MONITORING OF EROSION PLOTS IN SEVERAL AGROFORESTRY SITES WITH RESPECTS TO DIFFERENT SLOPES AND VEGETATION COMPOSITION AT GUNUNG WALAT EDUCATIONAL FOREST

By

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Introduction

Site quality is one of the criteria and indicator of a healthy forest ecosystem. It is measured by the soil fertility, but the soil fertility is affected by soil erosion and vegetation coverage in different slopes. Slope classification in Indonesia is divided into four major groups, those are flat (0-8 %), medium slope (8-15 %), moderate steep (15-25%, steep (25-45 %, and very steep (> 45 %). Soil erosion is a crucial problem in agroforestry system, because the agroforestry system in Gunung Walat Educational Forest was established on the slope ranging from 0 % to 45 % since 1997. The farmers come from the village surrounding GWEF. Traditional farming system is implemented in developing agroforestry system. Soil conservation is not implemented properly. Therefore, monitoring of the actual erosion and vegetation composition was conducted. Site quality depends on very much to the human activities.

Material And Method

Erosion-monitoring plots were established on different slopes ranging from 0 to 25 %. The plot size was 10 m x 20 m were established in different slopes, those were 0 to 8 %, 8 to 15 % and 15 to 25 %. Two erosion-monitoring plots were made for each slope classification.

Each slope Monitoring sticks were planted in planting distance of 2 x 2 m to monitor the erosion rate and the total observation points were 50 observation points (Fig.1). The monitoring stick of 25 cm length made of bamboo was put the scale of 1 mm to monitor the decrease of soil surface transported by the water run-off.

The rainfall of the GWEF was also monitored. The actual erosion rate was measured during the heavy rain season in February to March 2005. The erosion rate was measured based on the soil loss transported by water run-off.

Past erosion rate was studied using the approaches of the root collar position to the soil surface of the contour lines (Fig. 2). The total tree number for measurement of past erosion was 20 trees for each slope class. The average tree distance was 10 to 15 m. The plot of actual erosion rates was overlaid on the plot of past erosion rate. Both systems were easy to be understood by the farmers, simple and very cheap.

The vegetation composition in the plot was recorded in order to know the farmer planting preferences. The vegetation coverage was also recorded in the subplot 2 m x 2 m. Each plot consisted of 3 subplot of vegetation coverage in diagonal position (Fig.3).

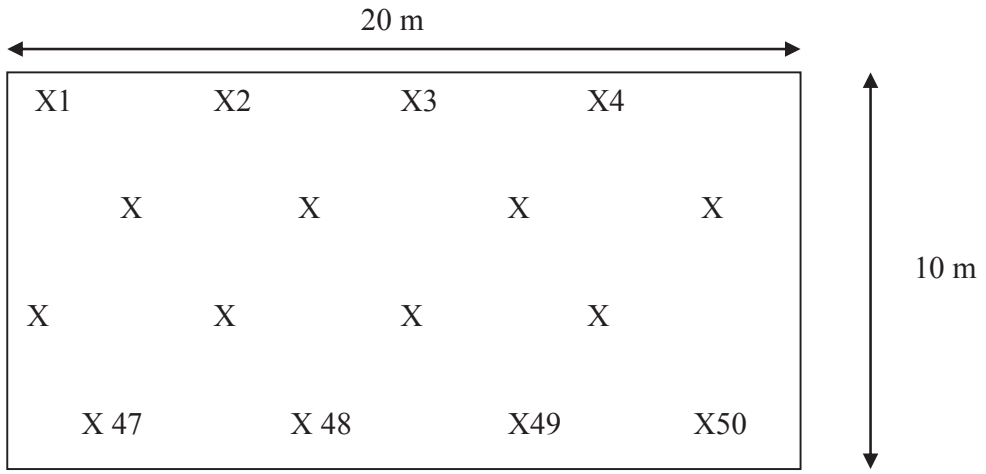

Figure 1 Stick position (X1 –X50) for erosion rate measurement in agroforestry area

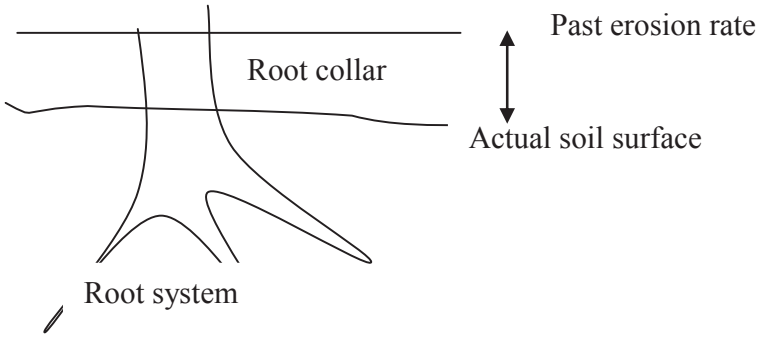

Figure 2 Past erosion rate measurement system in agroforestry area

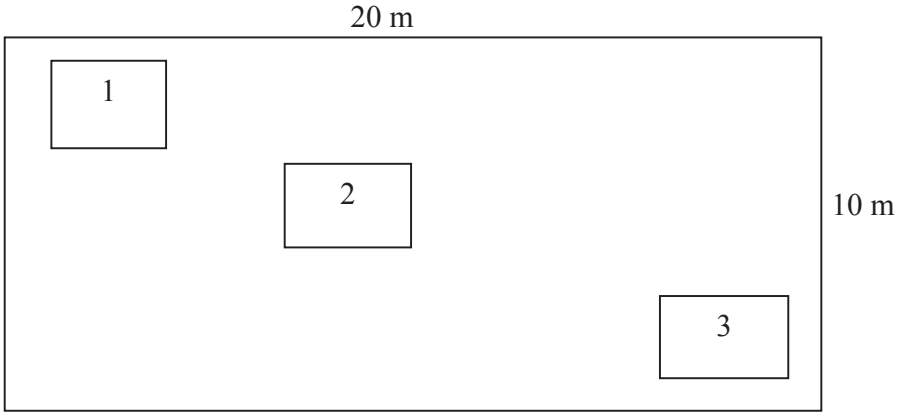

Figure 3 Subplot system of litter coverage measurement

Results And Discussion

The vegetation composition for each slope was *Altingia excelsa, Agathis lorantifolia*, cassava and shrubs in the slope 0 – 8 %, *Agathis lorantifolia, Altingia excelsa*, cassava, banana, coffee and cardamoms in the slope 8 – 15%, and *Agathis lorantifolia, Altingia excelsa* , cassava and coffee in the slope 15 – 25 % (Table 1). The number of trees in higher slope was smaller than in lower slope. It means in lower slope was more shaded than in higher slope.

Tablel.1 Vegetation composition in erosion-monitoring plots

No	Slope (%)	Vegetation		Number of trees per plot
		Forestry	Agriculture	
1	0 - 8	*Altingia excelsa, Agathis lorantifolia*	Casava and shrubs	8
2	8 - 15	*Agathis lorantifolia, Altingia excelsa*	Cassava, banana, coffee and cardamoms	5
3	15 - 25	*Agathis lorantifolia, Altingia excelsa*	Cassava and coffee	4

Table .2 Litter coverage in erosion-monitoring plots

No	Slope (%)	Subplot	Litter (%)	Soil opening (%)	Litter origin
1	0 – 8	1	20	80	Grasses, tree, cassava leaves
		2	80	20	
		3	35	65	
		Average	**45.0**	**55**	
		1	70	30	
		2	80	20	
		3	95	5	
		Average	**81.6**	**18.4**	
2	8 – 15	1	30	70	Coffee, banana, cardamom, cassava leaves.
		2	70	30	
		3	60	40	
		Average	**53.3**	**46.7**	
		1	20	80	
		2	25	75	
		3	35	65	
		Average	**26.7**	**73.3**	
3	15 - 25	1	35	65	Grasses, cassava, tree, yam , coffee leaves.
		2	25	75	
		3	75	25	
		Average	**45**	**55**	
		1	65	35	
		2	75	25	
		3	55	45	
		Average	**65**	**35**	

Table .2 shows the average litter coverage in the slope of 0 – 8 % was 45 % to 81.6 %, while in the slope of 8 – 15 % was 26.7 to 53.3 %, and finally in the slope of 15 – 25 % was 45 % to 65 %. It means in the lower slope the litter

deposit was better than in the higher slope. It is understandable that in higher slope might be possible more erosion rate than in lower area. Litter coverage is very important in agroforestry system in providing the soil humidity for microbial development, litter decomposition and nutrient cycle. In fact, the soil opening in the agroforestry system was quite important

The litter composition mostly came from the leaves of *Altingia excelsa, Agathis lorantifolia* and Coffee, which is quite difficult to be decomposed. The litter composition from agricultural crops was mostly in very small number. The litter from agricultural crops is mostly very easy to be degraded by the microorganisms.

This result will be used for soil management and conservation in agroforestry system in order to minimize the erosion rates.

Table .3 shows that the soil surface decrease due to past erosion rates (after 7 years of traditional agroforestry practice) was 28.61 cm, 23.07 cm and 24.94 cm /7 year or 4.08 cm/year, 3.29 cm/year and 3.56 cm/year or 612, 493.5, and 534 ton/ha/year for the slope of 0 – 8 %, 8 – 15 % and 15 – 25 %, respectively. It means that the depth of topsoil lost was 4.08, 3.29, and 3.56 cm / year, respectively.

The actual erosion rates in February 2005, was 825, 795, and 1185 ton/ha/month in the slope of 0 – 8 %, 8 – 15 % and 15 – 25 %, respectively. It means that the erosion rate in higher slope (15 – 25 %) was bigger than in the other lower slopes (0 – 8 % and 8 – 15 %).

Table 3 The erosion rate at different slopes in agroforestry system

No	Slope (%)	Average erosion rate			
		Past erosion rate		Actual erosion rate	
		(cm/year)	(ton/ha/year)	(cm/month)	(ton/ha/month)
1	0 - 8	4.08	612	5.5	825
2	8 - 15	3.29	493.5	5.3	795
3	15 - 25	3.56	534	7.9	1185

The erosion rate in agroforestry system was very high due to improper implementation of soil conservation technology. The farmers do not practice the soil conservation building. Therefore the water run-off was very high, especially in January, where the rainfall was also quite high. The annual rainfall in Gunung Walat Educational Forest is 2655 mm/year. In the long term, the soil erosion and improper soil conservation technique will affect to the soil fertility and agricultural crop productivity. On the other hand, shading from stand canopy will reduce also the productivity of light demanding species. Therefore, choice of species should be prioritized to

shade tolerance species in order to increase the productivity. Coffee, Cardamom and Yam are shade tolerance species, while cassava is light demanding species.

Conclusion

Erosion rate in agroforestry system in Gunung Walat Educational Forest is classified in high rate due to improper practice or lack of soil conservation techniques. The erosion rate in higher slope (15 – 25 %) was higher than in lower slope (0 – 8 %, and 8 – 15 %). Safety nutrient network must be established for long term agroforestry practice to increase the agricultural crops productivity.