

Focus Paper on healthy agricultural soils as natural carbon sinks



Definition

- This paper focuses on **mineral agricultural soils** managed as arable land including special crops and unproductive elements.¹
 - It tackles measures that prevent soil degradation and humus loss (resulting in the release of CO₂-emissions) as well as measures that build up humus (capturing additional carbon from the atmosphere).
 - The [Intergovernmental Technical Panel on Soils](#) of FAO has **defined healthy soils** as “the ability of the soil to sustain the productivity, diversity, and environmental services of terrestrial ecosystems”.
 - It is estimated that between 60 and 70 % of European soils are unhealthy to date (DG Environment 2024).
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Importance of healthy soils for the climate and other public goods

- **Storing CO₂**: Humus contains 58% carbon (C)). Soil contains about three times as much **organic carbon** as plants and twice as much as the atmosphere. On a global level there is a great potential to increase soil organic carbon in arable soils (Lal et al., 2011).
 - Providing ground for **agricultural food production and food security** (→ EU Farm to Fork strategy) and the production of renewable energies and forage
 - Preserving **nature and biodiversity** (→ EU Soil Strategy for 2030) as living soils are a habitat for many organisms and animals as well as the foundation of terrestrial ecosystems
 - Improving **natural water retention** capacity and groundwater levels, raising with the amount of humus in the soils due to less surface runoffs and higher infiltration rates (→ EU Water Framework Directive)
 - **Reducing effects of extreme weather situations** like water erosion, floodings and landslides during heavy or constant rains and drying up and wind erosion during droughts (→ EU Climate Adaptation Strategy)
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¹ for soils covered with grassland see [focus paper on extensively managed grasslands](#) on www.landcare-europe.org



Threats

- **Harmful agricultural practices**, such as monocropping, maintaining bare soil, deep ploughing and tillage or the intensive use of chemical and synthetical fertilizers and pesticides.
- **Loss of soils including humus** through wind and water erosion leading to desertification and land degradation.
- **Soil compaction & structure degradation** due to a lack of organic matter that leads to washing of fine particles into the lower layers of topsoil, where it forms a compact layer, enhanced by the use of heavy agricultural machinery. Soil compaction reduces biological activity, porosity, permeability, water retention and increases erosion.
- **Depletion of soil microbiomes** with negative effects on ecosystem processes & functionality
- **Loss of soil fertility and nutrients leaking** due to bad soil structure.
- **Soil sealing**: loss of soil, including farming land, due to covering the ground with impermeable artificial materials such as asphalt, leading to the loss of important soil functions.
- **Economic losses**: 50 billion EUR are lost every year due to soil degradation (DG Environment 2024)
- **Permanence (durability)**: Humus (which contains 58% carbon (C)) is not entirely stable but the process of storing soil organic carbon (SOC) from the atmosphere is reversable. Consequently, humus building measures must be continued permanently.
- **Displacement effects**: Building humus on a dedicated plot of land by bringing in organic matter from external sources, e.g. through organic fertilizers can lead to higher soil organic carbon on the specific plot, but will not automatically result in an overall improvement of the total CO₂ balance between carbon stored in the soil and the atmosphere.

Goals for soil management

Humus **stores carbon** and improves important **soil functions** like aggregate stability, water retention capacity, nutrient storage, cation exchange capacity and acid buffering capacity, and reduces the risk of soil erosion and soil compaction. Moreover, healthy soils can enhance the natural resilience of crops against pests and diseases, and consequently reduce the need for chemical inputs.

To build humus and avoid erosion it is necessary to:

- Keep the soil covered with plants
 - Implement diversified crop rotations and crop diversification
 - Reduce tillage for minimal soil disturbance
 - Return biomass to the soil
 - Reduce/avoid artificial fertilizers and pesticides
 - Farm within the local farm context, considering soil and climatic conditions
 - Integrate animals (+their manure) back into the landscape where possible
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Necessary framework for the CAP and CAP-strategic plans

To promote healthy soils, the Common Agricultural Policy (CAP) and its implementation in the National Strategic Plans (NSPs) of the Member States (MS) must be adapted.

Step 1: Defining and measuring soil health in the EU Soil Monitoring Law

- The EU Soil Monitoring Law should work with a definition and indicators for soil health that do not simply focus on chemical and physical properties of soils, but put soil biodiversity at the core.
- It should have a clear soil health assessment methodology and tackle issues like (diffused) soil pollution (e.g. pesticides), soil sealing, soil degradation and soil loss.
- Moreover, the Soil Monitoring Law needs to have binding targets, soil health plans, key obligations on sustainable soil management and supporting advisors to be effective.

Step 2: Strengthen GAEC requirements on soil protection

EU has defined a standards set for “good agricultural environmental conditions” (GAECs), four with relevance for soil health. Currently the implementation is too weak in several MS, for instance lacking clear definitions and offering many exceptions. MS need to implement GAECs with strong and clear requirements and definitions. The flexibility given by the EU should be used to adapt requirements to the regional context (e.g. geology, weather conditions), and not to make extensive exceptions on obligatory minimum standards.

- **GAEC 5: prevent soil erosion through relevant practices** should include limits on the dates of ploughing adapted to the geographical context (e.g. heavy rains), requirements to establish green cover after ploughing and limits on ploughing on sloped land and other land in risk of wind or water erosion.
- **GAEC 6: protect soil by defining rules for minimum soil cover** should clearly define sensitive period(s) with a sufficient time for soil cover adapted to the geographical context. These rules must apply for all arable land as well as for temporary grasslands, permanent crops and fallow land with minimum exceptions.
- **GAEC 7: preserve the soil potential through crop rotation** should combine practices on crop rotation and crop diversification including a clear definition of crops and secondary crops.
- **GAEC 8: maintain non-productive areas and landscape features** is relevant to prevent soil erosion especially through wind erosion in dry areas. Its obligatory implementation was paused by the EU and should be mandatory again for the MS.

Landcare Europe suggest to the EU to leave the choice of measures in Eco-schemes and Agri-Environmental-Climate Measures (AECM) to the MS. However, the EU should highlight the following suggestions (Step 3-5) to the MS and encourage them to implement them in their NSP according to the national contexts.

Step 3: Eco-schemes

Soil health must be covered by the yearly applied eco-schemes of the first pillar (Art. 31 Regulation (EU) 2021/2115). Measures suitable for eco-schemes for arable land are for instance:

- Promoting the maintenance of grassland
- Small parcelled farming land with different neighbouring crop types / mosaic management
- Cover or catch crops, perennial crops, winter crops
- Crop rotation, including long-term rotations, intercropping
- Legumes and legumes mixtures

- Leaving untreated stubble fields over winter
- Mulching of crop or pruning residues
- No use of synthetic chemical pesticides and mineral fertilisers
- Maintenance of modern and traditional agroforestry systems
- Maintaining organic farming
- Flower areas and strips
- Fallow land with spontaneous vegetation

Furthermore, multidimensional eco-schemes which have a stronger impact on soil health can be offered as yearly eco-schemes to give farmers the flexibility to try complex measures, e.g.:

- Whole farm scheme for biodiversity and soil health (Slovakia): Requires improvement of soil structure (25% of the farm), 1-3% non-productive elements (above GAEC 8), limit on size of parcels, delayed mowing/grazing, grass strips in permanent cultures
- Reduced tillage/ no tillage/ strip-till in combination with complex crop rotation and constant soil cover

Step 4: Agri-Environmental and Climate Measures for Soils

Agri-Environmental Measures need to be rewarded higher than eco-schemes as they are multiannual and have a higher effect for eco-system services. They need to be financially attractive and ideally complementary to related eco-schemes. The premium needs to include the added value for public services and not just a compensation for the extra workload or the lost income. Local adaptations need to be considered in the different strategies for soil carbon storage in farming land. Consultancy for farmers is essential. Measures include for instance:

- Converting arable land to permanent grassland
- Planting and care of hedges, bushes and trees
- Planning and planting of agroforestry systems
- Perennial flowering strips
- Multiannual, multidimensional schemes (see examples in Step 3)

Step 5: Offer advice on soil management

The CAP should include a financing instrument that enables the consultation of farmers on soil management. These should be eligible, not only for farming advisory services but also for qualified NGOs like Landcare(-like) organizations and model farmers. The consultation should not exclusively focus on CAP measures and requirements. It should rather be a holistic approach including education on soil health, soil functions and soil biology.



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