

# Increasing soil-C by increasing use of nitrogen

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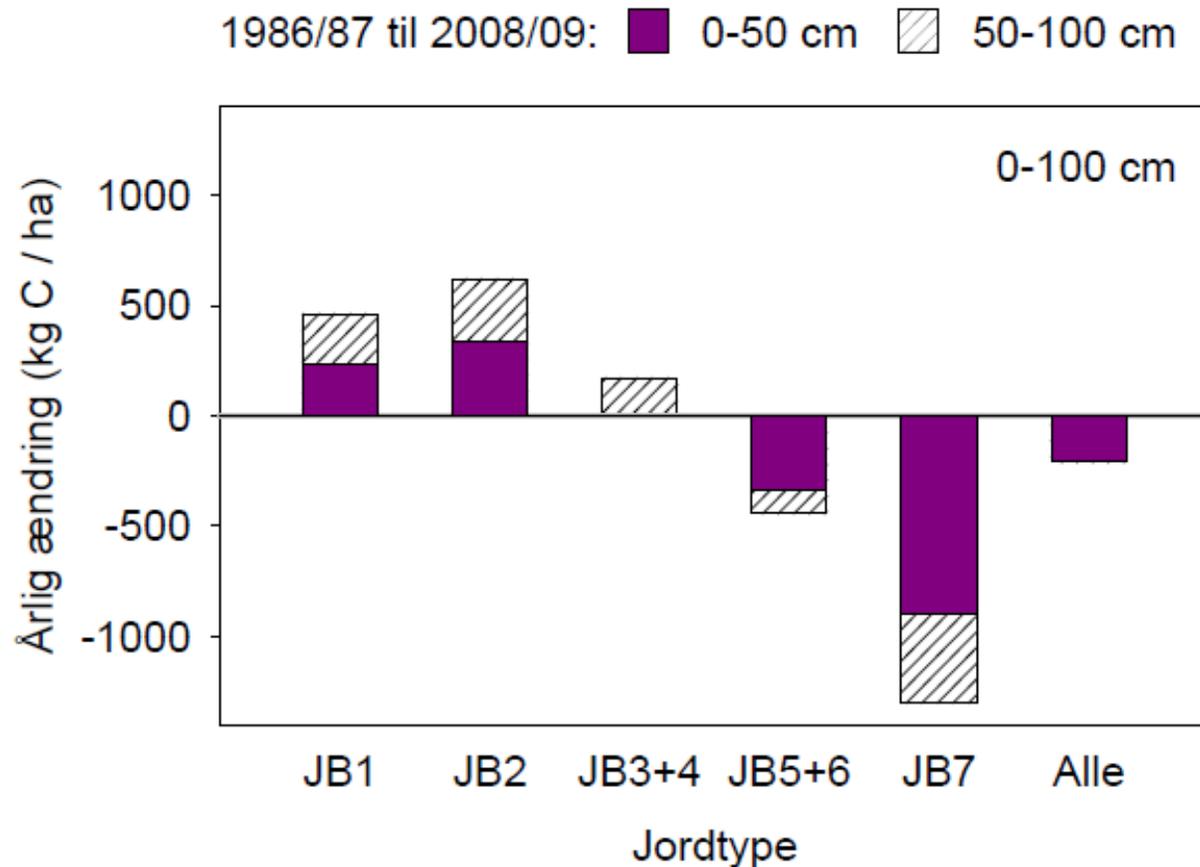
Landsforeningen for Bæredygtigt Landbrug

(Association for sustainable, intensified farming, DK)

# Increasing soil-C (SOC = soil organic carbon) by increasing use of nitrogen

- The level of soil organic carbon in Danish soils is low compared to our neighbour countries, and it is declining (mostly for clay soils).
- A lot of research has shown that nutrient deficiency will push SOC levels down.
- It is not possible to increase SOC without adequate amounts of N, P and S

# Change in SOC in DK from 1987 to 2009 (22 years)



Figur 1. Gennemsnitlig årlig ændring i perioden 1986/87 til 2008/09 i indholdet af kulstof i jord (0-1 meter) fra Kvadratnettet.

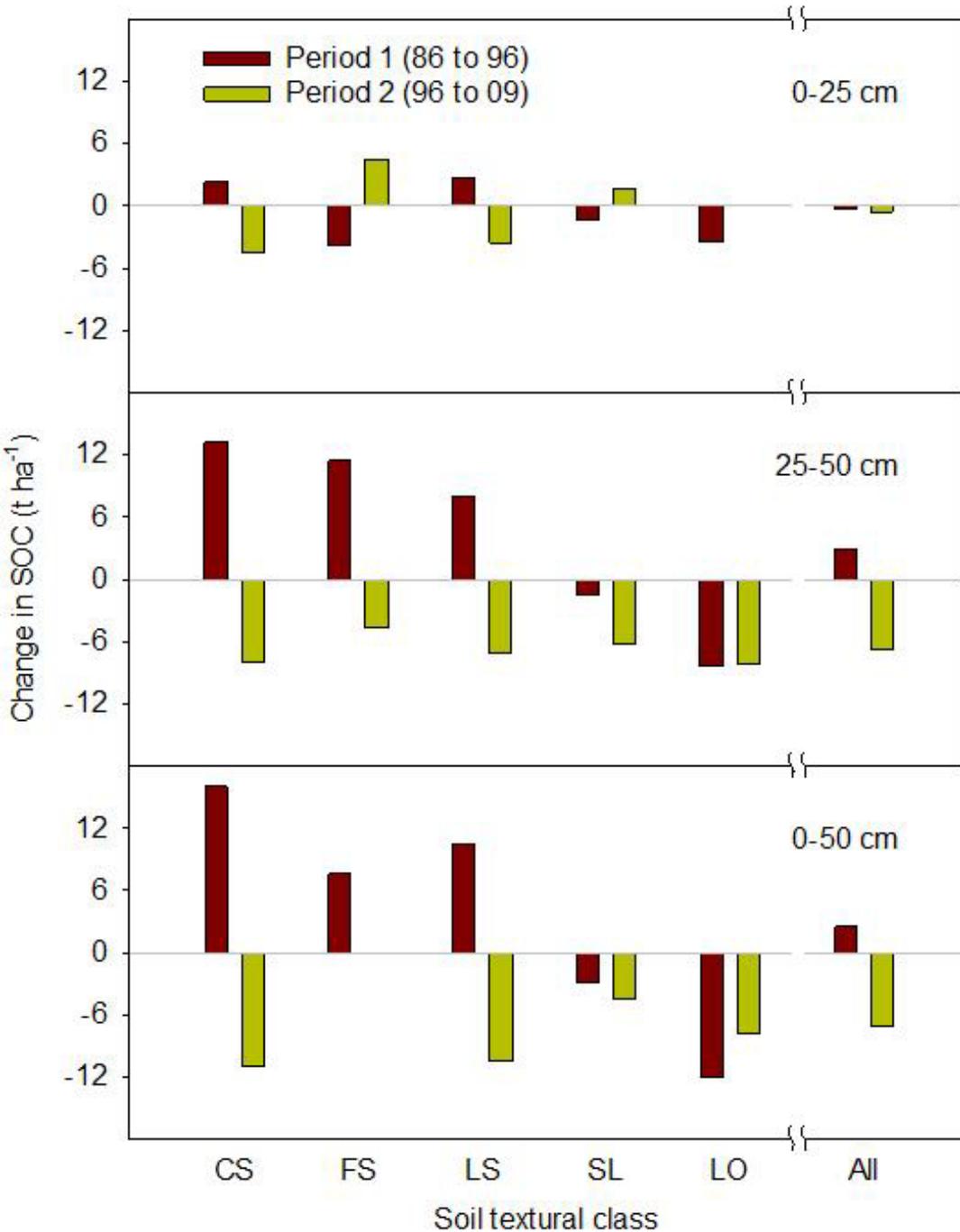
Taghizadeh-Toosi A. et al 2014

# The period is divided into 2 decades and 3 depths

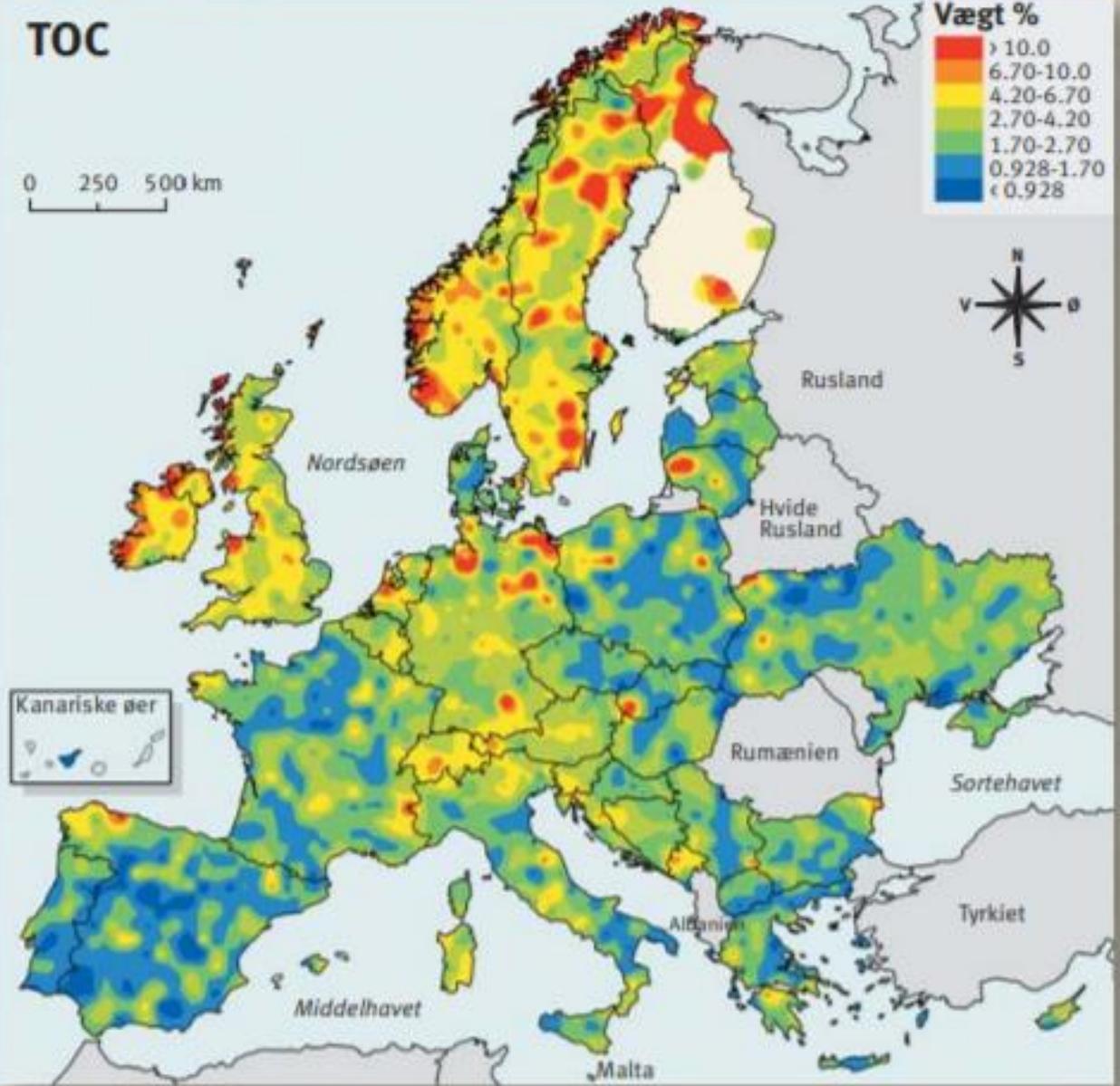
Changes in 0-25 cm were small.

In 25-50, by contrast, a large increase of jb- 1, 2 and 3 from 1986-1997, and then decrease from 1997.

Note that in the last period, there is a significant decrease in all soil types below 25 cm.



# TOC



Data from GEMAS 2015 indicate, that TOC in DK now is low compared to North Germany and Sweden.

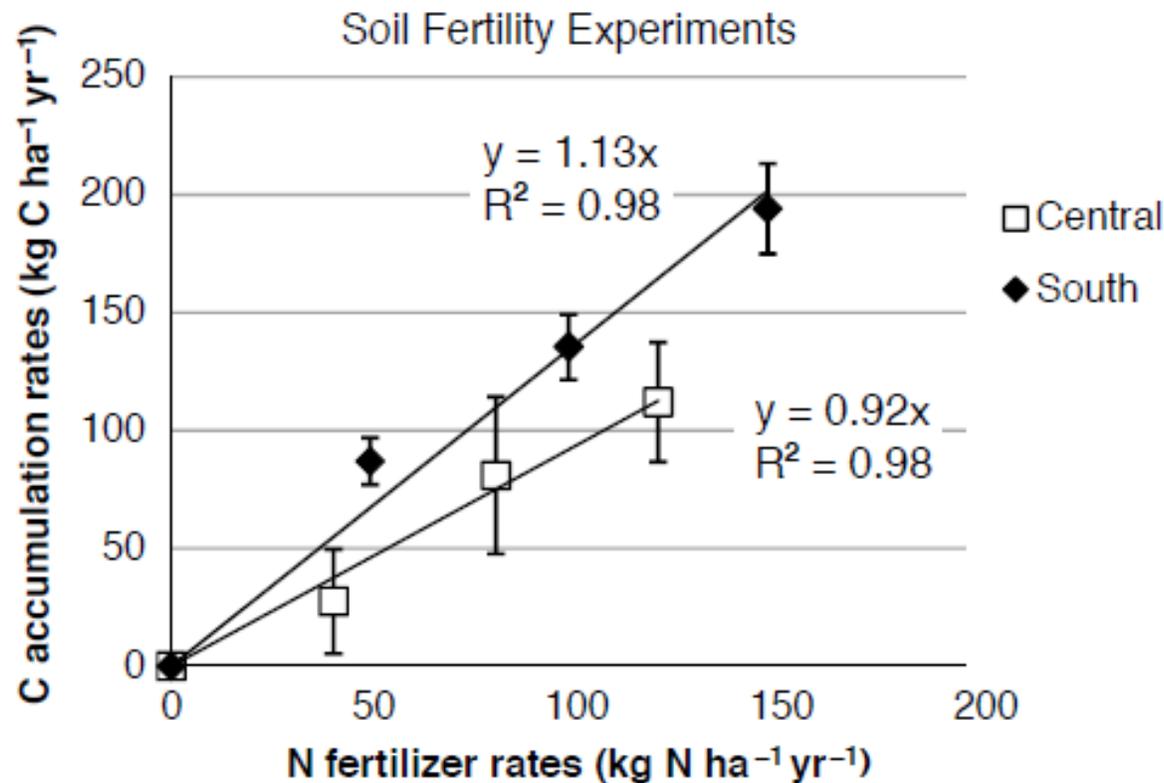
The cause could be a decade in DK with very suboptimal N supplies.

Organisk kulstof i jordprøver (TOC = Total organisk karbon) indsamlet under permanent græs i 34 lande. Resultaterne stammer fra det netop afsluttede GEMAS-projekt.

# Long Term Experiment, Rothamsted

- Increases in SOC following an increase in the annual mineral fertilizer N application are seen in the Broadbalk Wheat Experiment.
- This could be caused by increased organic C input to soil, resulting from increased crop growth or an increase in %N in crop residues caused by the increased N application facilitating increased C retention in soil, or a combination of these mechanisms.

## Southern Sweden is similar to DK



The analysis shown covers only the plowing layer - and thus not the subsoil. Therefore, the real effect of N fertilizer on SOC must be considered to be greater, as it has been shown in the article that there is greater influence of SOC in the subsurface by increasing N inflows

Figure 4. Relationship between N application rates and average annual C accumulation rates relative to the unfertilized control in the rotation without manure and ley. Bars indicate the standard error of the means. On average over all sites and experimental duration (4–5 decades), about 1 kg C was sequestered for each kg N applied as mineral fertilizer.

# Increasing soil-C (SOC) by increasing use of nitrogen

- Increasing soil-C (SOC) is absolutely dependent on optimal N supply
  - The C/N ratio in organic soil matter is between 8 and 12, thus, thus, it is impossible to increase C content without sufficient N.
- Swedish research shows that 1 kg N/ha can accumulate 1,13 kg C/ha
- The “4 per 1000” initiative is very ambitious, and perhaps not achievable, but we can stop the decline and start building up instead.
- Adequate nutrients, N, P and S along with crop growth throughout the year are key factors

# References

- Gregory, A. S. et al. 2016. Long-term management changes in topsoil and subsoil carbon and nitrogen dynamics in a temperate agricultural system.
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- Taghizadeh-Toosi, A et al. 2014. Changes in carbon stocks of Danish agricultural mineral soils during 1986 -2009.