Hydrological consequences of landscape fragmentation in mountainous northern Vietnam: Evidence of accelerated overland flow generation

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Abstract: Measurements of saturated hydraulic conductivity (K_S) and indices of Horton overland flow (HOF) generation are used to assess the influence of landscape fragmentation on near-surface hydrologic response in two upland watersheds in northern Vietnam. The fragmented landscape, which results from timber extraction and swidden agriculture, is a mosaic of surfaces having distinct infiltration characteristics. In general, human activity has reduced infiltration and altered near-surface flow paths on all disturbed land covers. Compacted roads, paths, and dwelling sites, for example, have the propensity to generate HOF for small rainfall depths. Although these surfaces occupy a small fraction of a basin land area (estimated at <1%), they contribute disproportionately to overland flow response during typical rainfall events. Recently abandoned fields have the lowest K_S of all non-consolidated, post-cultivation surfaces tested. Beginning 1-2 years following abandonment, diminished K_S recovers over time with the succession to more advanced types of secondary regrowth. If a grassland emerges on the abandoned site, rather than a bamboo-dominated cover, K_S recovers more rapidly. The decrease in K_S with depth below disturbed surfaces is more acute than that found at undisturbed sites. This enhanced anisotropy in near-surface K_S increases the likelihood of the development of a lateral subsurface flow component during large storms of the monsoon rain season. Subsequently, the likelihood of return flow generation is increased. Because the recovery time of subsurface K_S is greater than that for the surface K_S, the impact human activity has on hydrologic response in the fragmented basin may linger long after the surface vegetation has evolved to a mature forested association.

Author Keywords: Deforestation; Disk permeameter; Imperata cylindrica; Infiltration; Land-cover change; Saturated hydraulic conductivity; SE Asia; Tropical watershed hydrology

Index Keywords: Anisotropy; Hydraulic conductivity; Landslides; Rain; Timber; Vegetation; Landscape fragmentation; Hydrology; deforestation; hydraulic conductivity; hydrological response; infiltration; mountain region; overland flow; saturated medium; Asia; Eurasia; Southeast Asia; Viet Nam; Imperata; Imperata cylindrica

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