Effects of mountain tea plantations on nutrient cycling in upstream watersheds

Although anthropogenic reactive nitrogen (Nr) increases food production to support the global population, Nr emissions due to fossil fuel combustion and fertilizer production have likely exceeded the human operational space. Consequently, the abundant Nr leaking into ecosystems through water cycling causes eutrophication in freshwater systems and dead zone expansion in coastal zones. In this study, we collaborated with a research team from the Department of Life Science at National Taiwan Normal University to monitor the streamwater and rainfall chemistry of mountain watersheds in the Feitsui Reservoir Watershed in northern Taiwan. We examined the effects of agriculture on watershed nutrient cycling and found that riverine NO_3 concentrations increased with the cultivation gradient, suggesting that agriculture-enriched fertilizer-associated nutrients are present in streamwater. Moreover, high concentrations of ions in rainfall in cultivated watersheds indicated that agriculture can influence the atmospheric deposition of nutrients and a system's ability to retain nutrients. We estimated that a tea plantation at our study site contributed approximately 450 kg-N ha^{-1} yr^{-1} of NO_3-N to streamwater, which is an order of magnitude greater than previously reported for agricultural lands around the globe. This level can only be matched in areas of intense fertilizer application. Furthermore, we illustrated the N fluxes at the watershed scale to show that excessive N leaching and additional loss to the atmosphere via volatilization and denitrification can occur under conditions of intense fertilizer use. In summary, this study demonstrated the pervasive impacts of agricultural activities, especially excessive fertilization, on ecosystem nutrient cycling in mountain watersheds.

Reference

Teng-Chiu Lin, Pei-Jen Lee Shaner, Lih-Jih Wang, Yuting Shih, Chiao-Ping Wang, G.-H. Huang, Jr-Chuan Huang. (2015). Effects of mountain tea plantations on nutrient cycling at upstream watersheds. *Hydrology and Earth Systems Sciences*. 19(11), 4493-4504. DOI: 10.5194/hess-19-4493-2015.

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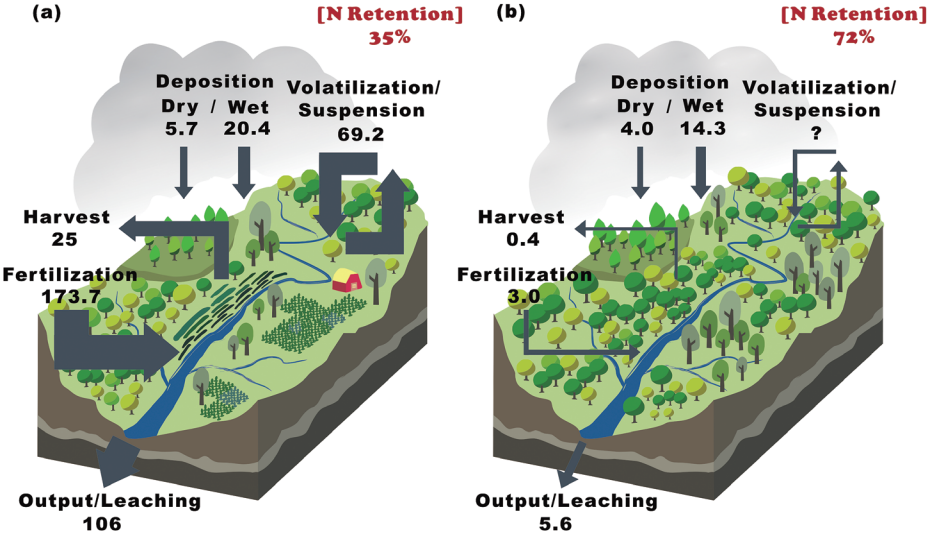

Figure 1. Schematic diagram of nitrogen fluxes in disturbed (a) and pristine (b) watersheds (units: kg-N ha^{-1} yr^{-1}).

(Biological N fixation is not included in the diagram and its effects on N retention is described in the Discussion.)