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Research project „Evaluation of factors affecting greenhouse gas (GHG) emissions reduction potential in cropland and grassland with organic soils" (No. 1.1.1.1/21/A/031)

Summary of results

Organic soils are one of the largest sources of greenhouse gas (GHG) emissions in Latvia. The total GHG emissions from drained organic soils in Latvia in 2020 were 5.4 million tonnes of CO_2 equivalents (carbon dioxide equivalent). These emissions are accounted for in land use, land-use change, and forestry (LULUCF) sector. Additionally, approximately 0.5 million tonnes of CO_2 equivalents of emissions are accounted for in the agriculture sector (25% of the total agricultural sector emissions in 2020). These are emissions caused by the release of nitrous oxide (N_2O) into the atmosphere during the decomposition of organic matter. Another 1.1 million tonnes of CO_2 emissions are associated with peat extraction for use in agriculture. Therefore, the total GHG emissions from managing drained organic soils in 2020 were 7.0 million tonnes of CO_2 equivalents, while the total GHG emissions in Latvia, excluding the LULUCF sector, were 10.5 million tonnes in 2020. This means that organic soils generate an emission volume equivalent to 66% of the total GHG emissions in Latvia, including those from energy, transport, agriculture, and other sectors. This indicates that organic soils are an extremely important, if not the most important, element in achieving climate policy goals.

The total area of organic soils in Latvia, according to the 2022 GHG inventory data, is 1.2 million hectares (19% of the country's total area), of which drained organic soils comprise 0.63 million hectares (52% of the organic soils). There are 0.69 million hectares of organic soils in forest lands, and 0.16 million hectares of organic soils in agriculturally used lands (AUL). Peat extraction continues or has recently ceased in approximately 3% of the organic soil areas.

It is important to emphasize that different information sources may provide varying figures for the area of organic soils. This discrepancy arises from the use of different definitions for various accounting purposes; the GHG inventory includes areas where the decomposition of previously accumulated organic matter in the soil is ongoing. In Latvia, the threshold for organic matter content is set at 20% (12% organic carbon) in the topsoil (up to 20 cm deep). Other countries use different thresholds, for example, in Denmark, soils with at least 6% carbon content in the topsoil are considered organic, and recent studies in this country, as well as in our study, have shown that mineralization processes characteristic for organic soils continue even when the carbon content in the soil decreases to 1-3%. Meanwhile, our neighbours in Lithuania consider only peat soils with at least a 40 cm thick peat layer as organic, i.e., the organic carbon content in the topsoil is at least 40%. The differences in organic soil definition significantly affects the reported area of organic soils.

The variations in definitions of organic soils indicate that some countries do not account for all emissions from organic soils, while others assess these emissions more objectively. However,

overall, knowledge about the processes determining GHG emission levels in organic soils is incomplete, and in recent years, not only in Latvia but also in other countries, there has been a rapid increase in understanding and knowledge about the relationship of organic soils on GHG emissions.

In Latvia, organic soils in agriculturally used lands (AUL) are, in absolute terms, the largest source of emissions (a total of 3.6 million tonnes CO_2 equivalents in 2020). Compared to 1990, the GHG emission volume from organic soils in AUL has almost halved. This is due to the mineralization of organic soils, transitioning into the mineral soil category, and the afforestation of organic soils. The remaining GHG emissions from organic soils have so far been offset by CO_2 sequestration in tree biomass in forest lands. However, as forests age and the afforestation of less valuable AUL decreases, forests will no longer be able to offset these emissions, and the land use, land-use change, and forestry (LULUCF) sector, traditionally considered a GHG sink, may become a source.

Traditionally considered a GHG sink (where CO_2 accumulation in wood and other carbon storages exceeds GHG emissions), the land use, land-use change, and forestry (LULUCF) sector is gradually becoming a significant, if not the largest, source of GHG emissions in Latvia. Our country is committed to moving towards climate neutrality, including reducing GHG emissions in the LULUCF sector. The high emissions from organic soils indicate that this category of GHG emissions should become at least as significant a climate policy goal as transport, energy, and agriculture, ensuring investments and adjusting the regulatory basis to achieve the goal of GHG emission neutrality.

The question of whether anything can be done about this, or whether we must resign ourselves to these emissions and start saving money to purchase CO_2 capture units from countries that have advanced further in implementing climate policy, is self-evident. For now, no one knows how much money will be needed, but if CO_2 capture units had to be purchased from commercial platforms like Verra or Golden Standard, it would cost approximately 200 million euros per year, including 110 million euros for GHG emissions caused by organic soils in agricultural lands. It is likely that after 2030, when this situation arises, CO_2 capture units will be much more expensive, so it may be more prudent to try to reduce GHG emissions rather than focusing on researching the CO_2 capture unit market.

Then the question remains open as to whether anything can be done to reduce emissions. The short answer is yes, emissions from organic soils can be completely eliminated, but there is also a catch – there is a lack of knowledge about the impact of various climate change mitigation activities on GHG emissions. The task of our project is to fill this knowledge gap, assessing the efficiency of GHG emission reduction solutions identified both in Latvia and other countries, and to develop tools for predicting the impact on climate change. The study did not arise in a vacuum – prior to this, the LIFE REstore project was implemented, which evaluated various alternatives for managing developed peat fields and concluded that the most effective solutions for achieving both short-term and long-term (2050) climate neutrality goals are afforestation of developed peat fields, as well as the establishment of commercial gardens for cranberries, tall bilberries, and probably other berry species. In the study, we evaluated the transformation of croplands into grasslands, afforestation with deciduous and coniferous trees, maintaining drainage systems or creating conditions typical of bogs, establishing tree plantations, including strip plantations along drainage systems, regulating groundwater levels in closed drainage systems, and rewetting grasslands while preserving vegetation typical for grasslands, i.e., performing actions to prevent afforestation of the rewetted area. In the study, we used both previously established demonstration sites (for example, the LIFE

OrgBalt project) and established new experimental sites in collaboration with the Forest Research Station.

We are currently in the middle of publishing of the research results – emission factors and impact of measures, as well as improvement of activity data. The preliminary results have not shown anything new – the most effective solution for reducing emissions is the afforestation of organic soils, and several times greater effect can be achieved by maintaining the drainage system. For instance, planting spruce in drained organic soil can reduce GHG emissions by 1600 tonnes CO_2 eq. per hectare over 120 years period, compared to maintaining grasslands, while growing birch in rewetted areas can reduce emissions by 350 tonnes CO_2 eq. per hectare during the same period. Significant difference is associated with different rotation periods. Maximum of mitigation effect is similar for the all of the commercially most valuable species. In both scenarios (afforestation and retaining of grassland), economic activity and local conditions have a significant impact. It is likely that in many rewetted areas, conditions typical for bogs will not be developed and trees will grow just as well or almost as well as in drained areas, although there is a higher risk of natural disturbances in rewetted areas. The study concluded that greater CO_2 capture than in planted spruce groves can be achieved in tree plantations, including protective shelter belts, if the wood is used for the production of wood products (plywood, lumber, etc.). Converting croplands into grasslands, especially if it is possible to regulate the groundwater level, also reduces GHG emissions, although the effect is much smaller than in the case of afforestation. The study did not find that rewetting organic soils had any positive effect, mainly because in summer, when most of the CO_2 emissions from the soil are formed, the groundwater level in the rewetted areas falls and they produce as many emissions as the drained areas, but in spring, these areas additionally produce methane (CH_4) emissions. On a positive note, GHG emissions from drainage ditches in Latvia are significantly lower than we have previously thought.

Information about the study is available on the website of the project applicant[1].

[1] https://www.silava.lv/petnieciba/aktivie-petijumi/siltumnicefekta-gazu-seg-emisiju-mazinasanas-potencialu-ietekmejoso-faktoru-izpete-zalajos-un-aramzemes-ar-organiskajam-augsnem