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“Bridging the gap between increasing knowledge and decreasing resources”

Effect of Water Erosion and Land Management on the Soil Carbon Stock of Intensive Rubber Plantation in Xishuangbanna, South-West China

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Abstract

Xishuangbanna, SW China, as the typical tropical rain forest region, has been dramatically changed in land use over the past 30 years. Rubber plantation combined with tea cultivation boosted from 1.3 % to 11.8 %, while deforestation decreased the forest cover from 69 % to 45 %. Land use transformation from forest to rubber leads to less litter layer and higher water repellency which both contributed to higher runoff revealing higher soil loss potential. Top soil loss due to water erosion is a major concern as it means losses of most fertile soil layers rich in carbon and nutrients determining soil quality and being an important factor in agricultural productivity. This study focuses on evaluating impact of water erosion on rubber plantations of different ages and identifying major factors affecting this process. The study was performed for three rubber plantations of different age: young with open canopy (2–3 years old), mid-age with almost closed canopy (8 years old) and old rubber with close and dense canopy (36 years old). Universal soil loss erosion (USLE) plots (3m*17 m) were built in each case to collect eroded soil and runoff. The collected sediments were analysed for its carbon content and texture. Components of local water balance such as throughfall, stemflow, total precipitation, rainfall intensity as well as ground cover were measured periodically to analyse the impact of different factors: canopy closure, rain and ground cover on soil and carbon loss in rubber plantation. Ground cover was measured every month. Carbon content, texture, bulk density and hydraulic conductivity of top soil of each site were analysed with core method sample collection. The trends of total precipitation and rainfall intensity of three sites were similar. Rubber plantation presented lower soil loss than local annual crop like maize but higher than rainforest. Mid-age rubber showed highest soil loss ($2.69 \text{ t ha}^{-1} \text{ a}^{-1}$) while old rubber showed lowest ($0.54 \text{ t ha}^{-1} \text{ a}^{-1}$). We conclude that soil loss during rubber plantation development is determined by canopy closure and ground cover which were closely related to land management. Based on this, better management and soil conservation can be proposed to improve ecosystem functions of rubber plantations.

Keywords: Intensive rubber plantation, land management, soil loss, water erosion