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RESEARCH ARTICLE

Land use change and soil organic carbon dynamics

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Abstract Historically, soils have lost 40–90 Pg carbon (C) globally through cultivation and disturbance with current rates of C loss due to land use change of about 1.6 ± 0.8 Pg C y^{-1}, mainly in the tropics. Since soils contain more than twice the C found in the atmosphere, loss of C from soils can have a significant effect of atmospheric CO_2 concentration, and thereby on climate. Halting land-use conversion would be an effective mechanism to reduce soil C losses, but with a growing population and changing dietary preferences in the developing world, more land is likely to be required for agriculture. Maximizing the productivity of existing agricultural land and applying best management practices to that land would slow the loss of, or is some cases restore, soil C. There are, however, many barriers to implementing best management practices, the most significant of which in developing countries are driven by poverty. Management practices that also improve food security and profitability are most likely to be adopted. Soil C management needs to considered within a broader framework of sustainable development. Policies to encourage fair trade, reduced subsidies for agriculture in developed countries and less onerous interest on loans and foreign debt would encourage sustainable development, which in turn would encourage the adoption of successful soil C management in developing countries. If soil management is to be used to help address the problem of global warming, priority needs to be given to implementing such policies.

Keywords Soil organic carbon · SOC · Land use change · Sequestration · Barriers · Sustainable development · Climate mitigation

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Introduction

Factors controlling the level of soil organic carbon

The level of soil organic carbon (SOC) in a particular soil is determined by many factors including climatic factors (e.g. temperature and moisture regime) and soil-related factors (e.g. soil parent material, clay content, cation exchange capacity; Dawson and Smith 2007). For a given soil type, SOC stock can also vary, the stock being determined by the balance of net C inputs to the soil (as organic matter) and net losses of C from the soil (as carbon dioxide, dissolved organic C and loss through erosion). Carbon inputs to the soil are largely determined by the land use, with forest systems tending to have the largest input of C to the soil (inputs all year round) and often this material is also the most recalcitrant. Grasslands also tend to have large inputs,