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Water Quality Changes on Highland Forest before, during and after Timber Harvesting

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Abstract. Timber harvesting activities associated with the deterioration in water quality, especially for those on weak structured soil. This study showed that average temperature and turbidity arisen during timber harvesting and lowered one year afterwards. pH and conductivity reduced gradually whilst dissolve oxygen ever increased one year after logging compared to the natural condition. Overall, water quality on highland slightly modified during timber harvesting but it came back to normal value one year after disturbances.

Keywords: Water quality, Highland forest, Timber harvesting

1. Introduction

Zulkifli & Rahim (1991) has studied the impact of logging on hydrological parameters. Their study was on logging and forest conversion. They found that commercial logging without instituting necessary conservation measures resulted in significant changes in stream water quality with the most affected parameters were turbidity, suspended solid and iron concentration. In addition, Rahim and Zulkifli (1994) stated that suspended solid and turbidity in the first year after logging increased by 12 and nine-fold. Ruslan and Manan (1980) stated that heavily compacted soil that caused by the heavy machine, the occurrence of surface runoff is rapid. This situation has accelerated the surface erosion which in turn support to the increase in sedimentation into the adjacent receiving stream. Forest cutting was also leads to the increase in soil water storage which support in microbial activities and enhance the decomposition rates (Little & Ohmann, 1988). This situation will facilitate in leaching of various ions which accumulated into the receiving stream and affected water quality status in the stream. A study was conducted to assess the timber harvesting effect on water quality at upper hill dipterocarp forest. This paper is an attempt to clarifying some of the issues with regards to water quality due to timber harvesting.

Marryanna *et al* (2006) through her study in Bukit Tarek Forest Reserve on the changes in chemistry profile of water quality reported that Silica showed significant fluctuation in comparison with the other parameters. It increased up to 0.958 mgl^{-1} in catchment that undergone clear felling compared with control catchment. However, the difference became smaller after the felling to 0.31 mgl^{-1}.The other parameters did not show any obvious difference between control and clear felling catchment. They fluctuated from 0.02 to 0.05 mgl^{-1} during harvesting and returned to almost normal condition after the harvesting. In addition**,** Marryanna *et al* (2007) studied the effect of clear felling timber harvesting at Bukit Tarek Forest Reserve on physical water quality found that pH increased about 1.6%, conductivity 49.2% and turbidity 350.8% during the process

2. Material and Methods

2.1. Plot Description

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This study was conducted at Compartment 44, of the Perak Integrated Timber Complex (PITC) Concession area located in Temenggor Forest Reserve within the Hulu Perak District, Grik, Perak (Figure 1). This area was harvested using available harvesting protocol with some modification. The harvesting protocol being developed was compared with current harvesting practices applied by the Perak Forestry Department, which is based on the Malaysian Selective Management System and reduced impact of logging principles. The major difference between the current and new harvesting protocol is the spatial distribution of the felled trees. The total concession areas cover 9000 hectares consisting of rich lower and upper hill dipterocarp forests. However, Block 5 study area covers 300 ha (Figure 1), which is approximately 600 m to just over 800 m above sea level. It also has a typical monsoon climate characterized by uniformly high temperature and high humidity. Therefore, it is not surprising that Temenggor FR received rain exceeded 3000mm per year at times. Besides, it received less rainfall during months of July and February. Average daily hours of sunshine are usually around 10 to 11 hours with potential evapotranspiration of about 1300 mm. Five catchments have been identified as the treatment blocks. Those catchments vary in areas and water level. One unlogged catchment was selected and monitored as a control plot. The harvesting experiment is part of the Conservation of biological diversity in production forest project funded by Global Environmental Facilities (GEF), International Tropical Timber Organization (ITTO) and the Malaysian Government.

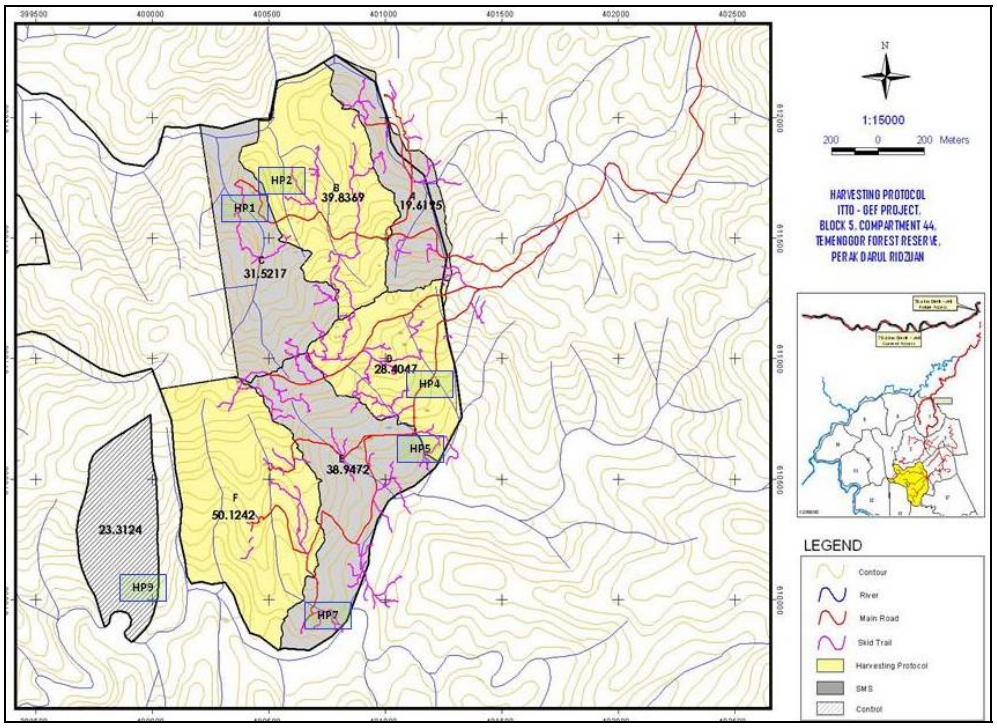

Fig. 1: Location of the study area at Block 5, Compartment 44, Temenggor F.R., Perak

2.2. Water Quality Measurement

Portable water quality sensor was used to collect physical water quality parameters on-site. Selection of the water quality parameter was based on the environmental impact assessment guidelines for forestry produced by the Department of Environment (DOE) (1998). Five parameters measured includes of temperature, pH, conductivity, turbidity and dissolved oxygen (DO). Changes in the stream water quality were evaluated against Interim National Water Quality Standard of DOE. Data was collected at monthly intervals from all monitoring stations since June 2009 until December 2011.

3. Result and Discussion

Table 1 showed that average temperature and turbidity was arisen during timber harvesting and decreased one year afterwards. Difference in temperature only slight (Figure 2) but turbidity risen twice than before logging. Water pH was slightly decreased from 7.12 before harvesting to 6.76 after harvesting while conductivity gradually decreased during and after harvesting. Turbidity level almost back to normal value while DO improved a year after harvesting processes completed. The turn back period of water quality

shown to be shorter compared to previous finding by Zulkifli and Rahim (1991) where it was mentioned that the recovery period of water quality in a catchment under harvesting was three to five years. Hence, the variation of water quality turning period differs at different locality.

Table 1. Average Monthly water quality at Block 5, Compartment 44, Temenggor F.R., Perak

Timber harvesting stage phase	Temperature (°C)	pH	Conductivity (µs/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/l)
Before	22.33	7.12	113.1	10.40	7.10
During	22.66	7.06	102.4	20.67	7.94
After	22.30	6.76	99.6	12.28	8.00

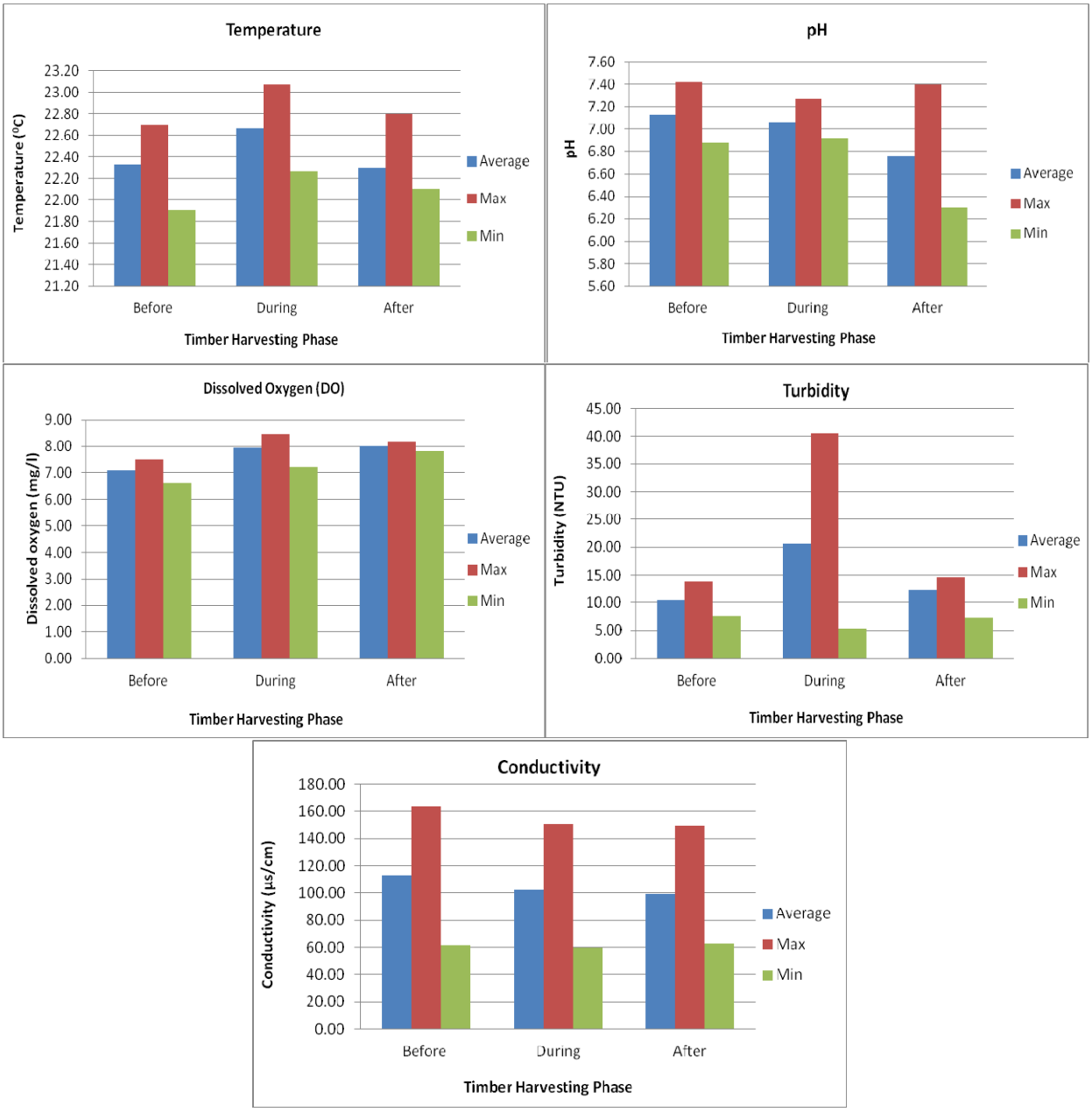

Fig. 2: Changes in water quality parameters before, during and after timber harvesting

In general, most parameters monitored were increased during timber harvesting and decreased a year after harvesting. Major fluctuation shown in turbidity where the maximum value was sharply increased at about three fold compared to before. Highest water temperature recorded during timber harvesting at 22.69 ^{0}C. The average temperature was decreased from 22.33^{0}C (before), 22.66^{0}C (During) and 22.30^{0}C after harvesting completed. pH and conductivity reduced gradually whilst dissolved oxygen ever increased one year after logging compared to the natural condition before it was logged. Average pH of water also decreased from 7.13 (before), 7.06 (during) and 6.76 (after). Variation of maximum and minimum pH value became stable during timber harvesting but it went broader considerably one year after timber harvesting. The average value for conductivity was 113.15 µs/cm (before), 102.40 µs/cm (during) and 99.60 µs/cm (after).

4. Conclusion

This study showed that value in water quality parameters slightly deviated one year after timber harvesting. Since Timber harvesting was the only source of disturbance, the water quality came back to normal when the open surface soil revegetated with the natural plants. At least one year is needed to gain the natural value of water quality on highland soil upon timber harvesting. The finding of this study would be the result of the improved harvesting technique applied in the study area. More comphrensive study should be conducted to verify and strengthen the finding of this study with concern to improve the harvesting technique for more ecosystems friendly.

5. Acknowledgement

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