Growing crops on organic soils increases greenhouse gas emissions

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The climate can be given a helping hand by taking organic soils out of rotation. Credit: Mogens H. Greve

Growing agricultural crops on organic (peat) soils is not good for the climate. When organic soils are drained and cultivated the organic matter in the soil will decompose which leads to emissions of greenhouse gases. This emission makes up as much as 6 percent of Denmark's total greenhouse gas emission. The good news is that we can do something about it.

Reducing the emission from cultivated organic soils is an obvious choice to achieve greenhouse gas emission reductions from agriculture, says Professor Jørgen E. Olesen from the Department of Agroecology at Aarhus University.

Decomposition of organic matter releases greenhouse gases

Organic soils—and raised bogs—have a high organic matter content which consists mainly of the detritus from plant roots and other plant residues. The reason that the organic matter is not broken down is because these soils have a naturally high water content which limits the amount of oxygen available.

Over the last couple of centuries most of the Danish organic peat soils have been drained and cultivated. These soils have often initially been very fertile, but because some settling of the soil takes place over time, the water table on these areas is often very high, which can create problems for their further cultivation or means they have to be redrained.

Over time the carbon content of cultivated organic soils will fall. Today, some of the cultivated formerly organic soils have become mineral soils that no longer produce significant emissions from the decomposition of organic matter.

An inventory of the land uses on organic soils in 2013 shows that roughly 81,000 ha are in rotation and 27,000 are used for permanent grassland. Around 67,000 ha of this area have an organic carbon content of more than 12 percent where the greenhouse gas emissions are particularly large if cultivated.

Sources of greenhouse gases

Agricultural management practices affect emissions of the three greenhouse gases: carbon dioxide (CO2), nitrous oxide (laughing gas) and methane. Nitrous oxide is produced during the conversion of nitrogen in the soil. Methane is formed when organic matter decomposes under oxygen-depleted conditions. Nitrous oxide is a 298 times more powerful greenhouse gas than CO2. Methane is 25 times more powerful than CO2.

The total emission is calculated as CO2 equivalents, where the effect of the climate is converted into a CO2 effect. Drained, peaty soils emit CO2 and nitrous oxide because the decomposition of the organic matter takes place in the presence of oxygen, while methane is emitted from anoxic wetland areas.

When organic soils are drained and cultivated, the organic content in the soil will start to decompose, which, as previously mentioned, will lead to the emission of greenhouse gases. In 2013 the total emission from drained organic soils was 3.3 million tonnes CO2-equivalents, which corresponds to 6 percent of the total greenhouse gas emission in Denmark. The methane and nitrous oxide emissions from livestock and manure management in farming make up 19 percent of total emissions.

Organic soils can be taken out of rotation

The climate can be given a helping hand by taking the organic soils out of rotation. Danish farmers can get compensation for taking fields out of rotation or putting them under extensive farming if certain stipulations for their organic matter content are met. Once the fields have been set aside, they cannot officially be tilled, fertilised or treated with pesticides.

The effect depends on the land use and soil carbon content prior to the start of the project as well as the water level after the change in land use. The climate effect can be up to 100 times higher compared to taking mineral soils out of rotation. This requires that the land is removed from agricultural land use, that a high water level is reestablished on this land, and that the removal is targeted organic soils with a high carbon content.

Provided by Aarhus University