
ALTERNATIVE MANAGEMENT OF RIVER WATERSHED WITH BATULESA METHOD FROM ENVIRONMENTAL ASPECTS

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ABSTRACT

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The research was conducted in the Meto Batulesa watershed, with a watershed area of 8,968 ha, located between two regencies, Kupang and Kupang city. The purpose of this research is to calculate the actual erosion rate and tolerable erosion, so that conservation alternatives can be found. Based on the map of land units, there are 19 land units that are then used for soil sampling, slope, observation of soil management and soil conservation. The sampling method used purposive sampling, the data taken to calculate erosion estimates using the Universal Soil Equation (USLE) method, while the erosion tolerance used the concept of equivalent depth and resource life based on (Hammer 1981) and (Arsyad 2010). The results of the study show that the highest actual erosion value of 225.68 tons/hectare/year and the lowest is 2.78 tons/hectare/year. The value of erosion tolerance among 19 land units, in which are 10 land units is above the erosion tolerance so that they require alternative management, while 9 of them are without conservation. Alternative management in the form of modifications to the values of C and P include 1. Terrace Gulud: Corn + Beans + Mulch of Plant Remnants, 2. Corn + Soybean with rotational cropping pattern + mulch of crop residues, 3. Bench terrace + corn cassava/soybean, 4. Secondary forest and 5. Primary forest.

INTRODUCTION

Efforts to overcome critical land in NTT by the government in carrying out conservation in NTT covering an area of 3,615 Ha/year so that the deviation between the rate of degradation and planting efforts reaches 4:1, if the deviation will increase sharply to 8:1 then the percentage of buildings and plants only reaches 50% of amount planted (Nama et al, 2016). Based on these data, it is necessary for conservation from the government to increase it to 50% again for maximum.

According (Kupang Department of Environment and Forestry, 2019), income Land degradation in the watershed in NTT is highly dependent on the integrated movement of all sectors and is supported by the availability of accurate and actual spatial data from competent data trustees. The cause of land degradation, namely the existence of forest land fires is one of the important inputs for watershed degradation, so it is necessary to arrange and regulate relevant regional regulations as well as strict sanctions against perpetrators of land and forest fire.

The real impact of degradation is erosion. One of the methods used to calculate the erosion rate is the Universal Soil Equation (USLE) method. This method is an erosion model designed to predict the average soil erosion in the long term from a farming area with a certain cropping and management system. The predicted form of erosion is sheet or groove erosion, but cannot predict deposition and does not take into account sediment yields from erosion of ditches, riverbanks, and riverbeds (Arsyad 2010). According to (Wischmeier & Smith, 1978), factors that affect the USLE equation are land use which plays a large role and is accompanied by conservation actions that will be carried out.

Several methods of vegetative soil conservation techniques are any use of plants or vegetation, or plant remains as a medium for protecting the soil from erosion, inhibiting surface runoff, and increasing soil moisture content, as well as improving soil properties, both physical, chemical and biological properties (Mulyandari & Susila, 2020). Mechanical soil conservation techniques or also known as civil engineering are efforts to cultivate agricultural land in accordance with the principles of soil conservation as well as water conservation. This technique includes mounds, mound terraces, bench terraces, individual terraces, credit terraces, contour bunds, garden terraces, stone rows, and stone terraces. Specifically for water harvesting purposes, mechanical conservation techniques include the construction of water catchment structures, *rorak*, and *dams* (Darjah et al, 2004).

One of the cross-regency watersheds on the island of Timor is Meto Batulesa. Meto Batulesa watershed with an area of 8,961 Ha which is located between two regencies, namely Kupang Regency and Kupang City. Based on the biophysics of the Meto Batulesa watershed, the average rainfall at 3 rain stations is Naioni 1,704.4 mm/year, Onesu 1,412.20 mm/year, and Bakunase 1,294.4 mm/year, accompanied by the type of soil *rensina* which is susceptible to hazards. Erosion and the slope ranges from 15-25% which is relatively steep and is supported by the use of land in the form of secondary dry land forest, dry land and shrub agriculture, and shrubs and open land. There is a change in land use to settlements and the shifting cultivation system practiced by farmers in the upstream area as well as the existence of former manganese mining by the community in the past. Upper Meto Batulesa watershed. This is thought to have caused erosion that occurred greater than the rate of soil formation or erosion that was tolerated. If the land management system in the upstream part of the Meto Batulesa watershed continues, it will certainly create new critical lands, while according to (RPJM-12 Kupang City, 2016), Naioni Village and Fatukoa Village are included in the protective area for the lower area with the aim of maintaining and revitalizing water catchment areas or areas that function hydrologically so as to ensure the availability of water resources.

The objectives of this research are to calculate the actual and tolerable erosion in the Meto Batulesa watershed, to provide conservation recommendations based on estimates of actual erosion and erosion tolerance in the Meto Batulesa watershed.

RESEARCH METHOD

The research location is located in the Meto Batulesa watershed, part of which is in the Kupang district and also the city of Kupang with a watershed area of 8. 967.66 Ha. Research (starting from May – June 2021). Field research for soil sampling using purposive sampling method or adjusted to the purpose so that the Stratified Random Sampling method is used so that it is distinguished from slope, land cover and soil type so that 19 land units were obtained.

The data collection carried out in this study used secondary data in the form of rainfall data from the Kupang BMKG, soil types from the Kupang district soil type map, Kupang district land cover map and slope map. Primary data in the form of soil sampling, soil profile observations, soil order determination, plant management observations and conservation actions.

The variable in this study is the rainfall in the Naioni, Bakunase, Oenesu areas. analyzed using the Bols 1978 formula to obtain the erosivity of rain. The K value was obtained from field and laboratory observations and adjusted to the K value based on (JICA, 1995). CP value used is based on (Abdurrahman. et al., 1984), and Arsyad 2000 while for erosion tolerance based on the age of use of the soil and the effective depth of the soil, field observations were carried out to determine the orders and sub-orders of soils with a taxonomy book guide (Department of Agriculture, 2015) so that the calculation of erosion tolerance is carried.

RESULTS AND DISCUSSION

a. Land

Of the 19 land units in the Meto Batulesa watershed, 2 types of soil were found, namely inceptisol soil and entisol soil.

Table 1 Soil Types in the Meto Batulesa Watershed

Sample	No. Unit Land	Type of soil USDA	Sub Order	Mark K
4	I	Inceptisol	Tropepts	0.07
1	II	Inceptisol	Tropepts	0.07
12	III	Entisol	Orthents	0.32
4	IV	Inceptisol	Tropepts	0.07
9	V	Inceptisol	Tropepts	0.07
8	VI	Entisol	Orthents	0.32
3	VII	Inceptisol	Tropepts	0.07
13	VIII	Inceptisol	Tropepts	0.07
12	IX	Entisol	Orthents	0.32
11	X	Inceptisol	Tropepts	0.07
14	XI	Inceptisol	Tropepts	0.07
7	XII	Inceptisol	Tropepts	0.07
2	XIII	Inceptisol	Tropepts	0.07
6	XIV	Inceptisol	Tropepts	0.07
14	XV	Inceptisol	Tropepts	0.07
10	XVI	Inceptisol	Tropepts	0.07
15	XVII	Inceptisol	Tropepts	0.07
14	XVIII	Inceptisol	Tropepts	0.07
12	XIX	Entisol	Orthents	0.32

Source: Research results and JICA, 2005

b. Slope

Table 2 Slope Class of Meto Batulesa Watershed

No	Slope class	Classification	Area_Ha	%
1	0 - 8%	Flat	3,417.52	38.11
2	8 – 15%	Sloping	3,996.75	44.57
3	15 – 25%	Slightly Steep	1553.39	17.32
4	25 -45%	Steep	-	
5	> 45	Very Steep -		
Total			8,967,66	100

Source: Based on Slope Class Map of Meto Batulesa watershed

Class slopes I is an area with a slope of 0-8% with a percentage of 38.11% of the total area of the entire research area. In this slope class the erosion hazard is relatively smaller. This is because the rain water that falls will not immediately flow in the form of surface runoff but will still be stuck on the ground surface and even infiltrate into the ground.

Class II is a slope with a slope of 8 -15% with an area percentage of 44.57% of the total area of the entire research area. The rate of erosion that occurs in this slope class is relatively higher than that of slope class I (if other erosion factors are the same) due to an increase in surface runoff which results in an increase in the strength to erode and transport soil particles.

For slope class III, a slope with a slope of 15-25% or a slightly steeper area of 17.32% of course the amount of erosion will be greater than the second slope class because it is included in the steep category.

c. Land Cover

Table 3 Table of C . Values

No	C Nilai Value	Sample
1	0.32 (tree without bush)	Sample 1
2	0.2 (Mixed Garden)	Sample 2
3	0.32 (tree without bush)	Sample 3
4	0.32 (tree without bush)	Sample 4
5	0.32 (tree without bush)	Sample 5
6	0.32 (tree without bush)	Sample 6
7	0.32 (tree without bush)	Sample 7
8	0.01 (undisturbed bush)	Sample 8
9	0.01 (undisturbed bush)	Sample 9
10	0.3 (shrub)	Sample 10
11	0.3 (shrub)	Sample 11
12	0.2 (mixed garden)	Sample 12
13	0.01 (undisturbed bush)	Sample 13
14	0.01 (undisturbed bush)	Sample 14
15	0.01 (undisturbed bush)	Sample 15

Source: Author's research results 2021

d. Rainfall

The R value is taken from the average monthly rainfall for 5 years and then calculated using the Bols formula (1978) and then. The classification is then used to determine the R value in the Meto Batulesa watershed with high rainfall classification, namely Naioni rain post, moderate rain classification, Oenesu rain post and low for Bakunase rain post.

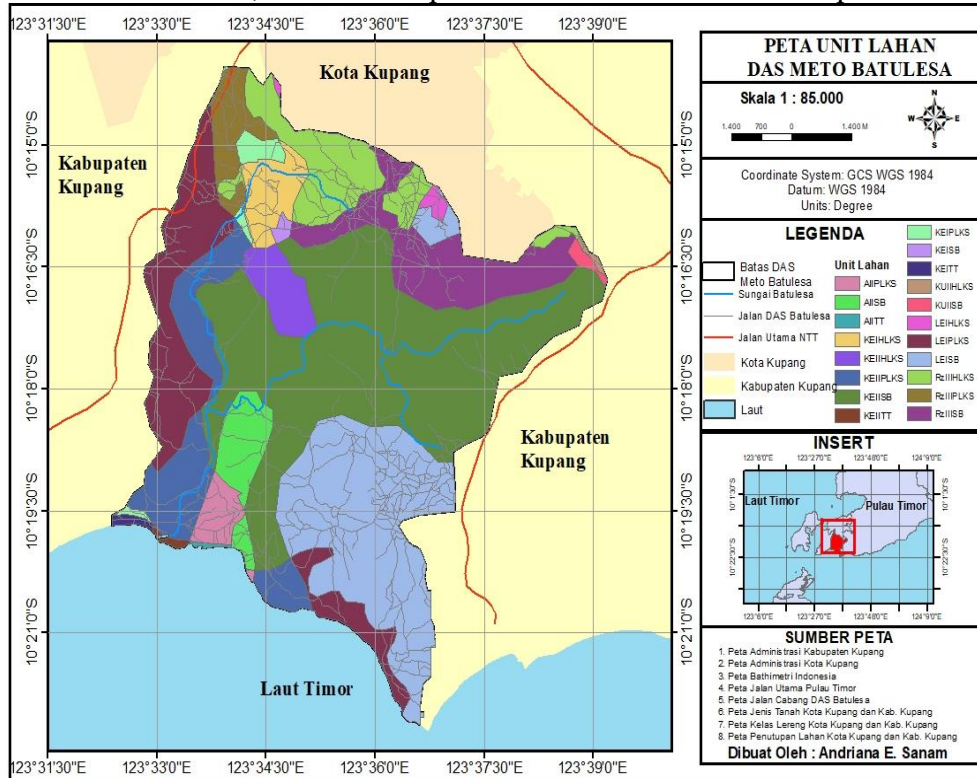


Figure 1 Map of Land Units in the Meto Batulesa watershed

e. Actual Erosion Value and Erosion Hazard Level

Table 4 Estimation of Actual Erosion in the Meto Batulesa Watershed

Unit Land	R	K	LS	C	P	A	Repr esent ative	Rain Post
I	1211	0.07	1.81	0.32	1	48.99	4	Naioni
II	1066	0.07	2.33	0.32	1	55.52	1	Oenesu
III	1066	0.32	0.71	0.20	1	48.61	12	Oenesu
IV	1211	0.07	1.81	0.32	1	49.00	4	Naioni
V	1211	0.07	3.16	0.01	1	2.68	9	Naioni
VI	1066	0.32	7.45	0.01	1	25.42	8	Oenesu
VII	1211	0.07	2.60	0.32	1	70.64	3	Naioni
VIII	1066	0.07	5.19	0.01	1	3.87	13	Oenesu
IX	1066	0.32	1.10	0.20	1	75.01	12	Oenesu
X	1066	0.07	1.01	0.30	1	22.67	11	Oenesu
XI	894	0.07	4.69	0.01	1	2.94	14	Bakunase
XII	1211	0.07	12.89	0.01	1	10.92	7	Naioni
XIII	1211	0.07	8.90	0.20	1	150.7	2	Naioni
XIV	1066	0.07	11.39	0.01	1	8,505	6	Oenesu
XV	1211	0.07	4.64	0.01	1	3.94	14	Naioni
XVI	1066	0.07	7.11	0.01	1	5.31	10	Oenesu
XVII	1066	0.07	7.42	0.01	1	5.53	15	Oenesu
XVIII	1211	0.07	3.28	0.01	1	2.78	14	Naioni
XIX	1066	0.32	3.31	0.20	1	225.68	12	Oenesu

From table 4, it can be seen that the erosion calculation using the USLE formula is the highest erosion on land unit 19 and the lowest on land unit 5. The high erosion rate on land unit 19 is caused by the length of the slope of 50 meters and landslides were found in that land unit.

Table 5 Erosion Rates in the Meto Batulesa Watershed

No.	Erosion Class	A (Erosion) Tons/Ha/Year	Land area
1	Class I	19.17	1,535,48
2	Class II	-	-
3	Class III	25,72	6594.07
4	Class IV	250,22	795.91
5	Class V	371.332	34.39

Source: 2021 data processing

From Table 5 the level of erosion hazard is obtained from the classification between soil solum and the amount of erosion per year so that the erosion hazard level (TBE) is included. The erosion hazard level in the Meto Batulesa watershed consists of four classes, including class I erosion, which is mild with the amount of erosion 19.17 tons/ha/year and the land area is 1,535.48 ha, the type of soil is inceptisol with a soil solum above 90 cm and the vegetation is shrubs. undisturbed, so that the rain that falls can be held in the bushes and there is little chance for surface runoff because the permeability is fast, and is on a slope of 0-8% flat to undulating 8-15% so that this is what causes erosion in this category. light.

For the medium category (III) erosion estimation is 25.72 tons/ha/year with a land area of 6.594.07 ha. The vegetation is in the form of undisturbed shrubs, trees without shrubs, and shrubs.

The level of erosion hazard with heavy category (IV) erosion value is 250.22 tons/ha/year with a land area of 795.91 ha, vegetation in the form of mixed gardens and trees without shrubs, as well as shrubs. Areas of heavy erosion are around Fatukoa, Oenesu and Naioni.

The classification of the erosion hazard level (V) is very heavy with an erosion estimate of 371.332 tons/ha/year with a land area of 34.39, the vegetation in the form of mixed gardens and the soil types are entisols and solum soils of 30-60 cm. The land use is in the form of open land, with a gentle to slightly steep slope. If the land cover is open land because there is no barrier to resist the flow of the soil surface, then erosion will certainly occur and is included in heavy erosion so that it is a priority scale for conservation.

Table 6 Erosion Tolerance Comparison

LAND UNITS	SOIL ORDER	SUB-ORDER	F K	Effective Depth (mm)	Depth equivalent	AGE USAG E (year)	T value
I	Inceptisol	Tropepts	1	600	600	400	1.5
II	Inceptisol	Tropepts	1	600	600	400	1.5
III	Entisol	Orthents	1	600	600	400	1.5
IV	Inceptisol	Tropepts	1	600	600	400	1.5
V	Inceptisol	Tropepts	1	600	600	400	1.5
VI	Entisol	Orthents	1	600	600	400	1.5
VII	Inceptisol	Tropepts	1	600	600	400	1.5
VIII	Inceptisol	Tropepts	1	800	800	400	2
IX	Entisol	Orthents	1	600	600	400	1.5
X	Inceptisol	Tropepts	1	600	600	400	1.5
XI	Inceptisol	Tropepts	1	900	900	400	2.25
XII	Inceptisol	Tropepts	1	900	900	400	2.25
XIII	Inceptisol	Tropepts	1	900	900	400	2.25
XIV	Inceptisol	Tropepts	1	600	600	400	1.5
XV	Inceptisol	Tropepts	1	900	900	400	2.25
XVI	Inceptisol	Tropepts	1	600	600	400	1.5
XVII	Inceptisol	Tropepts	1	600	600	400	1.5
XVIII	Inceptisol	Tropepts	1	900	900	400	2.25
XIX	Entisol	Orthents	1	600	600	400	1.5

Source: Data Processing 2021

The calculation of erosion tolerance is needed to determine the tolerance limit of the soil to be used. The method used in calculating the T value uses the concept of equivalent depth and resource life. The equivalent depth is the depth of the soil after it has been eroded.

Productivity reduced by 60% of the uneroded soil productivity. The value of the soil depth factor based on the sub-order of the soil multiplied by the effective depth of the soil will get the equivalent depth while the effective depth is the depth of the soil to a layer that inhibits the growth of plant roots. The equivalent depth is then divided by the useful life of the soil and then converted to tons/ha/year.

Comparison of actual erosion and tolerable erosion is very important to know because it has an important purpose as a determinant of whether conservation is needed or not. Based on this comparison, the $A < EDP$ value is in 1 land units (1, 2, 3, 4, 6, 7, 9, 10, 13, 15 and 19) which means that conservation is necessary. An alternative to reducing actual and modified erosion is the value of crop management factors or CP .

For the EDP value $> A$, it is in the land unit (5, 8, 11, 12, 15, 16, 17, and 18) so it does not require conservation but still maintains the carrying capacity of the environment.

f. Conservation Criteria

Land physical parameters

Table 7 Land Physical Parameters

Climate	Rainfall	1,136 mm Year
	Rainy day	103 days
Land physiography	Land slope	0-8 Plains 15-25 Steep
	Place Elevation	331 masl-350 masl
Landscape	Geomorphology	
	Land appearance (Relief)	Lowland - hills
	Rock distribution	Small Stone- Big Rock
	Root system depth	80-90 cm
Land Physical properties	Type of soil	Inceptisols and Entisols
	Texture	Sandy Clay loamy sand
	Structure	Angular lump
	Permeability	28.5-32.57 cm/Hour
	Consistency	Sticky wet soil, if the two fingers are stretched, the soil is left on both fingers, Moist soil: Slightly plastic can take the form of twists. Dry Soil: Hard to withstand pressure Wet soil: Slightly sticky, when both fingers are removed, some soil is left on one finger. moist:Slightly plastic, can be in the form of soil rotation, soil mass is easily deformed.dry :Hard : resistant to pressure, soil mass can be broken by hand
Hydrology	Level (BO)	0 and 09
	Erosion	55,553 tons/ha/year and 150,875 tons/ha/year

Source: Data Processing 2021

g. Forest landscape management indicators

Table 8 Forest landscape management indicators

Indicator	Criteria	Parameter	Information
Social culture	Social culture	Total population divided with an area.	the higher the population, the higher the pressure on land

	custom customs	violators are fined and reprimanded by the traditional leader	Customs regulate behavior will have an impact on the success of conservation
ecology	Erosion	Estimation of actual erosion	The lower the land cover, the erosion will occur
economy	Level Well-being	Income per capita	the higher the level of community income from the existence of the forest, the greater the damage to the forest

Source: Data Processing 2021

Based on field research on the economy, ecology and socio-culture of the Naioni community with a population of 1,112 people and an area of 3500km² difference. Between the total population and the area is the population density per kilometer so that it is obtained 1.59 km², meaning that every 1.59 km² distance is inhabited by 1 person so that the population density in Naioni Village is not too dense.

The average education level of the Naioni community is still low because some people only have elementary school education and some have not even finished elementary school. The customs used if there is a violation, the consequence is to pay a fine and be reprimanded by the customary leader.

The ecology used is the level of erosion based on the estimation of actual erosion which is in the heavy and very heavy category due to the land cover in the form of trees without shrubs. Based on the average per capita income level of Kupang City of 3.05 million per month in 2020 (Kupang City Economic Indicators, 2020).

h. Conservation Alternatives on offer

Of the 19 land units, 10 of them require conservation, 9 do not require conservation because their values are below the erosion tolerance. As for the management of the Meto Batulesa watershed, 5 alternative scenarios are given, including:

Table 9 Erosion Tolerance Value

Unit Land	cover Land	Representativ e Sample	Order Land	Sub Order	T valu e	Erosion	A: T
I	Secondary Dryland Forest	4	Inceptisol	Tropepts	15	37.10	A > T
II	Secondary Dryland Forest	1	Inceptisol	Tropepts	15	57.92	A > T
III	Dryland and Shrub Farm	12	Entisol	Orthents	15	41.78	A > T
IV	Dryland and Shrub Farm	4	Inceptisol	Tropepts	15	37.10	A > T

VI	Shrubs	8	Entisol	Orthents	15	21.85	A > T
VII	Shrubs	3	Inceptisol	Tropepts	15	53.48	A > T
IX	Open Ground	12	Entisol	Orthents	15	64.49	A > T
X	Open Ground	11	Inceptisol	Tropepts	15	19.50	A > T
XIII	Shrubs	2	Inceptisol	Tropepts	22.5	138.56	A > T
XIX	Open Ground	12	Entisol	Orthents	15	194.02	A > T

Source: Author's Analysis 2021

1. Terrace Gulud: Corn + Beans + Mulch of Plant Remnants

In land unit 3 in the form of entisol soil, found in Onesu village with rainfall of 1,704 mm/year and land unit 4 in Naioni subdistrict with the land cover being dry land and shrubland agriculture, with an average annual rainfall of 1,412 mm/year. The soil is inceptisol soil. The alternative conservation offered is in the form of a mound terrace with plant modifications in the form of corn, beans and plant residue mulch. If the alternative is given, the value of the management factor (CP) used is 0.01 so that the erosion value for land unit 3 becomes 146 tons/ha/year and for land unit 4 erosion per year becomes 0.92 tons/hectare/year. In land unit 9 the land cover is open land with an R value of 916.84 K value 0.32 LS 0.01 and CP 0.01 so that it has an erosion value of 1,

Table 10 Erosion Value After Modification

Unit Land	Land Cover	R	K	LS	CP	A2 (tonnes/ha/year)
III	Dryland and Shrub Farm	916.83	0.32	0.71	0.01	1.25
IV	Dryland and Shrub Farm	916.83	0.07	1.81	0.01	0.70
IX	Open Ground	916.83	0.32	1.10	0.01	1.93

Source: Author's Analysis 2021

2. Corn + Soybean intercropping pattern + crop residue mulch

In land units 3 and 4, the types of land cover are secondary dry land agriculture and shrubs, so that the conservation provided is in the form of corn plus soybeans with an overlapping crop pattern and added mulch for crop residues.

The cropping pattern uses overlapping crops, namely the land is planted with two or more plants with harvest time settings, so that after harvesting mulch the rest of the plants are spread around the soil and cover the soil so that if rainwater falls there is no runoff so that it can minimize the erosion value. The results of the calculation of erosion according to table 4.23 alternative erosion values are low, resulting in an erosion value of 6.49 tons/hectare/year and 3.60 tons/hectare/year theoretically the erosion value is reduced.

Table 11 Erosion Value After Modification

Unit Land	Land Cover	R	K	LS	C	P	A2 (tonnes/ha/year)
III	Dryland and Shrub Farm	916.83	0.32	0.71	0.09	0.36	6.49
IV	Dryland and Shrub Farm	916.83	0.07	1.81	0.09	0.36	3.60

Source: Author's Analysis 2021

3. Terrace Bench + corn cassava / cassava.

For the third scenario, alternative bench terraces are provided in the form of corn and cassava. The bench terrace is made to reduce the length of the slopes on land units 3 and 4, the slope length reaches 50 meters, if the bench terrace is applied, the length of the slope will decrease so that the erosion that occurs will be smaller. reduce from 41.78 tons/hectare/year reduced to 6.49 tons/hectare/year. In the fourth land unit, it was reduced from 37.10 tons/hectare/year to 1.30 tons/hectare/year.

Table 13 Erosion Value After Modification

Land cover Unit Land	R	K	LS	C	P	A2 (tonnes/ha/yr)
III Dryland and Shrub Farm	916.83	0.32	0.71	0.06	0.20	2.34
IV Dryland and Shrub Farm	916.83	0.07	1.81	0.06	0.20	1.30

Source: Author's Analysis 2021

4. Secondary Forest

The fourth scenario is conservation from secondary dry land forest, shrubs and open land to secondary forest, the change in the CP value is 0.01 so the erosion value is getting smaller.

Field observations at the research location found that there were factors supporting the occurrence of erosion, including slope length, vegetation cover and soil type

Table 14 Calculation of alternative secondary forest conservation

LAND UNITS	Land Cover	Representative Sample	R	K	LS	CP	A2 (tonnes/ha/year)
I	Secondary Dryland Forest	4	1112.1	0.0	1.81	0.0	0.70
II	Secondary Dryland Forest	1	1112.1	0.0	2.33	0.0	0.91
VI	Shrubs	8	916.83	0.3	7.45	0.0	10.93
VII	Shrubs	3	916.83	0.0	2.60	0.0	0.84
XIII	Shrubs	2	1112.1	0.0	8.90	0.0	3.46

XIX	Open Ground	12	916.83	0.3	3.31	0.0	4.85
				2		1	
IX	Open Ground	12	916.83	0.3	1.10	0.0	1.61
				2		1	
X	Open Ground	11	916.83	0.0	1.01	0.0	0.32
				7		1	

Source: Author's Analysis 2021

5. Primary Forest

On the land cover of secondary dryland forest and shrubs, the conservation alternatives given are primary forest so that the modified value is the CP value to 0.001 so that it reduces the value of the erosion rate.

Table 15 Calculation of alternative primary forest conservation

Land unit	Land Cover	R	K	LS	CP	A2(tons/ha/year)
I	Secondary Dryland Forest	916.83	0.07	1.81	0.001	0.12
II	Secondary Dryland Forest	1112.10	0.07	2.33	0.001	0.18
VI	Shrubs	916.83	0.32	7.45	0.001	2.19
VII	Shrubs	916.83	0.07	2.60	0.001	0.17
XIII	Shrubs	1112.10	0.07	8.90	0.001	0.69
XIX	Open Ground	916.83	0.32	3.31	0.001	0.97
IX	Open Ground	916.83	0.32	1.10	0.001	0.32
X	Open Ground	916.83	0.07	1.01	0.001	0.06

Source: Author's Analysis 2021

CONCLUSION

1. The highest actual erosion of 225,672 tons/ha/year was found in 19 land units in the Sumlili area, the lowest was 2,676 tons/ha/year in the Oenesu area. Calculation of erosion tolerance from 19 land units, 9 of which are below the erosion tolerance while 10 are above the erosion tolerance, and the erosion hazard level for the very heavy erosion category (V) there are 2 land units included in the heavy category (IV) 6 land units, the Medium category (III) 7 land units, and very light (I) 3 land units for the light category (II) Not found in the Meto Batulesa watershed.
2. Based on the physical condition of the Meto Batulesa watershed, the management alternatives offered include, 1. Terrace Gulud: Corn + Beans + Mulch of Plant Remnants, 2. Corn + Soybean with rotational cropping pattern + mulch of crop residues, 3. Bench terrace + corn cassava/soybean, 4. Secondary forest and 5. Primary forest.

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