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# Local Wisdom of Farmers on The Northern Slopes of Ungaran Mountain to Reduce Erosion on Agricultural Land

(Case Study in Persen Hamlet, Sekaran Village)

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***Abstract*— Persen Hamlet had a sloping topography on the northern slopes of the Ungaran mountain which caused erosion. The dominant erosion in Indonesia caused by runoff water causes the loss of top soil elements affecting soil fertility and detrimental to farmers who depend on agricultural products. Objectives of this research (1) to identify the erosion hazard level that occurred in Persen Hamlet on the northern slopes of Ungaran mountain as spatial analysis and (2) the relation about erosion hazard level to local wisdom farmer at Persen Hamlet, Sekaran Village in soil managing that used as agricultural erosion land. Methods of data collection on this study were interviews to explore the local wisdom of farmers in Persen Hamlet then field observations, for spatial analysis using the USLE approach which was inputted in the Geographic Information System (GIS) to create a map of erosion hazard levels in Persen Hamlet of the northern slopes of the Ungaran mountain. Data analysis technique used spatial data analysis, and to combine the research parameters, it analyzed the strategy to reduce agriculture erosion land through local wisdom conducted by farmers in Persen Hamlet. The results of research indicated that there is local wisdom conducted by farmer to reduce agricultural erosion land in Persen Hamlet of the northern slopes of the Ungaran mountain that could be known through behavior of farmer in Persen Hamlet in managing soil to reduce agricultural erosion land.**

***Keywords—Agricultural Erosion Land, Local Wisdom of Farmers.***

## I. INTRODUCTION

Erosion is susceptible to occur in agriculture land, and this condition will be worsened if the area has sloping slopes. Persen Hamlet is one of the hamlets in Sekaran Village which is located on the northern slope of Ungaran Mountain which has a sloping topography caused erosion. Erosion is a phenomenon of the destruction of soil and its movement or the lifting of soil or parts of soil to the other places [15]. In wet tropical regions, such as Indonesia, erosion domination was caused by water than wind [2],[11],[17]. Destruction and transport were caused by runoff affected in the erosion hazard levels. Banuwa [3] and [4] said that soil loss will only occur if both processes occur. Runoff causes erosion and loss of topsoil elements that affect soil fertility. As we know, that farmers depend on the level of soil fertility, especially the level of soil fertility on agricultural land. The majority of the people's livelihoods in Persen Hamlet are farmers. If soil fertility on agricultural land decreases, it will affect agricultural production in Hamlet Persen. If erosion is allowed to occur continuously, it will be possible for landslides to occur. Agricultural land that is susceptible to erosion hazards causes farmers to have the right strategy in managing land on agricultural land in order to reduce erosion rates.

The erosion rate is the level of soil erosion in a certain time unit caused by natural energy activities such as water, wind, ice, then the material eroded is moved to another place by that energy [13]. Factors that influence the rate of erosion consist of the factors that can be changed by humans (type of vegetation (plants), some of the nature of the soil (soil fertility, aggregate resistance, and infiltration capacity), and the length of the slope) and factors that cannot be changed by humans are climate, soil type, and slope steepness [10].

Objectives of this research are (1) to identify the erosion hazard level that occurred in Persen Hamlet on the northern slopes of Ungaran mountain (Sekaran Village) as spatial analysis and (2) the relation about erosion hazard level to local wisdom farmer at Persen Hamlet, Sekaran Village in soil managing that used as agricultural erosion lands. Agricultural lands that are usually processed by farmers show that there is an indication of agricultural behavior in reducing the rate of erosion in Persen Hamlet Sekaran Village which can be used to reduce the rate of erosion that occurs on agricultural land.

## II. METHODS

Data collection method in this study is the first to conduct a survey in the field and then determines the location or place that is suitable to be plug in erosion meter (erosion plot) in Persen Hamlet, Sekaran Village to measure the rate of erosion that occurred in the plot of

land. The results obtained from the data measurement in the field were compared using the USLE approach, for spatial analysis using Geographic Information System [16] then input the result of USLE calculation. Data analysis techniques used a quantitative approach namely the results of the primary data, the results of measurements in the field and then laboratory tests conducted using spatial data analysis and associated with the results of interviews with farmers in Sekaran Village to find out the local wisdom that farmers do in processing the land used as agricultural lands. Then, the results of the data are described through a qualitative approach. Secondary data were obtained from the numbers previously tested, and the data taken used as one of the parameters in analyzing the results of the research conducted.

After the calculation, data can then be analyzed through the erosion hazard level in Sekaran Village by using the Class Interval formula. Data analysis used a spatial approach to combine research parameters in the form of the results of erosion hazard levels in Sekaran Village then from several levels are found ways of handling to reduce erosion on agricultural land.

$$\text{Class Interval} = \frac{Highest\ Value - Lowest\ Value}{Total\ of\ Interval\ Class} \qquad (1)$$

Table 1. Parameters and Algorithms for Establishing USLE Erosion Models (USLE Approach)

| Parameters | Algorithm (Equation) |
|---|---|
| USLE Approach Formulation | **A = RKLSCP**<br>A = Average amount of soil lost (ton / ha / yr)<br>R = Rain erosivity index<br>K = Soil erodibility index<br>L = Length of Slope<br>S = Slope factor index<br>C = Plant factors<br>P = tillage factors |
| Rain Erosivity (R) | **R = $EI_{30}$= 6,119*(RAIN)1.21*(DAYS)-0,47*(MAXP)0.53**<br>RAIN = Average annual rainfall<br>DAYS = The average number of rainy days per year<br>MAXP = The maximum average rainfall in 24 hours per month for a year<br><br>To calculate rain erosivity, Researcher used data from BMKG Semarang City. |
| Erodibility (K) | **100K = 2,1 $M^{1,14}$ ($10^{-4}$) (12-a) + 3,25(b-2) + 2,5(c-3)**<br>K = Soil erodibility<br>M = Percentage of sand particle size (% very fine sand +% dust) x (100% - clay)<br>a = Percent of organic matter<br>b = Classification of soil structure<br>c = Soil permeability<br><br>To calculate Soil Erodibility, Researcher had been analyzed about soil erodibility in Soil Laboratory. |

Table 1, cont.

| | |
|---|---|
| Length Slope (LS) | **LS = $l^{-1/2}$ (0,00138 $S^2$ + 0,00965 S + 0,0138)**<br>L = Slope length factor<br>l = long slope (m)<br>m = Exponent numbers depend on the slope / slope of the ground<br>s = actual slope (%)<br>S = Slope (%)<br><br>Researcher conducted field surveying to measure Length and degree of slope at sample area, so researcher can calculate LS parameters. |
| CP = Crop Management (C) and Soil Conservation (P) based on Provision number index.<br><br>C and P determined by field observation in Sekaran Village to determine number of CP index in Sekaran Village | |

III. Source: several formulas abstracted [1], [5], [7], [14] and [16].

## IV. RESULTS AND DISCUSSION

The results of the research carried out in measuring the actual erosion rate with the USLE (Universal Soil Lost Equation) approach that has been calculated previously then combined with the depth of soil for each land unit. Classification of erosion hazard levels uses a classification from the Ministry of Forestry (1988). The table can be seen below.

Table 2. Classification of erosion hazard level (EHL)

| Effective Soil Depth (cm) | Erosion Hazard Level (ton / ha / yr) | | | | |
|---|---|---|---|---|---|
| | <15 | 15 - 60 | 60 – 180 | 180 - 480 | >480 |
| Depth (>90) | VL | L | M | H | VH |
| Medium (60 – 90) | L | M | H | VH | VH |
| Shallow (30 – 60) | M | H | VH | VH | VH |
| Very Shallow (<30) | H | VH | VH | VH | VH |

Source: Ministry of Forestry (1988) in [14]
Information : VL : Very Low; L : Low; M : Medium; H: High; VH : Very High

Table 3. Hazard Level and Actual Erosion Rate in Sekaran Village (included Persen Hamlet)

| No | Erosion Hazard Level | Coordinate (UTM) | | A (ton/year) |
|---|---|---|---|---|
| | | X | Y | |
| 1 | Low | 49 m 0434012 | 9219767 | 53.15 |
| 2 | Low | 49 m 0433428 | 9220480 | 50.63 |
| 3 | Very Low | 49 m 0433005 | 9219944 | 22.97 |
| 4 | Very High | 49 m 0433293 | 9221354 | 131.92 |
| 5 | Medium | 49 m 0432550 | 9220592 | 56.53 |
| 6 | Very Low | 49 m 0433776 | 9219944 | 6.97 |
| 7 | Very Low | 49 m 0434441 | 9220829 | 32.03 |

Source: The classification of erosion hazard levels based on the Ministry of Forestry (1988) abstracted by changes from [8] and [9].

It can be known based on the table above that based on the erosion hazard level in Sekaran Village, there are four levels where one of the Hamlets is Persen Hamlet. Erosion hazard levels in Sekaran Village consist of Very Low, Low, Medium, and Very High. Among the four levels, local wisdom can be found in Hamlet Persen, Sekaran Village which can be used as a strategy for handling erosion rates that occur on agricultural land. Erosion Hazard level occurs can be seen on the map, as follows:

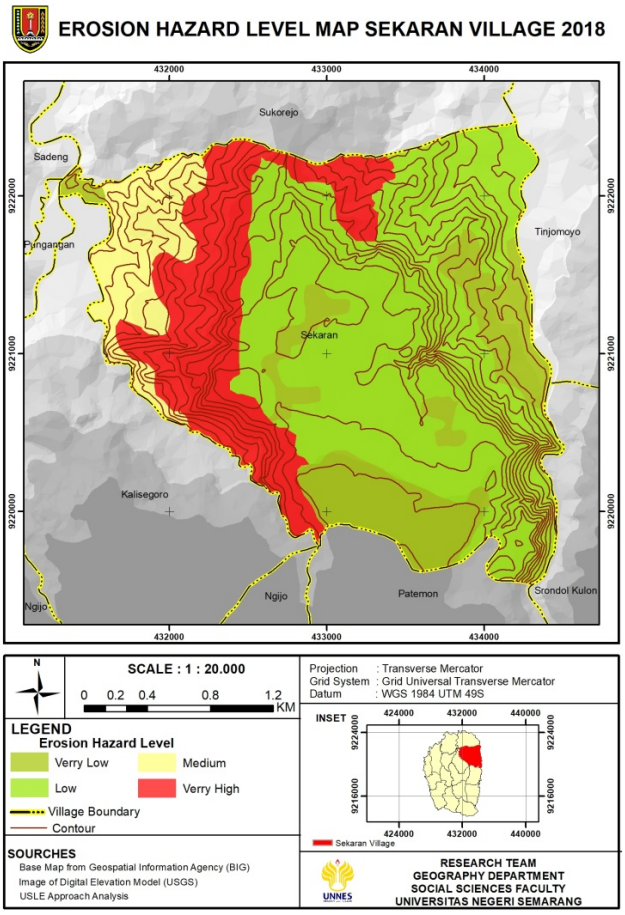


*Fig. 1. Erosion Hazard Level Map* [18]

After the results of the erosion hazard level in Sekaran Village are obtained, it is necessary to reduce erosion. Conservation efforts carried out to reduce the rate of erosion are [12], through vegetative (by utilizing plants or crop residues) and mechanics (physical treatment of plants for example terracing) and local wisdom of farmers in managing land to reduce erosion rates. Local wisdom of farmers is related to mechanical and vegetative conservation, and Persen Hamlet is one of the hamlets in Sekaran Village used to reduce the erosion rate on agricultural land.

Local wisdom of farmers in Persen Hamlet is used to reduce erosion on agricultural land, and its levels can be applied as follows:

1. On land that has a very low erosion rate, it can be handled by sowing used ashes from firewood.
   Sowing used ashes from firewood can loosen the soil and increase soil fertility. This local wisdom is rarely found especially in the millennial era at this time. Local wisdom like this needs to be preserved because Persen Hamlet, Sekaran the village is very rarely found. In this study, local wisdom has been discovered about farmers sowing used ashes from firewood in rice fields (agricultural lands).

2. On land that has a low erosion rate, it can be handled by placing fragments of leaves and grasses.
   Putting plant residues (leaves) from cassava plants on cassava farmland. The real reason for the farmer is to cut off part of the diseased (not edible) cassava trees. Then the rest of the grass that has been removed around the plant can protect the soil from rainwater directly. Then, the results of the plants that could not be used turned out to have an effect on reducing the rate of erosion, because if there is rain in an area covered by leaves of plants (grasses) that farmers just throw away can prevent rainwater from eroding the surface soil (top soil) so that no runoff occurs.

3. On land that has moderate erosion rates can be handled by trampling the soil to compact the soil.
   Trampling the soil is done after planting crops and harvesting crops. Where the soil that has been compacted if it is exposed to rainwater is a trigger factor that is the erosion of the soil surface (top soil) that brings the soil to move elsewhere. Land left alone after planting and harvesting crops or not being compacted after planting and harvesting crops can be more easily eroded than the soil that has been compacted on an agricultural land.

4. On land that has a very high erosion rate, it can be handled with "*Nyabuk Gunung*" (Arranging stones on land that is used as sloping agricultural land).
   *Nyabuk Gunung* or Arranging stones by farmers on a land that is used as sloping agricultural land, is actually a mechanical soil conservation technique that is terracing. However, farmers do not know that placing stones like this includes mechanical soil conservation. Farmers do this because farmers realize that the land on their sloping agricultural land makes the soil infertile and the plants they plant will grow sloping.

## V. CONCLUSION

The erosion rate was found in Persen hamlet, Sekaran Village where there is erosion of agricultural land. There are three levels, namely very low, low, medium and very high which then can be handled with local wisdom carried out by farmers in Persen Hamlet, Sekaran Village. These are (1) on land those who have very low erosion rates can be handled by sowing firewood ashes, (2) on land that has a low erosion rate which can be handled by placing the fragments of leaves and grass, (3) on land that has a moderate erosion rate which can be handled by trampling the soil to compact the soil and (4) On land that has a very high erosion rate which can be handled with "*Nyabuk Gunung*" (Arranging stones on land that is used as sloping agricultural land).

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