

## Soil CO<sub>2</sub> Emissions and Water-Table Dynamics in Agricultural Systems

### Context and objectives

CO<sub>2</sub> emissions from agricultural soils are both a climate concern and a clear indicator of ongoing soil degradation, as seen prominently in the Seeland region. Lower water tables accelerate peat oxidation, leading to substantial soil loss and long-term reductions in agricultural productivity. To better quantify these processes, the CHYN has developed low-cost CO<sub>2</sub> sensors capable of delivering reliable, high-frequency measurements of soil CO<sub>2</sub> fluxes. This master thesis aims to advance our understanding of how water-table dynamics, soil processes, and CO<sub>2</sub> emissions interact in intensively used agricultural areas. The study is carried out in the same field site as *Project SmartDrain*, allowing direct scientific links between the two parallel projects.

### Methodology

The student will combine continuous CO<sub>2</sub> flux measurements from the new CHYN sensor network with groundwater, soil-moisture, and hydrological data already available from the smart-drain monitoring infrastructure. The work includes data preprocessing, quality control, and the analysis of temporal CO<sub>2</sub> emission patterns under varying water-table conditions. The student will design and implement targeted field experiments in which the water table is deliberately manipulated via controlled drain operation, while simultaneously monitoring soil moisture and CO<sub>2</sub> fluxes at high temporal resolution. Because the smart drains can be operated independently, targeted field experiments may be conducted in coordination with the SmartDrain project team to observe how controlled water-table adjustments influence soil respiration and CO<sub>2</sub> release. Statistical analyses and process-based interpretation will be used to identify key drivers and quantify how water-management strategies affect soil carbon dynamics.

The study area is highly instrumented, offering a rare opportunity to combine sensing technology with hands-on fieldwork. The project includes deploying and maintaining CO<sub>2</sub> sensors, verifying hydrological measurements, and documenting system responses during coordinated drain-operation events. The findings will have direct implications for water-table management strategies aimed at reducing soil loss and mitigating CO<sub>2</sub> emissions in the Seeland while covering water needs of crops. By linking soil carbon processes with groundwater management practices, the thesis contributes to developing practical, climate-smart agricultural solutions.

### Supervision and collaboration

The project will be co-supervised by Philip Brunner, Daniel Hunkeler and Ursina Morgenthaler, a postdoc in the group of Daniel Hunkeler. The project will be carried out in close collaboration with the farmer and the Seeland farmer association, Proagricultura Seeland, providing further insight into the integration and acceptance of such technologies in the farming context.

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