against Erosion in Tilamuta District

Morphology	Score	Slope Slope	Score	Soil Type	Score
Plain	3	0 – 8%	4	Latosol, latosol	3
Hills	2	8 – 15%	3	1. Latosol, lithosol 2. Mediteran Red Yellow 3. Brown Forest Soil	2

Mountains	1	15 – 25%	2	Mediteran Red Yellow	2
		>25 %	1	Podzolic Red Yellow	1

Source: 2022 analysis results

Table 4. Classification of SKL Scoring against Disasters in Tilamuta District

Morphology	Score	Slope Slope	Score	Soil Type	Score
Plain	3	0 – 8%	4	Latosol, latosol	3
Hills	2	8 – 15%	3	- Latosol, lithosol - Mediteran Red Yellow - Brown Forest Soil	2
Mountains	1	15 – 25%	2	Mediteran Red Yellow	2
		>25 %	1	Podzolic Red Yellow	1

Table 5. Classification of SKL Scoring against Disasters in Tilamuta District

Land Use	Score	Rainfall	Score	Earthquake Prone	Score	Prone to Landslides	Score
Settlements	4	- 1250 mm/year - 1750 mm/year - 2250 mm/year	1	Stable	3	Low	3
Secondary dryland forest, Primary mangrove forest, secondary mangrove forest	3			Less Stable (Typology A, Typology B, Typology C)	2	Keep	2
Shrubs	2			Unstable	1	Tall	1
Dryland farming, bush mix dryland farming	1						

Table 6. Classification of SKL Scoring for Drainage in Tilamuta District

Morphology	Score	Slope Slope	Score	Soil Type	Score
Plain	3	0 – 8%	4	Latosol, latosol	3
Hills	2	8 – 15%	3	- Latosol, lithosol - Mediteran Red Yellow - Brown Forest Soil	2
Mountains	1	15 – 25%	2	Mediteran Red Yellow	2
		>25 %	1	Podzolic Red Yellow	1

Table 7. Classification of SKL Scoring for Drainage in Tilamuta District

Land Use	Score	Rainfall	Score
Settlements	4	- 1250 mm/year - 1750 mm/year - 2250 mm/year	1
Dryland farming, shrubs/shrubs, plantations	3		
Secondary dryland forest, Primary mangrove forest, secondary mangrove forest	2		

Source: 2022 analysis results

Based on the criteria and location characteristics for the suitability of residential areas according to Permen PU No. 41 of 2007, *an analysis of map overlaying* and scoring was carried out in Table 8.

Table 8. Methods of Land Suitability Scoring Analysis for Residential Areas

Criterion	Information		Score
Slope slope	0 – 8 %	Flat	4
	8 – 15 %	Ramps	3
	15 – 25 %	A bit steep	2
	25 – 40 %	Steep	1
	> 40 %	Very Steep	
SKL Water Availability	Tall		4
	Keep		3
	Low		2
	Very Low		1
SKL Against Erosion	Tall		4
	Keep		3
	Low		2
	Very Low		1
SKL Against Natural Disasters	Tall		4
	Keep		3
	Low		2
	Very Low		1
SKL Drainage	Tall		4
	Keep		3
	Low		2
	Very Low		1
Regional Spatial Direction	Cultivated Area	Rural Settlements Urban Settlements	4
		Other Designations Industrial Designation	3
		Agriculture Dryland Farming / Fields Plantation	2
		Wetland/Paddy Farming	1
	Protected Areas	Protected Forest Production Forest Hutan Rakyat Border Area (River/Beach/Lake)	

Source: Results of the 2021 study

The development of settlements in Tilamuta District is still centered on the main road network, which consists of residential houses, religious facilities, educational facilities, trade and service facilities, public facilities and government facilities. Tilamuta sub-district is planned as the center of government and the center of the education area, but the location of government offices is still not centralized and is not located in one area.

Residential areas/residential houses or places where people live, especially residential areas are also still not entirely in accordance with applicable standards. Quoted from the Regent's Decree

Number 007/249/VI/2021 concerning the Determination of the Location of Slum Housing and Slums in Boalemo Regency, that the area of slum settlements in Tilamuta District reaches 149,607 ha in terms of building conditions, environmental road conditions, drinking water supply conditions, drainage conditions. environment, conditions of waste water management and solid waste management (Hamer, 2003). This condition was mostly found in Bajo Village, West Pentadu Village, East Pentadu Village and Ayuhulalo Village.

The area of Other Use Areas (APL) in Tilamuta District is ±66.86 km2 from an area of 186.88 km2 or only about 35% of the Tilamuta District area which can be maximized as a built-up area (source: Results of Forest Area Map Analysis in Boalemo District). Related to this, the slope in Tilamuta District is also dominated by steep slopes, which is approx., where only about 26% of the area has a flat morphology suitable for development as an urban area.

Table 9. Area (Ha) According to Slope in Tilamuta District

No.	Village	Village Area (Ha)	Slope (Ha)				
			0 - 8%	8 - 15%	15 - 25%	25 - 40%	>40%
1	Ayuhulalo	6096	535	87	708	4137	629
2	Bajo	112	112	-	-	-	-
3	Hungayonaa	216	216	-	-	-	-
4	Lahumbo	4662	844	-	238	3066	514
5	Lamu	886	794	49	43	-	-
6	Limbato	60	60	-	-	-	-
7	Modelomo	267	258	-	-	9	-
8	Mohungo	382	276	-	1	105	-
9	Western Pentadu	331	331	-	-	-	-
10	Eastern Pentadu	427	90	153	-	184	-
11	Piloliyanga	4553	704	-	318	3390	141
12	Tenilo	696	239	34	223	200	-
Total (Ha)		**18688**	**4459**	**323**	**1531**	**11091**	**1284**
Percentage			24%	2%	8%	59%	7%

The results of the analysis of the Land Capability Unit (SKL) consisting of SKL for Water Availability, SKL for Erosion, SKL for Natural Disasters and SKL for Drainage resulted in an SKL classification consisting of High, Medium, Low, Very Low with the results shown in Table 10 to Table following:

Table 10. Area Based on Water Availability of Tilamuta District

No.	Classification	Area (Ha)	Information
1	Land Capability of High Water Availability	832	The land has low rainfall but is located in a residential area, a relatively flat soil surface (slope 0-8%) and latosol soil types that tend to be strong in erosion so that they are able to store groundwater reserves
2	Land Capability from Moderate Water Availability	3810	The land has low rainfall but is located in residential areas, dryland agriculture and plantations, flat to sloping ground surfaces (slope 0-15%) and latosol soil types that tend to be strong in erosion so that they are able to store groundwater reserves

3	Land Capability from Low Water Availability	3552	The land has low rainfall, is in dryland, shrub and forest farming, the soil surface is relatively steep (slope 15-25%) and is mediteran and brown forest soil which is sensitive to erosion so that it is less able to store groundwater reserves
4	Land Capability from Very Low Water Availability	10494	The land has low rainfall, the soil surface is very steep (slope >25%) and the podzolic type is very sensitive to erosion so it is less able to store groundwater reserves
Total		**18688**	

Source: Analysis Results, 2022

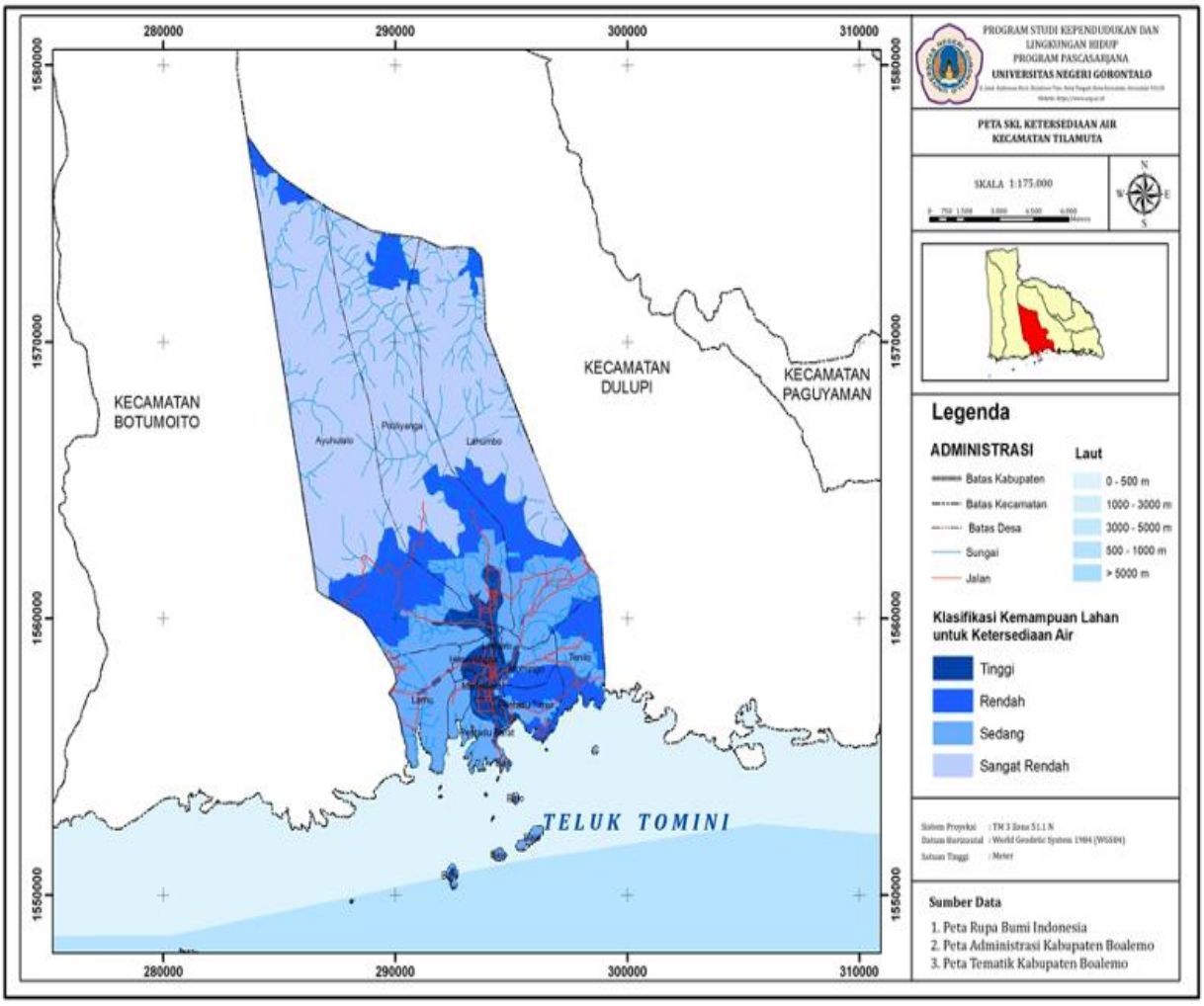

Figure 1. Skl Map of Water Availability in Tilamuta District

Table 11. Area Based on Drainage Skl tilamuta district

No.	Classification	Area (Ha)	Information
1	High Drainage Capability	6447	Lands with low rainfall are in residential areas, the soil surface is relatively flat (slope 0-8%) and latosol soil types are strongly inclined to erosion.
2	Medium Drainage Capability	5035	Lands with low rainfall are in residential areas, dryland agriculture and plantations, flat to sloping soil surfaces

			(slope 0-15%) and latosol soil types that tend to be strong in erosion
3	Low Drainage Capability	2604	The land has low rainfall, is in dryland, shrub and forest farming, the soil surface is relatively steep (slope 15-25%) and is of the mediterranean and brown forest soil types that are sensitive to erosion
4	Very Low Drainage Capability	4602	The land has low rainfall, the soil surface is very steep (slope >25%) and podzolic type is very sensitive to erosion
Total		**18688**	

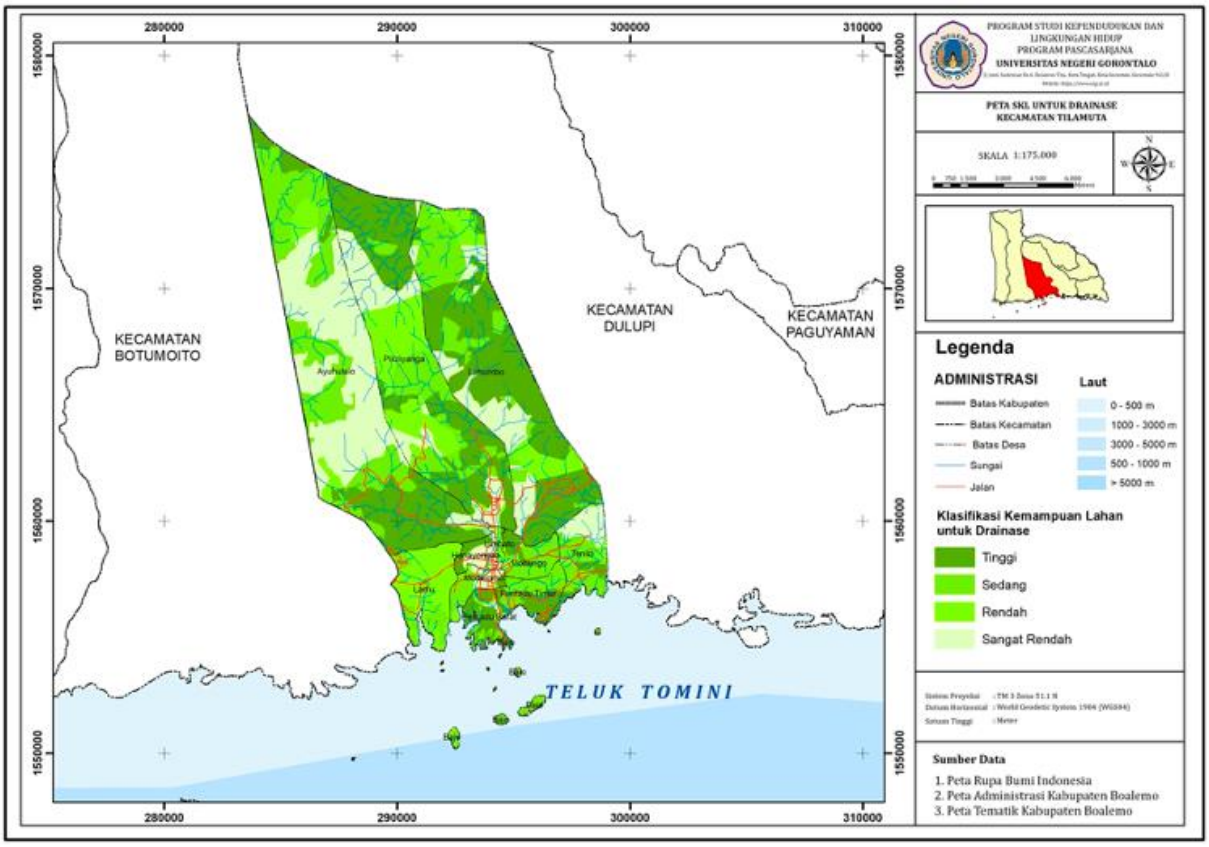

Figure 2. SKL Map for Drainage of Tilamuta District

Table 12. Area Based on SKL Against Erosion of Tilamuta District

No.	Classification	Area (Ha)	Information
1	Land's Ability to Resist High Erosion	448	The land is on a relatively flat surface (0-8%), residential land use, rainfall is low and has a latosol soil type that has a low level of sensitivity to erosion
2	Land's Ability to Resist Moderate Erosion	3161	The land is on a relatively flat to sloping surface (0-15%), residential and forest land use, rainfall is low and has a latosol soil type that has a low level of sensitivity to erosion

3	Land's Ability to Resist Low Erosion	8189	The land is on a relatively steep surface (15-25%), bushland and forest land use, rainfall is low and has mediteran soil types and brown forest soils that are sensitive to erosion
4	Land's Ability to Resist Erosion is Very Low	6890	The land is on a very steep surface (>25%), the use of dryland agricultural land, rainfall is low and has podzolic soil types that are very sensitive to erosion
Total		**18688**	

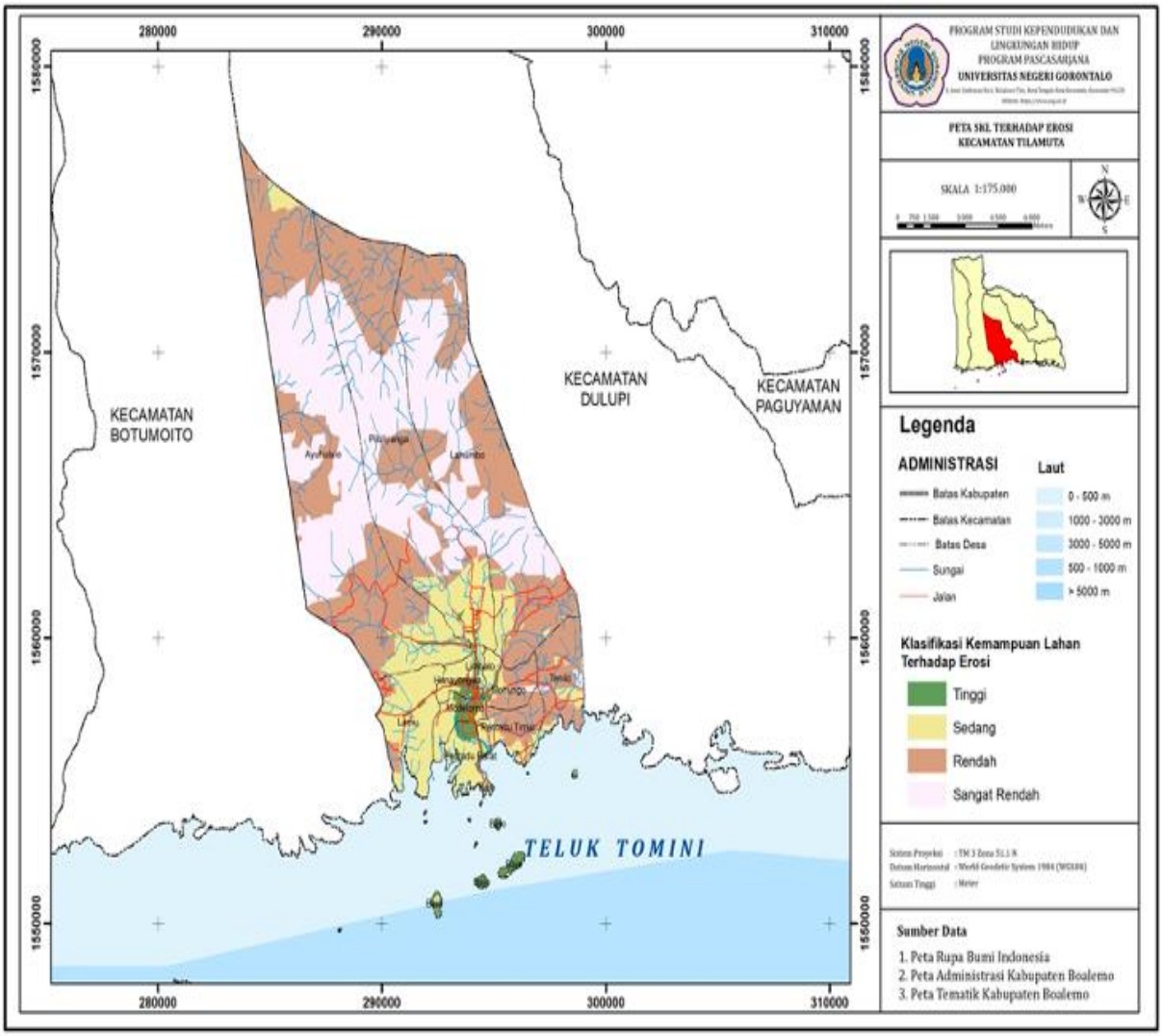

Figure 3. SKL Map against Erosion of Tilamuta District

Table 13. Area Based on SKL against Tilamuta District Disaster

No.	Classification	Area (Ha)	Information
1	High Disaster Capability	629	The land is on a relatively flat surface (0-8%), residential land use, rainfall is low and has a latosol soil type that has a low level of sensitivity to erosion
2	Land Capability Against Moderate Disasters	3356	The land is on a relatively flat to sloping surface (0-15%), residential and forest land use, rainfall is low and has a latosol soil type that has a low level of sensitivity to erosion

3	Low Disaster Land Capability	12688	The land is on a relatively steep surface (15-25%), bushland and forest land use, rainfall is low and has mediteran soil types and brown forest soils that are sensitive to erosion
4	Land's Ability to Resist Disasters Is Very Low	2015	The land is on a very steep surface (>25%), the use of dryland agricultural land, rainfall is low and has podzolic soil types that are very sensitive to erosion
Total		**18688**	

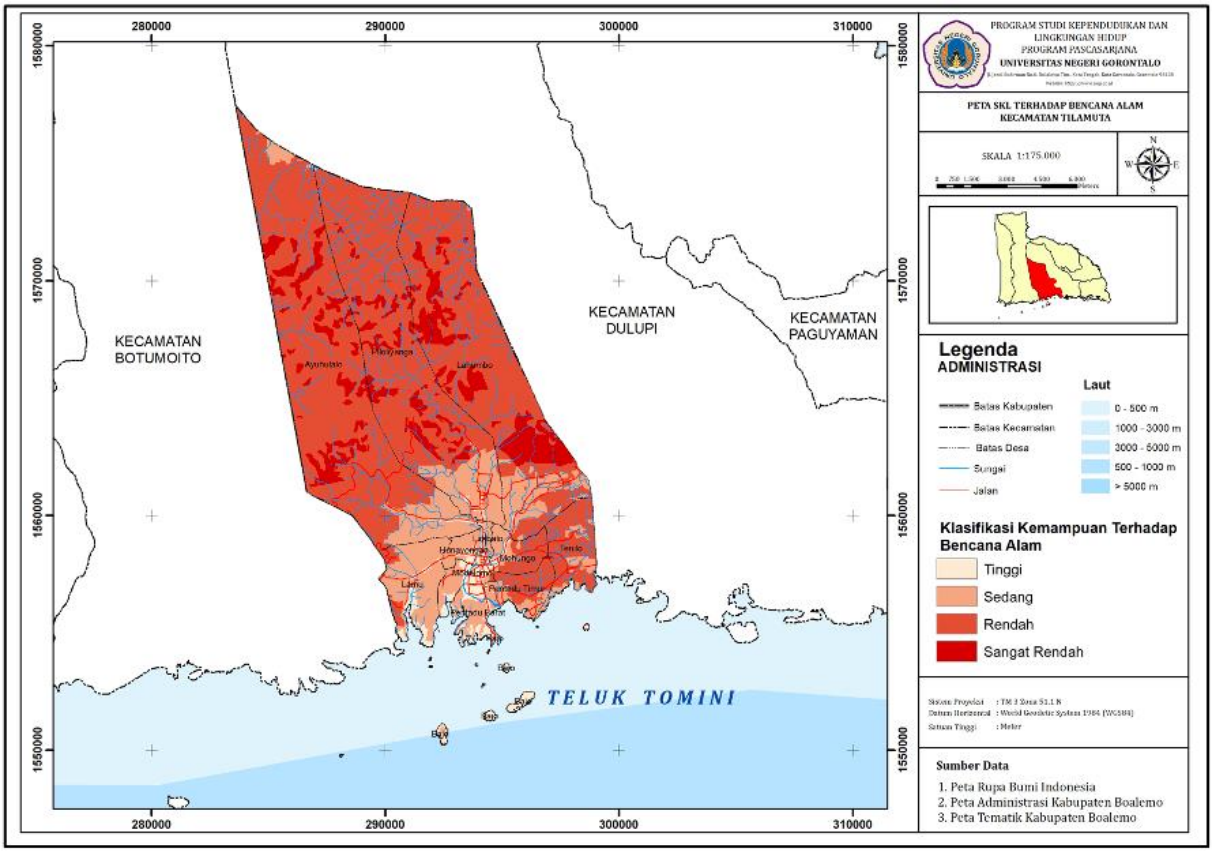

Figure 4. SKL Map of Natural Disasters in Tilamuta District

The results of the analysis of the suitability of urban settlement land in Tilamuta District show that there are 4 classifications of suitability of residential land in Tilamuta District, namely The Appropriate Zone (S1) covering an area of 402 ha, the Corresponding Sufficient Zone (S2) covering an area of 4202 ha, the Inappropriate Zone (S3) covering an area of 5223 and the Inappropriate Zone (N) covering an area of 8831 ha.

No.	Classification	Area (Ha)	Information
1	Suitable Zone (S1) to Be Developed as a Residential Area	402	The zone is mostly already in the form of an existing urban settlement area, has excellent land capabilities and is in accordance with the designation of spatial planning directives as a residential area. The area is in the center of Tilamuta city and is the seat of government of Boalemo District
2	Zones Are Suitable Enough (S2) to Be Developed as Residential Areas	4202	The zone is still around Zone S1 whose existing use is still partly residential areas and partly dryland/shrub farming. Have good land capabilities / good enough to be developed as an urban area. It can be a direction to develop residential areas where Zone S1

			can be focused on becoming the center of government and education according to the spatial direction of Boalemo Regency.
3	Less Suitable Zone (S3) Developed as a Residential Area	5253	The zone is located on a slope that tends to be steep, and soil conditions are more suitable for directing to the development of dryland farming. It is located outside the forest area, but there is a fairly high disaster vulnerability where it requires additional capital to make the zone a residential area.
4	Non-Conforming Zone (S4) to be Developed as a Residential Area	8831	The zone is not recommended to be developed as a residential area. It is in a forest area and is mostly on a steep/very steep slope, and is not intended as a built-up area
Total		**18688**	

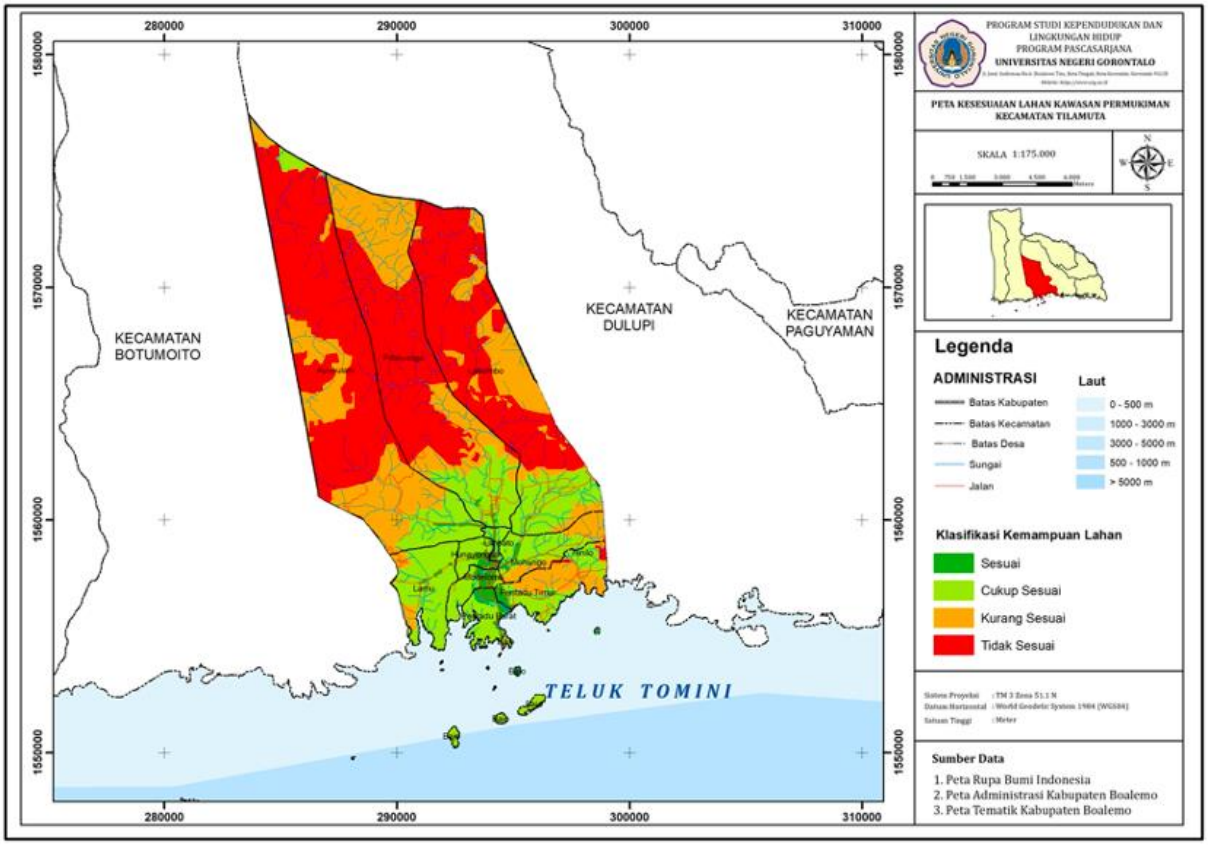

Figure 5. Land Suitability Map of Residential Areas in Tilamuta District

Conclusion

The results of the study concluded that there are four (4) land suitability classifications in Tilamuta District, namely the Suitable Zone (S1) covering an area of 402 ha, Sufficiently Appropriate Zone (S2) covering an area of 4202 ha, Unsuitable Zone (S3) covering an area of 5223 and Incompatible Zone (N) covering an area of 8831 ha. An inappropriate zone means that the zone is not intended to be built as a residential area because it is located in a forest area or will be designated as a forest area. The S1 zone can be directed to the development of government centers and trade and service areas, while the development of residential areas or residential residential areas can be developed in the S2 zone which is still around the S1 zone. Zone S3 can be developed as dry agricultural land or plantation area, while Zone N can be returned to its original function as a forest area.

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