Understanding and managing organic carbon sequestration in soils as delineated from long-term observations and field experiments

Ingrid Kögel-Knabner and Martin Wiesmeier

Chair of Soil Science, School of Life Sciences, Technical University of Munich, Freising-Weihenstephan, Germany

Soil organic matter is decisive for almost all soil properties and functions and plays a central role in the global carbon cycle. SOM is of central importance for the formation of a stable soil structure through microstructure formation and aggregation. In this way, it has a significant influence on the air and water balance of the soil, the aeration and microbial activity, the infiltration and storage of water, the stability of the soil aggregate, and the trafficability and workability of the soil. Soil compaction and erosion can be reduced by a sustainable supply with OM. In addition to its importance for soil fertility and functionality, humus is the largest terrestrial carbon reservoir on earth and thus plays a crucial role in climate regulation. A targeted buildup of SOM, especially in agricultural soils, could make a significant contribution to climate mitigation and adaptation. In order to store more OM in the soil with a positive effect on the climate, not only must the existing OM stocks be preserved, but more carbon (C) must also be sequestered from the atmosphere by accumulating C in the soil (C sequestration). Long-term observations and field trials are of utmost importance to quantify the basic strategies to build up OM: either the input of organic matter into the soil is increased by changing management/land use, or the decomposition of organic matter is reduced by increasing its residence time in the soil or promoting its stabilization.