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Rapid soil organic carbon re-accumulation after bamboo invasion on recovering landslide scars in a subtropical forest ecosystem of Taiwan

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Typhoon-induced landslides occasionally strip parts of the landscape off its vegetative cover and soil layer and export large amounts of biomass and soil organic carbon (OC). The resulting landslide scars remain low in OC and vulnerable for re-activation for several years until closed vegetation is re-established. In the subtropical mountains of Taiwan and in other parts of the world, bamboo species may invade at a certain point in the succession of recovering landslide scars. Bamboo has a high potential for carbon sequestration because of its fast growth and dense rooting system. However, it is still largely unknown how these properties translate into soil OC re-accumulation rates after landslide disturbance.

In this study, we investigated a chronosequence with 5 different sites on former landslide scars in the Alishan area in Central Taiwan, ranging in age from 6 to 53 years post disturbance. The younger landslide scars were colonized by Miscanthus giganteus, while after approx. 15 to 20 years of succession, bamboo (Phyllostachys) species were dominating. Biomass and soil OC stocks were measured on the recovering landslide scars and compared to an old-growth Cryptomeria japonica forest stand in the same area. Humic acids were extracted from the newly formed soils of the recovering landslide scars and analyzed for molecular characteristics.

Biomass carbon accumulated rapidly in bamboo stands but was significantly lower compared to the old-growth coniferous forest. However, soil OC stocks on the recovering landslide scars approached the levels of the old-growth forest after only few decades of succession. Similarly, humic acid characteristics (obtained from fluorescence and NMR spectroscopy) rapidly changed in the early phase of succession but seemed to stabilize during the later phase of landslide recovery. Our results demonstrate the high potential of bamboo for below-ground OC sequestration and storage, and show that the fresh OC inputs are rapidly converted to humic substances under subtropical conditions.