

Research for AGRI Committee – Agricultural potential in carbon sequestration: Humus content of land used for agriculture and CO₂ storage



The EU should reduce its net greenhouse gas emissions by at least 55% by 2030, compared to 1990 levels, as agreed in the EU Climate Law. On 14 July 2021, the Commission presented proposals to deliver these targets and make the European Green Deal a reality. In the context of the “Fit for 55” package, the Commission will now engage with sectors to prepare specific roadmaps charting their path to climate neutrality.

To this end, the Commission shall proceed with the quantification of the mitigation potential in agriculture up to 2030, which will include reductions in greenhouse gases (GHG) emissions, effects of land use changes and carbon storage in agricultural soils. An integrated policy framework covering agriculture, forestry, and land use (AFOLU) is proposed from 2030 with the view of achieving carbon neutrality in these sectors by 2035.

The agricultural sector emitted about 429 Mt CO₂-equivalent in 2019, which accounts for about 11% of total European GHG emissions. Methane emissions, mainly from enteric fermentation contribute about 54% of the total, followed by nitrous oxide emissions (about 44%) mostly related to soil fertilisation. Agricultural CO₂ (with a share of almost 3% of total GHG emissions from the agricultural sector) is attributable to soil management and land use change.

Achieving the Green Deal neutrality targets will require reshaping our food system and reducing agricultural emissions but also promoting carbon sequestration in agricultural soils.

The present document is the executive summary of the study on Agricultural potential in carbon sequestration: Humus content of land used for agriculture and CO₂ storage. The full study, which is available in English can be downloaded at: <https://bit.ly/3HJBL3N>

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Carbon sequestration potential in European agricultural soils

Agricultural GHG emissions decreased by 108 Mt CO₂-eq from 1990 to 2018, but this reduction occurred until 2005 and the emission rate has remained stable since then. Achieving further substantial GHG emission reductions in the agricultural sector will require significant changes in farming practices and agricultural policies.

More than 55% of the technical mitigation potential in the EU-27 agricultural sector lies with agricultural soils and manure management. There is great variability in the estimates of the realistic capacity of our agricultural soils to sequester carbon, due to the uncertain evolution of climate, policy, economic and technical scenarios. The most reliable values range from 9 to 24 Mt (Megaton¹) C y⁻¹.

Estimates of carbon stocks in the EU-27 soils range from 34 Gt (Gigaton²) in the 20 top cm to 75 Gt in the top 30 cm, with uneven geographical distribution, depending on rainfall and temperature patterns and geological and topographic characteristics. Soils of Nordic and Northeastern countries are carbon rich while those of the southern countries are generally carbon depleted.

Under the business-as-usual management scenario, from 2010 to 2050 total soil organic carbon stocks in the European agricultural soils could increase from the initial 12.8 to 13.9-14.1 Gt in cropland, and from 6.7 Gt to 8.9 -9.4 Gt in pastures, depending on the severity of the climate scenarios.

The potential for carbon sequestration is highest in the semiarid and arid regions of central and meridional Europe, since soils are here carbon depleted. The very rich soil carbon stocks of the northern zones must be preserved to reverse current CO₂ emissions to the atmosphere, very often due to peatland desiccation for cropping and grazing.

Sustainable agricultural practices adequate for carbon sequestration, and warnings

Some sustainable agricultural practices are particularly favourable to carbon sequestration in soil. **Cover crops and catch crops** increase carbon stocks in almost all types of soils and climate conditions, and their repeated use for decades can result in soils with greatly increased SOC stocks and total nitrogen reserves. **Reduction in tillage** results in increased carbon stocks in soil but can lead to reduced yield. Efficient combinations of reduced tillage with other practices such as cover and catch crops and adequate fertilization can reduce this problem, and has proven positive effects, including reductions in energy costs and soil erosion, improvement in the soil health and reduction of GHG emissions.

Augmenting plant diversity (as in multicropping and mixed cropping systems) is a suitable option to increase both plant production and soil carbon stocks. **Fertilisation with organic materials**, in particular manures, is widely seen as mandatory to increase SOC locally, usually combined with mineral nutrition. In several ways, manure is more beneficial to carbon sequestration and to soil health when applied as compost.

However, not any kind of compost is adequate for application to soil. Urban-waste compost, for example, is made of the organic fraction of urban garbage combined with pruning residues. Its use

¹ 1 Megatonne = 1.000.000 tons.

² 1 Gigatonne = 1.000.000.000 tons.

must be restrained to countries where it is obtained under quality controls that are strict enough to guarantee the absence of harmful components (heavy metals and other pollutants) and plastics or microplastics.

The rewetting and restoration of peatlands, agroforestry and grasslands are key to preserving and enhancing SOC stocks.

Biochar is being promoted as the most effective method to increase SOC content. However, its effects on plant production and soil health are highly dependent on its precise structure and composition, in turn dependent on the type of original biomass and the characteristics of the production process. Without a system of biochar labelling and qualification, a generic recommendation about using biochar in European crops as a method of increasing SOC stocks would be very risky.

Carbon sequestration in soil in the new Common Agricultural Policy

The renewed structure of the Common Agricultural Policy, due to come into effect in 2023, includes important tools to progress towards sustainable management of agricultural soils to combine increased carbon sequestration with enhancement of global soil health.

First, increased conditionality requires farmers to adopt environmental and climate-friendly practices to be eligible for direct support. Among these practices, the protection of permanent grasslands is of key importance for carbon sequestration.

Second, several eco-schemes are offered to farmers for voluntary implementation under Pillar I, together with rural development measures under Pillar II. In addition to a specific package of practices specifically dedicated to carbon farming, agroforestry and agroecology systems and improved nutrient management have proven positive effects on carbon sequestration in soil and soil biodiversity and health. In peatlands, paludiculture is a win-win option to combine agricultural exploitation with protection of carbon stocks and reduction of GHG emissions.

Making carbon sequestration in soil possible and climate-significant at the European scale

To achieve the Green Deal carbon neutrality's goals, the challenge of carbon sequestration in the agricultural soils of Europe must be widely accepted by farmers, and the effectiveness of the practices and strategies they adopt must be verifiable in terms of quantifiable changes in soil carbon stocks and permanence in soil of the sequestered carbon.

Measurement, reporting and verification (MRV) of these effects is often evoked as a constraint to fairly compensate farmers for results, due to lack of precision of measurement methods, high demand of field and laboratory work effort and high costs. However, rapid progress is being made in alternative approaches to soil carbon measurement and prediction, including proximal and remote sensing as well as in machine learning techniques. Increased research in these fields is required to make these new technologies available in practice.

To improve our knowledge on the response of soil carbon to agricultural practices, and then to improve the accuracy of soil carbon models, there is an urgent need to reinforce the European soil monitoring network and to increase the number of long-term agricultural research stations and agricultural lighthouses under different soil and climate conditions.

Farmers also need technical support and advice, integrated strategies and knowledge transfer, integrating all sectors involved in climate-smart agriculture.

If a significant increase in carbon sequestration is to be achieved, large agricultural areas will have to be managed accordingly, and the related compensations to farmers may prove unaffordable for public bodies. Complementary actions by private actors, or public private partnerships can help set up carbon markets which could play an important role for carbon sequestration, as exemplified by pilot projects in Europe and abroad.

Further information

This executive summary is available in the following languages: English, French, German, Italian and Spanish. The study, which is available in English, and the summaries can be downloaded at: <https://bit.ly/3HJBL3N>

More information on Policy Department research for AGRI: <https://research4committees.blog/agri/>



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