Soil Processes as a Basis for Targeting Carbon Sequestration Measures in Mineral Agricultural Soils

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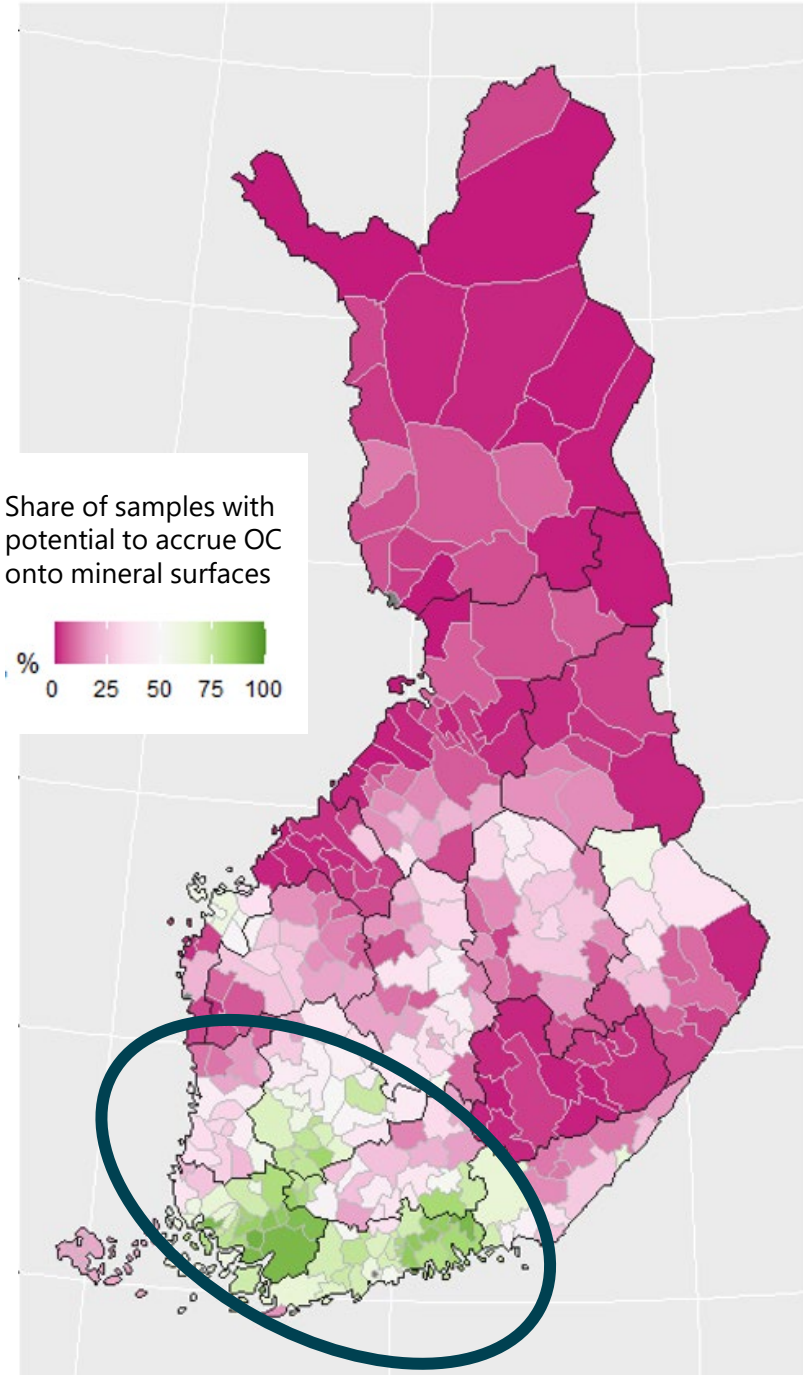
Luke

Soil Processes as a Basis for Targeting Carbon Sequestration Measures in Mineral Agricultural Soils (HiiletIn)

- Soil organic carbon plays a critical role in climate regulation and supports numerous soil functions, making it a keystone of soil health
- Mineral agricultural soils
  - 7% of the land area in Finland
  - Rich in organic carbon, carbon stocks (0-30 cm) range between 84 and 98 t C ha^{-1}
  - Soil organic carbon is decreasing at annual rate of 0.4%
- In HiiletIn project we
  - identified regions in Finland with potential to accumulate organic carbon in a relatively stable, mineral-protected form
  - identified areas in which organic carbon deficiency affects soil functionality - areas that would benefit the most from an increase in organic carbon content

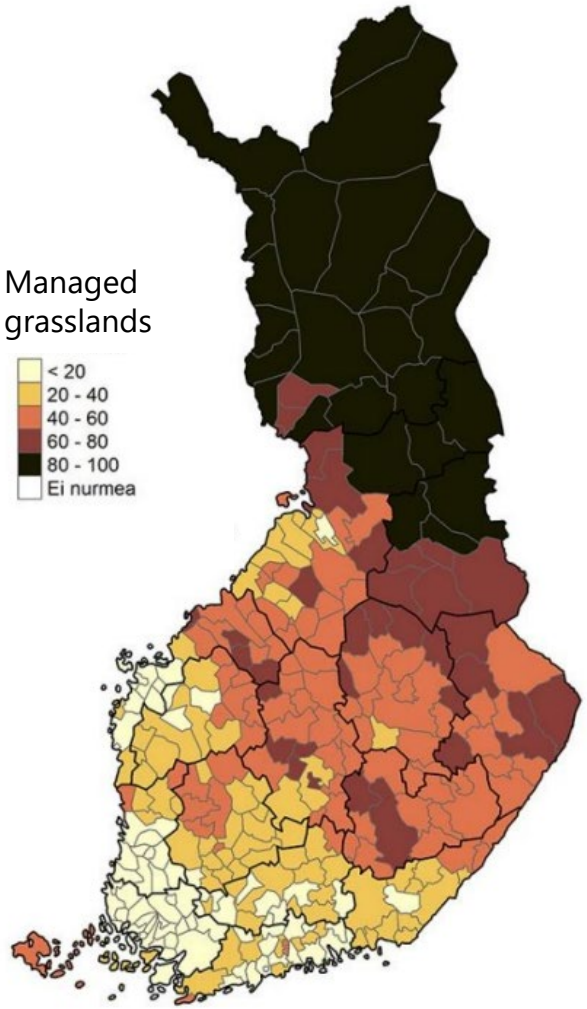
Deficit of Organic Carbon in Southern Finland

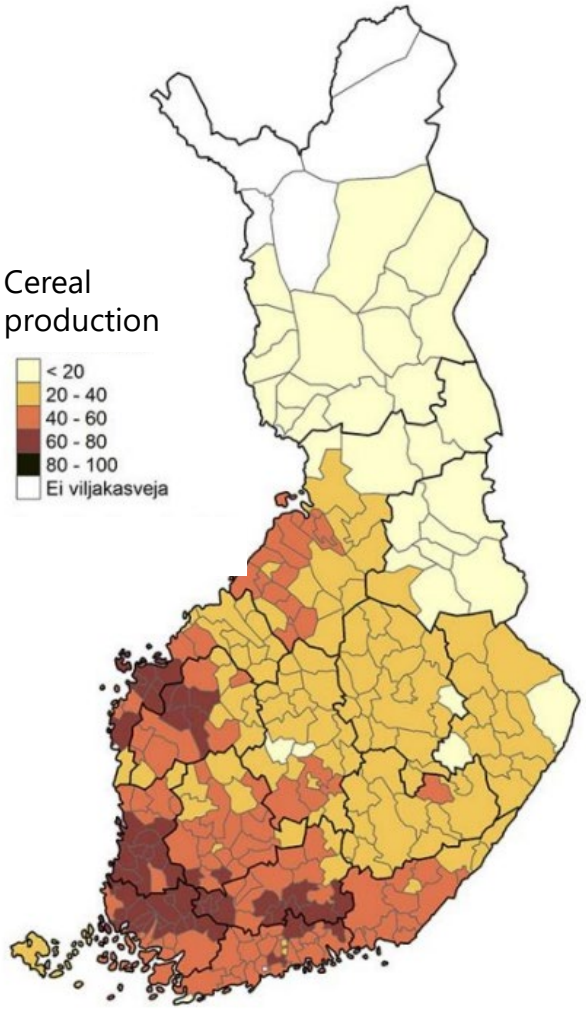
- In Northern Finland, the current organic carbon stocks are high and the potential for additional carbon accumulation is low
  - High risk of enhanced carbon losses due to the climate change
- The fine-textured soils in Southern Finland exhibit potential to accrue organic carbon
- In this area, soil functioning would benefit from carbon increase
  - Better aggregate stability – less erosion and lower risk for phosphorus losses and eutrophication of the surface waters
  - Higher productivity and better yields



Means to Increase Soil Organic Carbon in Southern Finland? 1/2

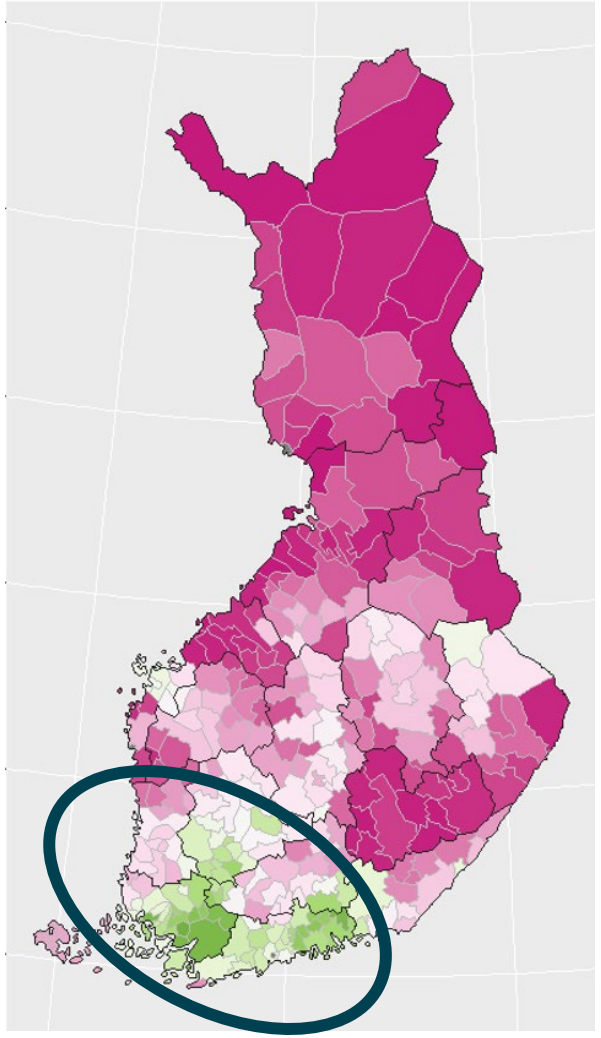
- Including perennial grasses in crop rotation?
  - Southern Finland is dominated by cereal production
  - Cattle production with managed grasslandss for silage production are in Eastern and Northern Finland
- Organic matter from manure?
  - Pig and poultry production in Western and Southern Finland
  - However, **phosphorus!**

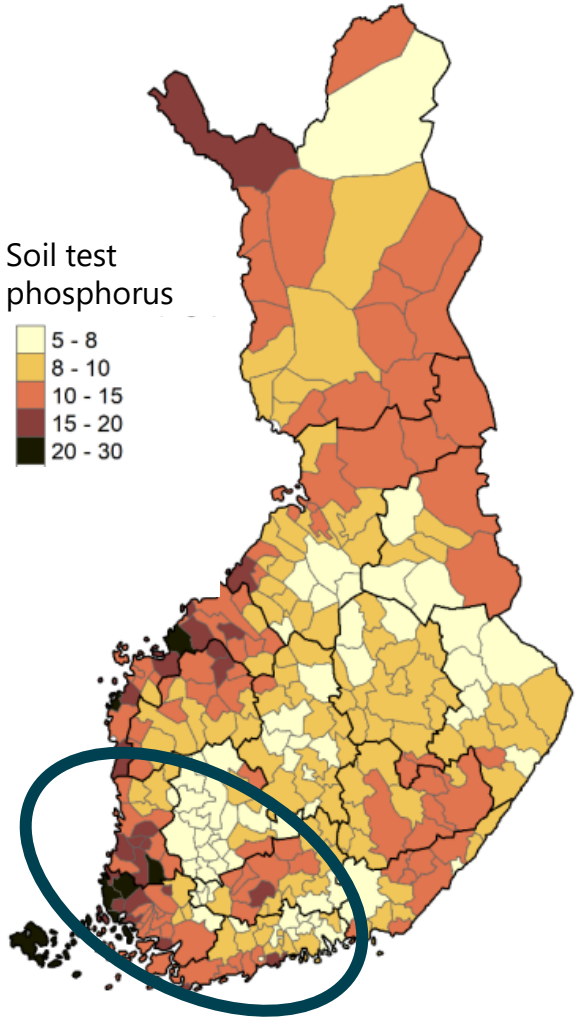




Means to Increase Soil Organic Carbon in Southern Finland? 2/2

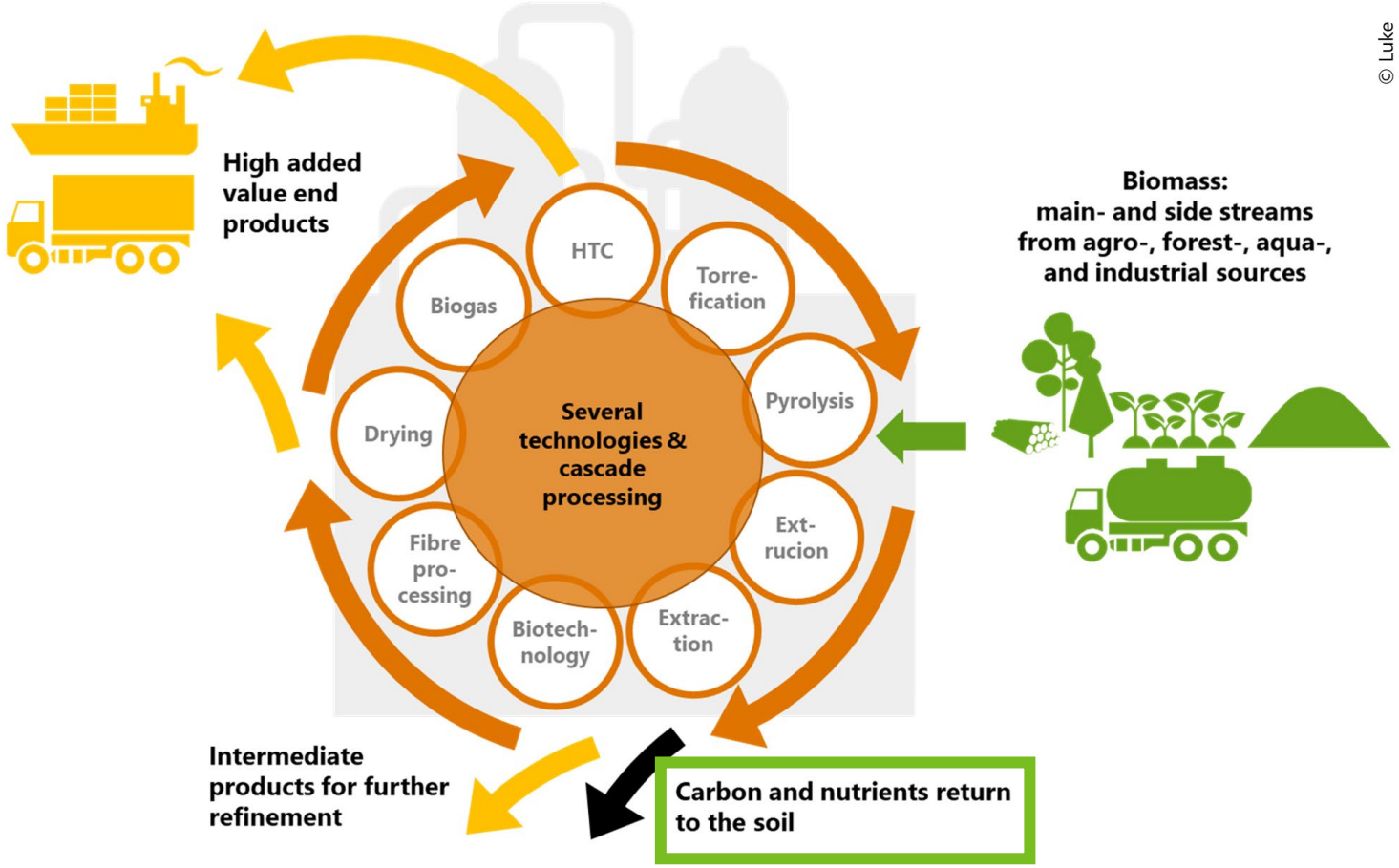
- The areas in need of organic matter are also high in phosphorus
  - Contributes to the eutrophication of the Baltic Sea
  - Manure as a source of organic matter would support phosphorus accumulation
- Other external organic biomasses?
  - Side streams from food processing and forest industry
- Maximising photosynthesis
  - Cover crops etc.





Returning Organic Carbon to Soil through Circular Bioeconomy

- Regional circular bioeconomy aims to process biomass as value added products, while remaining **carbon** and nutrient streams **can be returned to agricultural soils**
- For example:
  - Organic sludges from pulp and paper industry reduce soil erosion over several years after application
  - Sludges increased microbial-bound C and N in soil – linked to formation of stabile carbon



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Conclusions

- Carbon stocks are relatively high in Finnish mineral agricultural soils – increasing is difficult, maintaining crucial
- Increasing organic carbon content in the fine-textured mineral agricultural soils in Southern Finland would support soil functioning
    - Improved soil productivity and reduced risk for erosion
- More efficient recycling and processing of different types of biomasses would enable carbon inputs through means other than direct photosynthesis in the field
- **Targets for increasing soil organic carbon stocks should account for local soil conditions, regional management practices, and the availability of organic amendments and suitable side streams (external organic matter inputs)**

Thank you!

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NATURAL RESOURCES INSTITUTE FINLAND

Catch the carbon
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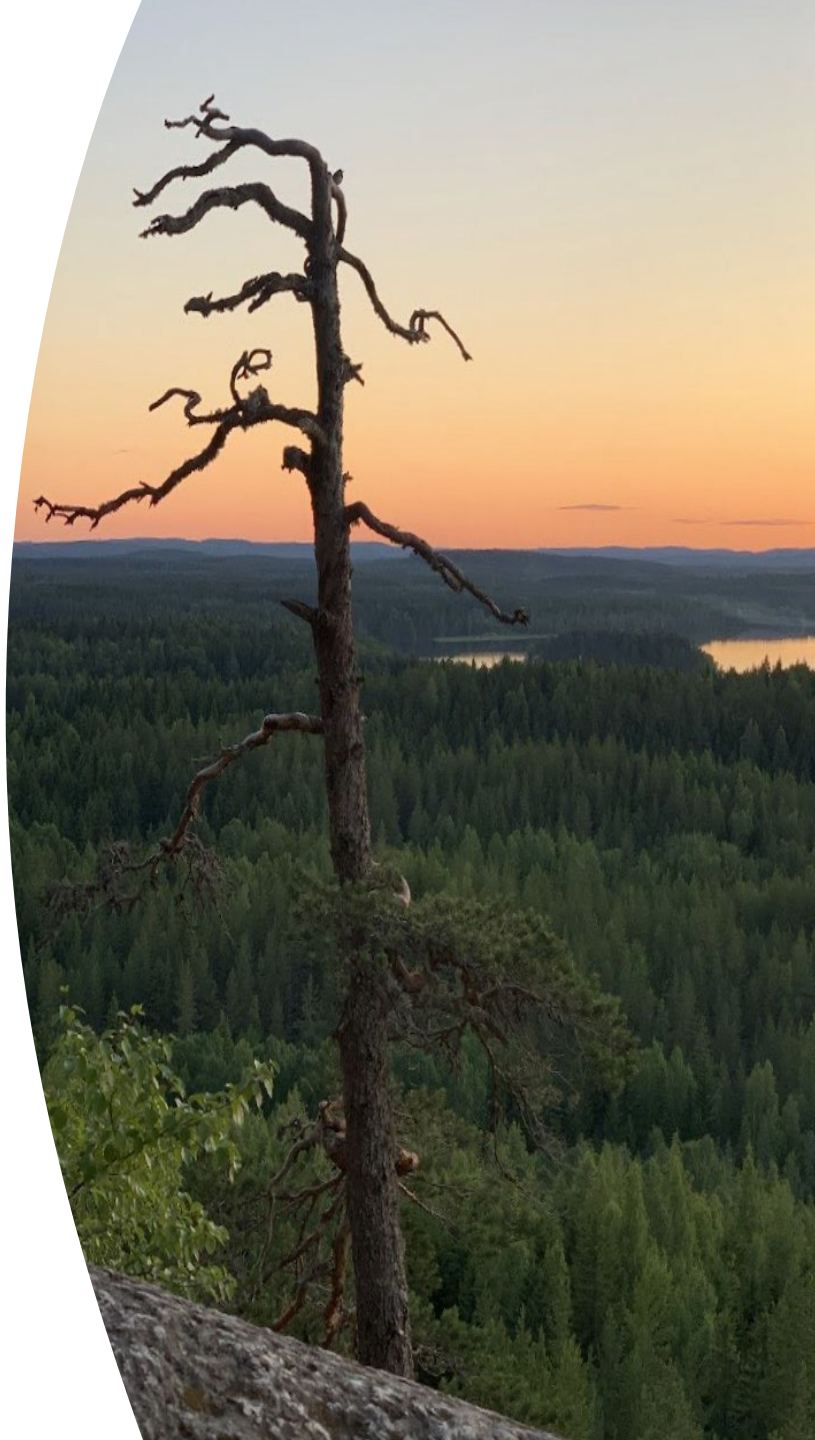

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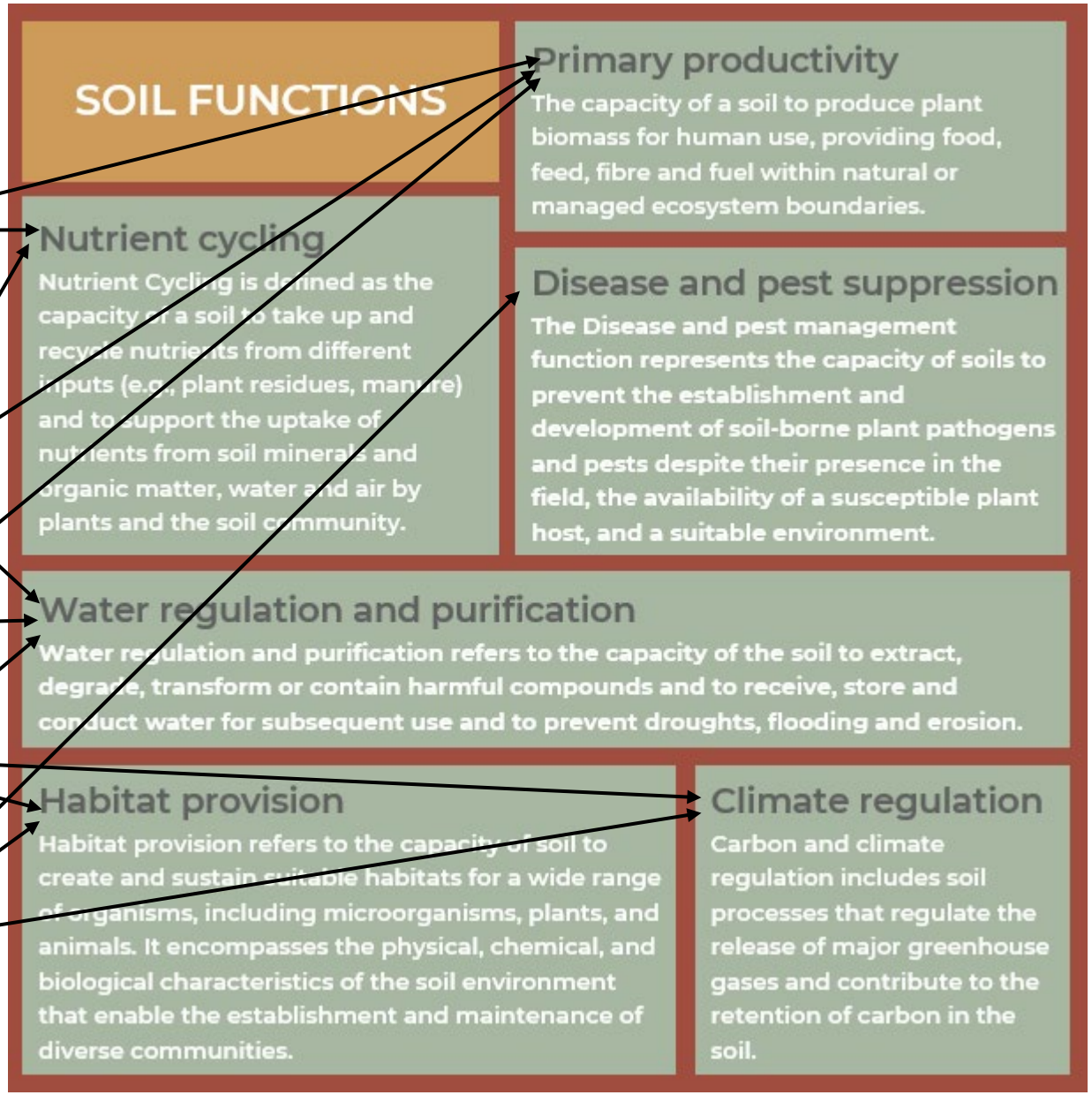
Soil functions and organic carbon

SOM-mediated processes that support soil functioning

- Mineralisation and provision of nutrients
- Compound retention
- Water retention
- Aggregation
- Carbon sequestration



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