

Accumulated Sediment Concentrations in Different Period of Mixed Harvesting Method at upper Hill Dipterocarp Forest of Malaysia

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Abstract. Compartment 44 of Upper Hill Dipterocarp Forest in Temenggor Forest Reserve was selected to assess the impact of commercial timber harvesting in different periods on sediment accumulation. Sediment assessment was conducted based on period basis which was in before, during and after harvesting time. It was found that total sediment accumulation in catchment during storm event higher compared to normal event. The accumulation of sediment also increased more than 100 times during harvesting process and decreased 10 times in the following year after harvesting processes completed.

1. Introduction

According to FAO (1993) deforestation in Tropical region has become a concern due to its effects on overland flow and erosion rate (Bonell, 1993). In the past, much attention had been given to the function of forest in sediment disaster prevention. Some relevant studies conducted in Malaysia (e.g. Douglas, 1968; Peh, 1981 and Baharuddin, 1988) attempted to quantify the effects of deforestation on hydrological parameters. Baharuddin (1988) through his study at Berembun hill dipterocarp forest at elevation 170 to 302 mean above sea level (m.a.s.l) found that the mean annual suspended sediment yield increased significantly after logging particularly a year after completion of logging. It was increased between 70% under close supervision to 97 % under current practice. A study by Lai et. al (1995) was concentrated on the sediment yield in a steep tropical catchments in the elevation range from 1035 to 1210 meters at Sungai Lawing basin, Selangor. He found that the concentration of suspended sediment increased 73.2% (19, 920 mg/l) during logging compared to only 28.3 % before logging. Besides harvesting regime, the coverage area of selected catchment will also gives a variation on the sediment concentration. Much fewer studies have been attempted to clarify the effect of deforestation in Malaysian upper hill forest. Therefore, this paper reports some finding on sedimentation observations at Temenggor Forest Reserve, Malaysia.

2. Materials and Method

2.1. Description of Research Plot

This study is being conducted at Compartment 44, of the Perak Integrated Timber Complex (PITC) Concession area located in Temenggor Forest Reserve (FR) within the Hulu Perak District, Grik, Perak. This area was harvested using available harvesting protocol (Selective Management System) with some modification. The major difference between the current and new harvesting protocol is the spatial distribution of the felled trees. The upper hill forest is situated approximately in the range of 600 meters to 800 meters above sea level (a.s.l). It also has experienced a typical monsoon climate characterized by uniformly high temperature and high humidity since the Temenggor FR received rain exceeded 3000mm per year at times. Besides, less rainfall has recorded during July and February. This paper will compare the accumulated sediment in six catchments namely HP1 (SMS), HP2 (New Protocol), HP4, HP5, HP7 and HP9 (Control).

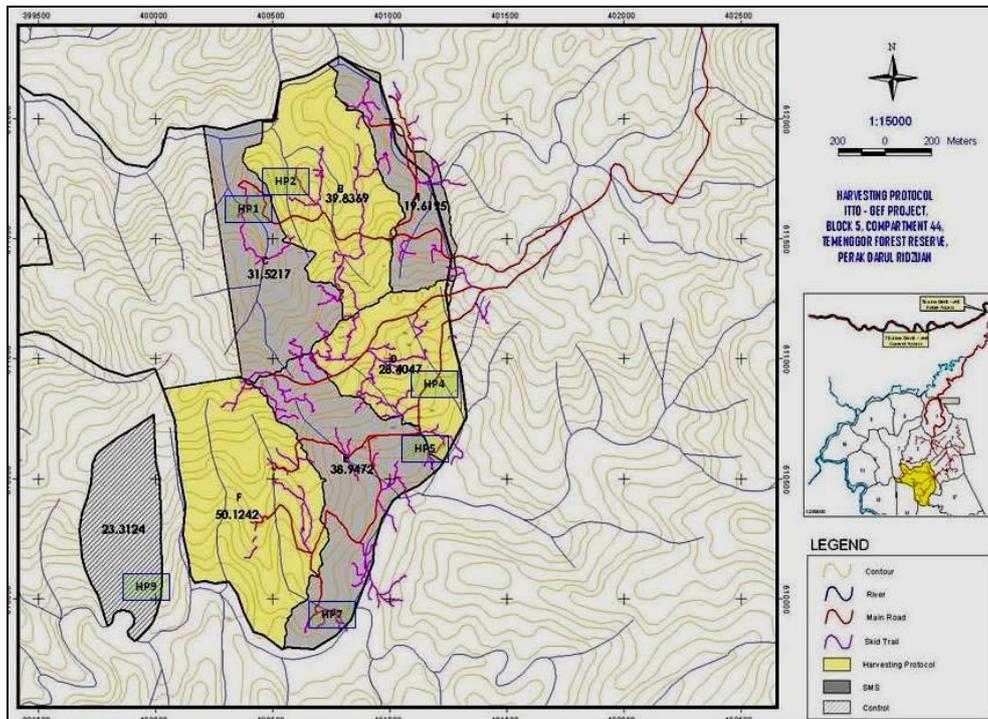


Figure 1. The location of the study area at Block 5, Compartment 44, Temenggor F.R, Perak

2.2. Sediment Assessment

The multi-stage sediment sampler equipped with 6 bottles at the interval of 10 cm each was installed at each catchment to collect storm flow samples. Samples from this device were analyzed in the laboratory using oven dry method. Glass Microfibre Filter (GFC), suction pump, weighing device, measuring cylinder and oven are used during laboratory analysis. Samples being over-dry at 500 degree for 1 hour before it re-weighing again.



Figure 2. A multi-stage of sediment sampling during storm equipped with bottle of 10-cm interval as water level.

3. Result and discussion

3.1. Sediment Concentration at different period

Assessment on sediment accumulated in the river before harvesting showed that normal event has total amount of sediment accumulated in whole catchment was 227.92 mg/l which was almost 20 times more compared to storm event (3,942,936.25 mg/l). Maximum sediment assessment in the river during harvesting processes showed that storm event accumulated more than 150 times compared to normal event. However,

the total accumulation decreased gradually after timber harvesting to 11 times compare to normal. The details are depicted in Table 1.

Table 1. Summary of the total sediment concentration at HP1 (SMS), HP2 (new protocol), HP4, HP5, HP7 and HP9 (control) in a different period of timber harvesting

Period	Normal	Storm
Before	227.92	3942936.25
During	117876.25	19176121.00
After	290.00	3300760.75

3.2. Sediment Concentration during Normal and Storm Event

Sediment is responsive on the water level fluctuation in the river. More water accelerates more surface, streambed and bank erosion which increased sediment concentration. The dynamics of the water level has influence the sediment accumulation behavior of the catchment. Table 2 shows the different periods of accumulative sediment during normal event. Before and after conditions show there is no significant changes between catchment. However, during harvesting there is significant changes in HP4 that shows the highest accumulative sediment recorded with 77058.25 mg/l.

Table 2: Total sediment in six catchments under SMS, NP and Control during normal event

Period	HP1	HP2	HP4	HP5	HP7	HP9
Before	42.47	44.51	34.38	41.30	43.45	21.80
During	na	143.25	75058.25	25.00	1615.50	41034.25
After	0.00	0.00	12.25	230.75	30.25	16.75

Note: SMS-Selective Management System, NP – New Protocol

Figure 3 shows that sediment accumulation of six catchments under normal event of timber harvesting processes. Most of sediment concentrated during harvesting process in HP4 due to forest road construction as well as heavy rains. Other catchments show the lesser amount of sediment than HP4.

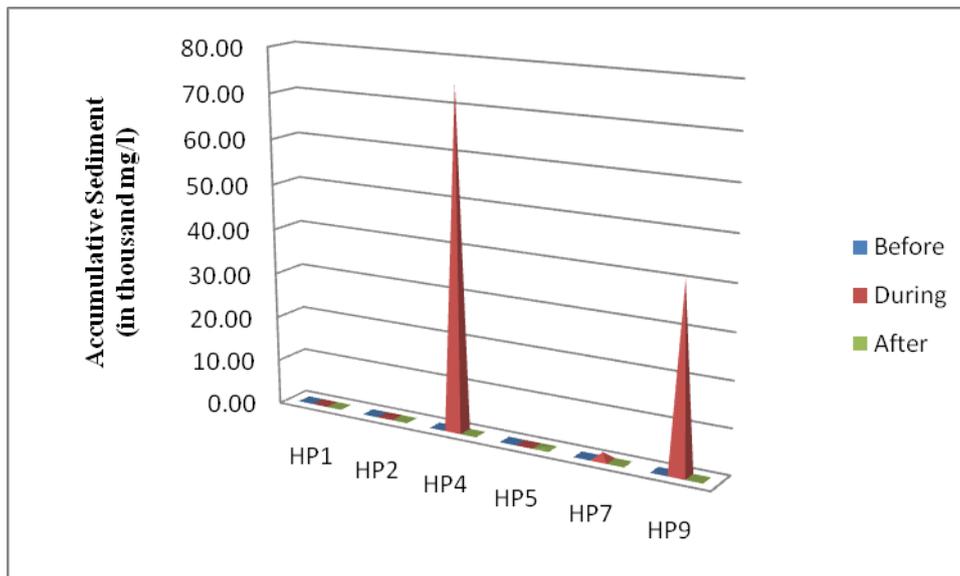


Figure 3. Sediment accumulation at station HP1 (SMS), HP2 (NP), HP4, HP5 HP7 and HP9 (Control) during normal event

In addition, during the storm event shows the significant changes in three different periods with the larger amount comparing to normal event. Table 3 shows that the highest amount accumulated in HP7

(5438773.75 mg/l). Subsequently, heavy rainfall and the usage of heavy machine such as san-tai-wong nearby the catchment give the impact to the run off sediment.

Table 3: Total sediment in six catchments under SMS, NP and Control during storm event

Period	HP1	HP2	HP4	HP5	HP7	HP9
Before	96455.25	3727652.50	12656.50	24001.25	27645.25	54525.50
During	5403537.00	5249895.75	83775.50	1823438.50	5438773.75	1176700.50
After	1942661.50	861190.25	49807.50	78493.25	305961.50	62646.75

Note: SMS-Selective Management System, NP – New Protocol

In occurrence of storm event before harvesting, HP2 led up the highest sediment accumulative while after harvesting, HP1 accumulated the highest sediment concentration compared to other catchments.

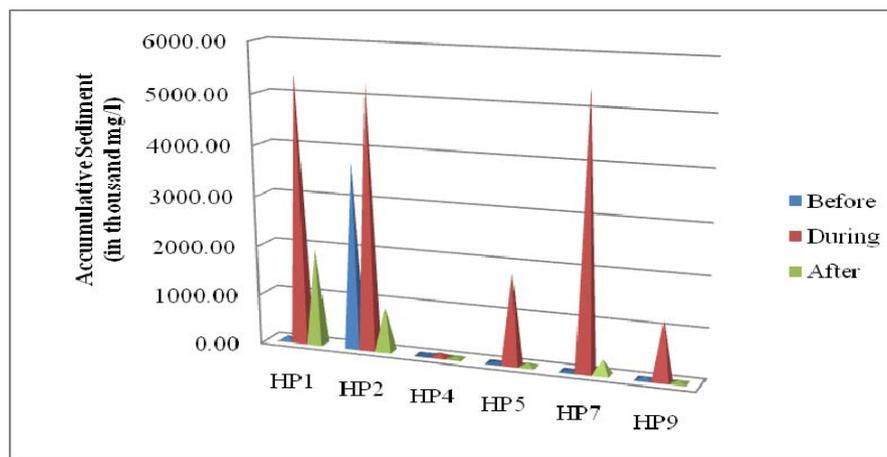


Figure 4. Sediment accumulation at station HP1 (SMS), HP2 (NP), HP4, HP5 HP7 and HP9 (Control) during storm event

4. Conclusion

The difference of harvesting period has given a significant impact to the sediment concentration as well the different method of timber harvesting. Though, other environmental factors such as precipitation and the usage of heavy machine might influences to the higher sediment accumulative respectively. More studies need to be conducted to determine the degree of improvement resulted from this technique.

5. References

- [1] Baharuddin, K. (1988). Effect of logging on sediment yield in a hill dipterocarp forest in Peninsular Malaysia. *Journal of Tropical Forest Science* 1(1): 56-66
- [2] Bonell, M. (1993). Progress in the understanding of runoff generation dynamics in forest. *Journal of Hydrologi* vol. 150: 217-275.
- [3] Douglas, I. (1968). Erosion in the Sg. Gombak catchment, Selangor, Malaya. *J. Trop. Geogr.* 26:1-16
- [4] FAO. (1993). Forest resources assessment 1990. Tropical Countries, FAO Forest Paper no. 112. Rome, 1993.
- [5] F.S. Lai, M.J. Lee & S. Mohd Rizal (1995). Changes in sediment discharge resulting from commercial logging in the Sungai Lawing Basin, Selangor, Malaysia. In: *Proceedings of a Boulder Symposium: Effects of Scale on Interpretation and Management of sediment and water quality.* IAHS Publ. No. 226 (55-62).
- [6] Peh, C. H. (1981). The suspended and dissolved sediment load of three small forested drainage basins in Peninsular Malaysia. *The Malaysian Forester* 44(4): 438-452