The study site in general
(Tommy Dalgaard, Gitte H. Rubæk, Chris Kjeldsen et al.)

- **Center of activities:** Western Denmark where Aarhus University, our main Agricultural Research Centre in Foulum and the Department of Agroecology with related fields stations are centered. In particular, the Island of Samsø is used for demonstration and visualization of Soil Care impacts.
- We can draw on extensive long-term data from our field stations (see below), and nearby agricultural landscape study sites; e.g. from the dNmark.org Research Alliance (2012-2018), the NitroEurope EU project (2007-2011), and other research projects; e.g. Velux funded activities in relation to Samsø.
- The study represents the most agriculture and livestock intensive western parts of Denmark, including significant organic production.
- The area is dominated by loamy moraines (about 40-70 m above sea level), with agriculture and rotation cropping systems as the dominating land use.
- The climate is temperate coastal with significant surplus rainfall, especially outside the main growth season.
- **Cropping systems:** About 75% winter cereals in rotation with winter rape at pig and cash crop farms, and in rotation with forage crops at dairy and cattle farms. About 10-20% permanent grasslands, mainly in river valleys.
- **Cropping intensity:** Conventional farming about 90% of the farm area, and organic farming about 10%.
- Intensive use of livestock manure, with precision fertilisation of slurry and fertilisers and precision farming.
- **Management of soil, water, nutrients and pests:** Strict norms on fertilizer application and documentation of nutrient efficient crop rotations.
- Irrigation widespread on the most sandy soils, and cropping systems with for e.g. potatoes or forage crops.
- Most soils are ploughed but reduced tillage are both conventional and organic.

- Examples: successful minimum tillage, and soil incorporation of straw and cover crops (maybe strip harvest). Row /alley cropping, new organic farming practices, including mobile green manure. More use of grasslands to prevent nutrient losses and erosion. Examples on Short Rotation Coppice energy crops.
  - **Problems that cause yield loss or increased costs**
    - Loss in organic Matter
    - Soil Compaction
    - Stone separation
    - Erosion (especially a problem in cereals and maize)
    - Severe nutrient losses (N and P) to the environment (especially from livestock farms)
  - The yield gaps are up to 40% for irrigated winter cereals and about 20% for non-irrigated.

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The National Soil Sampling grid (KVADRATNETTET)
(SEGES with input from AU scientists for soil analyses at the big campaigns)

- **7 km Grid of 50 by 50 m squares**
- **830 squares, hereof 590 on agricultural land**
- **Four depths (0-25, 25-50, 50-75, 75-100 cm) are sampled (16 cores per square)**
- **Full sampling campaign in 1986 for full soil classification**
- **Large sampling campaigns in**
  - 1997 (for C, P, Zn and Cu)
  - 2007 (for C).
  - Next large campaign is scheduled
- **Smaller subset is sampled every year or Soil N prognosis**
- **Database with information on fertilisation, fertiliser source, crop yields, soil and crop management are hosted and maintained at SEGES.**

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The SOILCARE project is a 5 year project aimed at identifying and evaluatng soil improving cropping systems and agronomic techniques increasing profitability and sustainability across scales in Europe. The SOILCARE project consortium consist of 28 partner institutes from 18 European countries. The SOILCARE project is coordinated by ALTERRA, Wageningen UR, The Netherlands.

- Starting date: March 1st 2016.
- Ending date: February 28th 2020.
- EU contract number: 677407

EU project officer for SOILCARE: Aneta Ryniak – aneta.ryniak@ec.europa.eu
Project coordinator: Dr. Rudi Hessel – rudi.hessel@wur.nl – tel. +31 317 468530

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This project is funded by the European Commission under the H2020 program.
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This project is funded by the European Union’s Horizon 2020 programme.

The Askov Long-Term Experiments on Animal Manure and Mineral Fertilisers
(Bent T. Christensen, Ingrid K. Thomsen and Gitte H. Rubæk)

- Initiated in 1894
- Nutrient source, mineral fertiliser (NPK) or animal manure (AM)
- Different rates of N, P and K applied, similar doses for each source
- Soil pH kept between 5.5 and 6.5
- Soil sampled and archived since 1923 (every 4 yr)

**Core treatments and year of establishment**

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 (unmanured)</td>
<td>1893</td>
</tr>
<tr>
<td>½ AM</td>
<td>1894</td>
</tr>
<tr>
<td>1 AM</td>
<td>1894</td>
</tr>
<tr>
<td>1½ AM</td>
<td>1894</td>
</tr>
<tr>
<td>2 AM</td>
<td>1923</td>
</tr>
<tr>
<td>½ NPK</td>
<td>1923</td>
</tr>
<tr>
<td>1 NPK</td>
<td>1984</td>
</tr>
<tr>
<td>1½ NPK</td>
<td>1923</td>
</tr>
<tr>
<td>2 NPK</td>
<td>1923</td>
</tr>
</tbody>
</table>

**Gross plots 110 m² (net plots 36 m²)**

**B2: Gross plots 69 m² (net plots 24 m²)**

**Nutrients in 1 AM and 1 NPK since 1973**

<table>
<thead>
<tr>
<th>Period/Crop</th>
<th>N</th>
<th>P</th>
<th>K</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wheat</td>
<td>100</td>
<td>19</td>
<td>88</td>
</tr>
<tr>
<td>Root crops</td>
<td>225</td>
<td>44</td>
<td>196</td>
</tr>
<tr>
<td>Spring barley</td>
<td>75</td>
<td>14</td>
<td>65</td>
</tr>
<tr>
<td>Grass-clover</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Annual mean</td>
<td>100</td>
<td>19</td>
<td>87</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>2006-</th>
<th>Wheat</th>
<th>Maize</th>
<th>Spring barley</th>
<th>Grass-clover</th>
<th>Annual mean</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>150</td>
<td>150</td>
<td>100</td>
<td>0</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>30</td>
<td>30</td>
<td>20</td>
<td>0</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>120</td>
<td>120</td>
<td>80</td>
<td>0</td>
<td>80</td>
</tr>
</tbody>
</table>

The St. Jyndevad Long-Term Experiments on liming and phosphate fertilisation
(Gitte Rubæk, Bent T. Christensen and Ingrid K. Thomsen)

- Initiated in 1942 on a coarse sandy acid soil
- Four P levels (0P, 15.6 kg P y⁻¹, initial dose of 156 kg P and 15.6 kg P y⁻¹ + 156 kg initially)
- Four levels of lime applied with 5-8 years intervals
- Three replicates in each field,
- Two fields grown with spring barley
- One field fallow since 1994, one with threes in the 1970es

**8 Mg lime**

**12 Mg lime**

**4 Mg lime**

**Gross plot size: 90 m²**

**Soil pH 1994, before liming**

<table>
<thead>
<tr>
<th>Depth (cm)</th>
<th>Treatment</th>
<th>a</th>
<th>b</th>
<th>c</th>
<th>d</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-20</td>
<td>3.6</td>
<td>3.6</td>
<td>5.2</td>
<td>5.3</td>
<td></td>
</tr>
<tr>
<td>30-40</td>
<td>4.2</td>
<td>4.3</td>
<td>5.5</td>
<td>5.7</td>
<td></td>
</tr>
<tr>
<td>50-70</td>
<td>4.4</td>
<td>4.4</td>
<td>4.7</td>
<td>5.4</td>
<td></td>
</tr>
<tr>
<td>85-95</td>
<td>4.3</td>
<td>4.3</td>
<td>4.6</td>
<td>5.2</td>
<td></td>
</tr>
</tbody>
</table>

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