The role of extreme events in the impacts of selective tropical forestry on erosion during harvesting and recovery phases at Danum Valley, Sabah

Abstract

Ten years' hydrological investigations at Danum have provided strong evidence of the effects of extremes of drought, as in the April 1992 El Nino southern oscillation event, and flood, as in January 1996. The 1.5 km(2) undisturbed forest control catchment experienced a complete drying out of the stream for the whole 1.5 km of defined channel above the gauging station in 1992, but concentrated surface flow along every declivity from within a few meters of the catchment divide after the exceptional rains of 19 January 1996. Under these natural conditions, erosion is episodic. Sediment is discharged in pulses caused by storm events, collapse of debris darns and occasional landslips. Disturbance by logging accentuates this irregular regime. In the first few months following disturbance, a wave of sediment is moved by each storm, but over subsequent years, rare events scour sediment from bare areas, gullies and channel deposits. The spatial distribution of sediment sources changes with time after logging, as bare areas on slopes are revegetated and small gullies are filled with debris. Extreme storm events, as in January 1996, cause logging roads to collapse, with landslides leading to surges of sediment into channels, reactivating the pulsed sediment delivery by every storm that happened immediately after logging. These effects are not dampened out: with increasing catchment scale. Even the 721 km(2) Sungai Segama has a sediment yield regime dominated by extreme events, the sediment yield in that single day on 19 January 1996 exceeding the annual sediment load in several previous years. In a large disturbed catchment, such road failures and logging-activity-induced mass movements increase the mud and silt in flood waters affecting settlements downstream. Management systems require long-term sediment reduction strategies. This implies careful road design and good water movement regulation and erosion control throughout the logging process.