DOI: 10.7763/IPEDR. 2012. V52. 18

Soil Erosion in Rubber Plantations on Kho Hong Hill, Hat Yai District, Songkhla Province, Thailand

Nitipat Nuanmano [1+], Saowalak Roongtawanreongsri [1], and Charlchai Tanavud [2]

[1]Environmental Economic Research Unit, Faculty of Environmental Management, Prince of Songkla University, Thailand.

[2]Faculty of Natural Resource, Prince of Songkla University, Thailand

Abstract. This study aimed to assess soil erosion rate and classification from rubber plantation area and bare soil area as a reference point on Kho Hong Hill in Hat Yai District, Songkla Province, Thailand, where original forest land has been changed to rubber plantation. The study used the USLE method of calculating soil loss using this equation: A = RKLSCP. The result of soil erosion in rubber plantation on Kho Hong Hill was 100.1 t/ha/year. Such rate is considered very high and can be classified as severe erosion. This research information can help guide the planning decisions for Kho Hong Hill conservation.

Keywords: Soil Erosion, Rubber Plantation, Kho Hong Hill, Thailand

1. Introduction

Soil erosion is a process resulting from different forces: water, wind or gravity. These forces cause soil elements or compounds to be detached and easily carried away to become sediments in other areas. (Tangtham, 2002). Soil erosion in Thailand is one of the important environmental and agricultural problems at present time. Runoff water on soil surface transports with it soil organic matter and nutrients in the form of solution or suspension. Thus, the result of soil erosion is soil degradation that reduces soil's suitability for agriculture and other vegetation, and decreases agricultural yields. It therefore affects the long-term sustainability of agriculture because soil physical properties and structure will be deteriorated. Operation on soil will also become more difficult. All this leads to productivity reduction and agricultural land loss.

Increasing rate of soil erosion particularly in high mountain areas, caused by changes from natural system to other land use activities, affects economic loss. Soil erosion in mountainous area is usually severe. Although natural causes also contribute to soil erosion, it is human unwise activities which are the most important factors. The result of soil erosion studied by Thailand's Land Development Department (2004) found that in 2002 and 2003 Thailand lost 463 million and 300 million tons of soil per year respectively, with higher rate of erosion on uplands area than lower land area.

Kho Hong Hill (KHH) in Hat Yai district, Songkla province in south Thailand has experienced soil erosion problem as well as other places in Thailand. The KHH is the last largest wilderness area closest to Hat Yai city. Its total area is approximately 1,212.4 ha (Ploynimphet, 2012). It is the source of water supply, both for consumption and for agriculture, for the surrounding communities. It also provides ecological services such as water absorption area, carbon dioxide absorption, oxygen regeneration and biodiversity areas. However, KHH has been converted to rubber plantation, orchards area and housing with higher accelerating rate in recent years. As of 2011, the area of rubber plantation covered up to 36.39% of total KHH area. As the original forest is converted to other land uses, environmental impacts to ecosystem and communities around Hat Yai are becoming evidenced. One of such unavoidable impacts is soil erosion.

Our study is therefore aimed to assess soil erosion rate from the forest-disturbed area, i.e. rubber plantation on KHH, compared with soil erosion rate from forest and bare soil in order that mitigation programs can be formulated to prevent or solve the problem before it becomes too severe to recover. However, due to space limitation, in this paper we will report only the study on soil erosion rate from rubber plantation.

+ *Email:* tikub_21@hotmail.com

2. Materials and Methods

2.1. Materials

Materials for each experimental plot were zinc plates, 2 plastic tanks and pipe.

2.2. Selection of the experimental plots

Six experiment plots have been selected: 3 plots in rubber plantations area and 3 plots in bare soil area on Kho Hong Hill. The area chosen were within slope range between 18-23%.

2.3. Size and structure of the experimental plots

The size of each experimental plot, both in rubber plantations area and bare soil area, is 4 x 12 meters. The structure of experimental plots is explained as the following:

- Four zinc plates with a height of 30cm were lined on all 4 sides of all the plots by embedding it 10 cm deep into the soil.
- Each experimental plot has 2 plastic tanks to trap sediment. These tanks have a capacity of 100 liters each, with circumference of 168 cm, diameter of 58 cm and surface area of 2,640 sq cm. There was a pipe connecting between these two tanks. The pipe size was 1:10 of the tank size.
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Fig 1: The experimental plot in rubber plantation area.

2.4. The collection and compilation of data on rainfall and soil erosion.

Field Data Collection was done during Nov 2011 - Jan 2012 (rainy season) by the following steps:

- Data collection and measurement of rainfall. The rainfall data was collected from the Thai Meteorological Department for each raining day.
- Collected sediment from the experimental plots of rubber plantation area and bare soil area on each raining day throughout the rainy season. Take one liter sample of the solution in the tank (water + sediment) and let it sink. Bring the wet sediment to dry in the oven at 105 °C for 24 hours in the laboratory. Calculate dry weight per unit area.

2.5. Data analysis.

- Factors calculation.
- The factors were calculated following Somkit Keawpromta's approach (2003) as follows.

a. R is the rainfall factor computed on the basis of rainfall energy, (R-factor)

$$R = 0.4669\ X - 12.1415 \quad (1)$$

Where

R is the rainfall-runoff factor (t/ha/y); and

X is the average annual rainfall (mm/y).

b. Slope and slope length/terrain factor, (LS-factor)

$$S = (0.43 + 0.30s + 0.043s^2) / 6.613 \quad (2)$$

$$L = (\lambda /22.13)^{0.5} \quad (3)$$

Where

L is the slope length factor;

S is the slope steepness factor; and

λ is the length in the runoff direction from the upstream point to the point where deposition begins on the hill slope.

c. Soil erodibility factor (K-factor)

$$K = A / RLSCP \quad (4)$$

Where

A is dry weight of sediment from experimental plot (t/ha);

R is the rainfall factor (t/ha/y);

LS is slope and slope length/terrain factor; and

CP is the cropping-management and erosion-control practice factor.

d. Soil and crop management factor (CP-factor)

$$CP = A_{cp} / A_{bare-plot} \quad (5)$$

Where

A_{cp} is dry weight of sediment from experimental plot of rubber plantation (t/ha); and
$A_{bare-plot}$ is dry weight of sediment from experimental plot of bare soil (t/ha).

- Soil loss calculation from the experimental plot was done by calculating soil loss in unit of t/ha and then estimated all soil loss of Kho Hong Hill area.

3. Results and Discussion

Table 1 : Rainfall and sediment quantity from the experiment.

Month	Rainfall (mm.)	Sediment (t/ha)
November 2011	480.4	18.75
December 2011	643.2	50.94
January 2012	377.5	30.42
Total	1501.1	100.11

Table 1 showed that the rainfall within the experimental period of 3 months during the rainy season (November 2011- January 2012) on Kho Hong Hill were 1,501.1 mm. Soil loss from rubber plantation was 100.11 t/ha. The factors used in the Universal Soil Loss Equation (USLE): A = RKLSCP are shown below.

	LS	R	CP	K
Rubber plantations	3.100	688.722	0.797	0.059

That range of soil loss between 93.75-125.00 ton/ha/year is classified by the Department of Land Development as severe. The rate of soil loss from rubber plantation on Kho Hong Hill was 100.1 t/ha/year, thus the degree of soil loss was severe. This high soil loss rate means that the ability of rubber plantation to prevent soil erosion was quite low.

If soil erosion rate from rubber plantation on Kho Hong Hill continues at this rate, soil degradation from inappropriate land use management is certain to be occurred in the future. The sediment from soil erosion may also deposit in the natural river and basin which can cause shallowness. This will cause off-site effects to aqua ecosystem, and high budget will be needed to remove the sediment and clean the environmental impact. Hence, there should be an immediate prevention scheme to take place as soon as possible to prevent further soil loss and soil fertility loss.

4. References

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