Identification needs and placement location of conservation building in upstream area with geographical information system

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Abstract. The upper course of water catchment areas is buffer area for conservation at the watershed. In upstream area there are also regions where also suitable for planting a variety of agriculture commodities. The activity can cause the accurence of erosion and land degradation, so as to encourage the flow of sediment to major rivers. The sediment carried by the flow of run off is to downstream so that causes silting-up of the grooves river due to sedimentation, that decrease capacity of flow the river and causes overflow of the river so there was a flood. Base on the problem, required building for conservation there is retaining sediment building on a grooves at the upstream to hold and controlling the flow of sediment. Therefor required to identification of the needs and right location to exact placement of the retaining sediment building. Because the nature of the land on the upstream area are hilly condition used geographical information system (GIS) to assist in identification of the needs and to determination of site the retaining sediment building. The purpose of the research is to prevent and control the flow of sediment that accur in upstream area and flow into the major river. The objective of the study is to understand the needs and appropriate location to placement of retaining sediment building in the watershed. Research methods that used is using geographical information system which combined with class and level of erosion and the technical requirement of retaining sediment building. The result showing that geographical information system can help in assignment the appropriate site of retaining sediment building in the grooves of upstream areas. According 29 catchment areas in the watershed, 17 of the region in accordance to putting retaining sediment building and 12 region other not appropriate. The number of retaining sediment building that can built in the watershed there was 22 location/points.

1. Introduction

1.1 Background.
Watershed is a land area constituting a unit with a river and the streams, the function is to catch, store, and distribute water from rainfall to lakes or to the sea naturally. Watershed boundaries on land a separation topografis and the limit on the sea to the areas of waters that are still affected by land activities [1]. Upstream areas of watershed is buffer area to conservation at the watershed, on the other hand in upstream areas is the land fertile and have a certain height, this is an area that suitable for planting a variety of agricultural commodities [2]. Activities related land management to the agricultural sector
can caused degradation land and erosion, so that promote the flow of sediment the results of the erosion into a groove a major river who are at the downstream of watershed [3].

The high the rate of erosion at upstream of watershed is a problem that clear impact upstream until to downstream, because of the sedimentation who transported to get bad for river and reservoir as storage in the watershed. The sediment carried away by the flow of run off to downstream so as to cause the occurrence of the silting up of the river which as a result of the sedimentation process, so there is can affect the capacity of the river and cause to overflow of the river so that there was a flood [4][5]. Therefore, required a building conservation which building retaining sediment in the grooves of the upstream watershed to hold and controlling the flow of sediment, therefore does not initiate the silting-up of the major river [6].

The establishment of the needs and siting buildings retaining sediment in upstream grooves is an important activity which can effective to hold and control sediment so does not until to downstream watershed, thereby required identification needs and the right location for the construction of building retaining sediment [7]. Because the nature of the land on the upstream area are hilly condition, used geographical information system (GIS) to assist in identification of the needs and to determination of site the retaining sediment building [8].

The purpose of the research is to prevent and control the flow of sediment that occur in upstream area and flow into the major river. The objective of the study is to understand the needs and appropriate location to placement of retaining sediment building in the watershed.

1.2 Soil and water conservation building.
Soil and water conservation is efforts to protect, recovery, increase and maintenance of a function land in accordance with capability and allocation of the land use to achieve sustainable development and life. Soil and water conservation activities aimed at protecting the soil surface water from a blow of rainfall, improve the infiltration, to prevent concentration of the surface, improve the function of the soil and increase capacity of watershed. Soil and water conservation techniques which are often conducted in the rehabilitation of forest and land is built building retaining sediment, with the aims to hold and control sediment flow and run off in the upper watershed [9].

Buildings retaining sediment is a small dam that is made at a groove on the upstream watershed, with the maximum height of 4 m, that function to hold and controlling sediment flow and run off. Technically, criteria site location of buildings retaining sediment is [9]:

- LMU in I and II priority/Critical location;
- Catchment area 10 - 30 Ha;
- Slope of groove 15 – 35 %;
- Maksimum height of building 4 m
- Slope of catchment area 15 – 35 %
- Priority in ordo 2 river
- Can be built series

2. Research Methods

2.1 Site discription.
The location of the research is in Ciesek sub-watershed, which is located on five subdistrict namely babakan madang, cisarua, megamendung, sukamakmur, and sukaraja, that is one of the Ciliwung Hulu watershed, with geografical coordinat is 6o 35’ LS – 6o 49’ dan 106o 49’ BT – 107o 00’ BT.
2.2 Experimental design.

2.3 Data analysis.
Determination the magnitude hazards erosion of area map is the result of overlay the outcomes of erosion that happen in areas. The magnitude hazards erosion map obtain from overlay map of class erosion and soil solum.
Table 1. The magnitude hazards erosion

| Soil Solum (cm) | I   | II  | III | IV   | V   | Description   |
|-----------------|-----|-----|-----|------|-----|---------------|
|                 | < 15| 15 - 60 | 60-180 | 180-480 | > 480 |               |
| Deep > 90       | S R | R   | S   | B    | S B  | 0–SR=Very Light |
| Moderate 60 – 90| R   | S   | B   | S B  | S B  | I – R = Light   |
| Shallow 30 – 60 | I   | II  | III | IV   | IV   | II – S = Moderate|
| Very Shallow < 30| B   | S B | S B | S B  | S B  | III – B= Heavy |

Source: Minister of Forestry, Indonesia (1998).

To get the map of erosion in each administrative area be done overlay once again. By combining map of magnitude hazards erosion of area with administrative map, to be obtained map of value erosion, class erosion, and the magnitude hazards erosion each area. Determination Catchment Area of Ordo II River in watershed. Methods to determination Catchment Area of Ordo II River in watershed is with polyline which draw a line from outlet point of the river to the backs of the contour that formed a catchment area polygon.

Further, map of catchment area each ordo II river input to ArcGIS and to clip map of the magnitude hazards erosion use polygon of catchment area ordo II river map. The outcome is map that contains information about the magnitude hazards erosion with polygon of catchment area ordo II river shape. Furthermore, used to determine the potential location of retaining sediment building which combine with slope of area and land cover.

![Figure 3. Clip of magnitude hazards erosion map](image)

3. Results And Discussion

The magnitude hazards erosion in Ciesek Sub Watershed there are three type, that is moderat, heavy, and very heavy.
Table 2. Magnitude hazards erosion (TBE) in Ciesek Sub Watershed

| District  | Subdistrict | Village     | Area (Ha) | Level Erosion | TBE   |
|-----------|-------------|-------------|-----------|---------------|-------|
| Cisarua   | Babakan madang | Bojong koneng | 44.819 | Kelas 1  | Berat |
|           |              |             | 0.342    | Kelas 3  | SB    |
|           |              | Cilember    | 43.940   | Kelas 1  | Berat |
|           |              |             | 2.410    | Kelas 2  | SB    |
|           |              |             | 196.276  | Kelas 3  | SB    |
|           | JOGJOGAN     |             | 0.440    | Kelas 1  | Berat |
|           |              |             | 8.202    | Kelas 3  | SB    |
|           |              |             | 9.809    | Kelas 3  | Sedang|

Based on the results of choice of location for the ordo II river, there are 29 river which classified as ordo II river. Determination siting location of retaining sediment building based on: the magnitude hazards erosion heavy/very heavy, catchmen area is 10 – 30 Ha, slope of area is 15 – 35 %, and land cover is not residensial area.

Table 3. Determination siting location of retaining sediment (DPn)

| Location | TBE      | Catchment | Slope    | Land cover | Remark | Potensi DPn |
|----------|----------|-----------|----------|------------|--------|-------------|
| 1        | Very Heavy Heavy | 40.845    | 15 - 35 % | Woodland   | OK     | 2           |
| 2        | 9.275    |           | 15 - 35 % | Woodland   | NOT    | -           |
| 3        | Heavy    | 10.793    | 15 - 35 % | Woodland   | OK     | 1           |
| Location | TBE      | Catchment | Slope      | Land cover | Remark | Potension DPn |
|----------|----------|-----------|------------|------------|--------|---------------|
| 4        | Heavy    | 2.694     | 15 - 35 %  | Woodland   | NOT    | -             |
| 5        | Very Heavy | 4.518    | 35 - 50 %  | Agriculture | NOT    | -             |
| 6        | Heavy    | 5.621     | 15 - 35 %  | Woodland   | NOT    | -             |
| 7        | Heavy    | 17.288    | 15 - 35 %  | Woodland   | OK     | 1             |
| 8        | Heavy    | 3.523     | 15 - 35 %  | Woodland   | NOT    | -             |
| 9        | Heavy    | 3.978     | 15 - 35 %  | Woodland   | NOT    | -             |
| 10       | Heavy    | 1.579     | 15 - 35 %  | Woodland   | NOT    | -             |
| 11       | Heavy    | 54.769    | 15 - 35 %  | Woodland   | OK     | 2             |
| 12       | Heavy    | 23.756    | 15 - 35 %  | Woodland   | OK     | 1             |
| 13       | Heavy    | 43.221    | 15 - 35 %  | Woodland   | OK     | 2             |
| 14       | Heavy    | 24.535    | 15 - 35 %  | Woodland   | OK     | 1             |
| 15       | Heavy    | 4.777     | 15 - 35 %  | Woodland   | NOT    | -             |
| 16       | Very Heavy | 5.723     | 15 - 35 %  | Agriculture | NOT    | -             |
| 17       | Very Heavy | 10.576   | 15 - 35 %  | Agriculture | OK     | 1             |
| 18       | Very Heavy | 13.616   | 15 - 35 %  | Agriculture | OK     | 1             |
| 19       | Very Heavy | 10.629   | 15 - 35 %  | Agriculture | OK     | 1             |
| 20       | Very Heavy | 102.261  | 15 - 35 %  | Agriculture | OK     | 2             |
| 21       | Heavy    | 12.959    | 15 - 35 %  | Woodland   | OK     | 1             |
| 22       | Heavy    | 24.918    | > 50%      | Woodland   | NOT    | -             |
| 23       | Heavy    | 16.021    | 15 - 35 %  | Woodland   | OK     | 1             |
| 24       | Heavy    | 20.88     | 15 - 35 %  | Woodland   | OK     | 1             |
| 25       | Heavy    | 8.426     | 15 - 35 %  | Woodland   | NOT    | -             |
| 26       | Heavy    | 28.95     | 15 - 35 %  | Woodland   | OK     | 1             |
| 27       | Heavy    | 8.732     | 15 - 35 %  | Woodland   | NOT    | -             |
| 28       | Heavy    | 39.874    | 15 - 35 %  | Woodland   | OK     | 2             |
| 29       | Heavy    | 27.208    | 15 - 35 %  | Woodland   | OK     | 1             |
Based on the table shows that the number of potential sites and in accordance with the criteria for retaining sediment building 17 catchment area of whole 29 catchment areas.

![Figure 4. Map of location DPn](image)

4. Conclusion And Recommendation
The result showing that geographical information system can help in assignment the appropriate site of retaining sediment building in the grooves of upstream areas. geographical information system will be used to help to determine the ordo of a river, counting catchment area, the slope of area and the land cover of area. According 29 catchment areas in the watershed, 17 of the region in accordance to putting retaining sediment building and 12 region other not appropriate. The number of retaining sediment building that can built in the watershed there was 22 location/points.

To finalization, Points which potensial to putting retaining sediment building carried trough ground check to find out about technical implementation for retaining sediment building development.

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