Baseflow persistence and magnitude in oil palm, logged and primary tropical rainforest catchments in Malaysian Borneo: implications for water management under climate change

ABSTRACT

While timber harvesting has plateaued, repeat-logging and conversion into plantations (especially oil palm) are still active in the tropics. The associated hydrological impacts especially pertaining to enhanced runoff, flood, and erosion have been well-studied, but little attention has been given to water resource availability in the humid tropics. In the light of the increasing climate extremes, this paper compared baseflow values and baseflow recession constants (K) between headwater catchments of five differing land-uses in Sabah, Malaysian Borneo, namely primary forest (PF), old growth/virgin jungle reserve (VJR), twice-logged forest with 22 years regeneration (LF2), multiplelogged forest with 8 years regeneration (LF3), and oil palm plantation (OP). Hydrological and meteorological sensors and dataloggers were established in each catchment. Daily discharge was used for computing K via four estimation methods. Catchment ranks in terms of decreasing K were VJR (0.97841), LF3 (0.96692), LF2 (0.90347), PF (0.83886), and OP (0.86756). Catchment ranks in terms of decreasing annual baseflow were PF (1877 mm), LF3 (1265 mm), LF2 (812 mm), VJR (753 mm), and OP (367 mm), corresponding to 68%, 55%, 51%, 42%, and 38% of annual streamflow, respectively. Despite the low K, PF had the highest baseflow magnitude. OP had the fastest baseflow recession and lowest baseflow magnitude. Baseflow persistence decreased with increasing degree of disturbance. K showed strong association to catchment stem density instead of basal area. For dynamic catchments in this study, the Kb3 estimator is recommended based on its lowest combination of coefficient of variation (CoV) and root mean squared error (RMSE) of prediction. For wetter catchments with even shorter recession events, the Kb4 estimator may be considered. Regarding climate change, logging and oil palm agriculture should only be conducted after considering water resource availability. Forests (even degraded ones) should be conserved as much as possible in the headwaters for sustainable water resource.