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Hydrogeomorphological and water quality impacts of oil palm conversion and logging in Sabah, Malaysian Borneo: a multi-catchment approach

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The last three decades have seen a combination of logging and land-use change across most of the rainforest tropics. This has involved conversion to oil palm across large parts of SE Asia. Although much is now known about the hydrological and sediment transport impacts of logging, relatively little is known about how impacts of oil palm conversion compare with those of logging. Furthermore little is known about the impacts of both on river morphology and water quality. This paper reports some findings of the first phase of a ten-year large-scale manipulative multi-catchment experiment (part of the SAFE – Stability of Altered Forest Ecosystems – Project), based in the upper part of the Brantian Catchment in Sabah, Malaysian Borneo; the project is designed to assess the degree to which adverse impacts of oil palm conversion (on erosion, downstream channel change, water quality and river ecology) might be reduced by retaining buffer zones of riparian forest of varying width from zero to 120 metres. Ten 2 km2 catchments of contrasting land use history have been instrumented since 2011 to record discharge, turbidity, conductivity and water temperature at 5-minute intervals. These comprise 6 repeat-logged catchments being subjected in 2015-16 to conversion to oil palm with varying riparian forest widths; a repeat-logged 'control' catchment; an old regrowth catchment; an oil palm catchment; and a primary forest catchment. In addition, (1) monthly water samples from the catchments have been analysed for nitrates and phosphates, (2) channel cross-sectional change along each stream has been monitored at six-monthly intervals and (3) supplementary surveys have been made of downstream bankfull channel cross-sectional size and water chemistry at a wider range of catchment sites, and (4) sediment cores have been taken and contemporary deposition monitored at a hierarchical network of sites in the large Brantian catchment for geochemical analysis and dating to establish the history of sedimentation and inferred changes in upstream sediment sources. Effects on river ecology were also assessed. This paper summarises the key findings to date, focussing on differences in suspended sediment dynamics, downstream bankfull channel size and shape, and pollution between oil palm catchments, and catchments under post-logging and primary rainforest.