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Vegetation and Soil Type Matter for Estimation of Organic Carbon Stocks in Agricultural Soils

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The soil organic carbon (SOC) pool, one of the most important reservoirs, has the potential to act as major source or sink of greenhouse gases due to its large extent and active interaction with the atmosphere. The conceptual C pools do not necessarily reflect biogeochemical processes. The inclusion of coupled dynamic changes in above and belowground biomass and soils is key to identify mitigation options in light of environmental pressures and to attain sustainable management. Both empirical and GIS techniques were employed to assess the impacts of land cover and soil type on total SOC stocks in Irish agricultural soils. The non-linear (exponential) depth distribution ratio models, developed using available measurement data, for SOC estimates fitted well for all Great Soil Groups (GSGs). These soil type-specific (mineral and organo-mineral soils) best fits were in conformity with the R2 (0.92-0.99%), the relative mean error (± <10%) and the relative mean square error (<0.72%). The k values of the exponential function (scale constant, cm-1) differed between the GSGs within the land cover classes (grassland = 0.034-0.057, rough grazing = 0.041-0.057 and arable land = 0.026-0.042). The SOC concentration (%) was finally estimated using the models to 100 cm based on the 10-cm depth values available in the national soil database of Ireland. The SOC density (t C ha-1) at the 0-10, 0-30 and 0-100 cm depths were 54.6, 136.8 and 229.1 for grassland (includes rough grazing), and 31.9, 87.1 and 160.6 for arable lands, respectively. The density differences between land covers and soil types across soil depths are attributed to variations associated with biomass inputs, microbial activity and dynamic carbon pools. The national SOC stock for grassland estimate was 1006.0 Tg of which 251.5 Tg and 599.1 Tg were from the 0-10 cm and 0-30 cm, respectively. For arable lands estimate, it was 61.7 Tg of which 12.8 Tg and 34.6 Tg were from the 0-10 cm and 0-30 cm, respectively. Results indicate that the empirical models have the potential to identify variations of SOC within vegetation and soil types, leading to a more robust estimate of SOC stocks in agricultural soils.