



On the rebound: soil organic carbon stocks can bounce back to near forest levels when agroforests replace agriculture in southern India

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Received: 31 July 2015 – Published in SOIL Discuss.: 21 August 2015

Accepted: 7 December 2015 – Published: 18 January 2016

Abstract. Tropical agroforestry has an enormous potential to sequester carbon while simultaneously producing agricultural yields and tree products. The amount of soil organic carbon (SOC) sequestered is influenced by the type of the agroforestry system established, the soil and climatic conditions, and management. In this regional-scale study, we utilized a chronosequence approach to investigate how SOC stocks changed when the original forests are converted to agriculture, and then subsequently to four different agroforestry systems (AFSs): home garden, coffee, coconut and mango. In total we established 224 plots in 56 plot clusters across 4 climate zones in southern India. Each plot cluster consisted of four plots: a natural forest reference, an agriculture reference and two of the same AFS types of two ages (30–60 years and > 60 years). The conversion of forest to agriculture resulted in a large loss the original SOC stock (50–61 %) in the top meter of soil depending on the climate zone. The establishment of home garden and coffee AFSs on agriculture land caused SOC stocks to rebound to near forest levels, while in mango and coconut AFSs the SOC stock increased only slightly above the agriculture SOC stock. The most important variable regulating SOC stocks and its changes was tree basal area, possibly indicative of organic matter inputs. Furthermore, climatic variables such as temperature and precipitation, and soil variables such as clay fraction and soil pH were likewise all important regulators of SOC and SOC stock changes. Lastly, we found a strong correlation between tree species diversity in home garden and coffee AFSs and SOC stocks, highlighting possibilities to increase carbon stocks by proper tree species assemblies.