

## **Hydrological dynamics of tropical streams on a gradient of land-use disturbance and recovery: A multi-catchment experiment**

### **ABSTRACT**

Although erosional impacts of rainforest logging are well established, changes in hydrological dynamics have been less explored especially in the post-logging recovery phase following repeat-logging cycles and mature phase of oil palm plantation cycles. This study addresses this gap by comparing hydrological characteristics of five catchments in a steep land area of Sabah, Malaysian Borneo on a gradient of disturbance and recovery – twice-logged forest, 22 years recovery (LF2); multiple-logged forest, 8 years recovery (LF3); mature oil palm, 20 years old (OP); and two primary forests (PF and VJR) as controls. Each catchment was instrumented with water depth (converted to discharge), conductivity, temperature, and turbidity sensors, and a raingauge connected to a solar-powered datalogger recording data at 5-minute intervals from November 2011 to August 2013. Data were analysed via the flow-duration curve (FDC) supplemented by the runoff coefficient (RR) and coefficient of variation in discharge (QVAR) for aggregated characteristics, as well as via a combination of the Dunn's test and multiple-regression at the storm event scale for focused hydrological dynamics. Results show that OP is characterised by a relatively low RR (0.357) but with high responsiveness during storm events and very low baseflow (38.4% of total discharge). Discharge in the LF3 (RR = 0.796) is always the highest while having an intermediate level of responsiveness. LF2 with longer-term recovery shown a reduction in terms of discharge (RR = 0.640). Being the benchmark, the undisturbed forest (PF) has the most buffered storm response with the highest baseflow (67.9% of total discharge). Stormflow and baseflow are anomalously high and low respectively in the near-primary VJR catchment, but this probably reflects the shallow soils and short-stature rainforest associated with its igneous and metamorphic lithology. From a management aspect, although hydrological recovery is more advanced in the 22 years than in the 8-years post-logging catchment, full recovery is yet to be achieved and might be hastened by enrichment planting of the degraded forest. The low baseflow and flashy nature of the mature oil palm have major implications

for downstream water supply in ENSO periods and flooding in La Nina periods. Steep lands in the humid tropics are best avoided from any form of landscape disturbance.