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Long-term effects of slurry and anaerobically digested slurry on soil organic matter

SOM 2022

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Norwegian Centre for Organic Agriculture (NORSØK)

Core areas :

- Recycled fertilisers
- Soil fertility
- Soil health
- Climate effects of agriculture
- Animal health and welfare

NORSØK- Experimental farm

- Milk production by dairy cows is the most important production.
- Organic farmland is used for grass-clover leys or pastures.

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Biogas plant

Untreated cow **S**lurry (**US**)

Anaerobic digester in Tingvoll

Biogas

Eletricity

Heat

Anaerobically Digestated Slurry (**ADS**)

What happens to the soil if the farmer puts the manure in a biogas digester?

Soil Effects long-term experiment (2010)

To compare long-term effects of anaerobically digested versus non-digested manure (slurry) on soil characteristics and crop yields.

Experimental desing

Treatments

Slurry type

Untreated **S**lurry (**US**)

Anaerobically Digestated Slurry (**ADS**)

Slurry rates

Low (110 kg N ha^{-1})

(Organic farm with small import of feed)

High (220 kg N ha^{-1})

(«Conventional» farm;
or organic with high import of feed)

Treatments

USL

USH

ADSL

ADSH

CONTROL

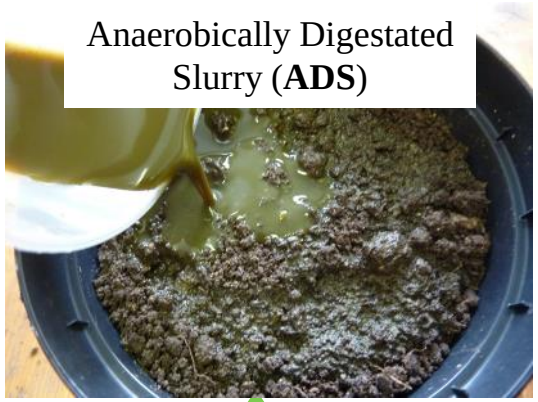
Results (2011-2021)

- Slurry and digestate composition
- SOM content
- Soil fertility
- Yield
- Nutrient budgets (NPK)

What happens with the cow slurry after digestion?

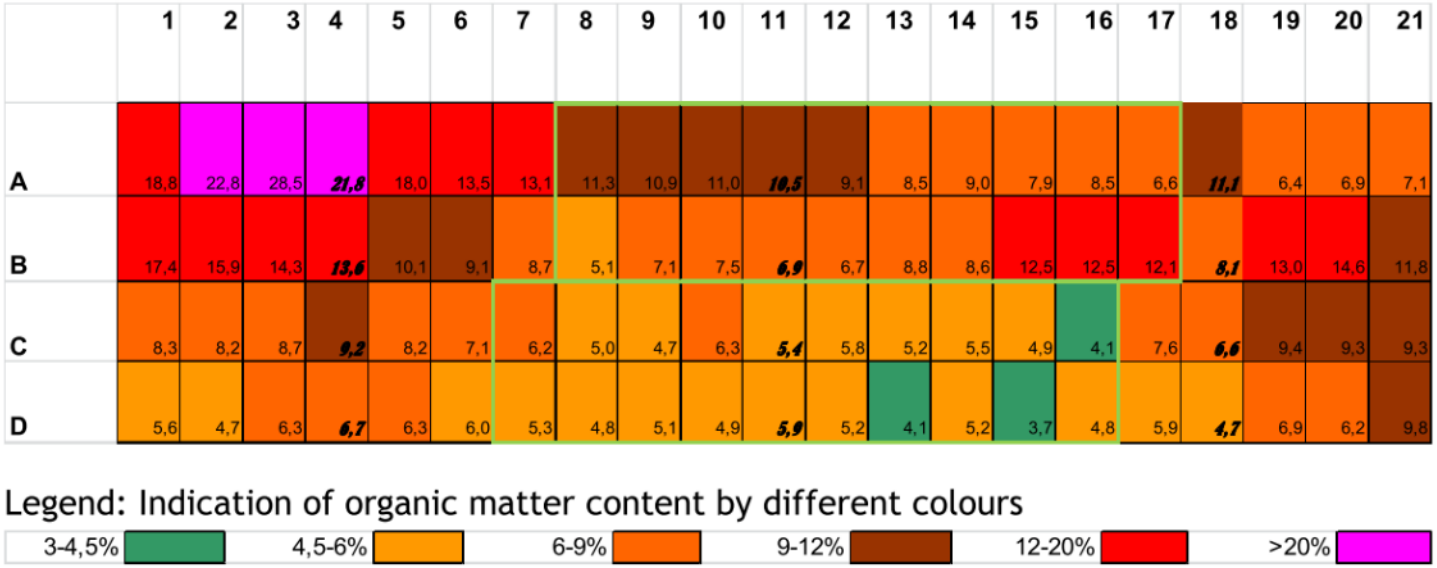
Mean values (*n= 50*) of the chemical analyses over time

Characteristics	US	ADS
Dry matter (%)	5.3	**3.4**
Loss ignition (%)	1.2	**0.9**
pH (water)	7.4	**7.7**
Tot-N (g/kg)	2.6	**2.2**
NH_4-N (g/kg)	1.5	1.4
NH_4-N tot N (% av tot-N)	60.6	**65.2**
P (g/kg)	0.5	0.4
K (g/kg)	3.1	**2.7**

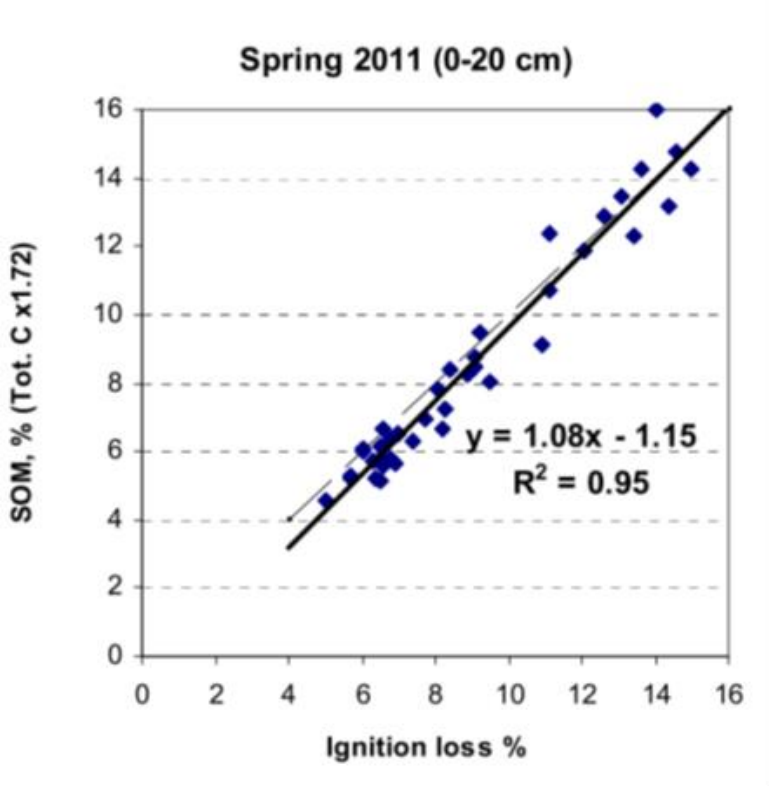


Native SOM variation

SOM in the field in 2010

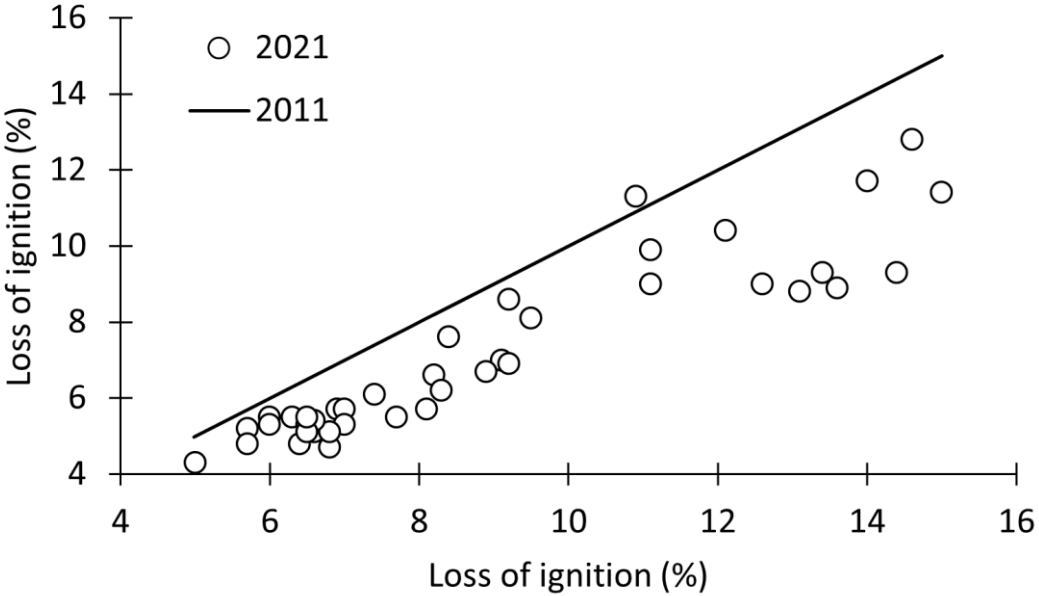


SOM measurements



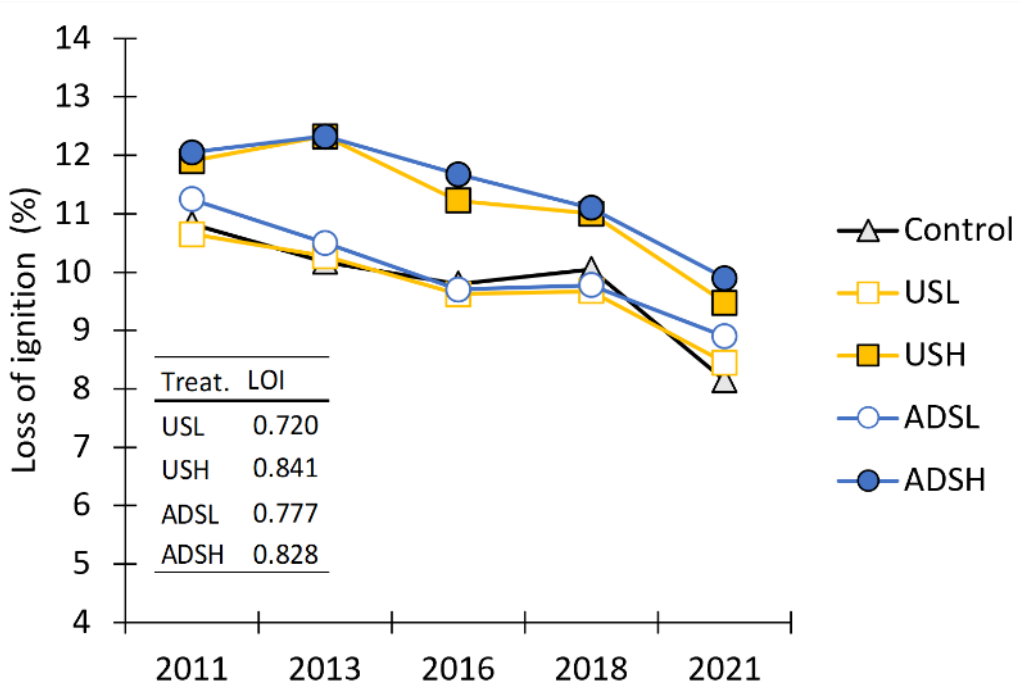
SOM in the last 10 years

Overall



SOM in the treatments

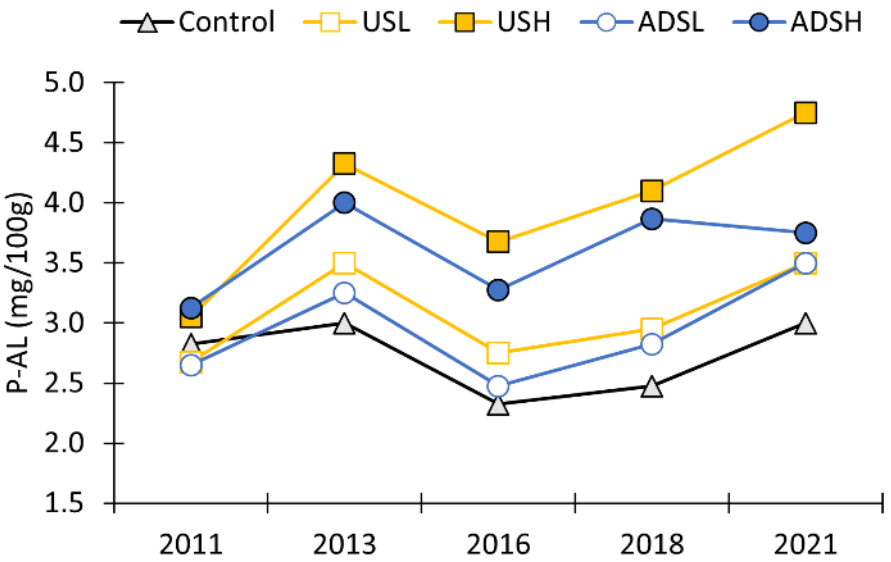
Treatments

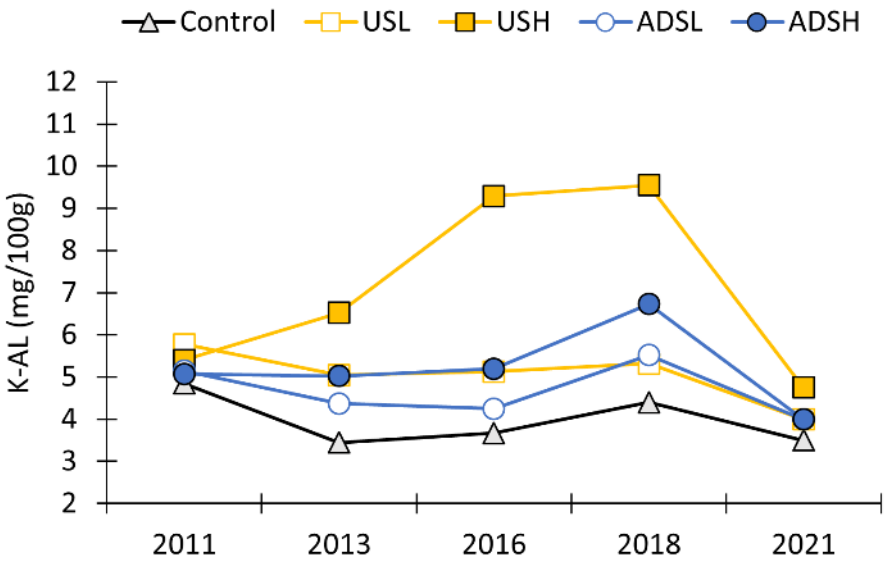


Estimated C input
(kg C ha^{-1} $year^{-1}$)

Treat.	LOW	HIGH
US	179	358
ADS	92	184

P-AL and K-AL





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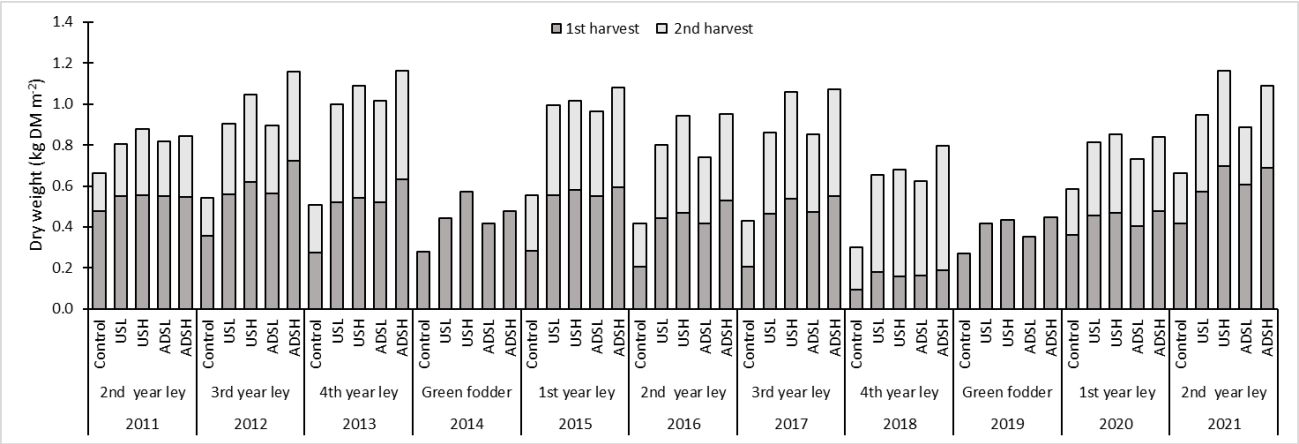
Yield

Rotation : 4 yr ley + 1 yr green fodder with re-establishiment of ley
2 harvest: June and August



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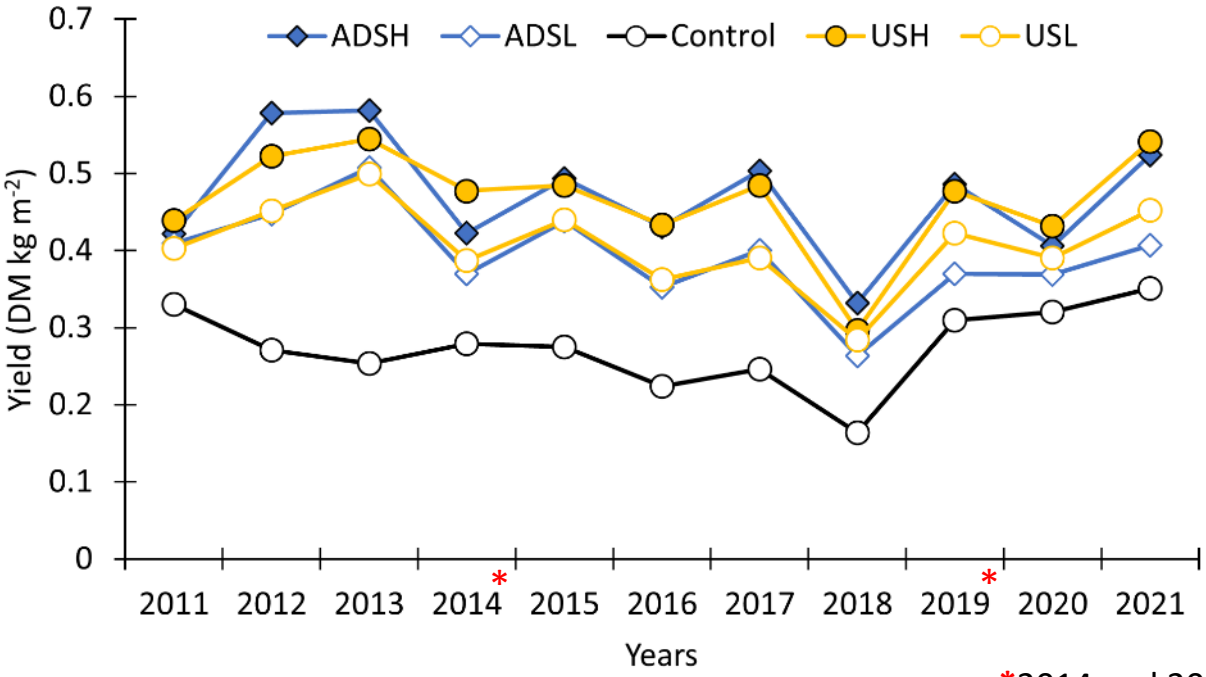
Yield in the last 10 years



*2014 and 2019 = Ley re-establishment

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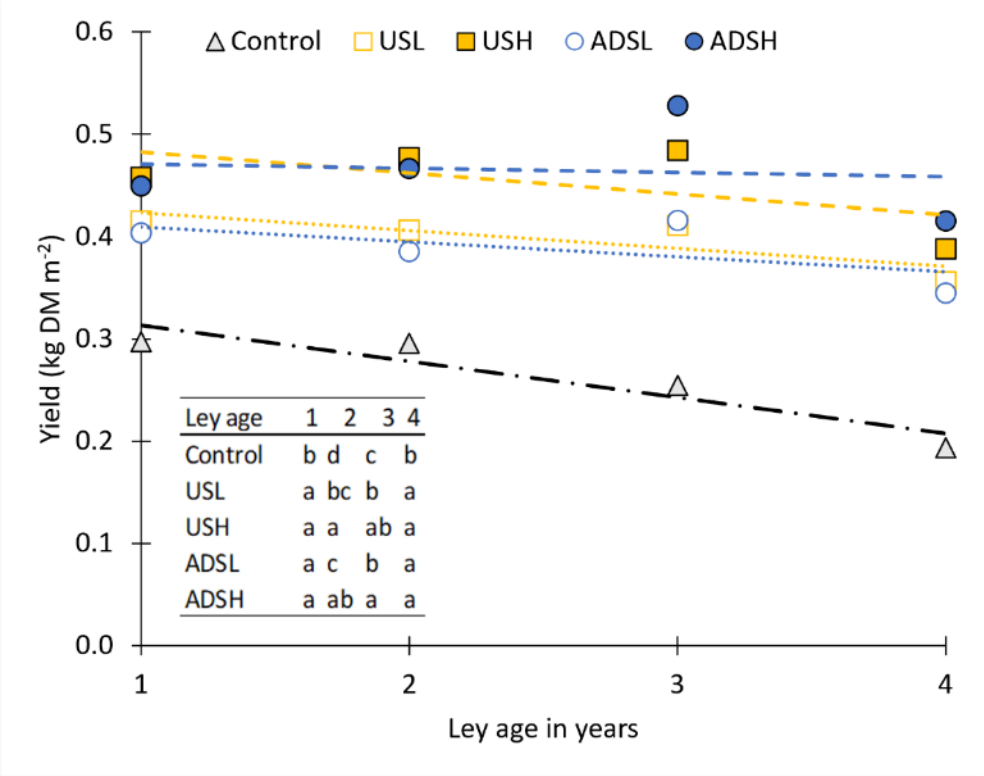
Yields of the ley



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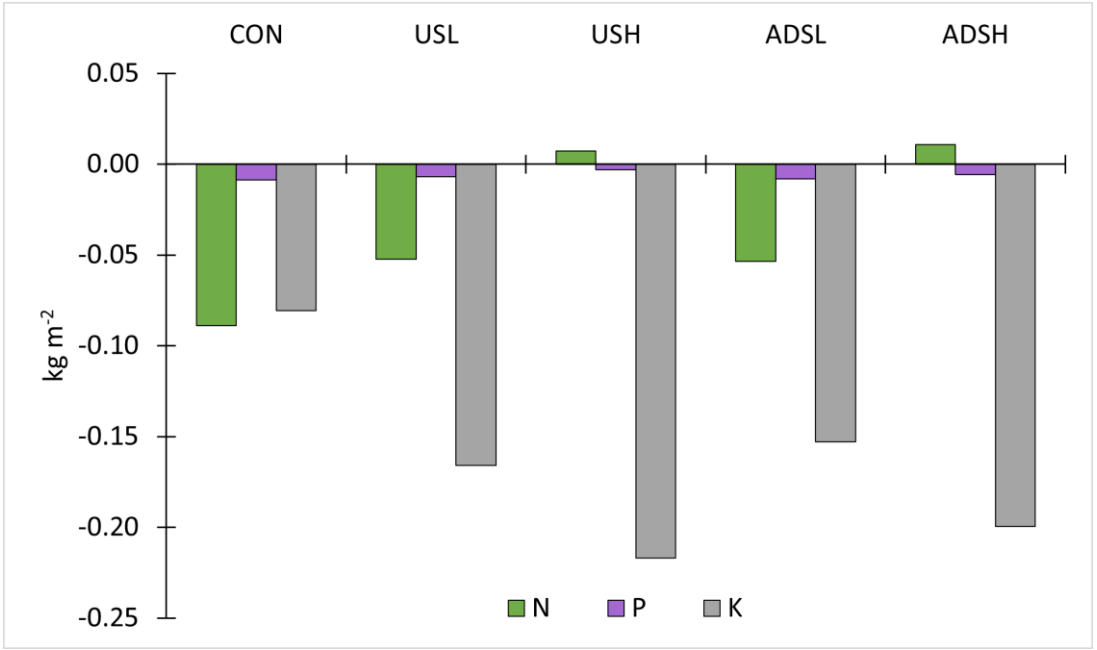
Nutrient budgets (2011-2021)

Nutrient budget = INPUT (fertilizer) – OUTPUT (yield)



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Summary

✓The effect of US and ADS on SOM, soil fertility and crop yield are similar, despite their initial differences.

✓Long-term application of US and ADS did not increase or even maintain the SOM content in the soil top layer.

✓Long-term application of high and low rates of ADS and US, maintained yields but at different levels; the yields were on average 17% higher by a double application of manure.

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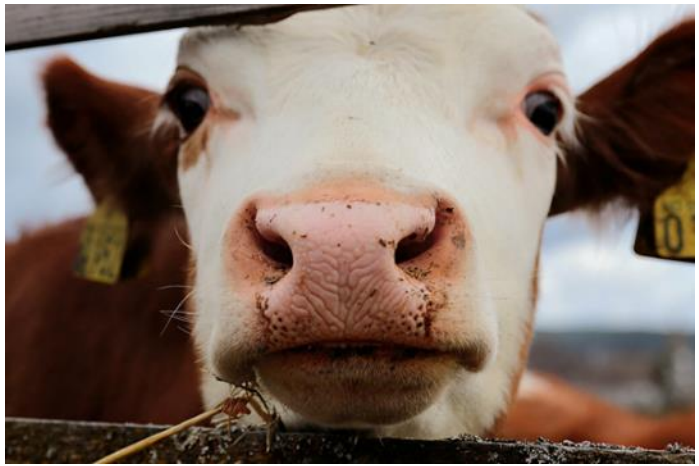
Thank you!
Questions ?



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More info:

https://www.norsok.no/

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