Erosion Zone Arround Upper Cisokan Dam, West Java, Indonesia

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Abstract

Study area is located in Cisokan drainage area, Bandung, West Java Province, Indonesia. Potential disaster that may occur around the study area is soil erosion and in this reaserch area upper Cisokan Dam is under development therefore the study of soil erosion is necessary. The objective is to characterize and to determine erosion zone that may affect to the study area. Some methods are used in this research such as desk study, field work and laboratory analysis. Desk studies consist of morphography analysis using Digital Elevation Model. Field works consist of Outcrops analysis, Survey of landuse area and measurement of actual erosion. Lab analysis consist correlation between geological factor, landuse and actual erosion to make deliniation for erosion zone. Result of this study shows that the lithology of this area is dominant by Miocene Sandstone which is erodible. Slope, elevation, geological structure, ground water facies , soil characteristicsand high rainfall which are developed in the study area are affects to erosion level. From this reasearch we can conclude that elevation in the research area has 400 – 1025 above sea level. Slope zonation in this study area is devidedinto two zones, namely steep and very steep slope.Steep slope occupy in 55% west study area. Very steep slope occupy in 65 % east study area. Opening land and vegetasion of this area increase erosion level which endanger Upper Cisokan Dam developement around the research area.

Keyword: Soil Erosion, Upper Cisokan Dam, Indonesia, Geohazard

1. Introduction

Erosional process in earth happens gradually and caused by some water and wind activity. Erosional process can be divided into two, geological erosion or normal erosion and accelerated erosion.

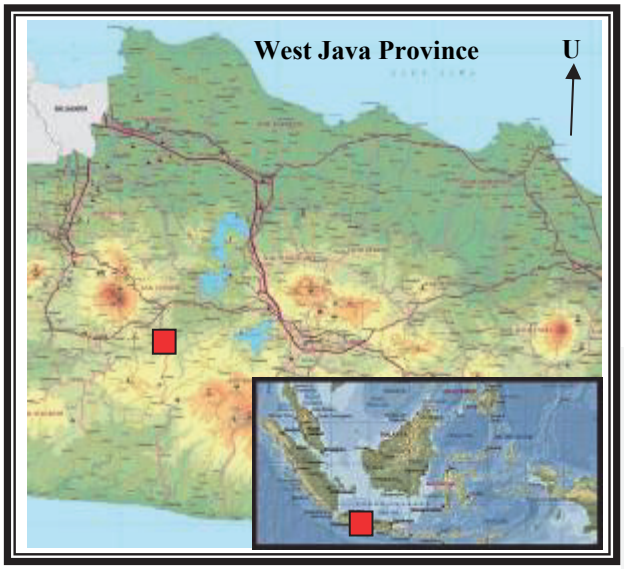
Normal erosion occurs naturally and continuously, forming topographic landform and producing sediment material. Water, wind and gravity are the main transport media.

Accelerated erosion in tropical region commonly caused by surface water activity. Water is the main transport media and play important role. Splash erosion, sheet runoff, interill erosion, rill & gully erosion, riverine erosion, wave action, foreshore erosion or beach erosion, and piping or tunnel erosion are kinds of water mediated erosion.

Soil erosion is the common geological hazard in tropical region and has major impact in area where it occurs. High rainfall intensity, steeply slope, and vegetation loss due to terrain utilization are factors that modified terrain characteristics in study area, forming sloping morphology that potentially act as gliding plane and may cause landslide, damaging village around, infrastructure and material loss.

The building of Upper Cisokan Dam located in study area. Power plant that supply 1040 Megawatt for Java-Bali Region is under development. Potential disaster that may occur around this area is soil erosion and slope stability problem and considering in development of Upper Cisokan Dam, this research become necessary.

Project Area



PLTA Upper Cisokan Dam development

Figure 1. Reasearch map location (not for scale)

Upper Cisokan Dam development take places in upper Cisokan River that belongs to Citarum Drainage System, West Java Pro vince Indonesia.The main component of Upper Cisokan Dam are Upper Dam that take places in Cirumanis River while the Lower Dam take places in Cisokan River.

Upper Cisokan Power Plant development head for supplying 1040 Megawatt to Java and Bali.PLTA Plta upper cisokan can store energy at the peak load , by pumping water from reservoirs from upstream to downstream as the depositary of energy and use excess energy at the base load ,it can be benefits as providers of electric power at the peak load, controled frequency, dynamic response, serves as generating facilities stand by mode and when collaps can performing black start..

Upper Cisokan catchment area is about 10,5 km2, fluctuation of water level in normal elevationl +777,5 masl and in the lowest condition at elevation +777,5 masl, Lower dam has 98,00 m concerete gravity, top Dam lenght 294,00 m in elevation +503 masl, wide catchment area 355 km2 and normal water level at elevation +499,5 m and lowest water level elevation +495,00 masl.

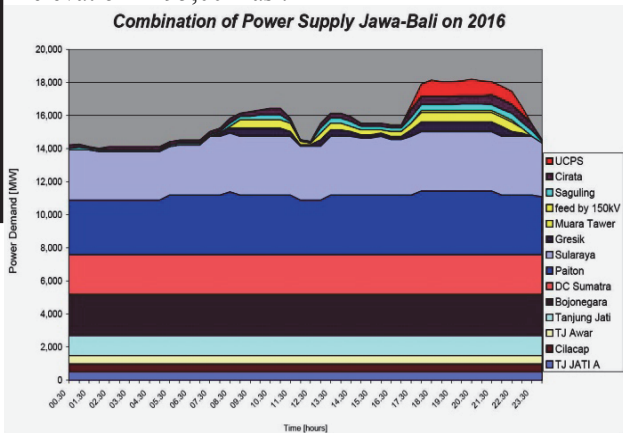


Figure 2. Curve daily load with annual maximum load

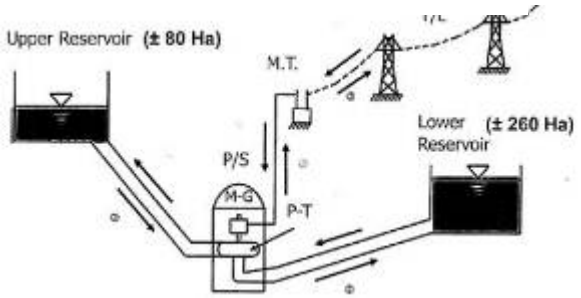


Figure 3. PLTA Cisokan works system

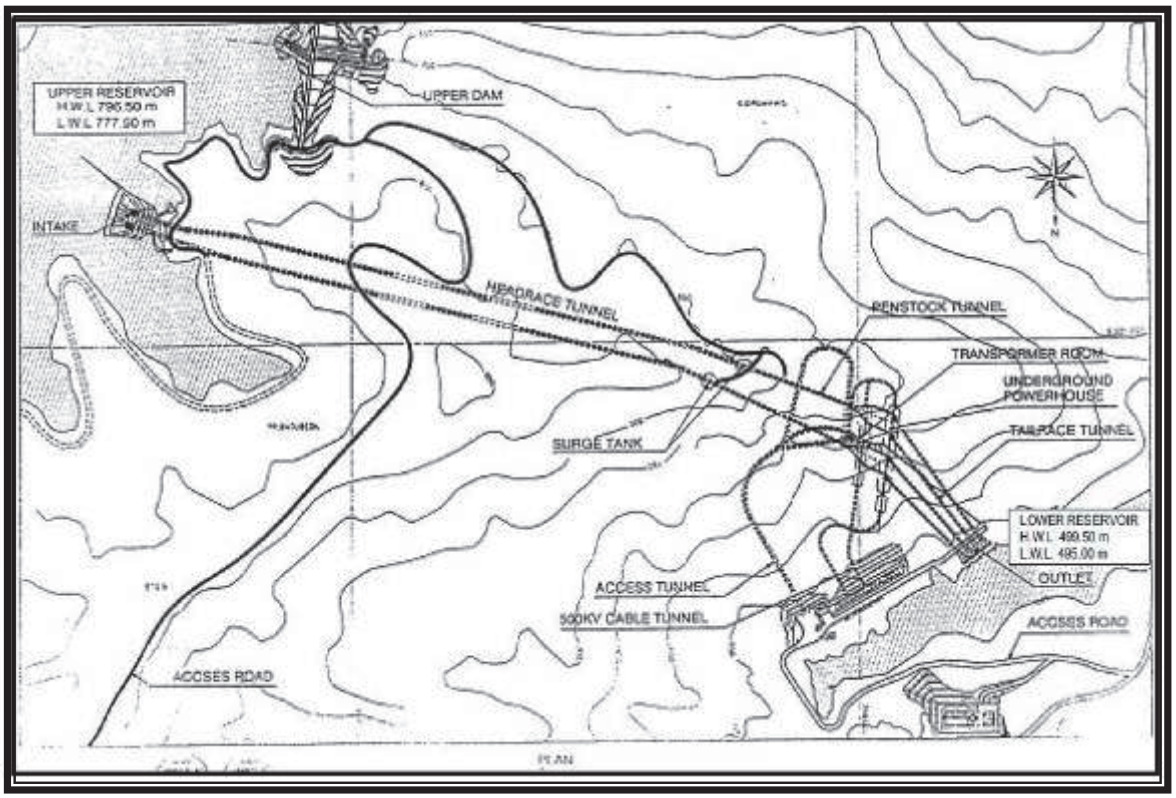


Figure 4. Layout of Construction Areas Upper and Lower Reservoirs (PT. PLN (Persero), 2010)

2. Methodology

Methodology consist of Literature study, fieldwork, and laboratorium analysis. Literature study done before fieldwork to collect secondary data consist of DEM analysis and geological region map quadrangle analysis. Fieldwork consist collect field data, outcrop analysis,landuse and actual erosion measurement.Lab analysis consist of data processing to analyze relation about geological factors, landuse and erosion factor to know the potential erotion zone.

3. Result and Discussion

3.1 Geomorfological and Geological Setting

Morfography reasearch area shows elevation between 400-1025 masl, according Van Zuidam classification (1985) the morphology consist of hill until high hill. Morfometri divided into two parts based on van zuidam (1985) , namely a steep slope 20 % -50 % dominant in the east the study area occupies 48 % the study areas .And the very very steep slope 50 % - 140 % . Occupy 52 % of all research area.

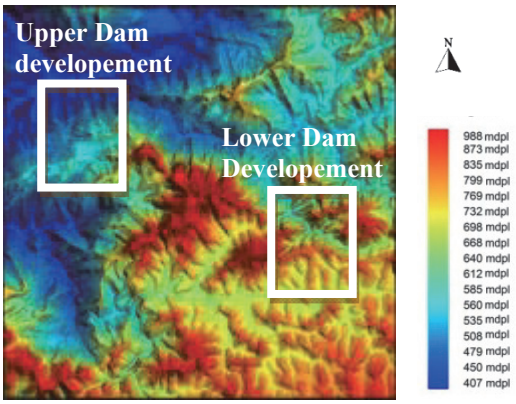


Figure 5. Digital Elevation Model Map

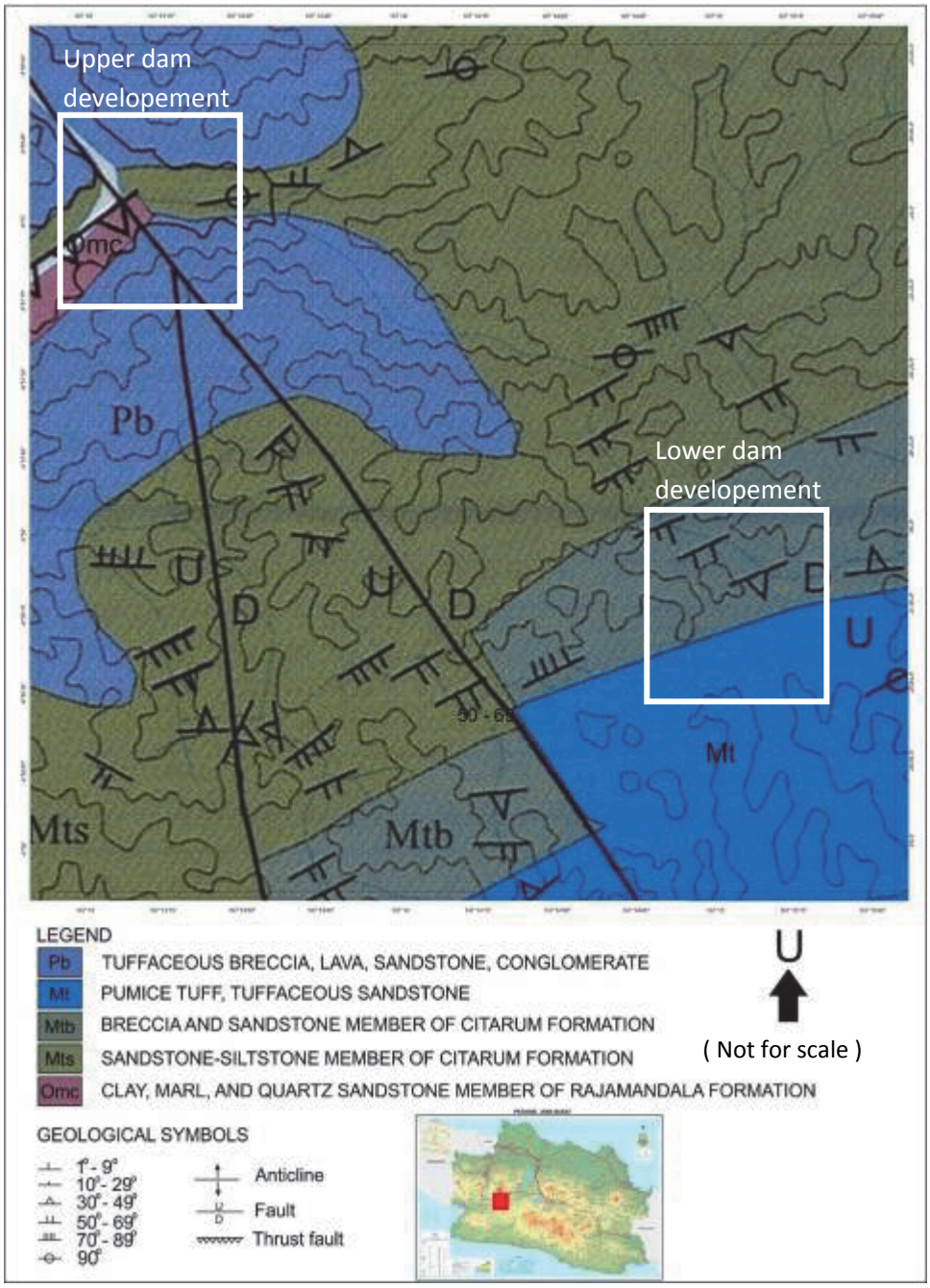


Figure 6. Geological Reasearch area based on Geological of Cianjur Quadrangle Sudjatmiko 2003; Modified

Based on physiography the study areas including into bogor zones and southern mountains zone.According to sudjatmiko (2003) in geological of Cianjur quadrangle map, research area consist of three formations namely Rajamandala formation, Citarum formation,and Jatiluhur formation. Geological of Cianjur quadrangle map ordered from elder to younger stratigraphy at the research area:

1. Clay, marl; quartz sandstones member of Rajamandala formation
2. sandstone and marl member of Citarum formation
3. Basalt and breccia sandstone member of Jatiluhur Formation
4. Pumice tuff and tuffaceous sandstone
5. Tuffaceous breccia, lava, sandstone and conglomerate.

The existence of a structural geology in the reasearch area consist of joint , fold and fault make the research area has complexity in tectonic history .A geological fault in meet the area will be used as upper reservoir.This should be evaluated for its harm in the construction of upper Dam reservoir.

3.2 Erosive Proses and Analysis

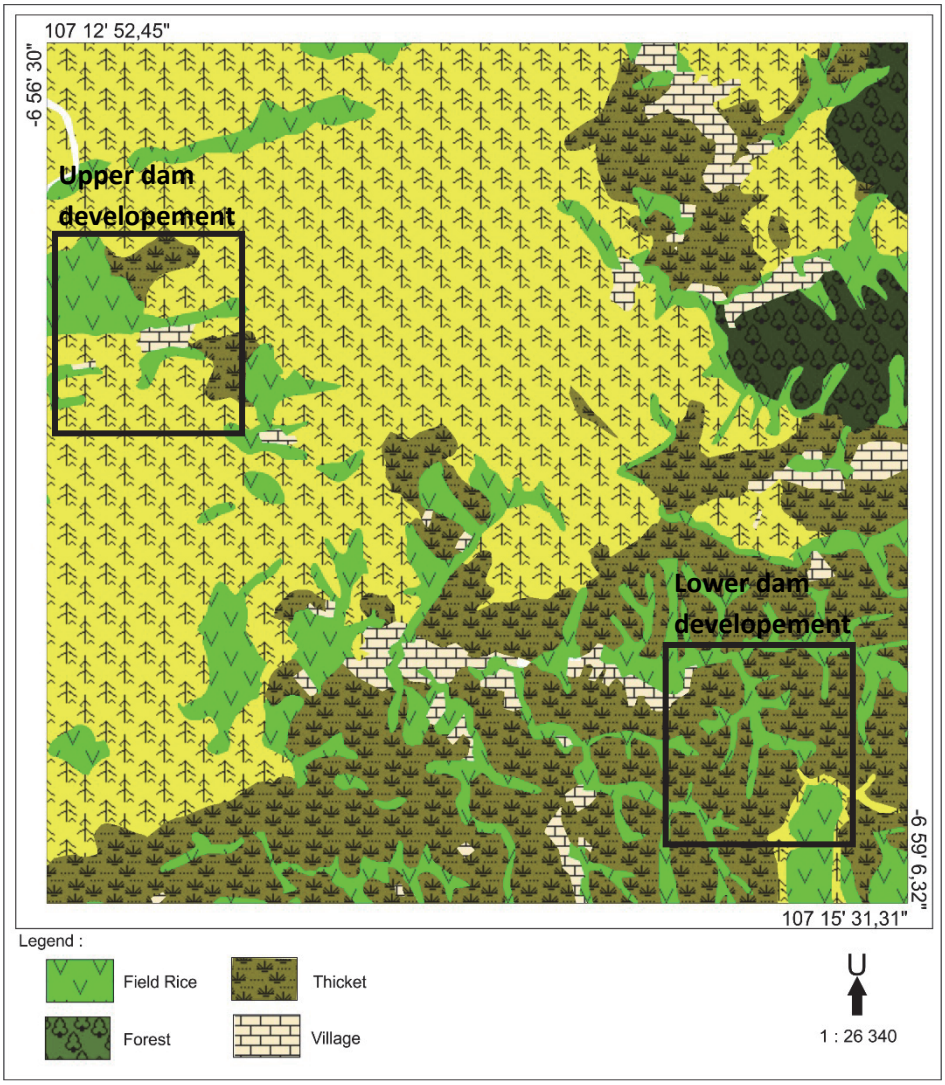


Figure 7 . Landuse map of reasearch area.

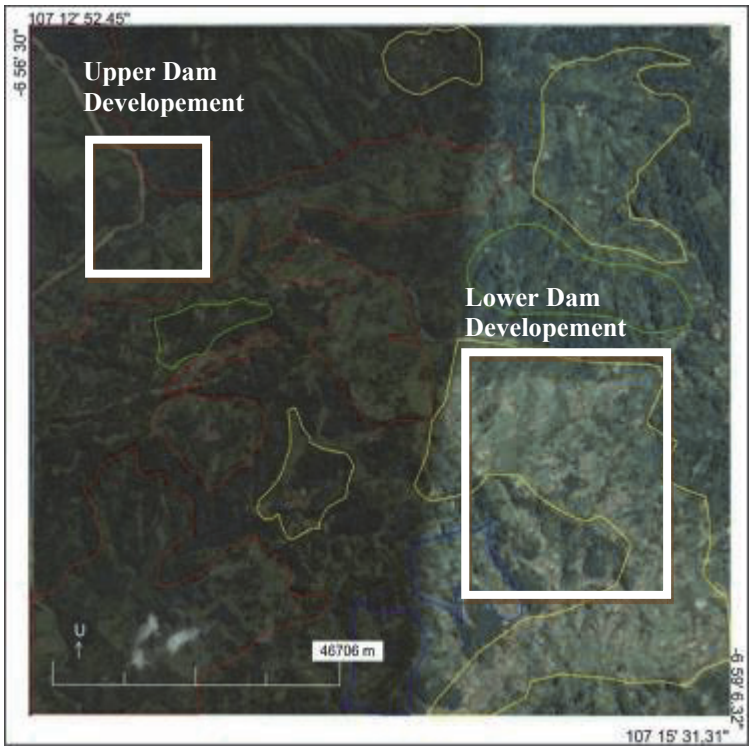
Code	Indicators
0	No roots are exposed; No crusting; No pedestal sprinkling; cover by vegetation more than 70% (Canopy and surface).
½	Little roots exposure; crusting; no pedestal sprinkling; soil on plants vegetation the upward plants slope higher than ground; cover by vegetation 30-70 %
1	Roots exposure;pedestal sprinkling; ground covered by plants with 1 to 10 mm depth; Little crastng, cover by vegetation 30 – 70 %.
2	Roots exposure dan sprinkling pedestal dan pile of the ground 5 cm; covered by vegetation 30 – 70 %.
3	Roots eksposure; sprinkling pedestal, pile of the ground with 5 - 10 cm depth, 2 – 5 mm width krastng, grass in the lower slope covered by material washing product come from the top slopes;cover by vegetation30 – 70 %
4	Roots exposure; sprinkling pedestal, pile of the ground 5 - 10 cm depth, coarse material

	are exposure; rill erosion more than 8 cm depth; open field.
5	Trench Erosion (”gully erosion”), rill erosion more than 8 cm depht, open field.

Table 2. Parameter of erosion code and its idicators.

Erosion can be classified based on sign of actual erosion such as rill erosion, a sheet erosion, and gully erosion in the field , from the data we can group into several codes and an indicator as explained in table above based on the intensity of erosion.Erosion in the study areas in general can be classified into:

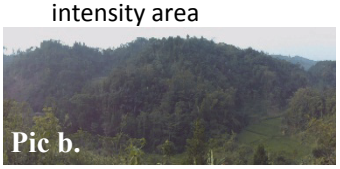
1. Very light erosion (code 0). no roots exposure; no krusting; no sparking pedestal; more than 70 % of the canopy and cover by vegetation, consist of a steep slope (20 % to 50 %) Occupy 4.8 % of all the research area..
2. Light intensity of erosion (Code ½ and 1) .The roots exposure; krusting; spraking pedestal;the upward plants slope higher than ground; the ground covered by plants with 1 to 10 mm depth; 30-70% average cover by vegetation, with a steep slope (20% - 50%), occupy 2,55 % of all research area.
3. Middle intensity of the erosion (Code 2 and 3).Roots exposure, sparking pedestal and a pile of ground with the depth of 5 and 10 cm, the thickness of krasting 2 – 5 mm, grass in the lower slope covered by material washing product come from the top slopes;cover by vegetation30 – 70 %.A steep slope (20% - 50%),occupy 20,33 % of all research areas.
4. Heavy intensity of erosion (Code 4 and 5).There is no roots exposure; no krusting; there is no sparking pedestal; Cover by vegetation less than 70% of the canopy, with a steep slope (20% - 50%), dominant in the eastern research area occupy 26, 7% percent of all research area.



Gambar 8. Erosion zone arround reasearch area

Explaination :

Pic a. Very weak of erosion intensity area



Pic b. Light of erosion intensity area

Pic e, f. Heavy intensity of erosion area, there is a gully erosion

Pic c, d. Midle of erosion Intensity area

3.3 Erosion Prevention

Here's a sampling of conservation practices that can be used. They are more effective when used in combination:

1. Filter strips and buffers slow water speed, filter pollutants, and trap sediment. They can be used to stop sediment from leaving the farm. Grass filter strips are effective on slopes less than 10 percent. Riparian buffers of native trees and shrubs protect streams and may be 40 to 300 feet wide, based on site conditions and stream width.
2. Grassed waterways are flat-bottomed channels planted with grass that are designed to slow water down to prevent gulley formation. Farm equipment can drive over the side slopes during the dry season. Waterways may need to be combined with rock linings or drop structures on steep slopes.
3. Conservation tillage reduces the amount of tillage and leaves at least 30 percent cover from crop residue after harvest and during winter months. Soil loss is reduced by 50 percent compared to bare soil.
4. Contour farming runs rows "on the level" perpendicular rather than up and down the slope. Crop rows form hundreds of small dams that slow water and reduce soil loss up to 50 percent.
5. Cover crops temporarily protect the soil until the main crop is planted. Cover crops also add organic matter and reduce weed growth. Plant cereal grains and legumes for winter cover crops. Buckwheat is a good summer cover crop.
6. Pasture management balances livestock numbers, forage, and water for a healthy farm income and environment. Pastures with at least 70 percent plant cover have little erosion and produce more forage. Set aside a "heavy use area" where animals are held to protect pastures when soils are wet or plants are recovering from grazing. For more information, see the Horses and Livestock section.

5. Acknowledgment, Appendix and References

Conclusion

Based on analysis above, the research area consist of the sedimentary rocks and tuff material with steep dipping in the fold and fault structural geology area.Research area is susceptible to soil erosion. An infertile soil condition make people to open their agriculture, the opening field caused the bad impact which the accelerated erosion can endanger to the local residents and Upper Cisokan development.The prevention can used some methode such as filter strips and buffers slow water speed, grassed waterways, soil conservation tillage, contour framing, cover crops and pasture management. Based on field observations, Upper Cisokan dam development has high potential of erosion. It needs well public participation, government and scientist to prevent the occurrence of natural disasters that can endanger life and can harm Upper Cisokan dam development. Geological factor, steeply slope, high rainfall intensity, and opening field can cause accelerated erosion.The early prevention is needed to minimize erosion.

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