Soil carbon sequestration in rainfed production systems in the semi-arid tropics of India

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ABSTRACT

Severe soil organic carbon (SOC) depletion is a major constraint in rainfed agroecosystems in India because it directly influences soil quality, crop productivity and sustainability. The magnitude of soil organic, inorganic and total carbon stocks in the semi-arid bioclimate is estimated at 2.9, 1.9 and 4.8 Pg respectively. Sorghum, finger millet, pearl millet, maize, rice, groundnut, soybean, cotton, food legumes etc. are predominant crop production systems with a little, if any, recycling of organic matter. Data from the long term experiments on major rainfed production systems in India show that higher amount of crop residue C input (Mg/ha/y) return back to soil in soybean-safflower (3.37) system practiced in Vertisols region of central India. Long term addition of chemical fertilizer and organic amendments improved the SOC stock. For every Mg/ha increase in SOC stock in the root zone, there occurs an increase in grain yield (kg/ha) of 13, 101, 90, 170, 145, 18 and 160 for groundnut, finger millet, sorghum, pearl millet, soybean and rice, respectively. Long-term cropping without using any organic amendment and/or mineral fertilizers can severely deplete the SOC stock which is the highest in groundnut-finger millet system (0.92 Mg C/ha/y) in Alfisols. Some agroforestry systems also have a huge potential of C sequestration to the extent of 10 Mg/ha/y in short rotation eucalyptus and *Leucaena* plantations. The critical level of C input requirements for maintaining SOC at the antecedent level ranges from 1.1 to 3.5 Mg C/ha/y and differ among soil type and production systems. National level policy interventions needed to promote sustainable use of soil and water resources include prohibiting residue burning, reducing deforestation, promoting integrated farming systems and facilitating payments for ecosystem services. A wide spread adoption of these measures can improve soil quality through increase in SOC sequestration and improvement in agronomic productivity of rainfed agro ecosystems.