

HYDROLOGICAL EFFECTS OF TROPICAL LAND USE MANAGEMENT INCENTIVES: PANAMA CANAL WATERSHED

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Panama lies in the seasonal tropics and over 85 percent of annual precipitation falls during the May-December wet season. Extreme rainfall events near the end of the wet season can produce flooding that impact Panama Canal operations. During the December-April dry season, occasional water shortages limit the draft of ships passing through the Panama Canal, as well as hydropower production. The Smithsonian Tropical Research Institute (STRI) Panama Canal Watershed Experiment- Agua Salud Project (ASP) broadly aims to improve our predictive understanding of the effects of land-use, land-cover, and land management decisions on the provisioning of ecosystem services in the Panama Canal Watershed (PCW) and in similar tropical landscapes with saprolitic soils. The hydrological component of the STRI-ASP is focused on runoff generation, flow paths, and residence times as affected by land-cover and land-use history. We have instrumented 10 watersheds that range in size from 7 ha to 178 ha, from which we collect high-frequency rainfall, meteorological, runoff, water quality, isotopic, and groundwater level data. Our study watersheds have similar topography, soil types, and rainfall; the dominant difference between them is land-cover and land-use history. Observed effects of land-use/cover and land management include differences in event-scale runoff volumes and peak flow rates, both of which affect flooding, water quality and erosion. Over seasonal time scales, we observe that land-use and land-cover also affect base flow discharges- an important dry-season ecosystem service. Ultimately, we aim to improve the ability of physics-based hydrological models to predict the influence of land-use and land-cover on hydrological response in tropical watersheds with saprolitic soils, which represent about 70 percent of the tropics. We share data with the Panama Canal Authority to test the scalability of our hydrological observations in larger watersheds. While this presentation focuses on hydrological processes and observations, our team includes socio-economists working to better understand the effectiveness of land-use incentives provided by the Panama Canal Authority in the PCW, and ecologists studying a wide-range of other land-cover related ecosystem service provisioning including timber production, habitat, and species diversity.

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