Dutch MRV approach for soil carbon monitoring

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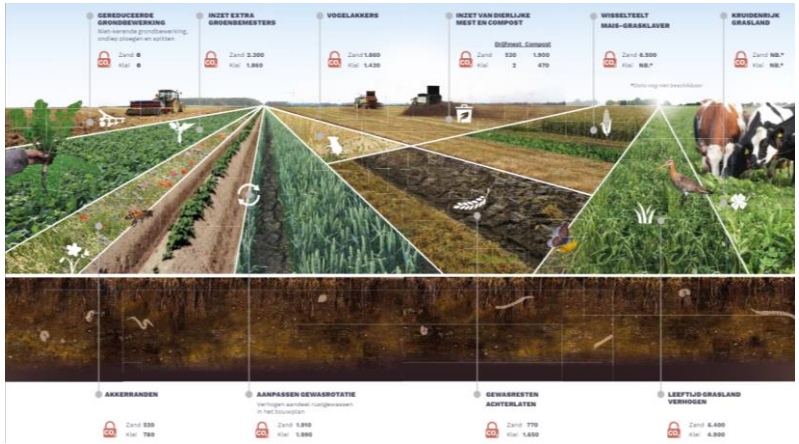
MARVIC MRV for carbon farming

Smart Land Use programme

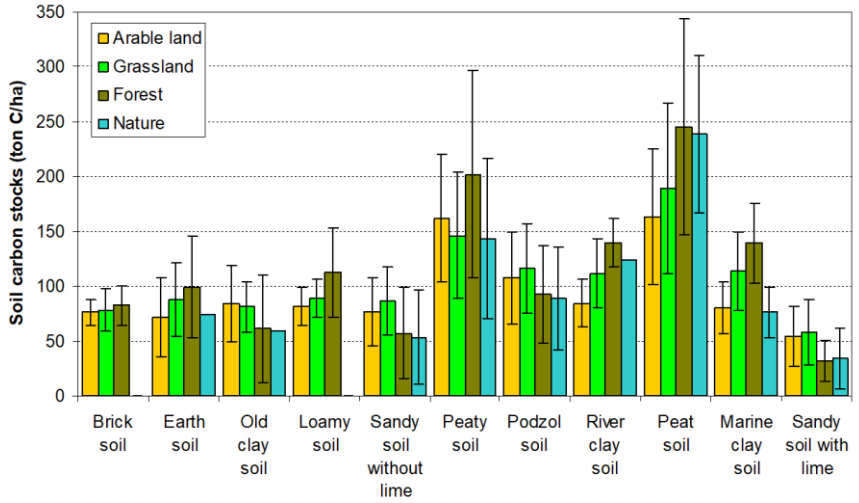
- **Objective**: provide knowledge to obtain the SOC sequestration target of 0.5 Mton CO_2 and contribute to the national programme on agricultural soils

- Themes
  - **Effectiveness** of carbon measures
  - Improved **application** in practice
  - **Monitoring** towards the target
  - **Incentives** for farmers
  - **Knowledge exchange**
  - **Integration** of results



Mineral soils in National inventory

- Until 2022 only impact of changes in land use on SOC stocks
- Impact of agricultural management not captures in NIR
- Tier3 approach required



SWOT analyse monitoring strategies

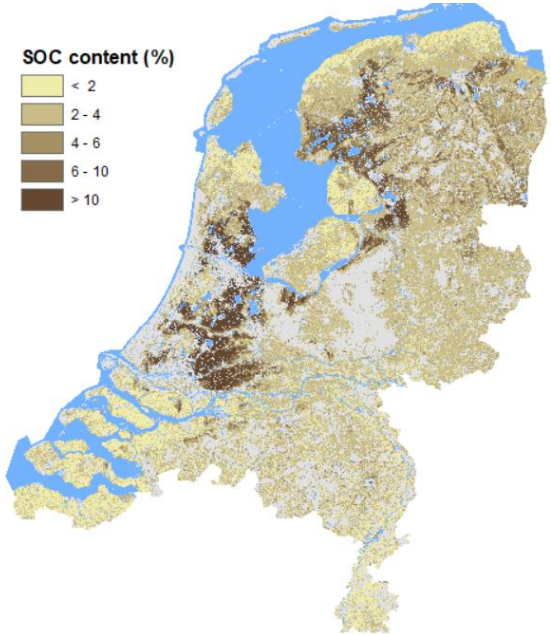
	Using soil analysis data from farmers	Modelling based on farm level data	Modelling based on national data	National scale SOC measurements
Strengths	• Large database (>100000 analyses per year) • No additional administrative burden for farmers	• Provides insights to farmers • Can be linked to existing farm level data (KLW, FMS)	• Simple and relatively cheap to organise • Insight in trends and effects of policies	• Statistically well developed soil survey
Weaknesses	• Representativity • Limited sampling depth (10 cm for grassland) • Uncertainty measurements	• Privacy and availability of data • For arable agriculture improved data linkage required	• Limited availability of national data on practices, additional data collection required	• Too few locations to signficantly prove whether the target is reached • No direct link to practices and policies
Opportunities	• Link to current practice • Aligned with other soil analyses (P status)	• Aligns with other sector initiatives (e.g. carbon footprints)	• RVO is already collecting more data for CAP • FADN can also be a source of data	• Monitoring of other soil properties as well • More suitable for verification of model results
Threats	• Differences between labs • Privacy issues regarding data	• Quality assurance, especially if linked to rewarding schemes	• Dependency on models and possible mismatch with measurements	• Outcome is uncertain, only result after the survey

Choice for RothC model

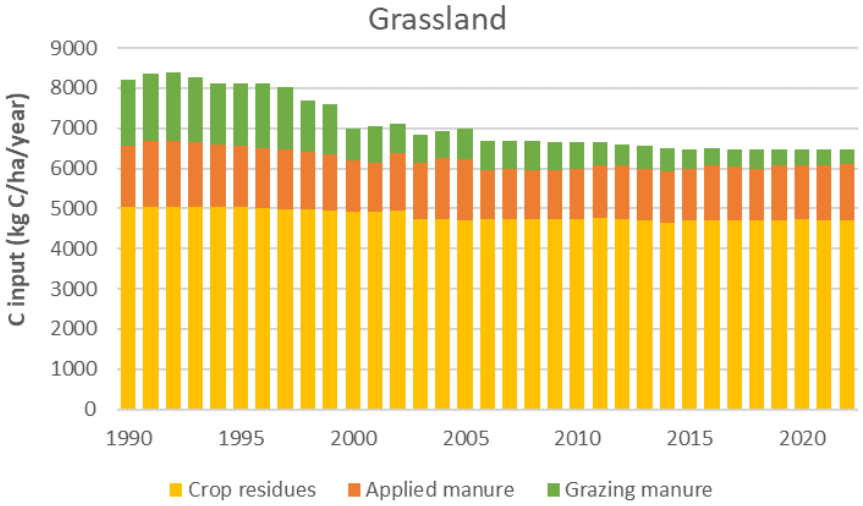
- Dynamic, process-based model for the turnover of OC in the topsoil
- Globally and scientifically acknowledged
- > 200 publications
- Limited input data required
- Calibrated and validated on long-term experiments Rothamsted
- Mineral soils only (<20% OM)
- Used in many projects and initiatives (CarboSeq, FAO GSOCseq, ...)

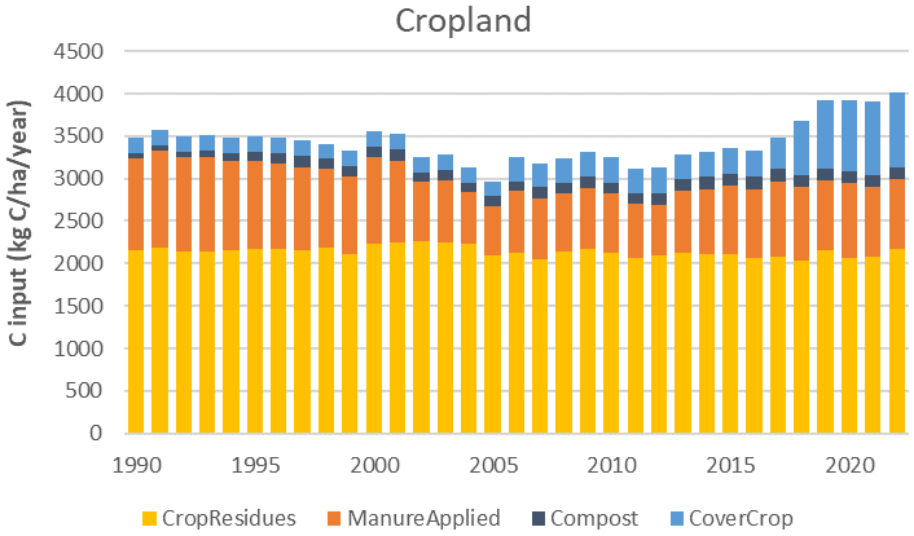
Approach for SOC in national inventory

- Application of RothC at national scale, calculations at postal code level (~3400 units)
- SOC data: detailed prediction map based on digital soil mapping (Helfenstein et al., 2022) using measured SOC data from national 2018 soil survey (Knotters et al. 2022)
- Input data (period 1990-2022)
    - Crop areas and cover crops → LPIS
    - Crop yields → Statistics at province level
    - Organic fertilizers → INITIATOR model
    - Straw use → FADN
    - Monthly climate data → KNMI (14 zones)



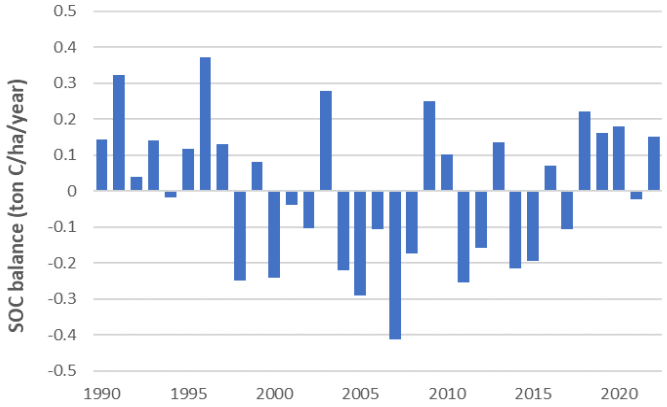
Carbon inputs to the soil



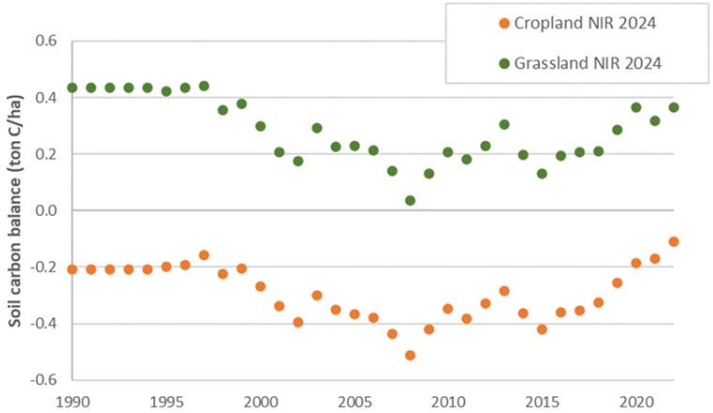


SOC balance

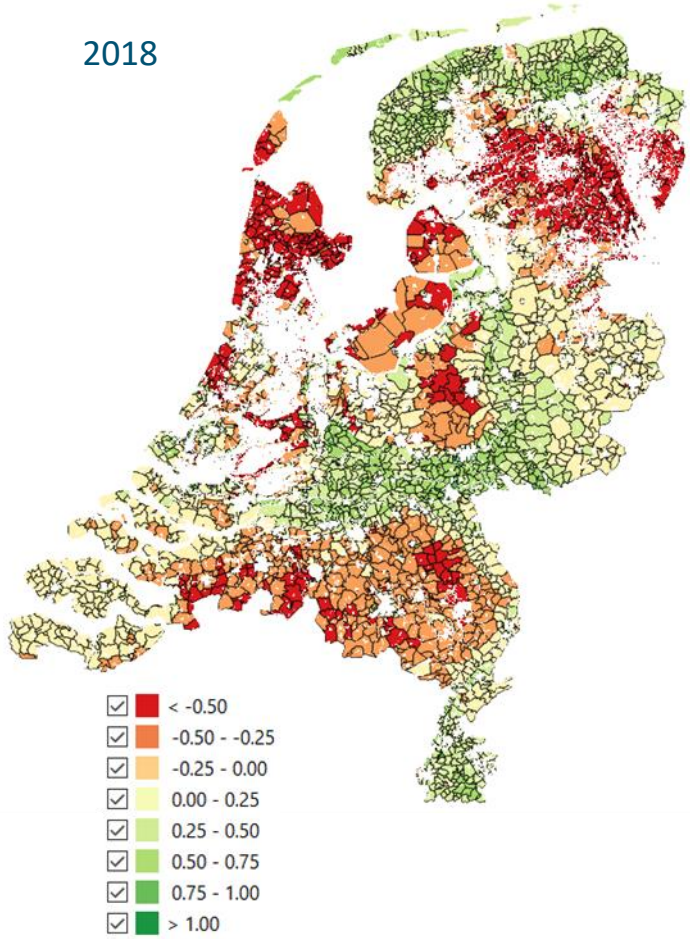
Annual SOC balance



5 year average SOC balance



2018



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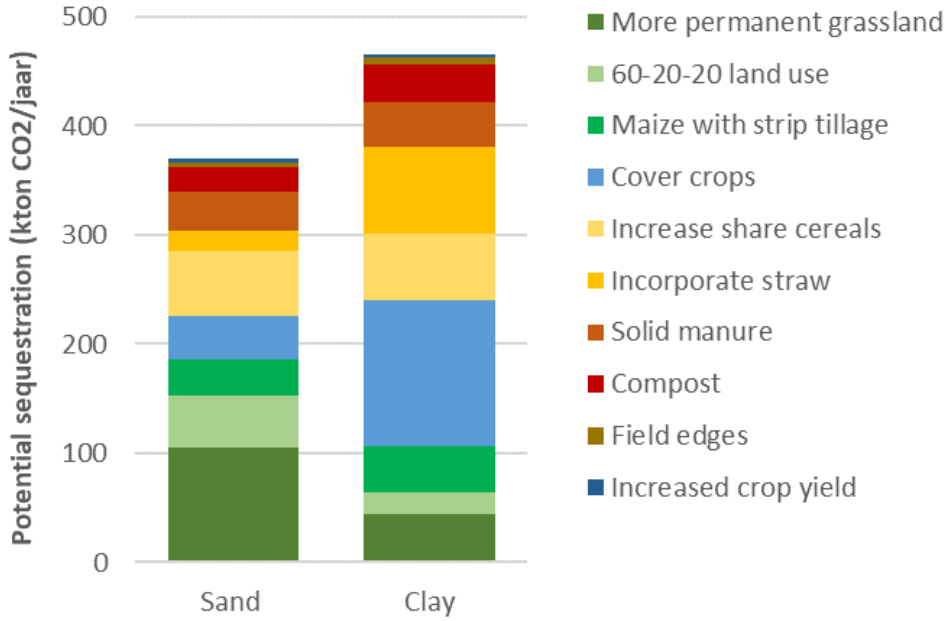
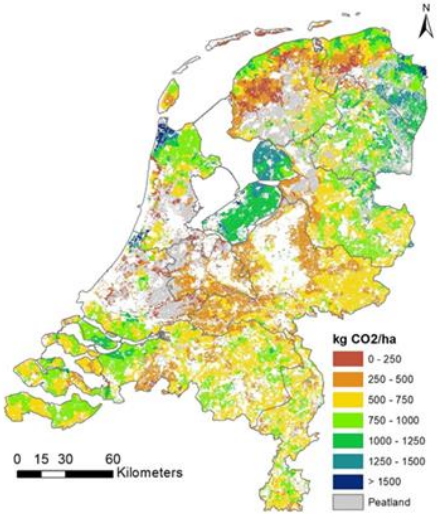
C sequestration potential of practices



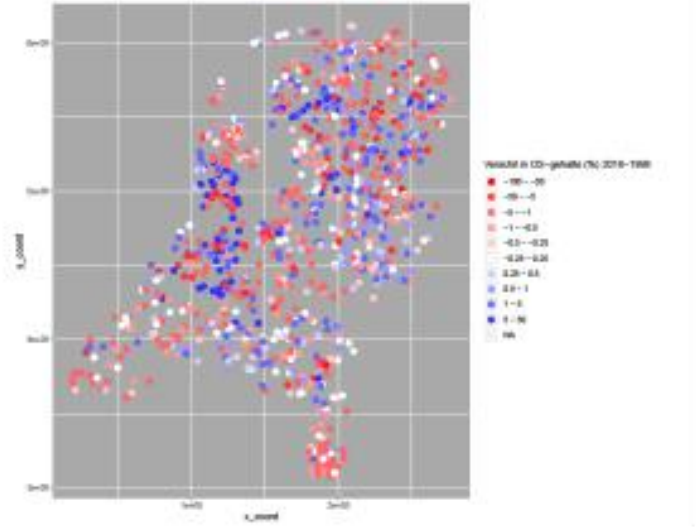
Lesschen et al. (2021)



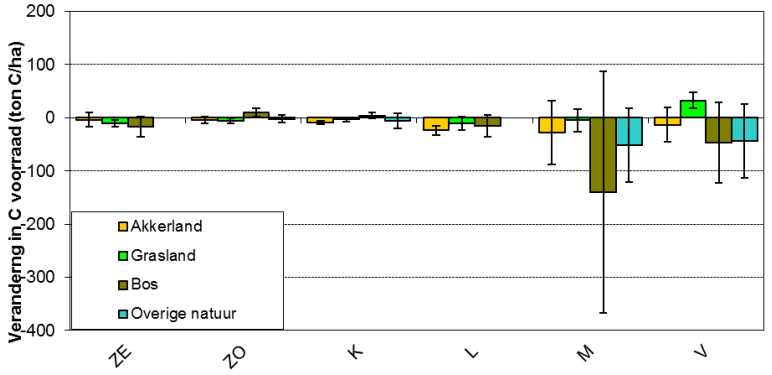
- Total potential 0.9 Mton CO_2/year
- 5% of current emissions from agriculture

National soil survey (CC-NL)

- Soil resampling campaign in 2018 at locations from old survey (1995-2002)
- 1152 locations, two depths
- Range of soil properties → baseline for soil quality assessment

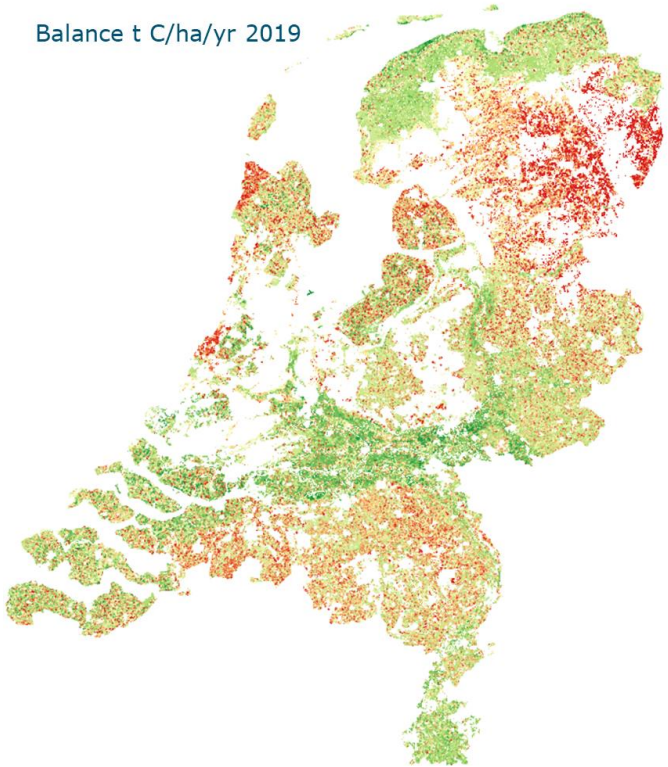


- Decline in SOC stocks in organic soils, no significant change in mineral soils
- Large uncertainty due to differences in sampling approach
- New survey in 2024



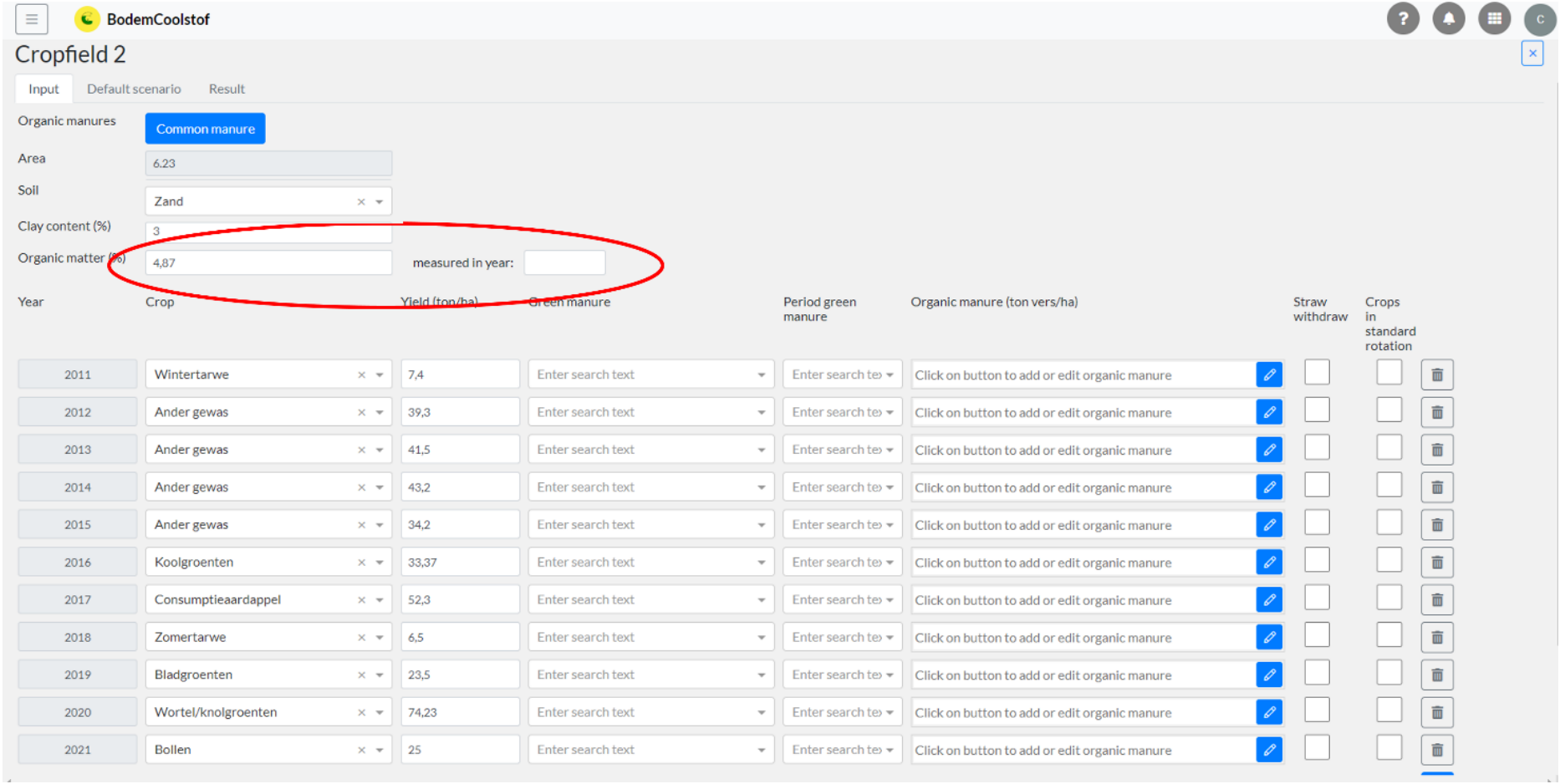
Towards field level monitoring

- ESA project: EO4CMS
- Application of RothC model at field level
    - LPIS data on crop and cover crop
- Combine with Earth Observation data
    - Soil cover
    - C input (biomass, esp. cover crops)
    - Detection of ploughing
- Validation planned based on 2018-2024 national soil survey



Development of an online soil carbon tool

- Farmers indicated the need for a tool to assess the impact of SOC practices
- Stimulate implementation of SOC practices:
    - Farmer will not invest in SOC practices if effect is unknown
    - Effect of practices is field/farm specific
- Web-based SOC tool based on RothC
- Online platform FarmMaps
    - Linked to LPIS
    - Possibility to import farm management

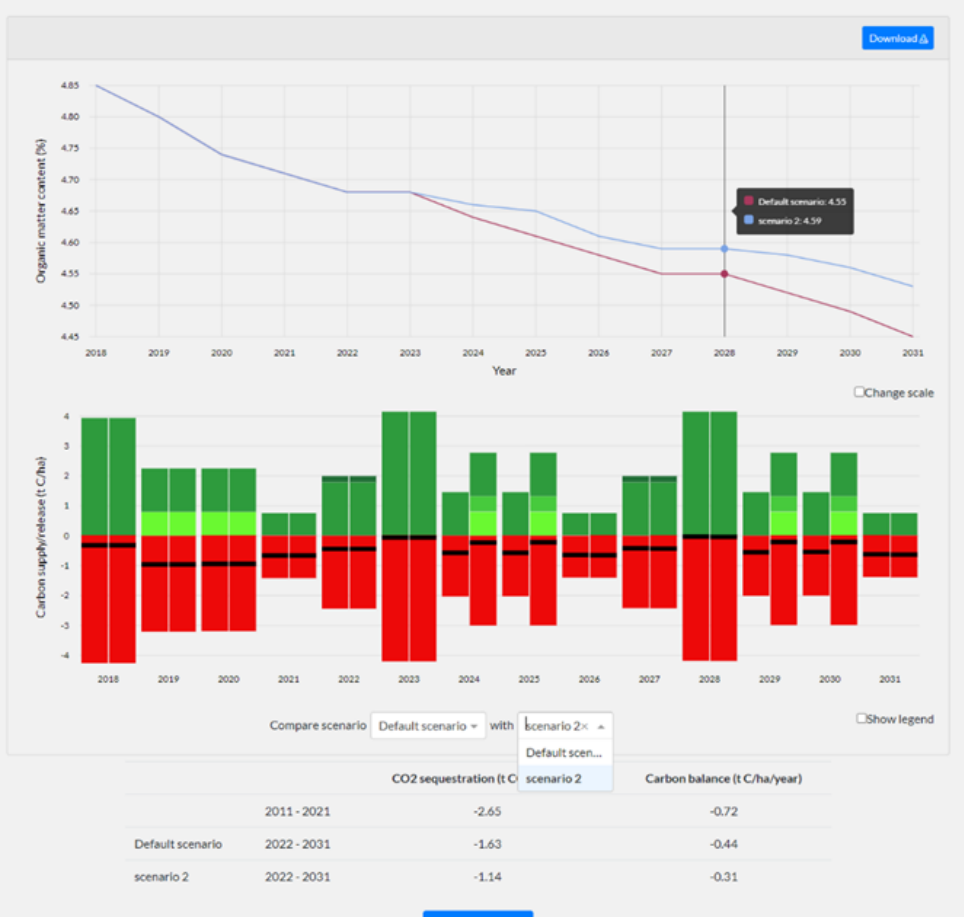

BodemCoolstof
Cropfield 2
Input
Default scenario
Result
Organic manures
Common manure
Area
6.23
Soil
Zand
Clay content (%)
3
Organic matter (%)
4,87
measured in year:
Year
Crop
Yield (ton/ha)
Green manure
Period green manure
Organic manure (ton vers/ha)
Straw withdraw
Crops in standard rotation
2011 Wintertarwe 7,4
2012 Ander gewas 39,3
2013 Ander gewas 41,5
2014 Ander gewas 43,2
2015 Ander gewas 34,2
2016 Koolgroenten 33,37
2017 Consumptieaardappel 52,3
2018 Zomertarwe 6,5
2019 Bladgroenten 23,5
2020 Wortel/knolgroenten 74,23
2021 Bollen 25
Enter search text
Click on button to add or edit organic manure

Soil carbon tool - Results

Changes in soil organic matter content over time (0-25 cm).

Carbon in/output per year

CO_2 sequestration and average carbon balance



- Data can be downloaded
- When all fields have data → farm results

Carbon certificates for permanent grassland

- Available methodology at SNK since 2021
- Permanent grassland = no ploughing of grassland for at least 10 years
- Group of farms start joint project
- At least 50% of total farm area should be part of the scheme
- Model calculation for C sequestration → certificates (5% per year)
- SOC measurements in year 0 and year 10 → verification (50% payment)
- 10 projects formally started (8000 ha)
- Methodology for arable land has been published recently

stichting Nationale Koolstofmarkt

Thank you

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