

Mitä on hiiliviljely?

What is carbon farming?

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29.11.2022

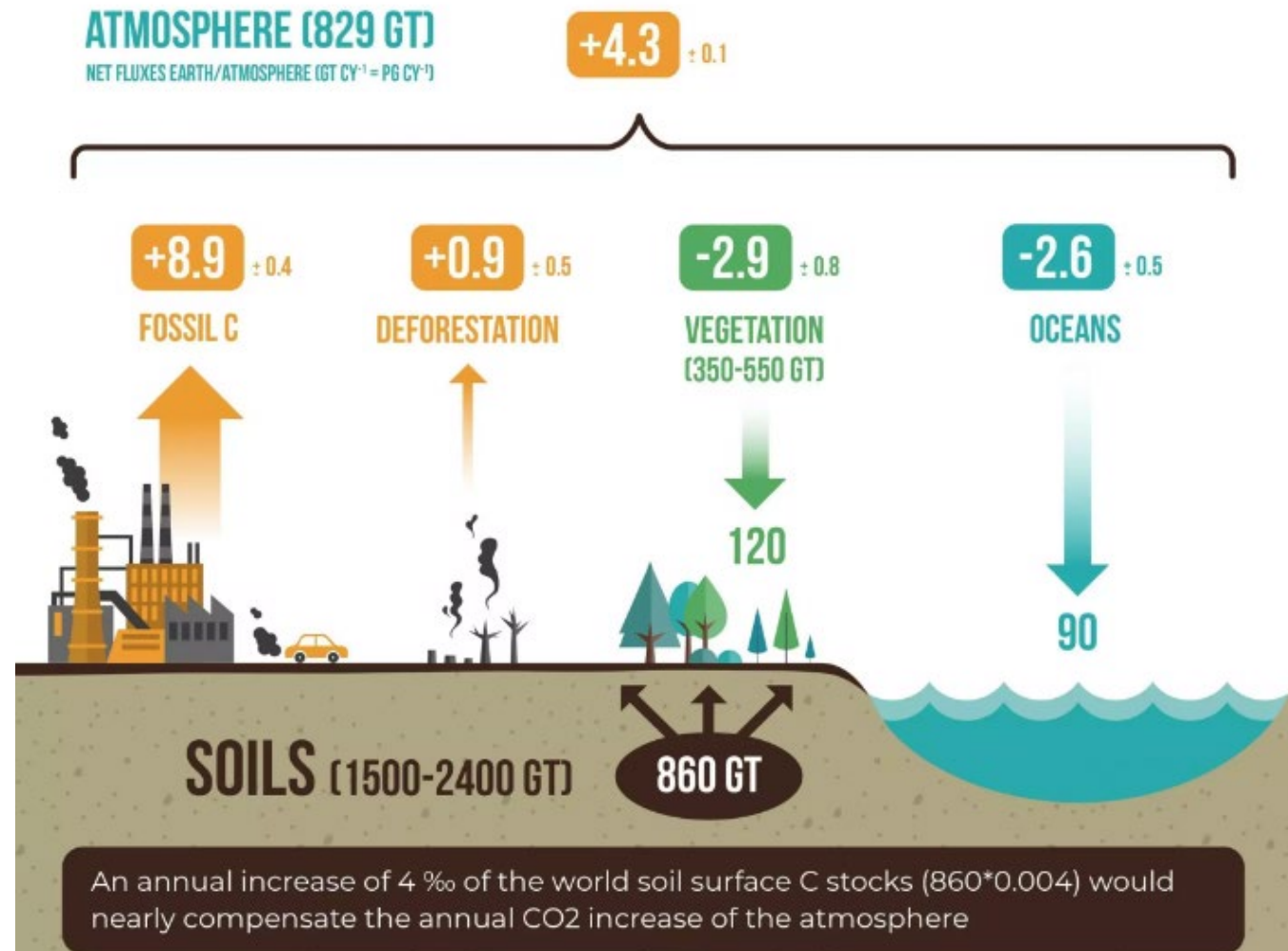


Small changes in soil C are significant

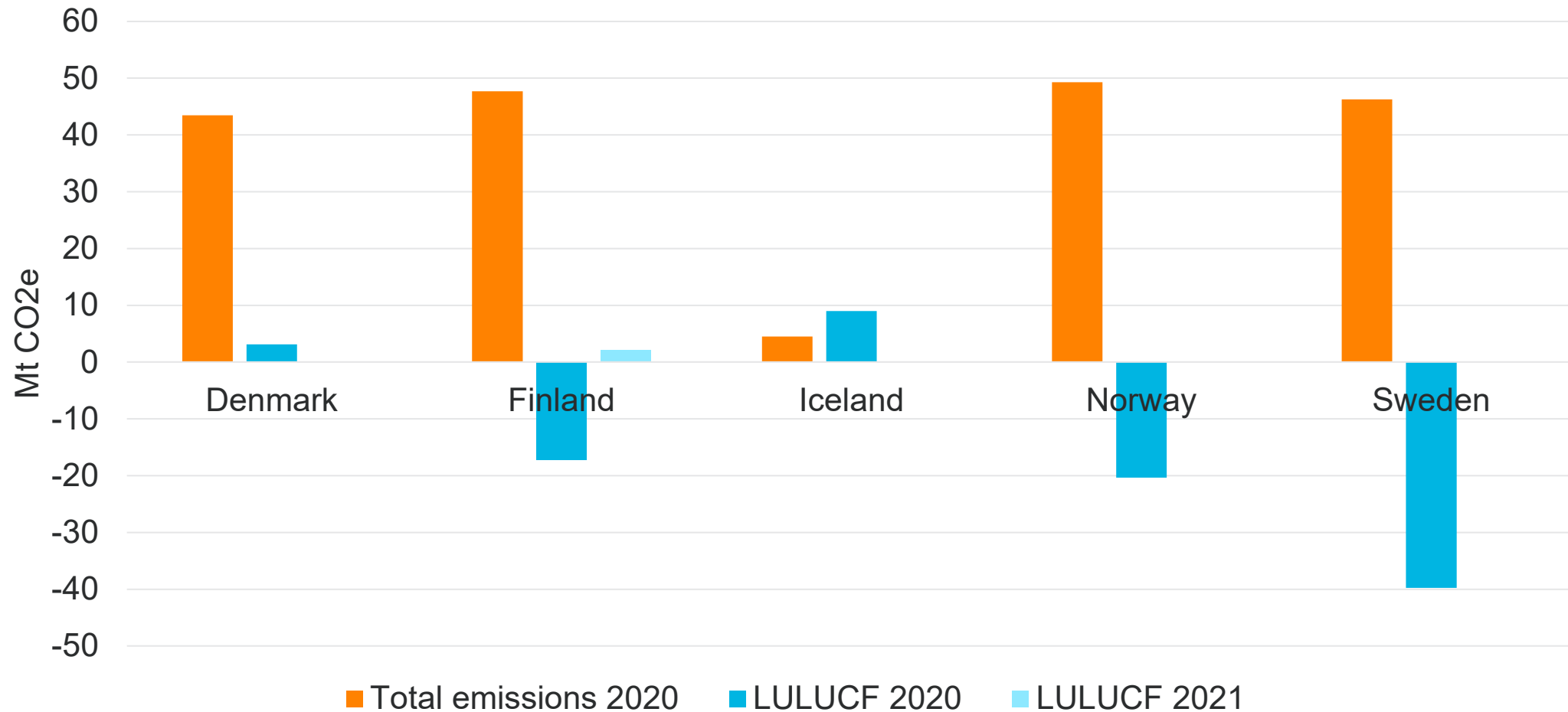
The 4 per 1000 initiative illustrated the significance of soils:
It was estimated that a 0.4% increase in topsoil C (30-40 cm soil layer) could almost counteract the net CO₂ increase in the atmosphere
(+4.3 vs. $860 \times -0.004 = -3.4$)



4 PER 1000 WHERE DOES IT COME FROM ?



A country is climate neutral if the C sink of the land use sector (LULUCF) equals total emissions of the country



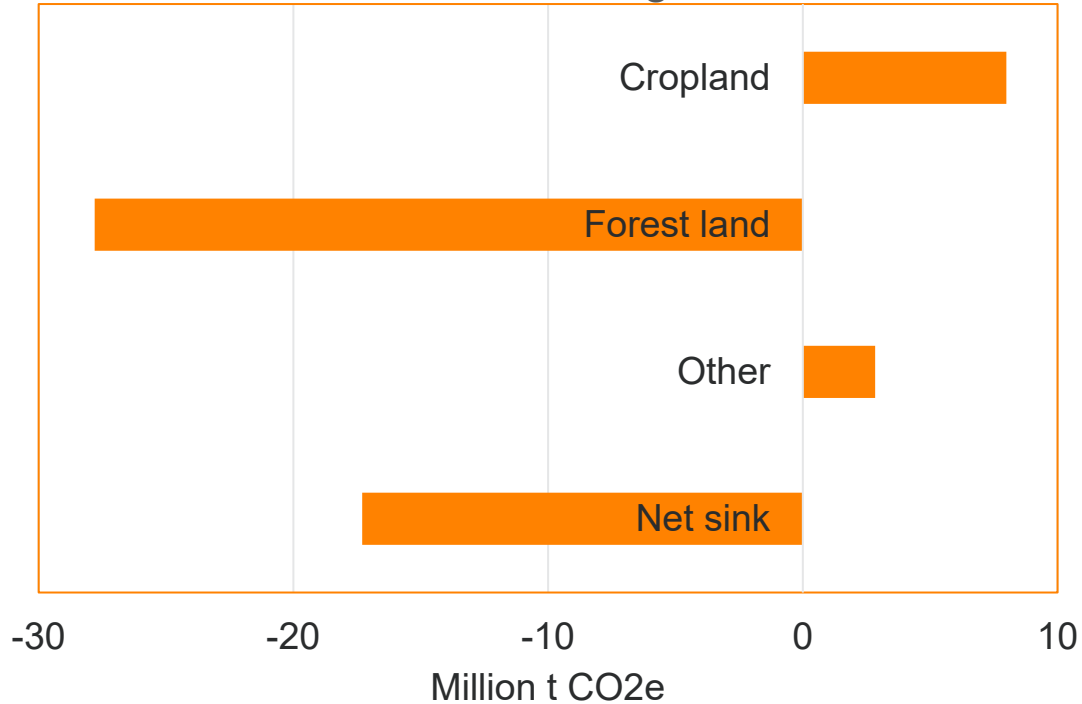
https://di.unfccc.int/flex_annex1 Year 2020, preliminary data for 2021 for Finland

[https://www.luke.fi/fi/seurannat/maatalous-ja-lulucfsektorin-](https://www.luke.fi/fi/seurannat/maatalous-ja-lulucfsektorin-kasvihuonekaasuinventaarion-pikaennakkotiedot-vuodelle-2021-uusien-puuston-kasvutietojen-huomioon-ottaminen-kaantaa-lulucfsektorin-paastolahteeksi)

[kasvihuonekaasuinventaarion-pikaennakkotiedot-vuodelle-2021-uusien-puuston-kasvutietojen-huomioon-ottaminen-kaantaa-lulucfsektorin-paastolahteeksi](https://www.luke.fi/fi/seurannat/maatalous-ja-lulucfsektorin-kasvihuonekaasuinventaarion-pikaennakkotiedot-vuodelle-2021-uusien-puuston-kasvutietojen-huomioon-ottaminen-kaantaa-lulucfsektorin-paastolahteeksi)

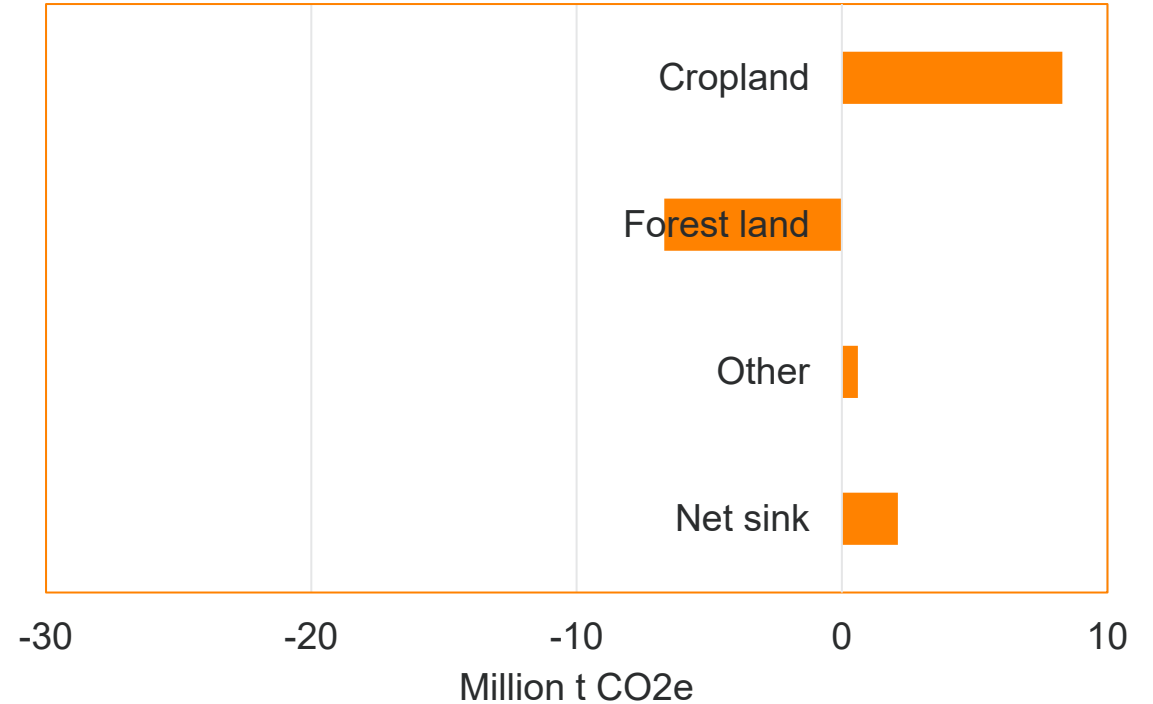
Role of carbon farming in the carbon sink of land use

In 2020, Finland had a strong C sink



When the net sink was ~20 Mt, potential mitigation in cropland was of minor importance compared to forests.

In 2021, the land use sector is a net emitter



With the diminished forest C sink, the significance of cropland increases.

Left: year 2020 https://di.unfccc.int/flex_annex1, Right: preliminary data for 2021, <https://www.luke.fi/fi/seurannat/maatalous-ja-lulucfsektorin-kasvihuonekaasuinventario/kasvihuonekaasuinventaarion-pikaennakkotiedot-vuodelle-2021-uusien-puuston-kasvutietojen-huomioon-ottaminen-kaantaa-lulucfsektorin-paastolahteeksi>

Carbon farming in the communication on Sustainable Carbon Cycles

- Carbon farming can be defined as a green **business model** that rewards land managers for taking up **improved land management practices**, resulting in the increase of carbon sequestration in living biomass, dead organic matter and soils by **enhancing carbon capture and/or reducing the release of carbon** to the atmosphere, in respect of ecological principles favourable to biodiversity and the natural capital overall.
- The financial incentives can come from public or private sources
- Examples of measures in agricultural production:
 - Agroforestry
 - Use of catch crops, cover crops, conservation tillage and increasing landscape features
 - Targeted conversion of cropland to fallow or of set-aside areas to permanent grassland;
- Examples of measures by land use changes:
 - Restoration of peatlands and wetlands
 - Afforestation
- Crucial to ensure that credits generated through carbon farming do not undermine other mitigation efforts

HOW CAN SOILS STORE MORE CARBON?

The more soil is covered, the richer it will be in organic material and therefore in carbon. Until now, the combat against global warming has largely focused on the protection and restoration of forests. In addition to forests, we must encourage more plant cover in all its forms.



Never leave soil bare and work it less, for example by using no-till methods



Introduce more intermediate crops, more row intercropping and more grass strips



Add to the hedges at field boundaries and develop agroforestry



Optimize pasture management with adapted grazing periods and rotations



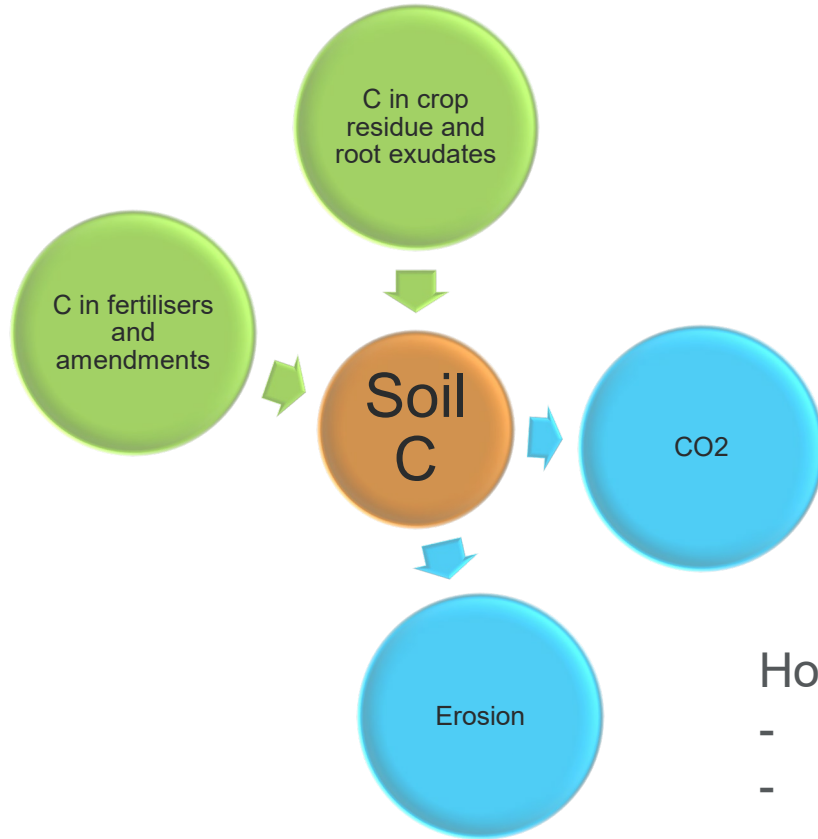
Restore land in poor condition e.g. the world's arid and semi-arid regions



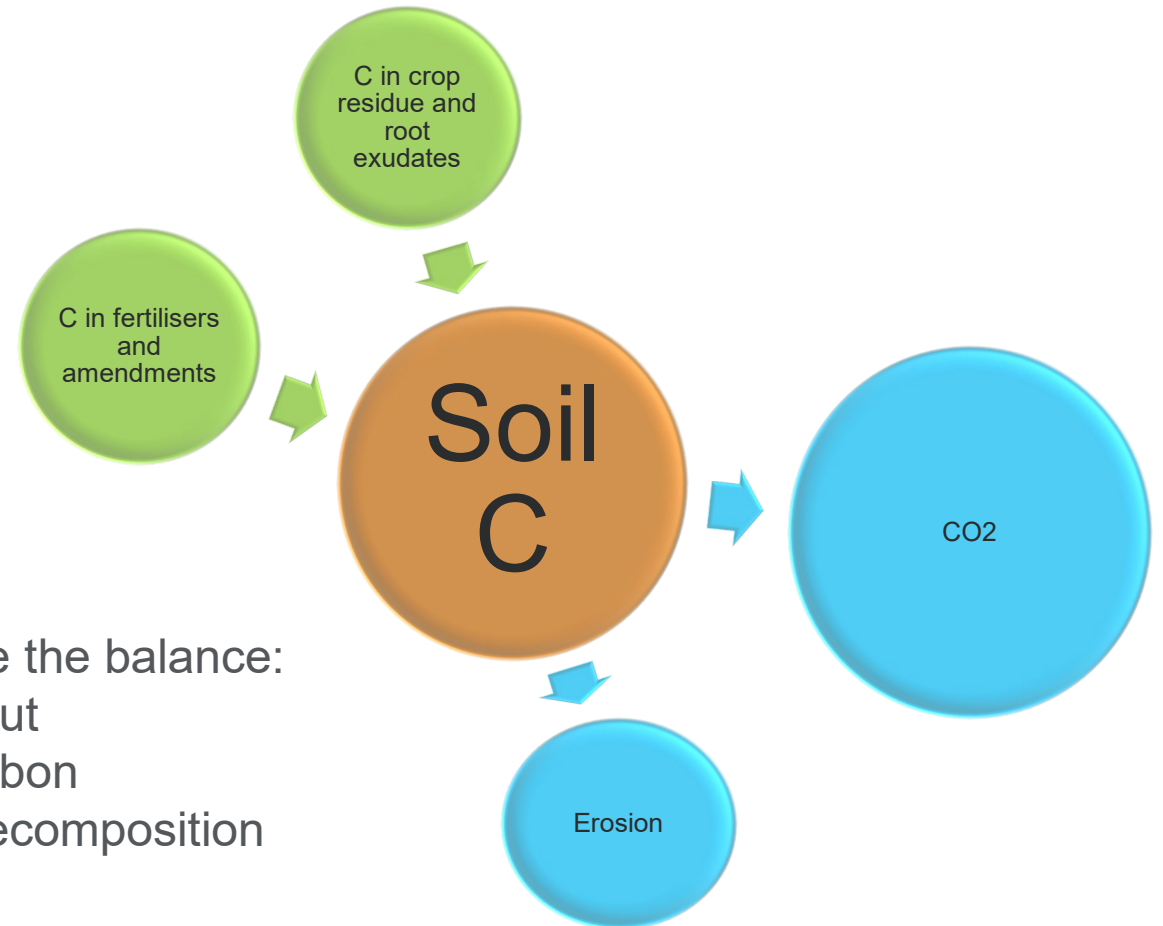
Improve water and fertilizers management and use organic fertilizers and compost

C is sequestered if input of C is higher than losses of C

Mineral soil: it is possible to reach balance or sequester C



Peat soil: C stock is so high that it is impossible to counterbalance losses with inputs if drainage exists



How to improve the balance:

- Increase input
- Stabilise carbon
- Decrease decomposition

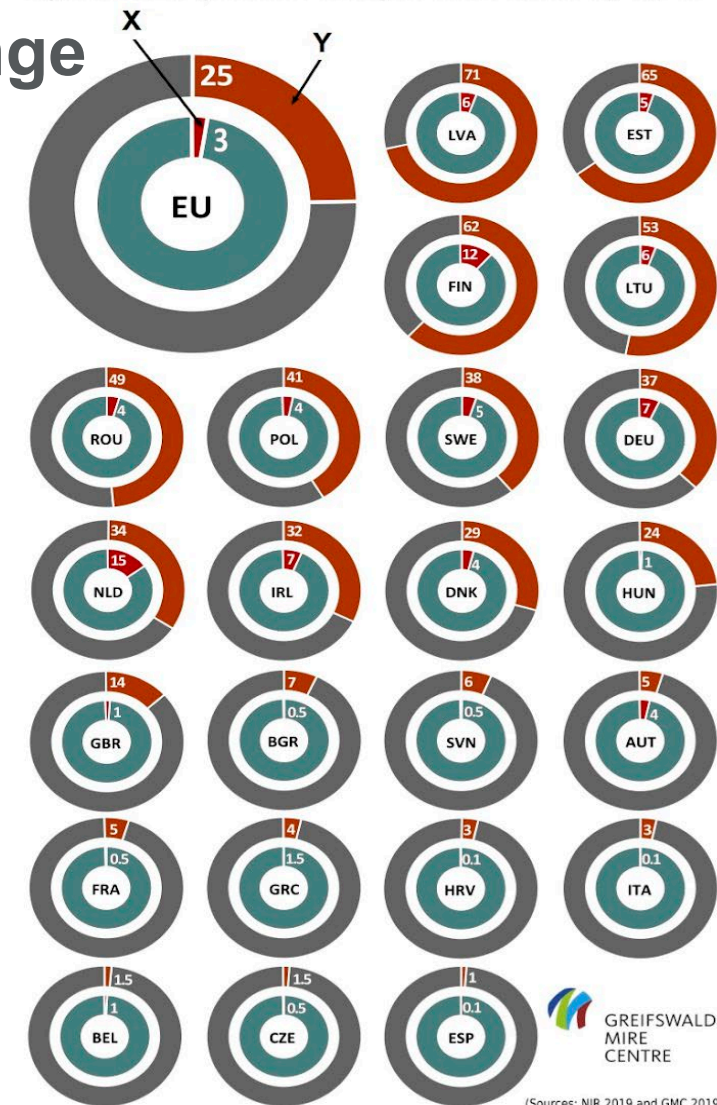
Challenges in Nordic conditions

- **Climate warming** enhances decomposition of organic matter
- **Short growing season** → difficult to have continuous vegetation cover
- **Animal production segregated from crop production** → manure and grasses in rotations not available everywhere
- **Harsh winters** damaging grass swards and breaking soil aggregates that could protect C
- Relatively **high prevailing C content** slowing down sequestration
- **Funding** is scarce and scattered, voluntary markets undeveloped
- **CAP**: extremely difficult to implement effective measures (like afforestation or restoration)
- High proportion of **organic soils** with high C losses due to drainage

High proportion of peat soils is both a challenge and an opportunity

- High emissions but also high mitigation potential
- Annual GHG emissions from drained peat soils are >200 Mt CO₂equivalent in the EU
- Raising the ground water table is the only measure that can stop peat loss
- Rewetting can aim at restoration or paludiculture: cultivation of wet-tolerant crops with raised ground water level
- Rewetting has a high GHG mitigation potential per area

Rewetting just X% of agricultural land will reduce agricultural greenhouse gas emissions by up to Y%

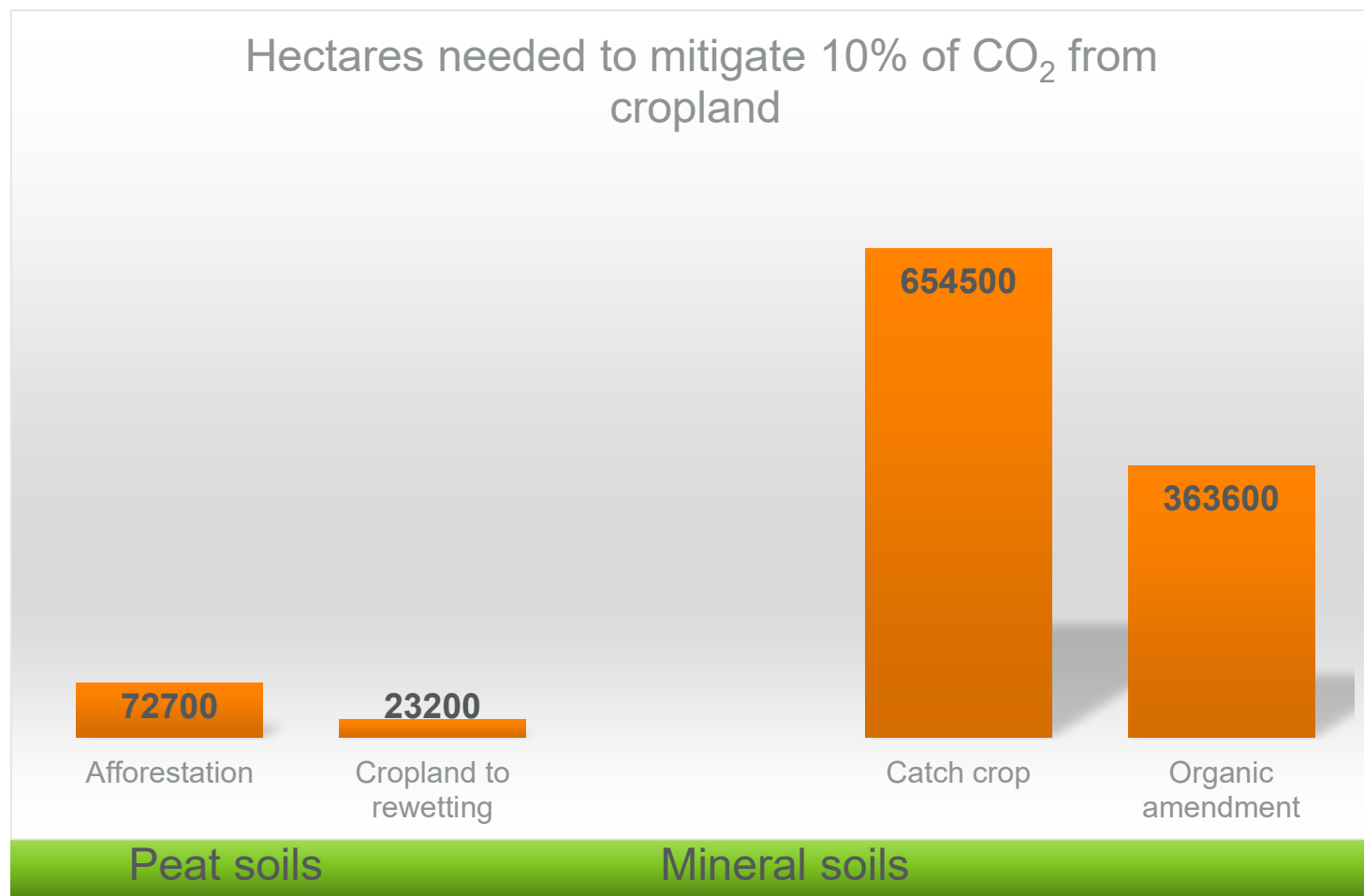


GREIFSWALD MIRE CENTRE
(Sources: NIR 2019 and GMC 2019)

Rewetting 3% of the area will reduce GHG emissions from agriculture by up to 25% in the EU.

Source: https://greifswaldmoor.de/files/dokumente/Infopapiere_Briefings/2020/Opportunities-for-paludiculture-in-CAP-1.pdf

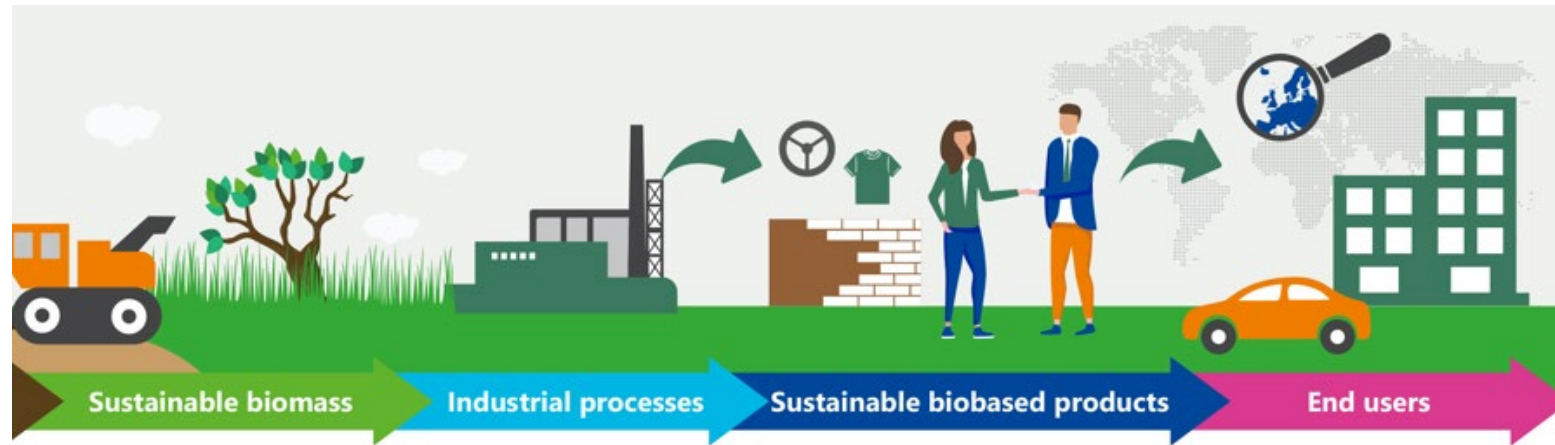
Example from Finland: 1% of field area could mitigate 10% of agricultural CO₂



Measures on peat soils are effective per hectare but those on mineral soils are easier to accept by landowners

These measures are not mutually exclusive – they all are achievable

Carbon farming and decarbonisation of industry can be combined



Carbon farming:

- It is easiest to sequester C in poor mineral soils or rewetted peatlands
- Many biomass crops are beneficial to soil quality → fields can be returned to production
- In Finland, marginal lands are e.g. abandoned peat mining sites or fields that have lost their production potential

Industry:

- Demand for biomaterials increases, e.g. bio-concrete, composites, fibres replacing cotton and synthetic fibres, materials replacing peat in horticultural growing media
- More area is needed for production → risk for deforestation → "marginal land" should be prioritised

Paludiculture: Cultivation of wet-tolerant crops with raised ground water table



Energy use
Willow
Cattail
Reed canary grass



Growing media
Reed canary grass
Common reed
Cattail



Construction
Cattail
White birch
Alder



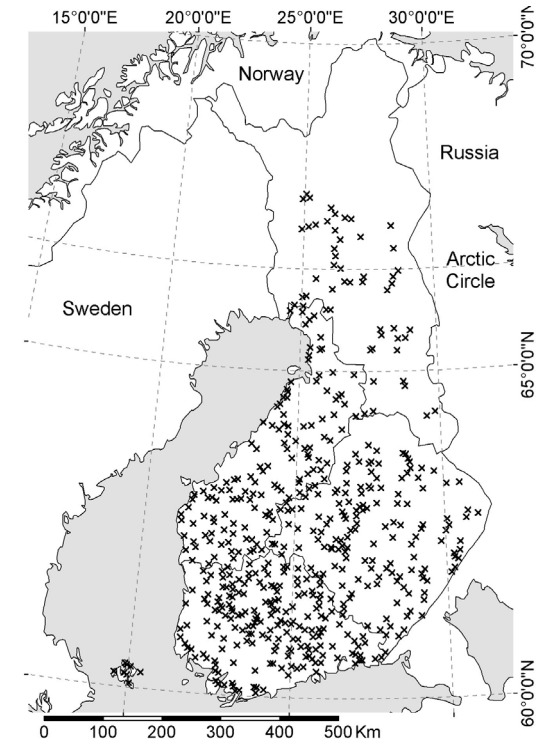
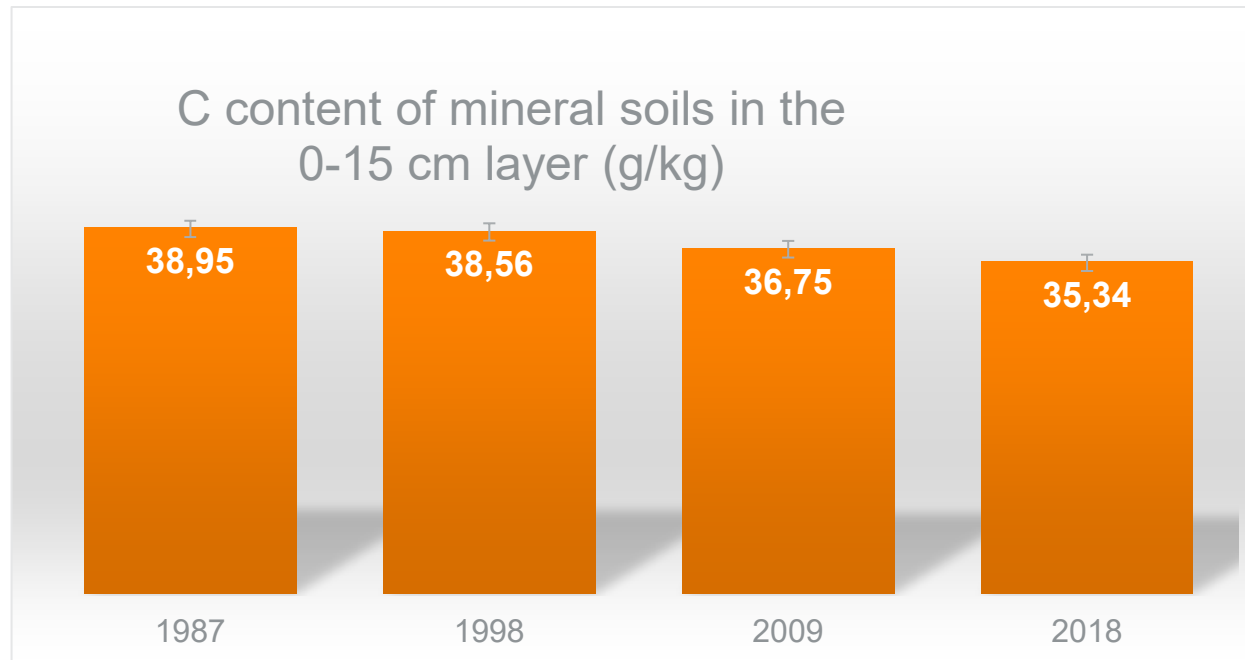
**Feed/
bedding**
Reed canary grass
Cattail
Common reed



Special products
Textiles
Composites
Biochar
Nanomaterials
Berries
Sundew
Ornamental use

Is there carbon farming?

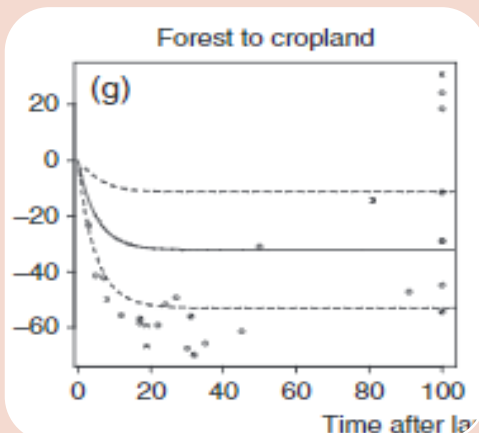
Cropland soil carbon stock has declined in Finland



- Loss of C 0,2 t/ha/year in 1987-2018
- C stock increased in fields with a perennial crop $\geq 80\%$ of the time

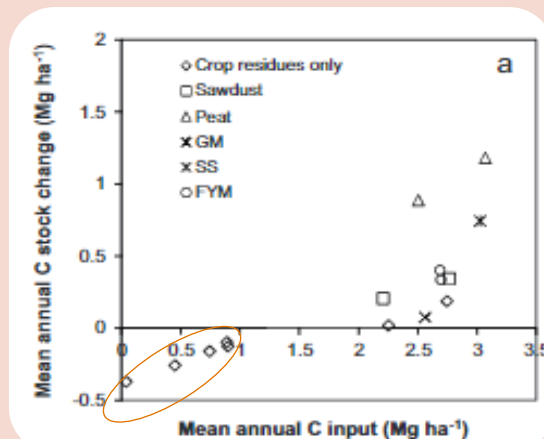
<https://www.luke.fi/fi/hiilen-maara-peltomaassa>

Why does the C content in Finnish croplands decrease?



Fields are young – they lose the C from the previous land use (forest)

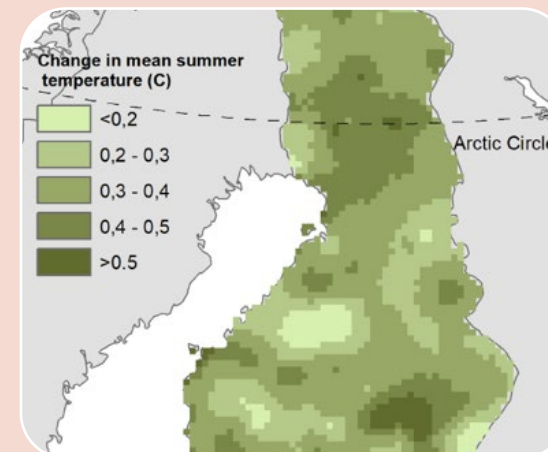
Figure: doi: 10.1111/j.1365-2486.2011.02408.x



Management changes

- Less perennial cropping
- Less manure
- Varieties with less crop residues

Figure: doi: 10.1016/j.agee.2011.02.029

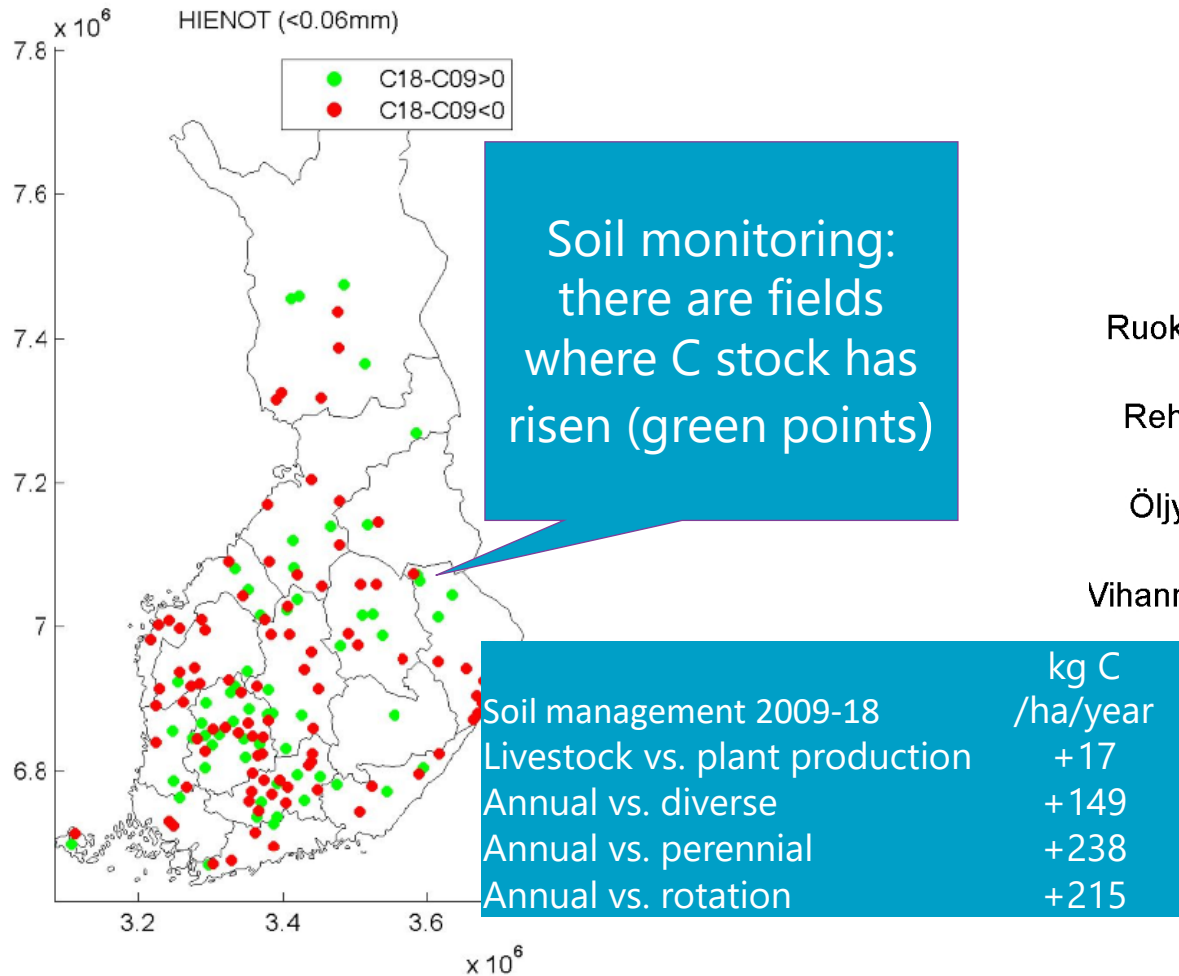


Climate change

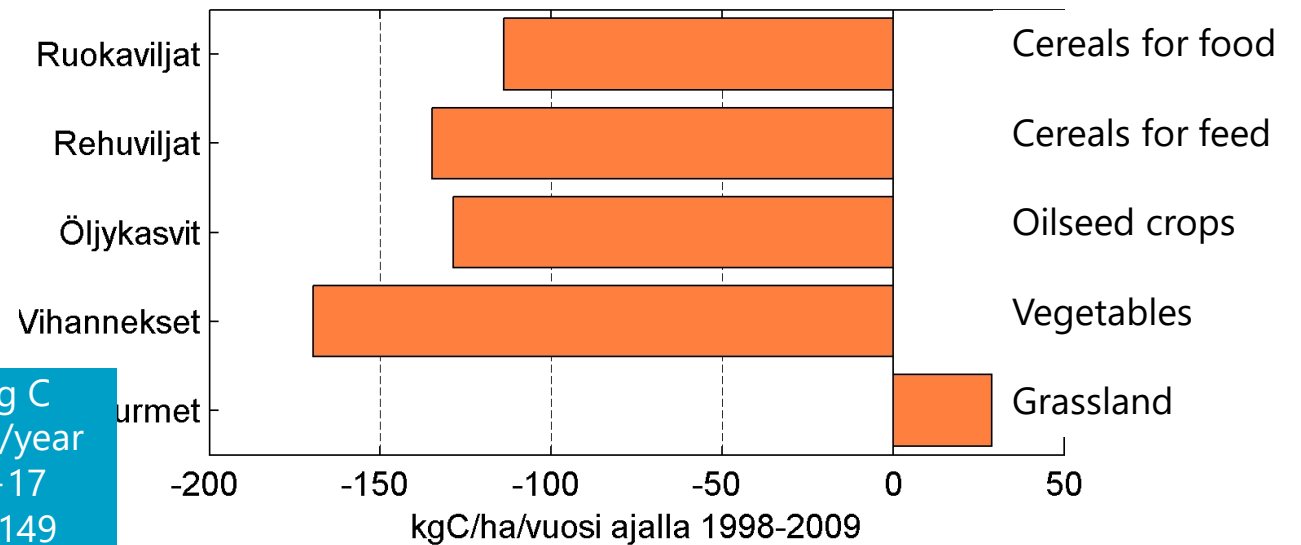
Heikkinen et al. 2022: "...it is unlikely that improved management practices are sufficient to counterbalance the climate change-induced SOC losses in boreal conditions"

DOI: 10.1111/gcb.16164

Evidence of carbon farming

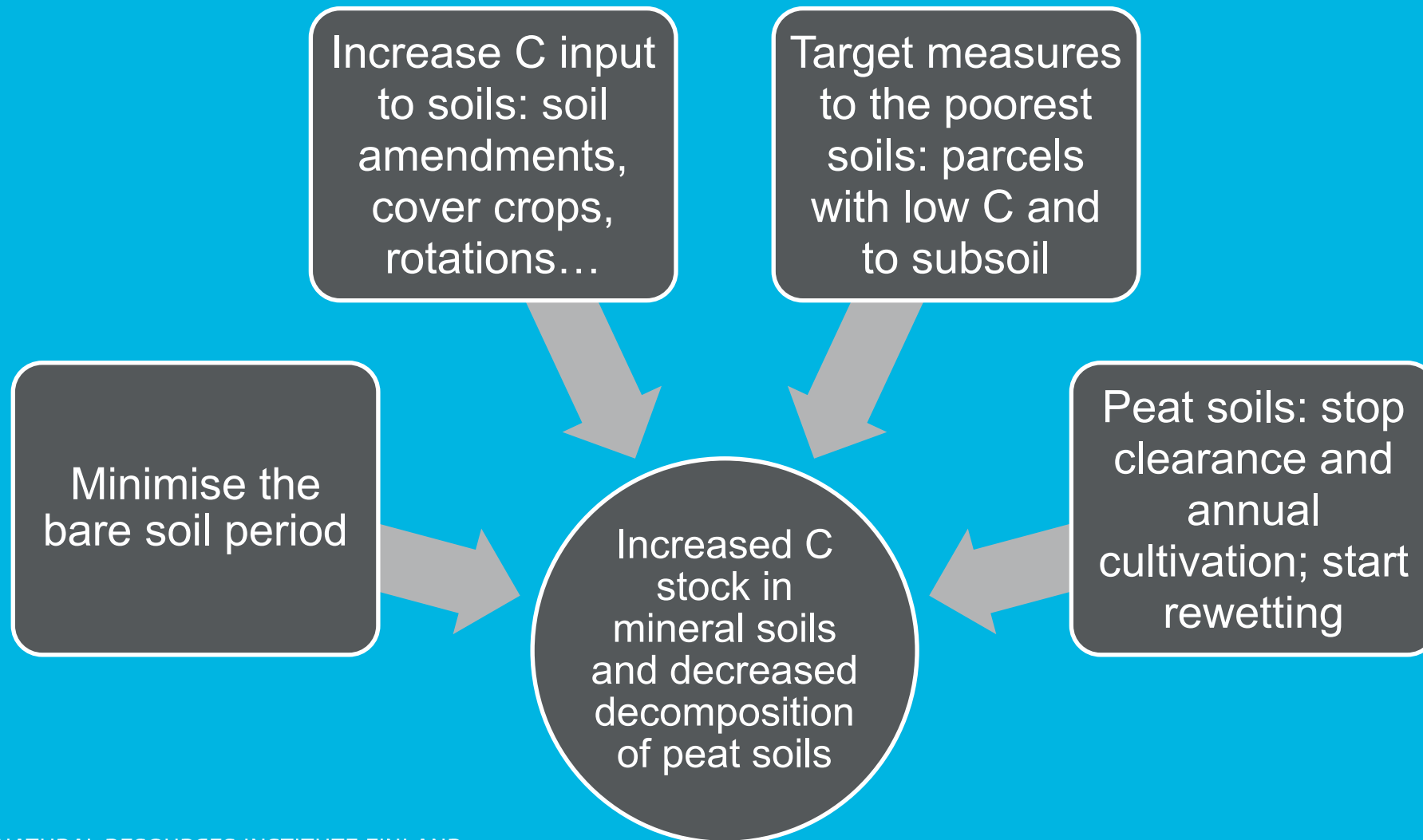


Soil monitoring: permanent grasslands on mineral soil have not lost C on average



"HOUSE RULES"

How to improve the carbon balance of Finnish croplands?



**Thank
you!**