CLIMATE CHANGE MITIGATION SCENARIOS INVOLVING DRAINAGE ACTIVITIES IN GRASSLANDS

Figure 1. Demonstration site No LVC305.

Drainage and water level management are crucial processes in agriculture to minimize soil degradation and nutrient leaching. In the context of nutrient-rich organic soils in grasslands, the fluctuations in water level can damage the soil and can potentially cause emissions of greenhouse gasses (GHG). Managing the level of water in the soil can be beneficial to even out wet and dry periods, both helping the farmer's productivity and soil quality.

The LIFE OrgBalt project demonstrates controlled climate change mitigation (CCM) measures scenario with the controlled drainage system in the grassland in one of the 17 demonstration sites of the project – the nutrient rich organic soil with the peat layer thickness at least 30 cm and groundwater level at least 30 cm from ground surface during the growing season. The drainage activities are part of numerous other CCM scenarios by cleaning and restoring drainage diches and drainage systems with the aim to manage the groundwater level. The demonstration site No LVC305 differs from others in terms of drainage activities and is set up to measure the impact of controlled drainage of grassland considering even groundwater level during the whole vegetation period on GHG emissions and other environmental factors. Potential benefits expected to be proven in this demonstration site are reduction in GHG emissions from organic soils due to limited fluctuations of groundwater level during and outside the growing season, reduced leaching of nutrients to surface water bodies as drainage water will be stored in the field. It is expected that during the summer season additional water will be available to meet crop demand thus ensuring higher carbon inputs into soil.

Potential benefits of controlled drainage:

- control over drainage and groundwater level within a specific drainage system, which under favorable conditions ensures possibility to increase groundwater level to necessary height from the ground surface,

- reduced emissions of GHG from organic soils by preventing seasonal groundwater level fluctuations , which directly affect availability of oxygen and microbioal activity in the soil,
- reduced losses of nitrogen and phosphorus to surface water bodies,
- in dry summers additional water might be available for agricultural crops to ensure better growing conditions and carbon sequestration in the soil.

Figure 2. Controlled drainage well

The drainage system includes installation of two water level control structures at the outlets of existing subsurface drainage systems.

One water level control structure represents conventional (free) drainage conditions, in this case adjustable boards are removed to ensure discharge of excess water from the agricultural field. Another structure represents controlled drainage conditions, in this case adjustable boards are used to raise the groundwater level in the field and increase water retention and storage within the soil profile. Installation of water level control structures consist of digging a trench, levelling and preparation of a foundation, filling with supporting materials, establishment of connection between structure and existing subsurface drainage system, retrofitting existing outlet. In the demonstration site of controlled drainage, the LIFE OrgBalt project performs same measurements of GHG emissions and other environmental data like in other agricultural demonstration sites, but in this object additional installations take place, like autonomous sensors for water pressure and temperature measurements, along with a sensor for measurements of atmospheric pressure at both water level control structures to quantify the amount of water leaving the fields. More detailed descriptions about the measuring processes in agricultural lands can be found in the LIFE OrgBalt article – “GHG emissions measurement and sampling in agricultural lands: towards data-driven decision making for managing carbon rich organic soils”.

During the agricultural operational cycle of the grassland throughout the year several steps are included in management of the groundwater levels. Prior soil tillage, when conditions need to suitable for field operation, complete removal of boards/stoplogs is recommended, which facilitates the accelerated drainage of excess water and lowering of groundwater level. In this case, controlled drainage operates in the traditional (free)

drainage mode. After field operations such as tillage, sowing and fertilizer application, it is recommended to place boards/stoplogs in a water level control structure, which controls groundwater level in the drainage system during the summer. The optimal height of the groundwater level from the ground surface and desired moisture conditions are determined by the depth of root systems of the given crop at different stages of their development.

In the period between two crops where there is fallow or crop residues in the field after harvest, the groundwater level may be set as close as possible to the ground surface. This prevents drainage and reduces leaching and transport of nutrients from the soil profile to open drains. Depending on the comfort of landowners or managers, the groundwater level during this period can be between 15 and 30 cm below the ground surface level.

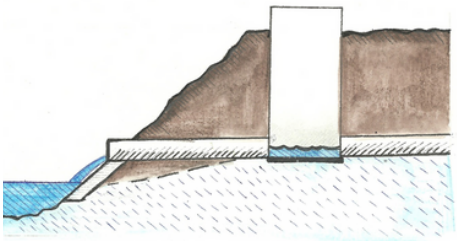

Figure 3. Controlled drainage system prior soil tillage.

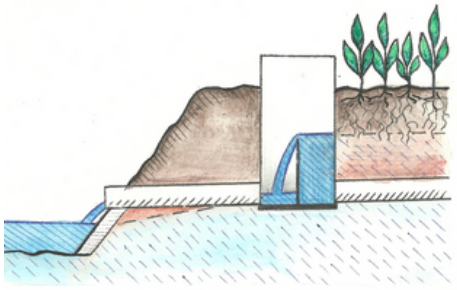

Figure 4. Controlled drainage system after field operations.

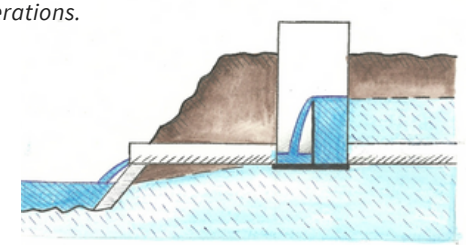

Figure 5. Controlled drainage system in the period between crops.

We asked **Andis Lazdiņš**, Senior researcher of the Latvian State Forest Research Institute "Silava", the **leading expert of project demonstration and reference sites** about the details of groundwater management cases.

What is the correlation between the groundwater level fluctuation and GHG emissions in agriculture?

CO2 emissions are usually higher if groundwater level drops, CH4 emissions increase if groundwater level is increasing, or area is flooded. This happens only if the soil is warm.

How long does it take to see the results from installation of the controlled drainage system in agricultural lands?

Result is immediate, while it depends from efficiency of the system – more fluctuations or deviations from the desired level means more emissions.

How are the climate change consequences, for instance continuous periods of droughts, influencing effectiveness of controlled drainage CCM scenario?

If there is no precipitation, groundwater level will drop and CO2 emissions might increase, while CH4 emissions will not occur.

Does the change of crops influence the groundwater level in the field with installed controlled drainage system?

Yes, different plant species transpire different amounts of water, especially perennial and annual crops consume different amount of water in spring and autumn, while water consumption is also affected by evaporation; therefore the effect of crop and management is complex.

LIFE ORGBALT TEAM

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Project "Demonstration of climate change mitigation potential of nutrient rich organic soils in Baltic States and Finland" (LIFE OrgBalt, LIFE18 CCM/LV/001158) is implemented with financial supportfrom the LIFE Programme of the EuropeanUnion and State Regional Development Agency of the Republic of Latvia. www.orgbalt.eu

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