Research project of counterparts funded at IPB

Name	Counterpart	Title
Suria Darma Tarigan	**B10**	Assessing the relative impact of changes in soil infiltration and plant evapotranspiration on catchment water yield in the Tropical Lowland Rainforest Transformation Systems (Sumatra, Indonesia)

Background and Objectives

Infiltration and evapotranspiration have a dominant role in water flow regulation. Water flow regulation, in turn, affects water yield and so determines whether there is water scarcity (drought) or excess (flooding) in an area. The evapotranspiration rate is determined mostly by land use or vegetation type but the infiltration rate depend on soil management practices. The infiltration rates in the rainforest transformation system falls into two categories. There are high infiltration rates (>30 cm h^{-1}) under forest but low infiltration rates (<10 cm h^{-1}) under agricultural plantations (oil palm and rubber) (Tarigan et al. 2016).

The OBJECTIVES of the research were: a) to measure infiltration rate in oil palm plantations under different management practices and, b) to assess the relative impact of changes in soil infiltration and plant evapotranspiration on the catchment water yield.

Methods

Data was collected in the PTPN VI and Harapan landscape in Jambi Province. The data collected was: a) soil infiltration rate under different land uses and plantation management practices (including mechanical and manual weeding), b) continuous river discharge for the calibration of a watershed hydrological transport simulation model, c) changes in evapotranspiration assessed from data in the literature. Infiltration was measured using a double ring infiltrometer. Continuous river discharge was measured using a HOBO data logger. The Soil & Water Assessment Tool (SWAT) hydrological transport simulation model was then used to assess the relative impact of change in soil infiltration and plant evapotranspiration on the catchment water yield. The research question was whether reduced infiltration or increased transpiration had caused significant impact on the catchment water yield. To answer this question, we calibrated and validated the SWAT model and assessed the relative impact of changes in plant transpiration and soil infiltration on the catchment water yield component.

Results and Conclusion

We found that soil infiltration rates under oil palm are very low (0.1 2.3 cm $hour^{-1}$, figure 1). Soil degradation and compaction are probably the reasons for these very low infiltration rates.

The infiltration rates in oil palm plantations are very low due to soil degradation and compaction and minimal management. Changes in the soil infiltration rate have a greater effect on fluctuations in catchment water yield than do changes in evapotranspiration. The fluctuations in catchment water yield because of the changes in the soil infiltration rate have the potential to lead to water scarcity during the dry season and flooding during the wet season.

Based on the SWAT simulation model, changes in the soil infiltration rate affected the catchment water yield more than changes in evapotranspiration (figure 2).

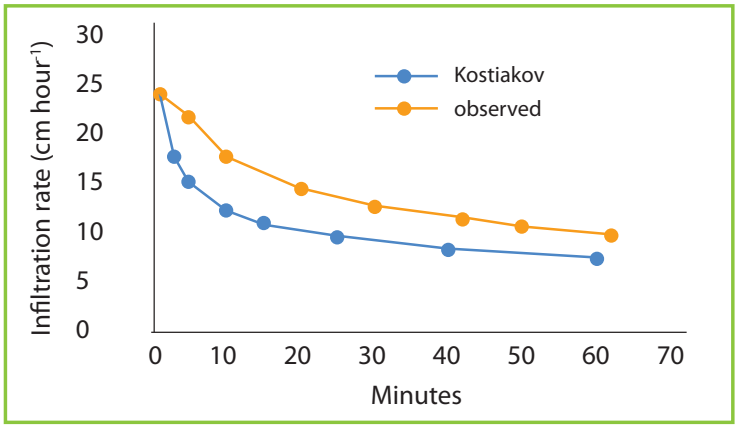

Figure 1. The very low infiltration rates under oil palm (in cm $hour^{-1}$). Comparison of the Kostiakov model predictions (blue) and the observed rates (orange).

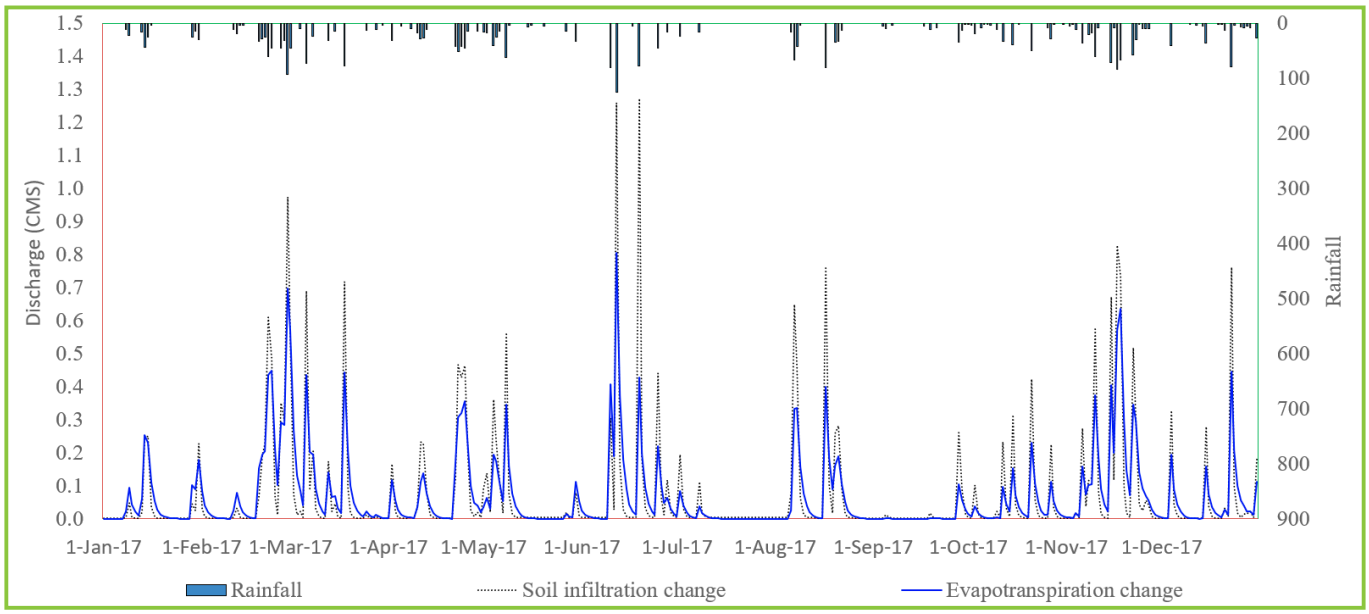

Figure 2. Relative impact of change in infiltration and evapotranspiration on the catchment discharge.

References

[1] Tarigan, S. D., Wiegand, K., Dislich, C., Slamet, B., Heinonen, J., and Meyer K.: Mitigation options for improving the ecosystem function of water flow regulation in a watershed with rapid expansion of oil palm plantations, Sustainability of Water Quality and Ecology, 8, 4–13, 2016.