Erosion Hazard Classification Analysis in Kantung the Watershed, Bangka District

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Abstract. Watersheds in the Bangka Belitung Islands Province are increasingly experiencing environmental damage from year to year. Location of the Kantung Watershed in Parit padang Sungailiat Bangka Village. The causes of damage to this watershed are mining activities, land use changes that were previously forested as residences and agricultural land that is not managed properly so that the impact is reduced forest as a natural protector, erodible soil or erosion. The method of analysis carried out in this study is the USLE (Universal Soil Loss Equation) approach. Based on the analysis that has been carried out by the USLE method, the total erosion size of the Kantung watershed is 521,684 tons / ha / year 3,140,190,871 tons / year / year with Class V (Very Heavy) erosion hazard classification. Based on the results of the erosion hazard classification obtained is class V (Very Heavy), with large erodibility, the slope of the dominant slope is very steep, changes in land cover especially for mining activities, residences and agricultural land without management, the recommendations for reducing erosion are mechanical and vegetative soil conservation methods

1. Introduction

Population growth, which requires a place to live, a place for activities and production so that residents use forest land to become residences for mining activities, agriculture without proper management and lack of public awareness on the preservation of watersheds. Watersheds in the Bangka Belitung Islands Province are increasingly experiencing environmental damage from year to year. [1].

Watersheds are classified into two, namely the restored watershed and maintained watershed. The watershed that is repatriated is a watershed whose land conditions, quality, quantity and continuity of water and use of regional space are not functioning properly. Whereas, the watershed that is maintained is a watershed with land conditions, quality, quantity and continuity of water as well as proper functioning of regional space, the Kantung watershed is a restored watershed, which means that the watershed is not functioning properly, so action is needed to achieve environmental carrying capacity. Watersheds with restored classifications need to be carried out to achieve compatibility of environmental carrying capacity [2].

The Kantung watershed has an area of 6019.332 hectares, located in Karya Makmur Sungailiat Bangka Village [1]. Based on the survey in the field and based on data from the relevant agencies [3], the activities that took place in the Kantung watershed included mining, agriculture. Mining activities carried
out along the river resulted in a pedestal on the riverbed. As a result, the capacity of the river will decrease so that the water does not flow properly. This watershed has undergone many land use changes, the dominant type of land cover is 3999.506 ha of dry land agriculture without management and residences 1165.528 Ha, very steep slope> 40% is 2864,643 Ha.

The event of moving or transporting land or parts of land from one place to another by natural media is called erosion [4]. Along with the increasing human activity towards land use which includes deforestation, construction / development activities, and mining, it will increase the amount of erosion that occurs [5]. Erosion that occurs in the sacred watershed is not normal erosion but is not normal because it is caused by human activities, especially mining activities.

Several studies related to erosion have been carried out by several previous researchers by obtaining the factors that cause erosion: mining activities [6], deforestation, land conversion into agricultural land and residences [7], economic use and environmental impacts [8], agricultural intensification, land degradation and other anthropogenic activities [9], agricultural sloping lands [10], land slope and length, crop management / land use, soil management and soil erodibility. [11], plant cover effects on interception and rainfall energy; rock fragment (stoniness) effects on infiltration, flow velocity and splash erosion [12], climate change due to precipitation [13], water and land slope and length [14], land use/land cover (LULC) [15], to reduce the amount of erosion there are several conservation methods that can be carried out namely by mechanical, vegetative and chemical conservation [16].

Based on the problems in the Kantung watershed, the researchers conducted a study to find out how much erosion occurred in the Kantung watershed and how the conservation method recommended in the Kantung watershed.

2. Result

The amount of erosion in the Kantung watershed can be calculated by multiplying erosion factors using the USLE (Universal Soil Loss Equation) method, namely Rain Erosion (R) factors, Soil Erodibility (K), Slope Length and Slope (LS) and crop management factors (C) and soil conservation measures (P) [16]. In the analysis of each land unit obtained by overlapping (overlaying) several maps of topographic differences, slope class maps, maps of land use types and soil types. This spatial data is processed using SAGA software.

Rain erosion is defined as the number of rain erosion index units in a year. The value of R is the power of rain damage [16]. Rainfall data used to calculate rain erosion factors is rainfall data with a span of 10 years, namely rainfall data from 2009 to 2018 [17]. Rain erosivity factors can be searched using monthly rainfall data (cm) and the formula proposed by Wischmeier, 1959 (in Renard, et.al, 1996) [16].

Erodibility of the soil, or sensitivity factor for soil erosion, is soil resistance both to release and transport, mainly depending on soil properties, such as texture, aggregate stability, shear strength, infiltration capacity, organic matter content and chemistry [16]. To find out the type of soil obtained from secondary data in the form of soil type distribution map along with soil erodibility value (K) [3]. The Kantung watershed has several types of soil, namely brown podsolic soil is the widest type of soil, then red-yellow podzolic, and alluvial.

The length and slope factors (LS) are determined by using the Sacred Watershed slope class distribution map [1]. The Sacred Watershed, it can be seen that the slope of the land varies from 0 -> 40%. Based on its topographical form, the Kantung watershed area is grouped into 3 slope classes (s), namely 0 - 8%, 8-15%, and> 40%.

Factor C is influenced by vegetation, soil surface conditions, and land management to the extent of erosion [16]. The value of crop management factor (C) is determined based on the type of land cover and land management in each unit of land in the KAS watershed.

The value of the human action factor in soil conservation (P) is the ratio between the amount of erosion of the land with a certain conservation action against the amount of erosion on the land without conservation action [16]. Based on direct observations in the field, it is known that land management in the Kantung watershed has no conservation actions taken by the government and the community. So that the value of land management (P) is categorized without conservation measures P = 1.00.
Table 1. The erosion class of the Kantung watershed land unit

| No. | Land Code       | R   | K   | LS  | C   | P | A (ton/ha/year) | Erosion Class |
|-----|----------------|-----|-----|-----|-----|---|----------------|---------------|
| 1   | HLKS >40% PC   | 1986.711 | 0.16 | 9.5 | 0.03 | 1  | 905.940   | III           |
| 2   | HLKS 8-15% PM  | 1986.711 | 0.32 | 1.4 | 0.03 | 1  | 26.701    | II            |
| 3   | B >40% PC      | 1986.711 | 0.16 | 9.5 | 0.3  | 1  | 905.940   | V             |
| 4   | P 0-8% AV      | 1986.711 | 0.47 | 0.4 | 0.6  | 1  | 224.101   | IV            |
| 5   | P 0-8% PM      | 1986.711 | 0.32 | 0.4 | 0.6  | 1  | 152.579   | III           |
| 6   | P 8-15% PM     | 1986.711 | 0.32 | 1.4 | 0.6  | 1  | 534.028   | V             |
| 7   | P >40% PC      | 1986.711 | 0.16 | 9.5 | 0.6  | 1  | 1811.880  | V             |
| 8   | BA 0-8% AV     | 1986.711 | 0.47 | 0.4 | 0.05 | 1  | 18.675    | II            |
| 9   | BA 8-15% PM    | 1986.711 | 0.32 | 1.4 | 0.05 | 1  | 44.502    | II            |
| 10  | BA >40% PC     | 1986.711 | 0.16 | 9.5 | 0.05 | 1  | 150.990   | III           |
| 11  | PLK >40% PC    | 1986.711 | 0.16 | 9.5 | 0.1  | 1  | 301.980   | IV            |
| 12  | PLK 0-8% AV    | 1986.711 | 0.47 | 0.4 | 0.1  | 1  | 37.350    | II            |
| 13  | PLK 0-8% PM    | 1986.711 | 0.32 | 0.4 | 0.1  | 1  | 25.430    | II            |
| 14  | PLK 8-15% PM   | 1986.711 | 0.32 | 1.4 | 0.1  | 1  | 89.005    | III           |
| 15  | PLKC >40% PC   | 1986.711 | 0.16 | 9.5 | 0.1  | 1  | 301.980   | IV            |
| 16  | PLKC 0-8% AV   | 1986.711 | 0.47 | 0.4 | 0.1  | 1  | 37.350    | II            |
| 17  | PLKC >40% PM   | 1986.711 | 0.32 | 9.5 | 0.1  | 1  | 603.960   | V             |
| 18  | PLKC 8-15% PM  | 1986.711 | 0.32 | 1.4 | 0.1  | 1  | 89.005    | III           |
| 19  | PRT >40% PC    | 1986.711 | 0.16 | 9.5 | 1    | 1  | 3019.801  | V             |
| 20  | PRT >40% PM    | 1986.711 | 0.32 | 9.5 | 1    | 1  | 6039.601  | V             |
| 21  | PRT 8-15% PM   | 1986.711 | 0.32 | 1.4 | 1    | 1  | 890.047   | V             |
| 22  | PRT 0-8% AV    | 1986.711 | 0.47 | 0.4 | 1    | 1  | 373.502   | IV            |

Information:

*Type of land use:* HLKS = Secondary Dryland Forest; SB = Shrubs; P = Residence; TT = Open Land; BA = Water Body; PLK = Dryland Agriculture; PLKBS = Agriculture of Mixed Bushes; PRT = Mining

*Soil Type:* PM = Red Yellow Podsolic; AV = Alluvial; P = Chocolate Podsolic

The amount of erosion obtained gives varied results for each type of land unit analyzed in the KAS watershed land unit. Based on the amount of erosion, erosion in the Kantung watershed unit is classified into four erosion classes from the light, medium, heavy and very heavy classes. This difference is because each land unit has slope slope, land management and conservation actions that are different.
Table 2. Results of calculation of the erosion of the Sacred Watershed

| No | Land Code   | Area (ha) | ton/ha/year | ton/year | Erosion average |
|----|-------------|-----------|-------------|----------|-----------------|
| 1  | HLKS >40% PC | 7.268     | 90.594      | 658.439  | 0.109           |
| 2  | HLKS 8-15% PM | 31.288   | 26.701      | 835.434  | 0.139           |
| 3  | B >40% PC    | 99.992    | 905.940     | 90586.434| 15.049          |
| 4  | P 0-8% AV    | 14.258    | 224.101     | 3195.236 | 0.531           |
| 5  | P 0-8% PM    | 65.657    | 152.579     | 10017.976| 1.664           |
| 6  | P 8-15% PM  | 197.965   | 534.028     | 105718.684| 17.563         |
| 7  | P >40% PC    | 887.648   | 1811.880    | 1608311.512| 267.191       |
| 8  | BA 0-8% AV   | 2.259     | 18.675      | 42.182   | 0.007           |
| 9  | BA 8-15% PM  | 5.654     | 44.502      | 251.618  | 0.042           |
| 10 | BA >40% PC   | 19.757    | 150.990     | 2983.054 | 0.496           |
| 11 | PLK >40% PC  | 1671.169  | 301.980     | 504659.813| 83.840         |
| 12 | PLK 0-8% AV  | 668.556   | 37.350      | 24970.667| 4.148           |
| 13 | PLK 0-8% PM  | 8.573     | 25.430      | 218.002  | 0.036           |
| 14 | PLK 8-15% PM | 1651.209  | 89.005      | 146965.242| 24.416         |
| 15 | PLKC >40% PC | 19.846    | 301.980     | 5993.158 | 0.996           |
| 16 | PLKC 0-8% AV | 0.070     | 37.350      | 2.617    | 0.000435        |
| 17 | PLKC >40% PM | 51.114    | 603.960     | 30870.546| 5.129           |
| 18 | PLKC 8-15% PM| 150.741   | 89.005      | 13416.635| 2.229           |
| 19 | PRT >40% PC  | 98.228    | 3019.801    | 296628.771| 49.279         |
| 20 | PRT >40% PM  | 9.623     | 6039.601    | 58116.511| 9.655           |
| 21 | PRT 8-15% PM | 197.201   | 890.047     | 175517.856| 29.159         |
| 22 | PRT 0-8% AV  | 161.259   | 373.502     | 60230.484| 10.006          |

Total Area        6019.332
Total Erosion Kantung Watershed (ton/ha/year)    521.684
Total Erosion Kantung Watershed (ton/year)      3,140,190.871

Erosion Hazard Classification  Class V (Very Heavy)

The total erosion obtained was 521,684 tons / ha / year or 3,140,190,871 tons / year, so the classification of erosion hazard classes in the Kantung watershed had Class V (Very Heavy) erosion hazard classes. Factors that influence the magnitude of erosion that occur in the Kantung watershed, namely the dominant slope level factor is very steep, the slope the slope the greater the LS value and the greater the speed of surface flow, so that the soil is eroded and transported and erodibility is greater soil
erodibility index then the greater the soil grain transported due to falling rain, land cover also greatly affects the amount of erosion produced, such as mining and residence activities will increase the value of C, and without good management also increase the value of P.

Based on the results of the erosion hazard classification that is obtained is class V (Very Heavy), with large erodibility, the slope of the dominant slope is very steep, changes in land cover especially for mining, residence and agricultural land without management, the recommendations for reducing erosion are mechanical and vegetative soil conservation methods. On The agricultural land to reducing erosion was made terracing, to eks mining land reforestation was done.

3. Conclusion

Based on calculations using the USLE (Universal Soil Loss Equation) method, the amount of erosion in the Kantung Watershed is 521,684 tons / ha / year or 3,140,190,881 tons / year with Class V (Very Heavy) erosion hazard classification. The recommendations for reducing erosion are mechanical and vegetative soil conservation methods.

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