Project brief

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CarboCheck – practical app for soil carbon management in agriculture

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- **Most farmers do not focus on humus management**
- **Building humus in agriculturally used soils sequesters CO_2 as soil carbon, supporting climate protection goals**
- **The CarboCheck app allows for targeted humus management, including field-specific forecast of soil carbon content development**
- **Meeting the demands of farmers for a humus management tool is often challenging due to the complexity and uncertainty of the data.**

An increase in humus content in agriculturally used soils offers high potential for additional storage of climate-damaging CO_2. This can contribute to mitigating anthropogenic climate warming and achieving the climate protection goals of the federal government. The CarboCheck project investigated how targeted humus management at agricultural farms can be implemented and supported by a humus balance app.

Background and Objectives

A survey conducted at the beginning of the project among approximately 800 farmers revealed that most farmers are unaware of the current state of humus levels on their operational areas, and there is little interest in humus management. If farmers do use a method, it is typically the humus balance method of the VDLUFA, which is unsuitable for assessing the climate protection effects of humus build-up in agriculture. Farm managers have stated that they are willing to spend a maximum of 10 minutes per year engaging with humus and humus management. However, a financial incentive could increase their willingness.

In recent years, there has been significant increase in interest in carbon farming among both society as a whole and agricultural farms. A growing number of companies and initiatives are offering payment systems to farmers who engage in humus build-up through their management, thus sequestering CO_2. The procedures are mostly similar. Firstly, the initial humus stock, i.e., the current state, is measured. If it has demonstrably increased after a predetermined number of years, money is paid out, generated through the sale of voluntary CO_2 certificates on the market.

From a scientific perspective, this method is at least questionable. Demonstrating an increase in carbon (C) in soils on the short timescale of a few years is hardly possible due to slow changes and high spatial variability, unless organic fertilizers are used to increase humus. However, this only involves a shift of humus between areas and does not constitute general humus build-up. Another criticism is the reversibility of humus build-up occurring during the measurement period. A measure is considered climate-effective only if it is long-term.

The goal of the CarboCheck project was to develop a software tool that

- is as easy and quick to use as possible,
- predicts field-specific humus development under given management and site conditions,
- considers internationally established soil carbon models,
- makes humus management accessible and practical,
- helps optimize and significantly simplify humus management on farms.

Approach

Based on knowledge of soil carbon modelling at the Thünen Institute and the Helmholtz Centre for Environmental Research (UFZ), internationally established carbon models were aggregated into a model ensemble, implemented, and consolidated in a single software application. The model results were validated using a dataset from experimental and practical data of long-term field trials and soil monitoring areas in the federal states.

Additionally, a tool (CPix) was developed to estimate the current humus content by using a soil photo and additional location data related to climate and parent material. Data from the German Agricultural Soil Inventory (BZE-LW) were used for this purpose.

Results

Due to user-friendliness and ease of access, both applications were implemented into an app. For customers of the business partner HELM-Software, a direct link to the field register is available, eliminating the need for additional data entry. HELM-Software is currently developing the app and has already announced its release on their website.

Figure 1: Interface of CarboCheck-App. Source: HELM-Software

The CarboCheck app can be used by farms to optimise their humus management. The app presents forecast results using traffic light colours, green for humus build-up, yellow for humus balance (no change), and red for humus loss.

To offset specific model uncertainties and conceptual differences, multiple models are used. All models are calibrated for conventional farming, with no extension to organic farming available so far. Furthermore, the project timeline did not allow for the inclusion of nitrogen mineralization from humus in the soil, which is also a crucial aspect.

Additionally, soil humus content is often not measured, but the CPix tool can estimate its value based on soil colour. Throughout the project, it became clear that while the tool's results are superior to those from soil carbon maps, laboratory analysis remains essential for accurate humus determination.

Conclusions

During the project, it became evident that promoting interest and knowledge in humus and humus management on farms is crucial due to the need and potential. Humus management is unlikely to be widely implemented as long as there is no direct gain for the farms. Although laboratory measurements remain the best way to precisely determine humus content, farmers are often unwilling to bear these additional costs. The CarboCheck app provides an estimation of humus development based on given site and management conditions. However, it is important to note that there are significant uncertainties in humus prognosis, and some areas, such as grasslands and sites near groundwater, cannot be accurately modelled. It is understandable that farmers have high expectations of science and desire accurate results, but without corresponding input data on field management from recent years and decades, achieving this is not feasible.

Recommendations

- In the context of carbon farming linked with humus build-up, it is crucial to ensure that the measures do not lead to additional greenhouse gas emissions elsewhere and are primarily long-term.
- Humus management must immediately financially benefit farms.
- For farms not using the paid HELM-Software, data entry is too cumbersome. Creating freely accessible, cost-free alternatives contradicts economic promotion within the BMEL project call but is necessary for widespread use.
- Some pioneer farmers, as implemented in HumusKlimaNetz, could potentially harness the benefits of targeted humus management. The latest findings and models from CarboCheck are being applied and further developed in such initiatives and other projects.

Further information

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