Increasing organic carbon stocks in Swedish agricultural soils due to unexpected socio-economic drivers

Christopher Poeplau, Martin A. Bolinder, Jan O. Eriksson, Mattias Lundblad, and Thomas Kätterer
Swedish University of Agricultural Sciences

Management changes can induce significant alterations of soil organic carbon (SOC) stocks. Including trends in SOC within a certain land-use category can thus strongly influence the annual national inventory reports for greenhouse gas emissions. In 2013, the European Union has therefore decided that all member states shall report the evolvement of SOC within agricultural soils to increase the incentives to mitigate climate change by improving the management of those soils. Here, we present the country and county-wise SOC trends in Swedish agricultural mineral soils on the basis of three soil inventories conducted between 1988 and 2013. In the past two decades, the average topsoil (0-20 cm) SOC content of the whole country increased from 2.48% to 2.67% representing a relative change of 7.7% or 0.38% yr-1. This is in contrast to trends observed in neighboring countries such as Norway and Finland. We attributed this positive SOC trend to the increasing cultivation of leys throughout the country. Indeed, the below-ground carbon input of perennial grasses is up to fourfold as compared to cereals, which leads to a significant soil carbon sequestration potential under cropping systems with ley. The increase in ley proportion was significantly correlated to the increase in horse population in each county ($R^2=0.71$), which has more than doubled in the past three decades. Due to subsidies introduced in the early 1990s, the area as long-term set-aside land (mostly old leys) also contributed to an increase in leys. This discloses the strong impact of rather local socio-economic trends on soil carbon storage, which also need to be considered in larger-scale model applications. This database is used in the continuous validation process of the Swedish national system for reporting changes in SOC stocks.