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RESEARCH ARTICLE

EROSION PREDICTION AND CONSERVATION PLANNING IN THE BUBUH SUB-WATERSHED, BANGLI REGENCY

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ABSTRACT

Erosion is a natural process that is difficult to remove or zero erosion rates. The purpose research was analysing erosion hazard and conservation planning. The method used is a survey and take soil samples for analysis in the laboratory. Parameters analysed: texture, volume weight, permeability and organic matter. Soil erosion rate is calculated with USLE. The calculation results show that erosion is very light (land units 1, 2, 3, 4, 6, 7, 8, 9, 10, 11, and 12) and light (land units 5). The highest value is in moor land use (29.83 tons/ha /year) and the lowest is rice field land use (0.003 tons/ha/year). The level of erosion hazard is classified as very mild and mild, but the actual erosion that occurs exceeds tolerable erosion. Conservation actions is by increasing plant density, planting soil cover crops, adding organic matter, mulching, repair existing terraces.

KEYWORDS

Conservation, Erosion, Planning, Prediction, Watershed.

1. INTRODUCTION

Increasing demand for land continues to increase due to the addition of the population, while the area of land cannot increase so that there is a change in land use, resulting in land damage and impact on environmental sustainability (Suharyadi et al., 2011). If land use and management do not meet the rules of soil and water conservation, it can cause loss of topsoil due to erosion. Erosion is a natural process that is difficult to eliminate or zero erosion rate. The impact of erosion is a decrease in soil quality in terms of chemical, physical and biological soil. This means that soil erosion contributes negatively to agricultural production, water quality, ecosystem health in the aquatic environment and landscape aesthetic value (Arsyad, 2010).

An approach to understanding erosion hazard is important to know to improve land use management. Calculate the magnitude of erosion by focusing on the main contributing factors (Cassim et al., 2019). Erosion assessment can be done by measuring soil loss using the Universal Soil Loss Equation (USLE) (Udayakumara et al., 2010). Knowing the estimated loss of land using USLE, we can estimate the conservation planning undertaken and the costs required for erosion control measures (Brychta and Janecek, 2019).

The research was carried out in the Bubuh Sub-watershed, because it is the upstream of several watersheds in Bangli Regency. Bubuh Sub-watershed is administratively located in Tembuku District of Bangli Regency which has Regosol soil type, has an average high rainfall of 215.2 mm/month and the slope from flat to very steep, the dominant land use of mixed gardens without conservation action, so it has the potential erosion. To maintain land productivity and avoid more severe land damage, it is necessary to analyze the level of erosion hazard that occurs and to conserve soil on eroded lands. Based on the above problems, a study was carried out with the title: Erosion Hazard Analysis and Conservation Planning in the Bubuh Bangli Sub-watershed. The purpose of the study was to analyze the level of erosion hazard and to plan soil and water conservation.

2. MATERIAL AND METHODS

Figures and tables, as originals of good quality and well contrasted, are to be in their final form, ready for reproduction, pasted in the appropriate place in the text (Sitorus et al., 2012). Try to ensure that the size of the text in your figures is approximately the same size as the main text (10 point). Try to ensure that lines are no thinner than 0.25 point.

2.1 Research Location

The study was conducted in the Bubuh Sub-watershed Tembuku District of Bangli Regency, with an area of 2.897.99 ha. Geographically the study area is located at 8º 18 '1 "- 8º 30' 59" South Latitude and 115º 23 '49 "- 115º 23' 6" East. Administratively the research location is limited by Kintamani District in the north, Rendang District in the east, Tembuku Subdistrict in the west and Banjarangkan sub-district in the south.

2.2 Materials and Tools

The materials used in this study are chemicals ($K_2Cr_2O_7$, H_2SO_4, $FeSO_4$, H_2O_2 and Calgon), earth map (CSRT Worldview recording 2013-2015), slope class map and soil type (scale of 1: 50,000) and soil samples. The

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tool used in the research software QGIS 2.18, GPS (Global Positioning System).

2.3 Research Procedures

Determination of land units is based on overlapping land type maps, slope class maps and land use maps using QGIS software 2.18. Land that has the same type of land, slope class and land use is classified into one land unit (Simanungkalit et al., 2015; Singh and Panda, 2017). Each unit of land is sampled to be analysed for physical, chemical and biological properties in the laboratory.

2.4 Research Methods

The method used in this study is a survey method to the field to observe the slope, slope length, soil structure, land use and existing land management, while soil analysis: texture, volume weight, permeability and organic matter is carried out in the laboratory (Prawijiwuri, 2011). To determine erosion using the USLE method, namely: A = R x K x LS x CP (Arsyad, 2010).

Where:

A = amount of erosion (ton/ha/year)
R = rain erosivity index (tons/ha/cm of rain).
K = Erodibility index (ton/ha/unit of rain erosivity index)
LS = Factor of slope length and slope
CP = Plant and soil management factors.

To determine the tolerable erosion (Edp) is calculated by the Hammer equation, namely: Edp or T = (Effective Depth x Depth Factor) / (Land Use Age (300 years) (Arsyad, 2010). Erosion Hazard Level is calculated based on the amount of erosion (A) and tolerable erosion (Edp or T), with the equation EHL = A/T. Land conservation planning is carried out based on the results of the calculation danger level of erosion (Gunawan et al., 2013). Conservation actions need to be done by improving crop management (C) and land management (P) so that erosion can be minimized.

3. RESULTS

Rain erosivity (R); Erodibility of soil (K); Length (L) and slope (L) factors; Plant factors (C) and land management (P). The results of the calculation of rain erosivity with the Bols equation (1978) obtained value of rain erosivity index for one year amounted to 2,502.1 tons / ha / cm of rain (Salmah, 2001). Erodibility of land with the equation, 0.09 - 0.53 classified as very low – high (Wischmeier and Smith, 1978; Arsyad, 2010). The length of the slope in the study area is from 2.2 to 32 meters, while the slope of the slope is from 2 - 42%. Based on the calculation of LS values with the Keersebilk equation, LS values are obtained from 0.12 to 4.23 (Banuwa, 2013). The value of plant factors and soil management is done by matching the conditions in the field with CP values from the Bogor Soil Research Center (Arsyad, 2010). The results of field observations obtained CP values from 0.0015 to 0, 28. (Table 1).

3.1 Calculation of Erosion (A)

The results of erosion calculations that occur at the study site are very mild to very heavy (0.13-1384.82 tons/ha/yr). Very light erosion (0.13-2.78 tons/ha/yr) covering an area 258.30 ha (15.18%) on units 4, 7 and 10. Light erosion (24.09-55.37 tons/ha/yr) covering an area of 622.37 ha (36.58%) units 12 and 6. Medium erosion (105.86 - 176.27 tons/ha/year) covering an area 628.85 hectares (36.95%) units 1, 3 and 11. Heavy erosion (209.53 and 275.22 tons/ha/year) covering an area 93.93 ha (5.25%) units 2 and 8. Very heavy erosion (545.55 and 1.384.82 tons/ha/year) covering an area of 97.77 ha (5.74%) units 5 and 9 (Table 1) and Figure 1.

3.2 Tolerable erosion (Edp) and Erosion Hazard Level (EHL)

Edp value obtained using the Hammer equation = 35.01-54.42 tons / ha / yr. The highest Edp value occurs land unit 10 and the lowest occurs in land unit 2 (Arsyad, 2010). While the results of the level erosion hazard calculation are 0.003-29.83 tons / ha / yr, the lowest is in wetland land use and the highest is in dry land use (Table 1).

Table 1: Calculation of Erosion (A), Tolerable Erosion (Edp), and Erosion Hazard Level (EHL) in Bubuh Sub-watershed, Bangli

Land Unit	Area Land (ha)	R	K	LS	CP	A (tons/ha/yr)	Edp (tons/ha/yr)	TBE (tons/ha/yr)
1	458,50	2502,1	0,31	0,48	0,28	105,86	46,87	2,26
2	78,78	2502,1	0,16	4,23	0,12	209,53	35,01	5,98
3	156,07	2502,1	0,36	2,42	0,08	176,27	39,93	4,41
4	68,11	2502,1	0,30	2,45	0,0015	2,78	45,08	0,06
5	31,45	2502,1	0,50	3,97	0,28	1384,82	46,42	29,83
6	239,35	2502,1	0,53	0,52	0,08	55,37	46,89	1,18
7	179,83	2502,1	0,29	0,96	0,0015	1,06	53,48	0,02
8	15,15	2502,1	0,44	0,89	0,28	275,22	54,42	5,06
9	66,32	2502,1	0,29	3,69	0,2	545,55	39,79	13,71
10	10,36	2502,1	0,30	0,12	0,0015	0,13	42,61	0,003
11	14,28	2502,1	0,09	2,539	0,28	153,85	45,01	3,42
12	383,01	2502,1	0,35	0,69	0,04	24,09	40,43	0,60

4. DISCUSSION

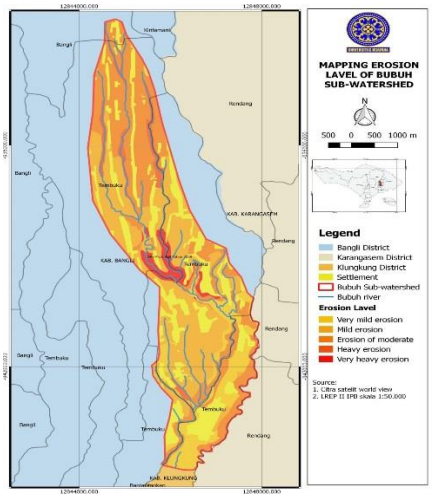

Figure 1: Mapping Erosion Level of Bubuh Sub-watershed

According to a study, the level of erosion hazard is determined based devided between the amount of actual soil erosion and tolerable soil erosion (Arsyad, 2010). The Erosion Hazard Level in Bubuh Sub-watershed is very light and mild. The largest TBE is in dry land (land unit 5), which is 29.83 tons/ha/yr with steep topography (38%) and the lowest is in rice fields (land unit 10), which is 0, 003 tons/ha/yr with flat topography (2 %). Land units (1, 2, 3, 5, 6, 8, 9 and 11) the level of erosion hazard is very mild, but the erosion that occurs is greater than the tolerable erosion so it needs conservation action (Gelagay and Minale, 2016). According to a study, erosion always of the upper part, but the rate of formation is generally not able to compensate for soil loss due to accelerated erosion, therefore increasing plant density, planting ground cover crops, addition of organic matter, mulching, improvement of terraces or intercropping systems can help minimize soil loss (Rahim, 2003). The effect of vegetation on surface run off and erosion has a function to: (a) rain interception by plant canopies, (b) reduce surface run off and water damaging forces, (c) the influence of roots and biological activities related to vegetative growth, (d) its influence on the stability of the structure and porosity of the soil, and (e) transpiration resulting in water content.

5. Conclusion

1. Erosion 0.13 - 1,384.82 tons/ha/ year is classified as very light to very severe, tolerable erosion (Edp): 35.01 - 54.42 tons/ha/year.
2. The unit of land that requires conservation measures covering 913.59 ha or 53.65% (land units 1, 2, 3, 5, 6, 8, 9 and 11). Conservation actions is by increasing plant density, planting soil cover crops, adding organic matter, mulching, repair existing terraces or intercropping system.

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