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PATTERNS FOR HANDLING EROSION HAZARDS AND LAND CRITICALITY IN THE BAUMATA WATERSHED IN KUPANG DISTRICT

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ABSTRACT

Baumata watershed is located in Kupang district. The land use conditions are mostly forests, paddy fields, with low root depth and play a major role in the process of causing soil damage, accelerating the rate of erosion and increasing the volume of surface runoff. This research examines the current level of erosion hazard in the existing land use of the Baumata Watershed and its area by considering the Regional Spatial Planning (RTRW) of Kupang Regency and its surroundings in the Baumata Watershed. The method used to calculate the rate of erosion is the MUSLE method where the method uses an approach from the surface runoff factor. The data processing uses a Geographic Information System (GIS). The erosion rate watershed is 3,402,685 tons/ha/year with a watershed area of 2,439.35 ha. Land rehabilitation and soil conservation (ARLKT) directions that are appropriate for the conditions of the Baumata watershed are 87 annual crop cultivation areas. 21 % (2,127.42 ha), Seasonal Plant Cultivation Areas 10.67 % (260.38 ha), and Buffer Areas 2.11 % (51.55 ha). The existence of data and information on the magnitude of erosion rates and land criticality in the Baumata watershed in Kupang district can be used to anticipate early landslide disasters in the area.

Keywords: Erosion; Land Criticality; MUSLE; GIS.

1. Introduction

A watershed is a land area that is topographically limited by mountain ridges that collect and store rainwater and then channel it to the sea via the main river. This land area is called a water catchment area (DTA or catchment area) which is an ecosystem whose main elements consist of natural resources (soil, water, and vegetation) and human resources as the utilization of natural resources [1].

The emergence of critical land is an indication of less than optimal land use, the harmony between use and conservation efforts is still not balanced. This problem will affect socio-economic life around the Watershed [15]. Currently, almost all large rivers in Indonesia have been classified as critical watersheds. Meanwhile, in terms of the erosion rate, it can be stated that the erosion rate in several rivers in Indonesia is very high [2].

Policies related to watershed management should encourage the implementation of land management practices that are conducive to preventing land and water degradation. It must always be realized that the costs incurred for watershed rehabilitation are much more expensive than the costs incurred for efforts to prevent and protect the watershed [16].

The Baumata Watershed is one of the watersheds in Kupang Regency which contributes large amounts of river water to the downstream part [17] of Kupang City. However, along with the extraordinary increase in forest damage resulting in greater potential for floods and landslides and increasing from year to year, improvements to management aspects regarding the management of

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the Baumata watershed must be carried out immediately in addition to repairing facilities and infrastructure that have been damaged by the disaster [18].

2. Materials and Method

Baumata watershed is a cross-regional watershed, namely it is right on the border between the Kupang City area and Kupang Regency. The Baumata watershed is a cross-regional watershed, namely it is right on the border between the Kupang City area and Kupang Regency. There are 10 (ten) sub-districts/villages included in the Baumata watershed, including: 7 villages in Kupang district, namely Tarus Village, East Penfui Village, Baumata Village, North Baumata Village, West Baumata Village, East Baumata Village, Oeltua Village, and 3 sub-districts in Kupang City, including: Lasiana Village, Penfui Village and Kolhua Village.

2.1 Data and Tools

The data used in this research includes:
- Annual Rainfall Data for the last 10 years.
- Rain Gauge Station Map.
- Noelmina River Area Unit Map
- Watershed map.
- Existing land use map, land slope, land height.
- Land use map.
- Data on geological conditions.
- Map of soil solum depth, soil texture and soil structure.
- Population data.

All data in the form of spatial data (maps) will be digitized to obtain a digital map in CAD format with the same scale and coordinates. Then exported as vector data for the ArcView GIS program. The equipment used includes software from geographic information systems (GIS), namely Autodesk Map 2004, ArcView GIS 3.3, and Surfer Ver.8.0 as well as Ms Office for data analysis and a set of computers.

2.2 Methodology

The stages of analysis carried out in the study are:

1. Average Rainfall

The average rainfall [12] data analyzed is in a certain period. Determination of the value of rainfall is taken according to the rain observation station (SPH) in the region [13]. The rain observation stations taken according to (planning) have at least 3 comparison stations for data consistency and homogeneity. This method is used to calculate the average rainfall by taking into account the area of influence of each station.

There are 3 types of methods used to determine the average rainfall height over a certain area from rainfall figures at several measuring or recording post points, namely [3][20] the arithmetic Method, the Polygon Thiessen method, and the Isohyet method [14][19]. By regional conditions and the distribution of rain observation stations [21]. The Polygon Thiessen method of average rainfall is used. The formula for determining average rainfall is the Thiessen Polygon Method as follows:

$$\mathrm{P} = \frac{A_1 P_1 + A_2 P_2 + \ldots + A_n P_n}{A_1 + A_2 + \ldots + A_n}$$

Where P is the regional average rainfall (mm). P1, P2, …, Pn is the rainfall recorded at rain gauge posts 1, 2, …n. A1, A2, …, An is the area of polygons 1, 2, …n. n is the number of rain gauge posts.

2. Design Rainfall Analysis

In planning this design rain, the Log Pearson III method was chosen [4] with the consideration that this method is more flexible and can be used for all data distributions. The stages for calculating maximum design rainfall using the Log Pearson III method.

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Calculate the logarithm of design rainfall with a certain return period

$$LogX = \overline{LogX} + G.Sd$$

Where :
Log x = Logarithm of design rainfall.
$\overline{Logx}$ = Logarithm of average rainfall.
G = Constant (from table)
Sd = Standard deviation.

3. Probability Distribution Testing

The probability distribution test is carried out to determine which probability distribution equation can be used to show the statistical distribution of the sample data being analyzed.Testing the suitability of rain data can be determined using Chi-square and Kolmogorov Smirnov.

4. Rain Intensity

Rain intensity analysis is determined by three methods, namely: Bell, Van Breen, and Hasper Weduwen.

5. Land Use

This understanding shows that land is a landscape where all living things live and survive by making use of it.

6. Flow Coefficient

The value of the flow coefficient is used to determine the design debris in the testing area. For determining the flow coefficient with the following equation:

$$Cm = \frac{C_1.A_1 + C_2.A_2 + \dots\dots\dots + C_n.A_n}{A_1 + A_2 + \dots\dots\dots + A_n}$$

$$Cm = \frac{\sum_{i=1}^{n} C_i.A_i}{\sum_{i=1}^{n} A_i}$$

Where:
Cm = Average drainage coefficient.
C1, C2, …, Cn = Flow coefficient according to surface conditions.
A1, A2, …, An = Area of drainage area adjusted to surface conditions

7. Planning Debt

In drainage planning, in general, the discharge calculation used is the rational method. The calculation of the design discharge is used to determine the value of the peak flood plan discharge in an area. The formula for calculating the planned flood discharge using the rational method is as follows.

Q = 0,00278 .Cs. C.I.A

Where:
Q = Planning debt (m3 /sec)
C = Surface flow coefficient
I = Rainfall intensity (mm/hour)
A = Watershed area (ha)

8. Estimation of Erosion Rates Based on the MUSLE / MPUKT Method

To estimate the amount of erosion in this study, the MUSLE (Modified Universal Soil Loss Equation) or MPUKT (Midified Universal Soil Loss Equation) method was used. This method is a modification of USLE (Universal Soil Loss Equation) or PUKT (Universal Soil Loss Equation).
The equation of MUSLE [5] as below:

A = Rw x K x L x S x C x P

Where:
A = Amount of soil loss per unit area of land (tons/ha)
Rw = Surface runoff erosivity index (mm).
K = Soil erodibility index.
L = Slope length factor.

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S = Slope factor.
C = Plant factor/ground cover vegetation factor.
P = Plant management action factor.

9. Estimated Land Criticality

a. Permissible Erosion (Edp)

Calculate the allowable erosion value based on the equivalent depth of soil and the expected sustainability of soil resources (age) using the equation:

Edp = (Equivalent soil depth/Soil sustainability)

b. Erosion Level (TBE)

The erosion level (TBE) is obtained by comparing the level of erosion on a land unit with the effective depth. The classification of erosion hazard levels can be seen in the following table:

Table 1. Classification of erosion hazard levels

Erosion Soil Solum (cm)	Erosion Class (ton/ha/year)				
	I (<15)	II (15-60)	III (60-180)	IV (180-480)	V (>480)
A. High (> 90)	SR	R	S	B	SB
B. currently (60-90)	R	S	B	SB	SB
C. shallow (30-60)	S	B	SB	SB	SB
D. very shallow (<30)	B	SB	SB	SB	SB

Source: Utomo, WH, 1994

10. Land Capability Classification

The work carried out to assess the factors that determine the usability of land, then grouping or categorizing land uses according to their characteristics is called 'Land Capability Classification'.

11. Soil Rehabilitation and Conservation Patterns

The RLKT pattern land conservation program (Land Rehabilitation and Soil Conservation) is a long-term plan (25 years) that contains general directions regarding:

1. Use/utilize land according to its capabilities.
2. RLKT methods or techniques for each land use area
3. The priority order for handling watersheds or sub-watersheds is according to their level of criticality.

RLKT pattern conservation program format which is implemented at the watershed or sub-watershed scale in Java and consists of land use directions, RLKT directions, and the order of watershed criticality levels.

12. Geographic Information Systems (GIS)

GIS is a computer system that has the following four capabilities in handling geographically referenced data: [a] Input, [b] Data management (data storage and retrieval), [c] Data analysis and manipulation, [d] Output. In GIS, data is stored in digital format, large amounts of data can be stored and retrieved quickly and efficiently. Another advantage of GIS is the ability to manipulate data and analyze spatial data by linking data or attribute information to unite different types of data in a single analysis [6].

3. Results and Discussion

3.1 Delineation of the Baumata Basin

Before hydrological analysis is carried out, this study first determines the catchment area or watershed in the river and tributaries of the Baumata River. The process of determining the Baumata watershed requires Digital Elevation Model (DEM) data and river network maps which can be downloaded on the official website https://www.tanahair.indonesia.go.id/portal-web belonging to the Geospatial Information Agency (BIG).

The total area of the Baumata watershed resulting from watershed delineation using ArcSWAT is 2,439.3505 Ha.

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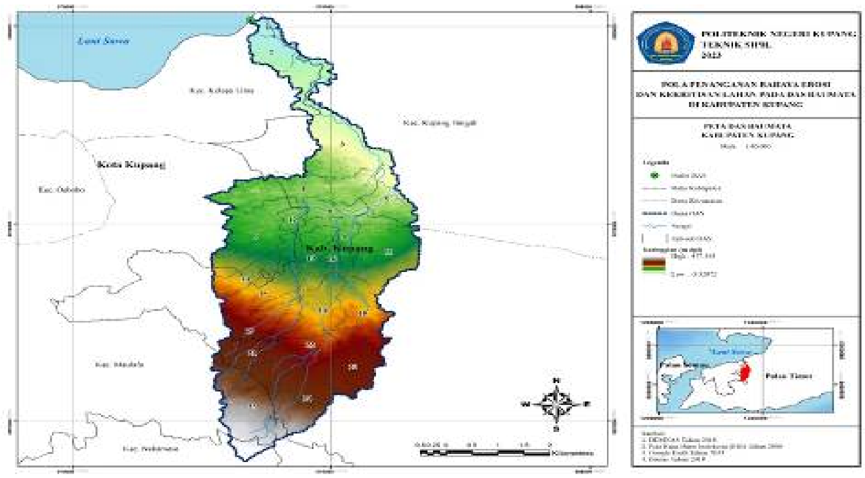

Figure 1. Baumata Watershed
Source: Arc GIS 10.8 Analysis, 2023

3.2 Average Rainfall Analysis

Based on data on the distribution of rain stations sourced from BWS Nusa Tenggara II and BMKG Lasiana Kupang, there are three rain stations closest to the Baumata River, namely the BMKG Lasiana Rain Post, the BMKG El Tari Rain Post and the Tarus Rain Post. Hydrological analysis requires regional average daily rainfall data with a minimum period of ten years. Analysis of regional average rainfall in this study uses the Thiessen Polygon method considering the condition of the study area which has an uneven distribution of rain posts.

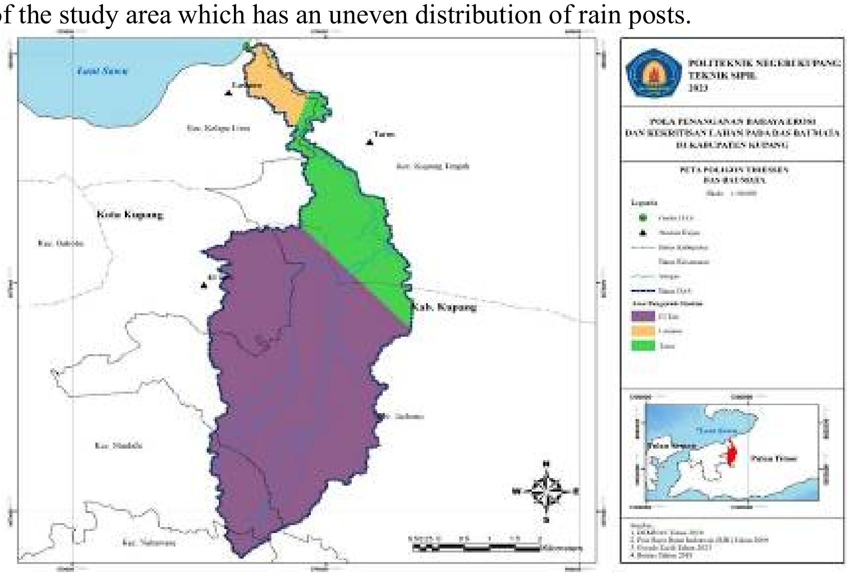

Figure 2. Thiessen Polygon of the Baumata Watershed
Source: Analysis Arc GIS 10.8, 2023

From the analysis results, El Tari Rain Station has the largest area ofinfluence, namely 1,868,797 Ha (76.61%), after that Tarus Station 456,096 Ha (18.70%), and finally Lasiana Station 11,4457 Ha (4, 69 %). The results of the regional average maximum daily rainfall analysis are presented in Table 2.

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Table 2. Average Rainfall

No.	Year	Thissen Coef			Average Rainfall (mm)
		St Lasiana	St El Tari	St Tarus	
		0.047	0.766	0.187	
1	2012	1210.70	1191.00	1166.50	1187.342
2	2013	1916.80	2128.00	2264.60	2143.629
3	2014	1393.00	1579.10	1598.50	1573.994
4	2015	1355.10	1290.21	1585.50	1348.465
5	2016	865.90	1106.30	964.00	1068.413
6	2017	1428.80	1606.70	1631.50	1602.988
7	2018	1331.70	1433.80	1318.00	1407.356
8	2019	957.60	1035.00	1060.50	1036.135
9	2020	1237.40	1224.70	1283.50	1236.289
10	2021	2050.20	2680.80	2172.50	2556.170

Source: Analysis, 2023

3.3 Design Rainfall

Design rainfall is the largest rainfall that may occur in an area with a certain opportunity. In this study, the design rainfall analysis method used is the Log Pearson Type III method.

Table 3. design rainfall analysis method used is the Log Pearson Type III method

No	Tr (year)	R average (Log)	Sd (log)	Skew. Coef (Cs)	Prob. (%)	K	Rainfaal Design	
							Log	mm
[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]
1	1.01	2.07	0.20	0.82	99	-1.721	1.71	51.86
2	2	2.07	0.20	0.82	50	-0.135	2.04	109.18
3	5	2.07	0.20	0.82	20	0.778	2.22	167.59
4	10	2.07	0.20	0.82	10	1.337	2.34	217.82
5	25	2.07	0.20	0.82	4	1.997	2.47	297.04
6	50	2.07	0.20	0.82	2	2.461	2.57	369.23
7	100	2.07	0.20	0.82	1	2.902	2.66	454.29
8	1000	2.07	0.20	0.82	0.1	4.266	2.94	861.57

Source: Analysis, 2023

3.4 Design Discharge Calculation

Calculated rainwater runoff discharge, several things must be used, namely the land use of the research area, so that we can determine the flow coefficient in the research area. Determining the discharge of rainwater runoff using the rational method;

$Qah = 0.278 \times C \times I \times A$. The work steps are as follows.

Watershed Area Calculation (A)

Calculation of the area of the drainage area uses the Arcgis 10.3 application following the calculationsteps:

1. Collect data that will be used in making the map that will be used, namely administrative data, and road network data, this data is in the form of a shp file.
2. Enter data into the ArcGis 10.3 application
   a. Input the shp file used
   b. Input the layer into ArcGis 10.3 so that the lines and flow boundaries appear

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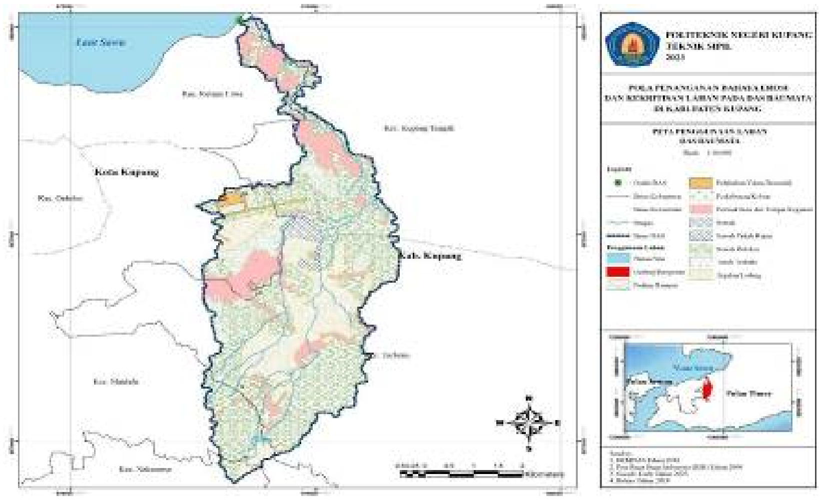

Figure 3. Land Use of the Baumata Watershed
Source: Arc GIS 10.8 Analysis, 2023

Table 4. Baumata Watershed Runoff Discharge

No	Sub-sub watershedS	Area Sub-sub DAS (Ha)	Q Return Period 1.01 year (m^3/sec)	Q Return Period 2 year (m^3/sec)	Q Return Period 5 year (m^3/sec)	Q Return Period 10 year (m^3/sec)	Q Return Period 25 year (m^3/sec)
1	1	190472.71	1.134834	2.389245	3.667560	4.766763	6.500400
2	2	602068.89	6.008536	12.650185	19.418404	25.238283	34.417262
3	3	2670175.56	3.924409	8.262326	12.682912	16.484101	22.479247
4	4	1903085.08	4.963661	10.450336	16.041573	20.849382	28.432150
5	5	825997.46	3.068735	6.460820	9.917546	12.889929	17.577901
6	6	458324.92	2.212009	4.657094	7.148776	9.291331	12.670521
7	7	34482.13	1.070618	2.254047	3.460028	4.497031	6.132568
8	8	625125.43	4.158139	8.754418	13.438287	17.465868	23.818077
9	9	1817016.57	3.921767	8.256767	12.674380	16.473010	22.464124
10	10	838038.87	4.515288	9.506348	14.592521	18.966037	25.863847
11	11	1884680.87	4.774862	10.052847	15.431414	20.056353	27.350703
12	12	445325.74	2.444454	5.146477	7.899993	10.267695	14.001981
13	13	34961.05	4.765385	10.032893	15.400784	20.016544	27.296415
14	14	618694.22	8.077757	17.006657	26.105717	33.929846	46.269883
15	15	1009765.32	4.269750	8.989400	13.798992	17.934681	24.457393
16	16	211339.86	1.862612	3.921486	6.019596	7.823726	10.669157
17	17	274625.52	1.819529	3.830779	5.880358	7.642757	10.422371
18	18	1325098.93	9.306796	19.594237	30.077726	39.092306	53.309891
19	19	956673.79	3.508578	7.386850	11.339032	14.737446	20.097348
20	20	1122926.90	12.554028	26.430863	40.572146	52.732003	71.910244
21	21	1053004.81	3.102447	6.531795	10.026497	13.031532	17.771005
22	22	634224.87	7.819842	16.463653	25.272190	32.846502	44.792535
23	23	1006139.24	3.988756	8.397803	12.890874	16.754391	22.847841
24	24	1657605.11	3.975412	8.369709	12.847748	16.698339	22.771403
25	25	2193651.69	4.439960	9.347753	14.349075	18.649628	25.432361
	Total	**24393505.52**					

Source: Analysis, 2023

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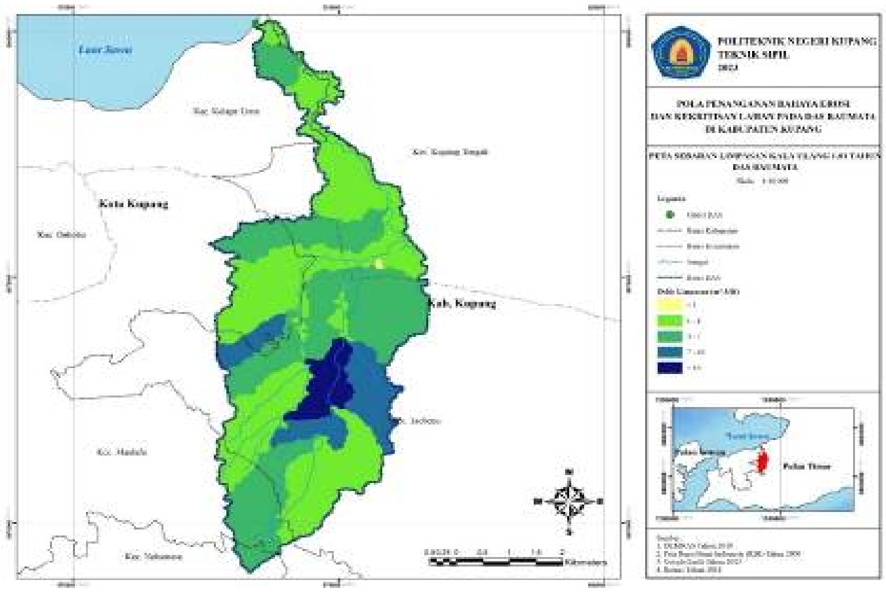

Figure 4. Distribution of surface runoff discharge at the 1.01 return period of the Baumata watershed
Source: Arc GIS 10.8 Analysis, 2023

3.5 Erosion Rate Analysis MUSLE Method

a. Surface Runoff Erosivity Index (Rw)

Estimate the sediment results from each surface runoff event by replacing the rain erosivity index with surface runoff erosivity (Rw) with the formula:

$Rw = 9.05x(Vo.\ Qp)^{0.56}$

In this study, the Rw value is calculated per Baumata sub-watershed. Thus, the monthly average rainfall (R) and rainy days (Rn) are the same for all 25 sub-watersheds, which is the regional average of 3 (three) rain stations.

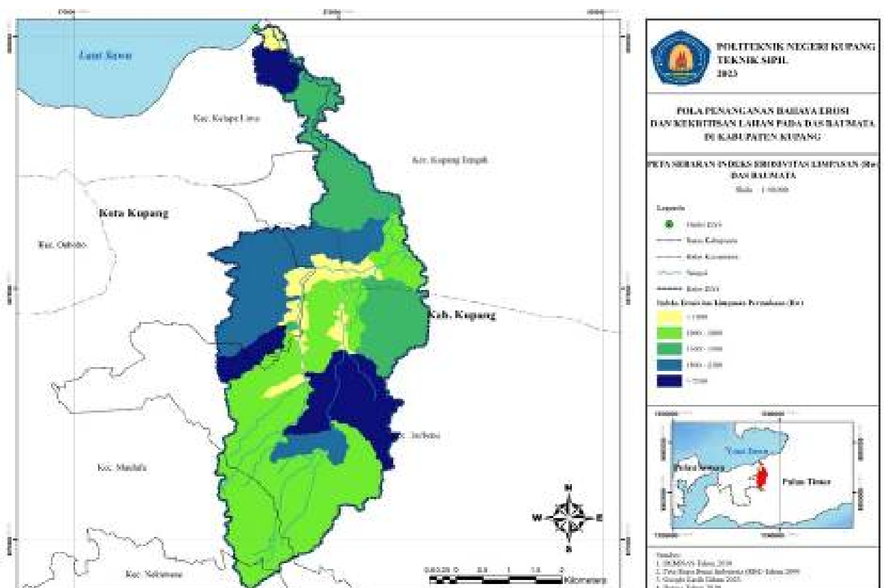

Figure 5. Distribution of Surface Runoff Erosivity Index (Rw)
Source: Analysis Arc GIS 10.8, 2023

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b. Soil Erodibility Index Analysis (K)

Soil that has a high erodibility (K) value with the same rainfall will erode more easily than soil with a low erodibility (K) level. K values are estimated by looking at the map and referring to the tables listed in the reference. The K factor data is entered into the attribute data on the soil type map.

Table 5. Data on Soil Types for the Baumata Watershed

No.	Type of soil	K Factor	Area (m^2)	Area (Ha)	Prosentage (%)
1	Red latosol	0.08	23.083.729.710	2.308.373	94.63
2	Complex of reddish-brown Mediterranean soil and lithosol	0.19	511.657.110	51.166	2.10
3	Gray alluvial and grayish brown alluvial	0.19	794.265.500	79.427	3.26
4	Regosol gray	0.30	3.853.250	0.385	0.02
		Total	**24.393.506**	**2.439.351**	**100**

Source: Analysis, 2023

c. Analysis of Slope Length (L) and Slope (S) Factors

Calculation of the slope length factor (L) is calculated using the equation as (Field Engineering Plan for Land Rehabilitation and Watershed Soil Conservation, Department of Forestry 1998):

Data on sub-watershed 1:

Lo = 1,205.239 m

$L = \sqrt{(1.205{,}239/22)} = 7.402$

for slope slope = 8.95% then based on the table the value of S = 1.4

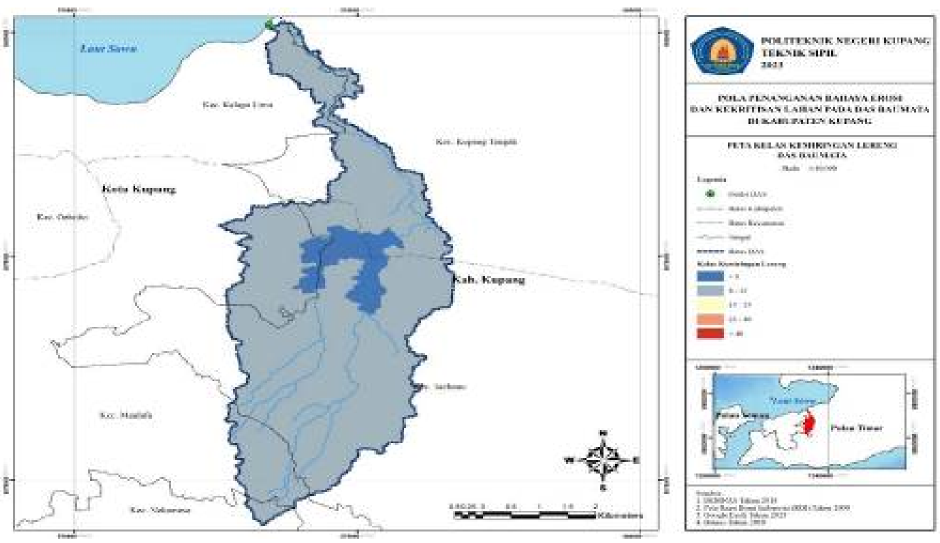

Figure 6. Distribution of slope classes for the Baumata watershed
Source: Analysis Arc GIS 10.8, 2023

d. Analysis of Crop Management Factors and Soil Conservation Action Factors (CP)

The values of plant management factors and soil conservation action factors (CP) for land use in the Baumata watershed can be seen in the table 6.

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Table 6. Crop Management Factors and Soil Conservation Action Factors (CP)

No	Land Use	CP Factor	Area (m^2)	Area (Ha)	Prosentase (%)
1	Lake/Situ	0.000	44739.981	4.474	0.18
2	Building	1.000	13978.813	1.398	0.06
3	grassland	0.010	2666467.660	266.647	10.93
4	Domestic Air Port	0.800	253948.991	25.395	1.04
5	Plantation/Garden	0.020	74601.967	7.460	0.31
6	Settlements and Places of Activity	0.200	3563505.714	356.351	14.61
7	Field	0.200	146714.274	14.671	0.60
8	Rain-Fed Rice Fieldsn	0.200	501206.064	50.121	2.05
9	Shrubs	0.010	12292031.883	1229.203	50.39
10	Open Land	1.000	8126.482	0.813	0.03
11	Moorland/Field	0.430	4828183.694	482.818	19.79
		Total	**24393505.522**	**2439.351**	**100.00**

Source: Analysis Return, 2023

e. Erosion Rate Analysis

The overlay results of the prediction of erosion rates in the Baumata watershed using the MUSLE method can be seen in Figure 8 and a summary of the calculations can be seen in Table 7.

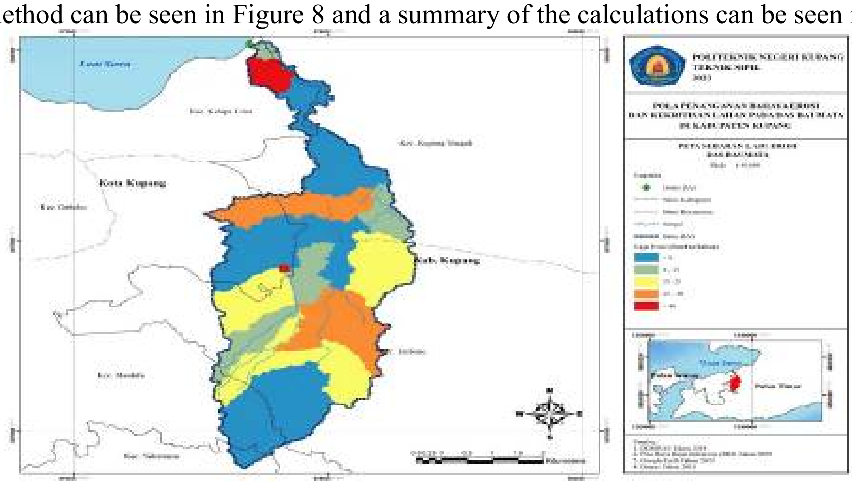

Figure 7. Distribution of land erosion rates in the Baumata watershed
Source: Arc GIS 10.8 Analysis, 2023

3.6 Erosion Hazard Level (TBE)

The soil solum in the Baumata watershed is predominantly less than 30 cm. This is the reason why most of the TBE in the Baumata DAS is of heavy value.

Table 7. Percentage of TBE in Baumata Watershed

No	Erosion Hazard Level (TBE)	Area (m^2)	Area (Ha)	Percentage (%)
1	Very Light	413796	41.38	1.70
2	Light	12148309	1214.83	49.80
3	Medium	3192935	319.29	13.09
4	Heavy	6226273	622.63	25.52
5	Very Heavy	2413479	241.35	9.89
	Total	**24394792**	**2439.48**	**100.00**

Source: Analysis, 2023

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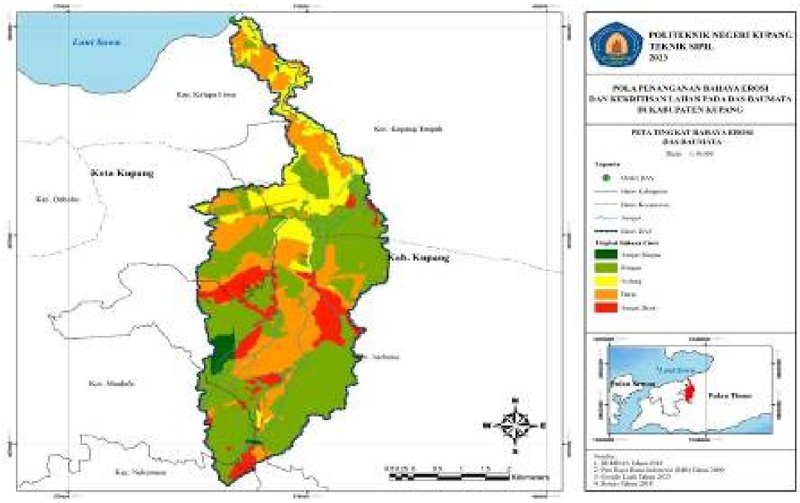

Figure 8. TBE of Baumata Watershed
Source: Arc GIS 10.8 Analysis, 2023

3.7 Land Capability Classification

Land capability classification aims to determine the capability of the land based on soil properties and limiting factors that influence the land for certain uses.

Table 8. Percentage of Land Capability Classes in the Baumata Watershed

No	Land Capability Classes	Area (m^2)	Area (Ha)	Percentage (%)
1	IIIe	478.18	0.05	0.00
2	IIIg	2354391.20	235.44	9.65
3	Ive	9418232.65	941.82	38.61
4	Ivs	10207051.79	1020.71	41.84
5	VIIe	2413351.69	241.34	9.89
	Total	**24393505.52**	**2439.35**	**100.00**

Source: Analysis Arc GIS 10.8, 2023

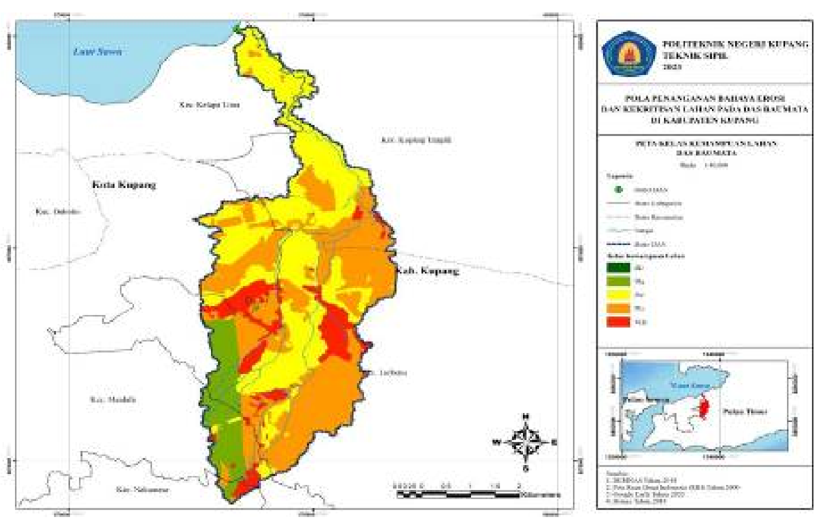

Figure 9. Land Capability Classes of the Baumata Watershed
Source: Arc GIS 10.8 Analysis, 2023

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3.8 Land Use Directions

Referring to the regional development plan of Kupang City and Kupang Regency and based on physical and environmental developments in the Baumata watershed area, directions for the utilization of the Baumata watershed can be determined. The coverage of areas designated as Protected Areas, Buffer Areas, Annual Crop Cultivation Areas, and Annual Crop Cultivation Areas/Settlements can be seen in the following figure.

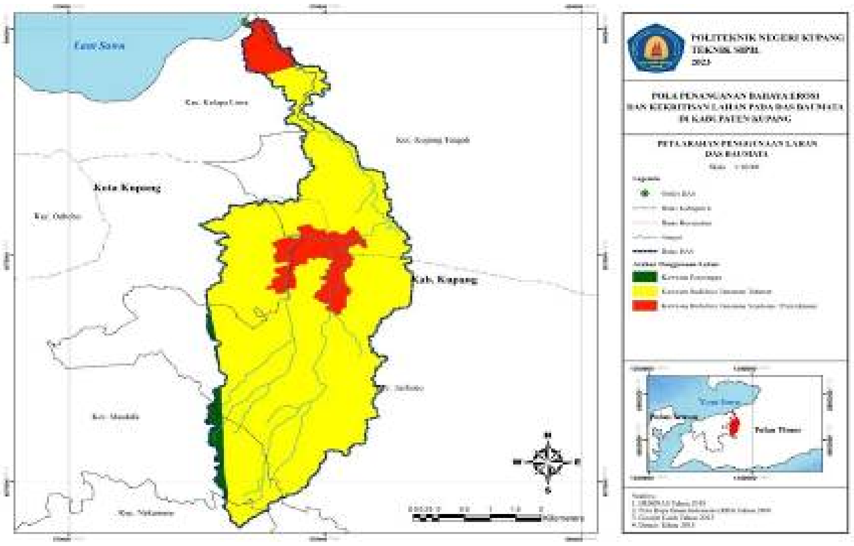

Figure 10. Land Use Directions for the Baumata Watershed
Source: Arc GIS 10.8 Analysis, 2023

Table 9. Percentage of Baumata Watershed Land Use Directions

No	Land Use Directions	Area (m^2)	Area (Ha)	Percentage (%)
1	Buffer Area	515510	51.55	2.11
2	Annual Crop Cultivation Area	21274171	2127.42	87.21
3	Seasonal Crop Cultivation Areas / Settlements	2603825	260.38	10.67
	Total	**24393506**	**2439.35**	**100.00**

Source: ArcView GIS 3.3 Spatial Analysis, 2023

3.9 Conservation of the Baumata Watershed

a. Vegetative Conservation

The results of the land capability class analysis in the Baumata watershed are dominated by Class IVs, then Class IVe, VIIe, IIIg and IIIe. For this reason, efforts to vegetatively conserve the Baumata watershed can be carried out by adjusting land use to the land capability class. The following are recommended Baumata watershed conservation efforts according to land capability classes.

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Table 10. Recommendations for Baumata Watershed Conservation Efforts Based on Land Capability Classes

No.	Land Capability Class		Area (Ha)	Percentage (%)	Soil Properties in Each Class	Recommendations for Conservation Efforts	Intensity/ Kind Land Use
1	IIIe	Class III	0,05	0,00	Very rough, covered in loose rock	Leave it as a protected forest, nature reserve, etc	Protected forest or nature reserve
2	IIIg	Class III	235,44	9,65	Very rough, covered in loose rock	Leave it as a protected forest, nature reserve, etc	Protected forest or nature reserve
3	Ive	Class IV	941,82	38,61	Very rough, covered in loose rock	Leave it as a protected forest, nature reserve, etc	Protected forest or nature reserve
4	Ivs	Class IV	1.020,71	41,84	Very rough, covered in loose rock	Leave it as a protected forest, nature reserve, etc	Protected forest or nature reserve
5	VIIe	Class VII	241,34	9,89	Very rough, covered in loose rock	Leave it as a protected forest, nature reserve, etc	Protected forest or nature reserve
		Total	**2.439,36**	**100,00**			

Source: Arc GIS 10.8 Analysis, 2023

b. Mechanical Conservation

Mechanical land conservation efforts aim to reduce the rate of surface runoff so that its destructive power is reduced and to collect surface runoff and then channel it through buildings or channels that have been prepared.

Table 11. Recommended Locations for Control Dams and Oeltua Reservoir Locations

No.	Building	Coordinate UTM Zone 51S		Village	District	Regency/City
		X	Y			
1	Check dam recommendations 1	573759.789	8869792.174	Kolhua	Maulafa	Kota Kupang
2	Oeltua Reservoir	573774.728	8870102.647	Kolhua	Maulafa	Kota Kupang
3	Check dam recommendations 2	575079.962	8874063.775	Baumata Utara	Taebenu	Kab. Kupang
4	Check dam recommendations 3	574235.578	8874664.759	Penfui	Maulafa	Kota Kupang

Source: Analysis, 2023

4. Conclusions

The rate of erosion currently occurring in the Baumata watershed is 3,402,685 tons/ha/year with a watershed area of 2,439.35 ha.The condition of the erosion hazard level, land criticality and land capability classification in the Baumata watershed, namely for TBE and land criticality, most of the conditions are Light 49.80% (1,214.77 ha), then Heavy 25.52% (622.59 ha), Medium 13 .09 % (319.28 ha), Very Heavy 9.89 % (241.34 ha) and Very Light 1.70 % (41.38 ha). The Land Capability Class consists of Class IVs 41.84% (1,020.71 ha), Class IVe 38.61% (941.82 ha), Class VIIe 9.89% (241.34 ha), and Class IIIe 0 .05 ha. Directions for land rehabilitation and soil conservation (ARLKT) that are suitable for the conditions of the Baumata watershed, namely Annual Crop Cultivation Areas of 87.21% (2,127.42 ha), Seasonal Crop Cultivation Areas of 10.67% (260.38 ha), and Seasonal Crop Cultivation Areas of 10.67% (260.38 ha), and Buffer of 2.11% (51.55 ha). Apart from vegetative conservation efforts, mechanical conservation efforts are also carried out by building control dams or check dams which are recommended in areas with

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Heavy and Very Heavy TBE. There are 3 recommendations for check dams in the Baumata watershed

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