



Organic matter decline



What is organic matter decline?

Soil organic matter includes all living soil organisms together with the remains of dead organisms in their various degrees of decomposition. The organic carbon content of a soil is made up of heterogeneous mixtures of both simple and complex substances containing carbon. The sources for organic matter are crop residues, animal and green manures, compost and other organic materials. A decline in organic matter is caused by the reduced presence of decaying organisms, or an increased rate of decay as a result of changes in natural or anthropogenic factors. Organic matter is regarded as a vital component of a healthy soil; its decline results in a soil that is degraded.

*A soil that is rich in organic matter
(Source: Soil Atlas of Europe)*

Why is soil organic matter/carbon important?

Soil organic matter is a source of food for soil fauna, and contributes to soil biodiversity by acting as a reservoir of soil nutrients such as nitrogen, phosphorus and sulphur; it is the main contributor to soil fertility. Soil organic carbon supports the soil's structure, improving the physical environment for roots to penetrate through the soil.

Organic matter absorbs water – it is able to hold about six times its weight in water – making it a lifeline for vegetation in naturally dry and sandy soils. Soils containing organic matter have a better structure that improves water infiltration, and reduces the soil's susceptibility to compaction, erosion, desertification and landslides.

On a global scale, soils contain around twice the amount of carbon held in the atmosphere and three times the amount found in vegetation. Europe's soils are an enormous carbon reservoir, containing around 75 billion tonnes of organic carbon. When soil organic matter decays, it releases carbon dioxide (CO₂) into the atmosphere; on the other hand, when it is formed, CO₂ is removed from the atmosphere.

What causes organic matter decline?

Soil organic carbon content is affected mostly by climate, texture, hydrology, land use and vegetation.

Climate

Organic matter decays more rapidly at higher temperatures, so soils in warmer climates tend to contain less organic matter than those in cooler climates.

Soil texture

Fine-textured soils tend to have more organic matter than coarse soils; they hold nutrients and water better, thus providing good conditions for plant growth. Coarse soils are better aerated, and the presence of oxygen results in a more rapid decay of organic matter.

Soil hydrology (drainage)

The wetter a soil is, the less oxygen is available for organic matter to decay, so that it accumulates.

Land use (tillage)

Tillage mixes oxygen into the soil and raises its average temperature, thereby contributing to an increased rate of organic matter decay. Loss of organic matter also occurs because erosion washes away topsoil and humus. Overall, cropping returns less organic matter to the soil than does native vegetation.

Vegetation

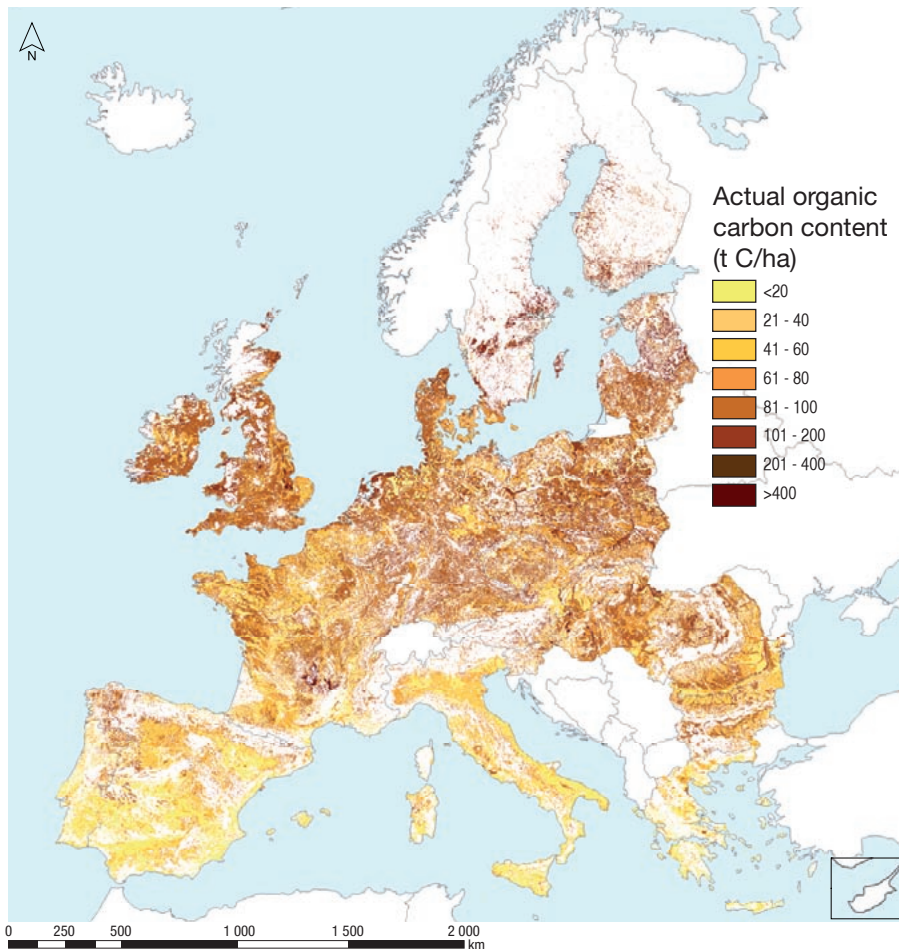
Roots are a great contributor to soil organic matter. Grassland produces deep roots that decay deep in the soil. Forest soils in contrast rely primarily on the decay of surface litter for organic matter input. Crops produce more above-ground biomass than roots. The organic matter input on cropland depends on the land management practices, including whether crop residues are removed or left behind.



An example of spatial variability of soil organic carbon content (Source: Soil Atlas of Europe)

Location and magnitude

Recent trends in land use and climate change have resulted in soil organic carbon loss at a rate equivalent to 10 % of the total fossil fuel emissions for Europe as a whole. In general, soils with low organic carbon content can be found in warm, dry climates and soils with a higher organic carbon content can be found in colder, wetter climates. Almost half of European soils have low organic matter content, principally in southern Europe but also in areas of France, the United Kingdom and Germany.



Map showing the actual organic carbon content in agricultural soils in the 27 Member States of the European Union

Links with other soil degradation processes and environmental issues

Loss of soil organic carbon content can limit the soil's ability to provide nutrients for sustainable plant production. This may lead to lower yields and affect food security. Less organic carbon also means less food for the living organisms present in the soil, thus reducing soil biodiversity.

Loss of soil organic matter reduces the water infiltration capacity of a soil, leading to increased run-off and erosion. Erosion in turn reduces the organic matter content by washing away fertile topsoil. Under semi-arid circumstances this may even lead to desertification.

Global warming is predicted to speed up the decay of organic matter, releasing more CO₂ and increasing climate change. Desertification might move north as a consequence. Carbon reservoirs, which are maintained by cold and wet climatic conditions, will release substantial amounts of CO₂ and methane (CH₄) into the atmosphere under warmer conditions. This also happens when wetlands are drained or peat harvested. Continued drainage of Europe's remaining peat bogs, for example, would release 30 million tonnes of carbon annually, the same amount as from an additional 40 million cars on Europe's roads.

Further reading

<http://soco.jrc.ec.europa.eu>

http://eusoiils.jrc.ec.europa.eu/projects/soil_atlas/



This fact sheet is based on the findings of the 'Sustainable agriculture and soil conservation' (SoCo) project. It is part of a package of ten sheets organised around the three main topics of the project. The sheets cover the following topics:

- Introduction:
 - Fact sheet no. 1: Linking soil degradation processes, soil-friendly farming practices and soil-relevant policy measures;
- Soil degradation processes:
 - Fact sheet no. 2: Water erosion and compaction;
 - Fact sheet no. 3: Organic matter decline;
 - Fact sheet no. 4: Salinisation and sodification;
- Soil-friendly farming systems and practices:
 - Fact sheet no. 5: Conservation agriculture;
 - Fact sheet no. 6: Soil-friendly tillage practices;
 - Fact sheet no. 7: Soil-friendly farm infrastructure elements;
- Soil-relevant policies:
 - Fact sheet no. 8: Requirement to keep land in good agricultural and environmental condition (GAEC);
 - Fact sheet no. 9: Agri-environment measures;
 - Fact sheet no. 10: Advisory services.

All SoCo fact sheets and project reports can be downloaded at: <http://soco.jrc.ec.europa.eu>.

