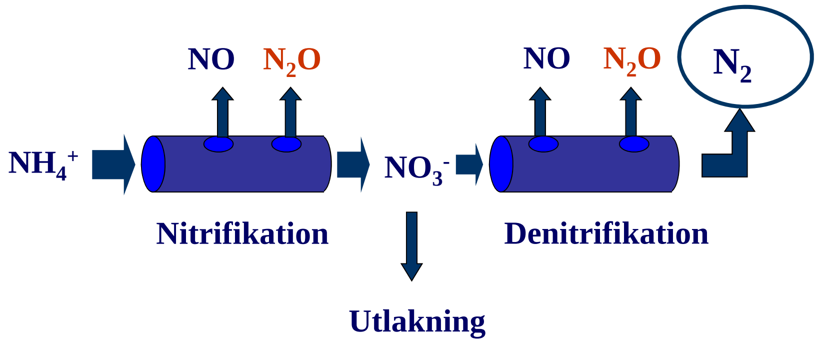
LUSTGAS FRÅN MARK – HUR MINSKA?

ÅSA KASIMIR
INSTITUTIONEN FÖR GEOVETENSKAPER
GÖTEBORGS UNIVERSITET

asa.kasimir@gu.se

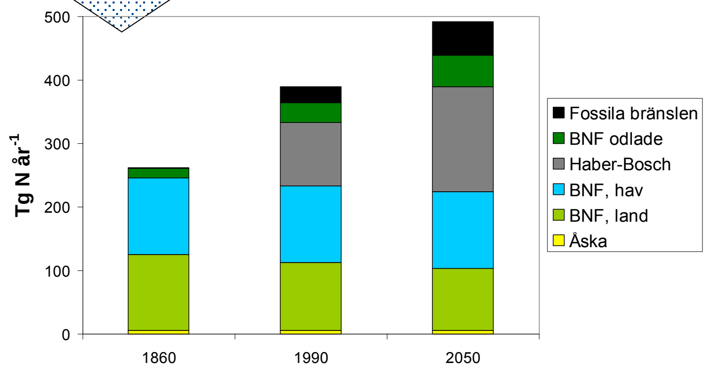
”Hole in the Pipe”



(Firestone & Davidsson, 1989)

N-fixering

Global tillförsel av kväve
från atmosfärens N_2 till "reaktivt N"
Terra=10^{12}

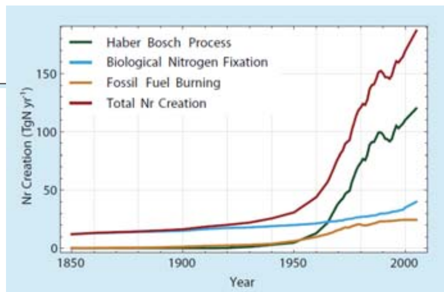


(Galloway et al. 2004, Biogeochemistry)

GÖTEBORGS UNIVERSITET

AR5 I, Climate Change 2013, the Physical Science Basis

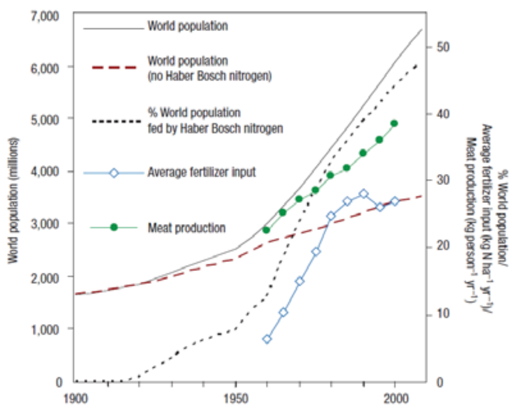
a. Conversion of N_2 to Nr	2005
Anthropogenic sources	
Fossil fuel combustion	30 (27–33)
Haber–Bosch process	
Fertiliser	100 (95–100)
Industrial feedstock	24 (22–26)
Biological nitrogen fixation (BNF)	60 (50–70)
Anthropogenic total	**210**
Natural sources	
BNF, terrestrial	58 (50–100)
BNF, marine	160 (140–177)
Lightning	4 (3–5)
Natural total	**220**
Total conversion of N_2 to reactive N	**440**



Chapter 6

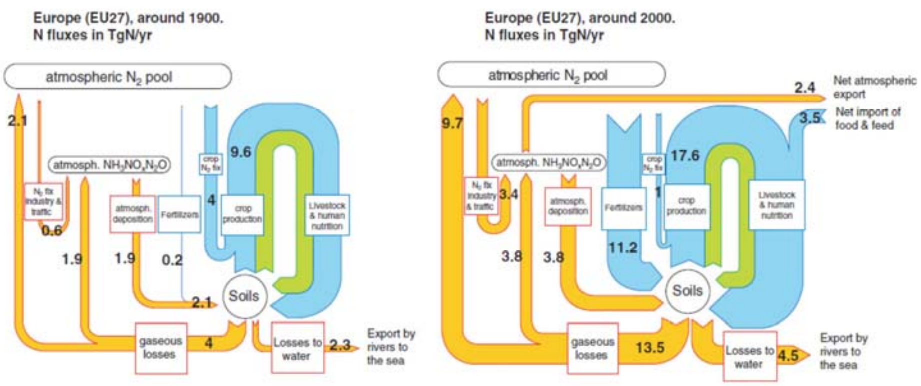
GÖTEBORGS UNIVERSITET

Global population growth projections of 2–3 billion people over the next 40 years, combined with changing diets, result in a predicted increase in food demand of 70% by 2050.



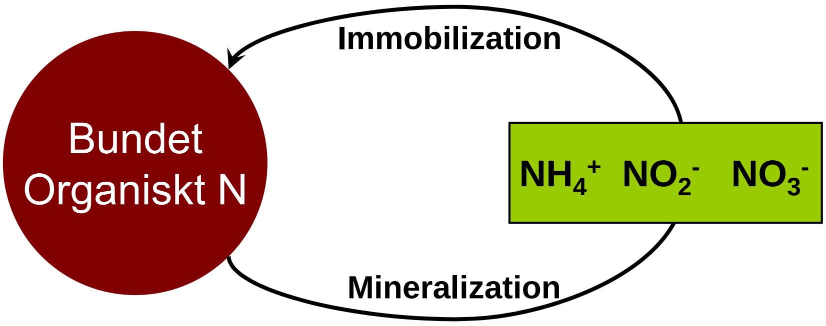
GÖTEBORGS UNIVERSITET

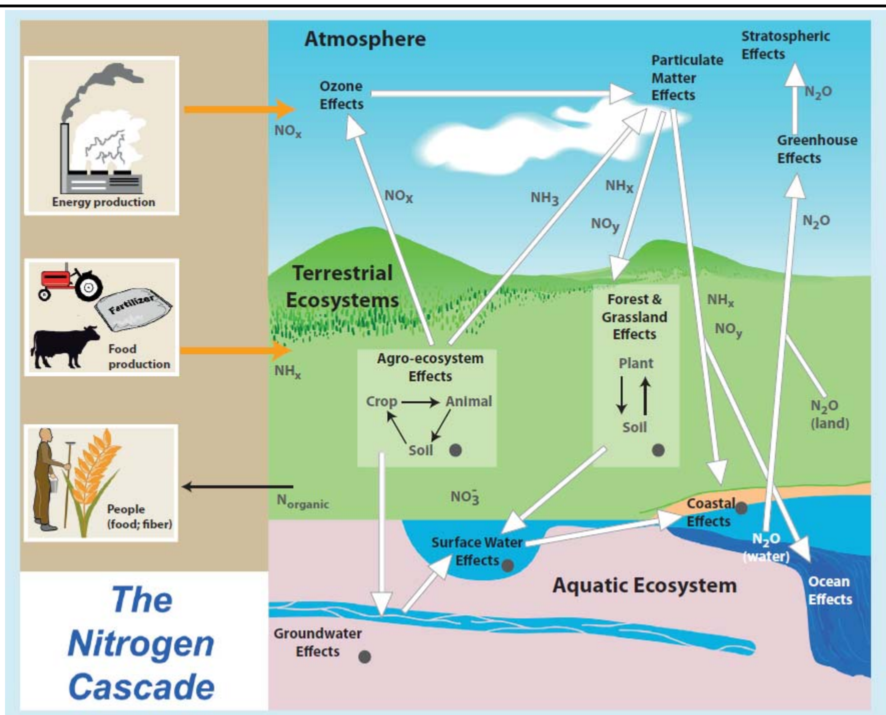
European N budget



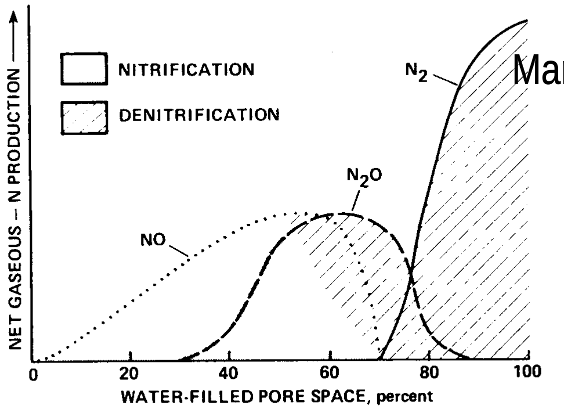
from: European Nitrogen Assessment

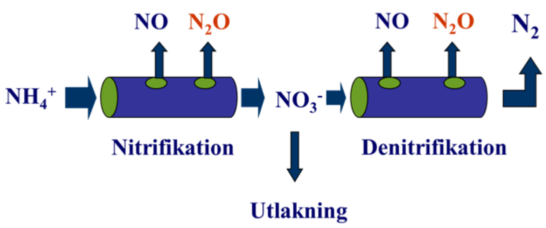
Nr = reaktivt kväve (till skillnad mot N_2)



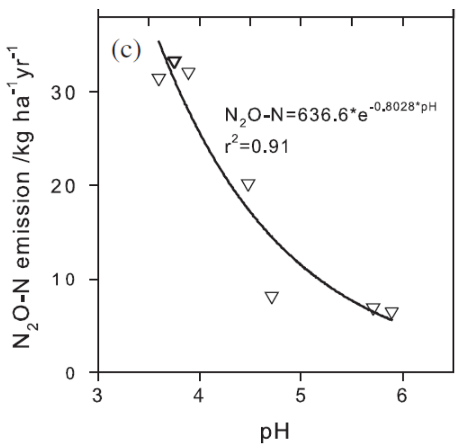


Markfuktens betydelse





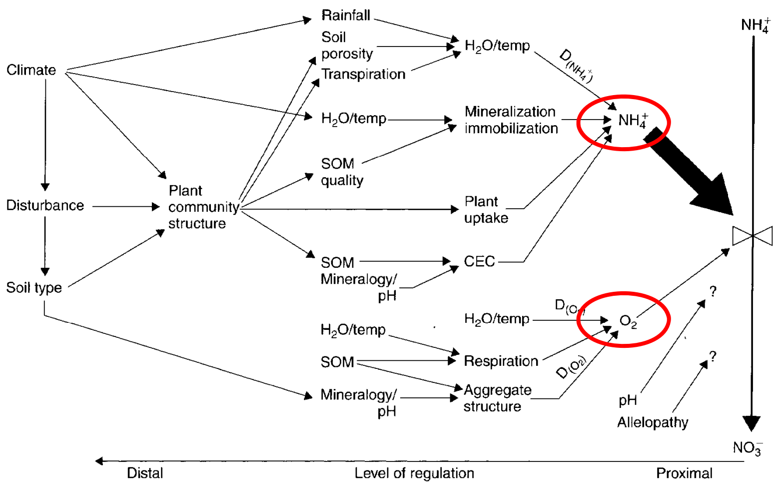
Falköping björkskog



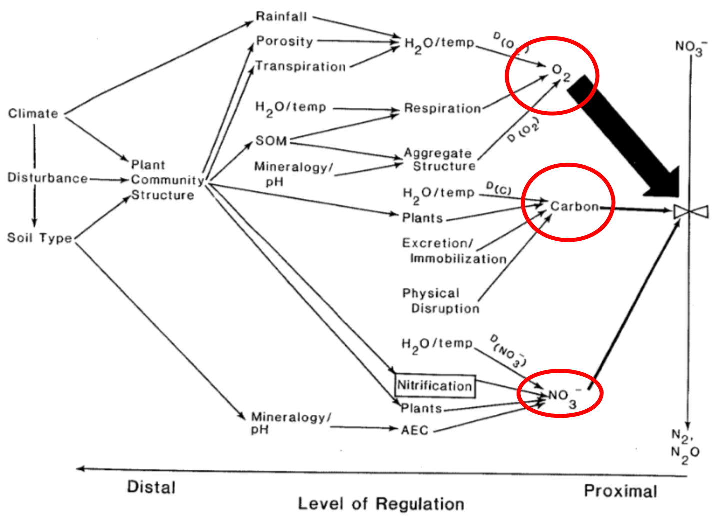

European Journal of Soil Science

Strong pH influence on N_2O and CH_4 fluxes from forested organic soils

Controls on nitrification



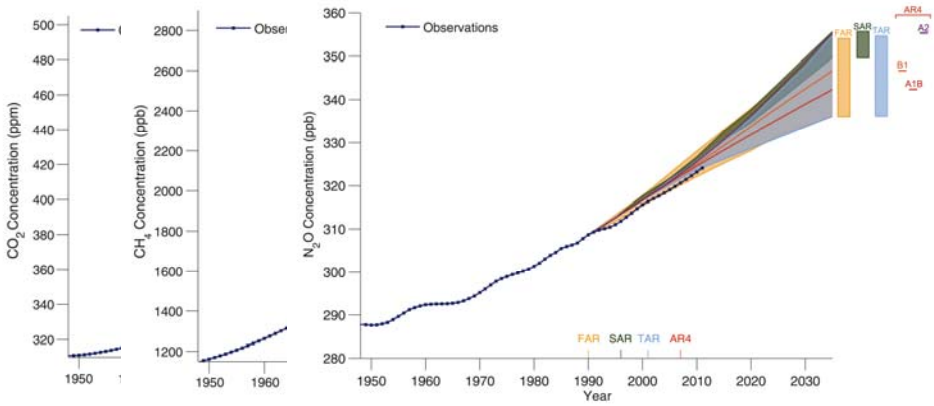
Controls on denitrification



Med vetskap från processer som producerar N_2O:

- Ge förslag på hur man kan göra för att minimera N_2O emissionen!

IPCC Assessment Report 5 (AR5),
Working Group I (The Physical Science Basis)



N_2O, nu den tredje viktigaste långlivade växthusgasen

Koncentration av N_2O vid WMO/GAW luftprovtagningsstationer, som funktion av latitud och år 1980-2010.

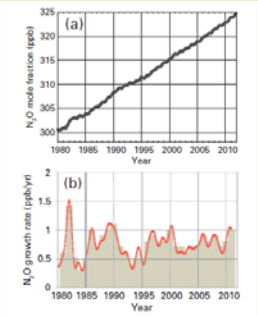
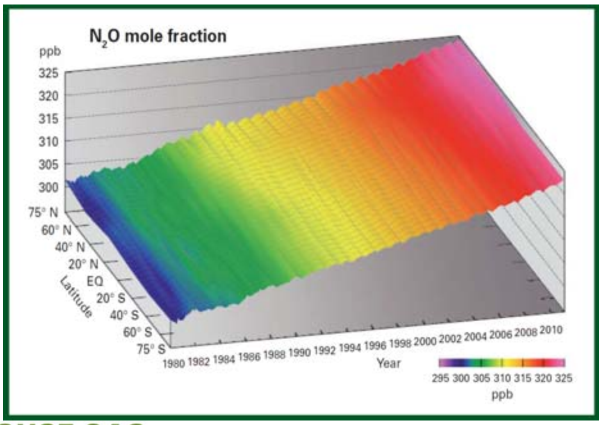


Figure 5. Globally averaged N_2O mole fraction (a) and its growth rate (b) from 1980 to 2011. Annually averaged growth rate is shown by columns at (b).



World Meteorological Organization Weather · Climate · Water
GLOBAL ATMOSPHERE WATCH

WMO GREENHOUSE GAS BULLETIN

The State of Greenhouse Gases in the Atmosphere Based on Global Observations through 2010

No. 7 | 21 November 2011

GÖTEBORGS UNIVERSITET

October 2014 European Council and the European Commission's blueprint for tackling global climate change beyond 2020.3 The EU has set an ambitious economy-wide domestic target of at least 40% greenhouse gas emission reduction for 2030.

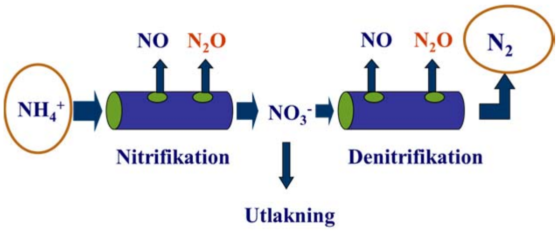
The 2014 European Council conclusions also mandated the European Commission to put forward policy to include Land Use, Land Use Change and Forestry (LULUCF) into the EU's 2030 climate and energy framework. The European Council specifically acknowledged "the multiple objectives of the agriculture and land use sector, with their lower mitigation potential, and the need to ensure coherence between the EU's food security and climate change objectives".

The European Council invited the Commission "to examine the best means of encouraging the sustainable intensification of food production, while optimising the sector's contribution to greenhouse gas mitigation and sequestration, including through afforestation".

GÖTEBORGS UNIVERSITET

6.3.4 Global Nitrogen Budgets and Global Nitrous Oxide Budget in the 1990s

The atmospheric abundance of N_2O has been increasing mainly as a result of agricultural intensification to meet the food demand for a growing human population. Use of synthetic fertiliser (primarily from the Haber–Bosch process) and manure applications increase the production of N_2O in soils and sediments, via nitrification and denitrification pathways, leading to increased N_2O emissions to the atmosphere.



GÖTEBORGS UNIVERSITET

N_2O i atmosfären

För-industriell

$[N_2O]$=270 nmol / mol

Tillförsel: 10,2 Tg N_2O-N / år

Bortförsel: 10,2 Tg N_2O-N / år

Steady-state

Atmosfär

Ekosystem

Crutzen et al. (2008) Atmos. Chem. Phys. 8, 389-395

N_2O i atmosfären

För-industriell	År 1995
$[N_2O]$=270 nmol / mol	**$[N_2O]$=315 nmol / mol**
Tillförsel: 10,2 Tg N_2O-N / år	Tillförsel: 15,8 Tg N_2O-N / år
Bortförsel: 10,2 Tg N_2O-N / år	Bortförsel: 11,9 Tg N_2O-N / år

Antropogen global tillförsel: 5,6-6,5 Tg N_2O-N / år

Därav jordbruk: 4,3-5,8 Tg N_2O-N / år

GÖTEBORGS UNIVERSITET

IPCC WG-I (2013)

SECTION 2 (N_2O)	
	AR5 (2006/2011)
Anthropogenic sources	
Fossil fuel combustion and industrial processes	0.7 (0.2–1.8)[a]
Agriculture	4.1 (1.7–4.8)[b]
Biomass and biofuel burning	0.7(0.2–1.0)[a]
Human excreta	0.2 (0.1–0.3)[a]
Rivers, estuaries, coastal zones	0.6 (0.1–2.9)[c]
Atmospheric deposition on land	0.4 (0.3–0.9)[d]
Atmospheric deposition on ocean	0.2 (0.1–0.4)[e]
Surface sink	–0.01 (0– -1)[f]
Total anthropogenic sources	**6.9 (2.7–11.1)**
Natural sources[a]	
Soils under natural vegetation	6.6 (3.3–9.0)
Oceans	3.8(1.8–9.4)
Lightning	—
Atmospheric chemistry	0.6 (0.3–1.2)
Total natural sources	**11.0 (5.4–19.6)**
Total natural + anthropogenic sources	**17.9 (8.1–30.7)**

NIR Sweden 2016

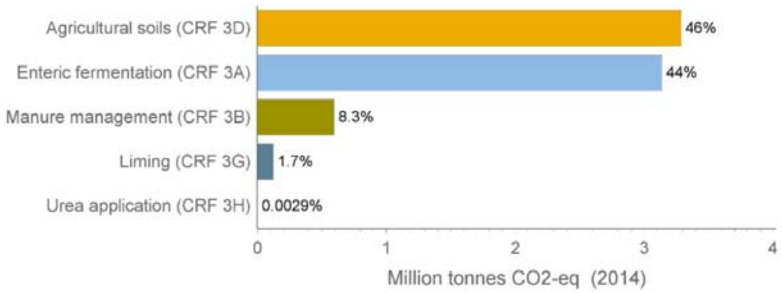


Figure 2.34. Emissions from the agriculture sector in 2014 (Gg CO_2-eq).

Table 5.16. Emission factors for N_2O emissions from soils

Direct emissions from soils	**Emission factor** % N_2O-N of N-supply	**Note**
Mineral fertiliser	1%	1
Manure	1%	1
Crop residue	1%	1
Manure during Pasture/Range/Paddock	See table 5.16	1
Background emission due to cultivation	Kg N_2O-N/ha/yr	
Cultivation of Histosols	13	2
Indirect emissions from soils	% N_2O-N of N-supply	
Atmospheric Deposition	1% of emitted N	1
Nitrogen Leaching and run-off	0.75% of N lost from leaching	1

(1) 2006 IPCC Guidelines, (2) 2013 IPCC Wetlands supplement.

GÖTEBORGS UNIVERSITET

TABLE 3.D SECTORAL BACKGROUND DATA FOR AGRICULTURE
Direct and indirect N_2O emissions from agricultural soils
(Sheet 1 of 1)

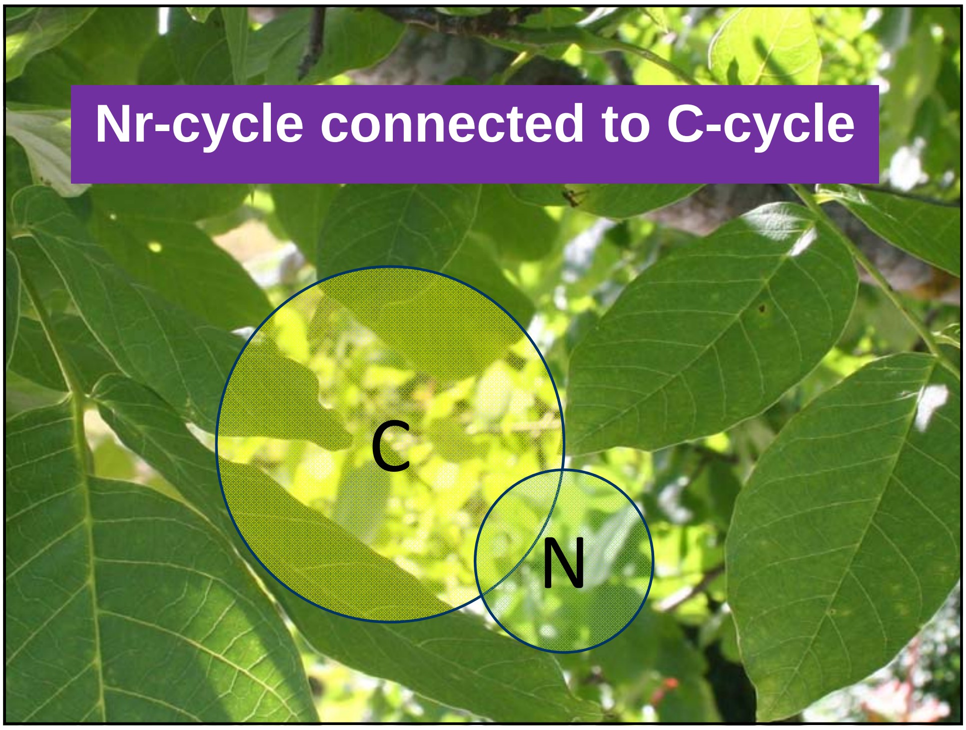
Inventory 2014
Submission 2016 v3
SWEDEN

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	ACTIVITY DATA AND OTHER RELATED INFORMATION		IMPLIED EMISSION FACTORS	EMISSIONS
	Description	Value kg N/yr	kg N_2O-N/kg N[(1)(2)]	N_2O (kt)
a. Direct N_2O emissions from managed soils				10,05
1. Inorganic N fertilizers[(3)]	m application of inorganic fertilizers to cropland and grassland	181090000,00	0,01	2,85
2. Organic N fertilizers[(3)]	N input from organic N fertilizers to cropland and grassland	82002683,50	0,01	1,29
a. Animal manure applied to soils	N input from manure applied to soils	75640811,20	0,01	1,19
b. Sewage sludge applied to soils	N input from sewage sludge applied to soils	2079586,80	0,01	0,03
c. Other organic fertilizers applied to soils	N input from application of other organic fertilizers	4282285,50	0,01	0,07
3. Urine and dung deposited by grazing animals	N excretion on pasture, range and paddock	44209769,68	0,02	1,18
4. Crop residues	N in crop residues returned to soils	87324457,09	0,01	1,37
5. Mineralization/immobilization associated with loss/gain of soil organic matter [(4)(5)]	ineral soils that is mineralized in association with loss of soil C	23126366,67	0,01	0,36
6. Cultivation of organic soils (i.e. histosols)[(2)]	Area of cultivated organic soils (ha/yr)	146919,00	13,00	3,00
7. Other		NO	NO	NO
b. Indirect N_2O Emissions from managed soils				0,98
1. Atmospheric deposition[(6)]	Volatilized N from agricultural inputs of N	21619264,02	0,01	0,34
2. Nitrogen leaching and run-off	her agricultural inputs that is lost through leaching and run-off	54262708,00	0,01	0,64

GÖTEBORGS UNIVERSITET

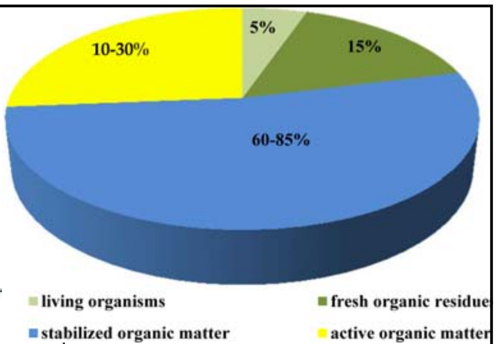
- Hur kopplar N-cykeln till atmosfärens N_2O?
- Decoupling N-cykeln - N_2O emission?
- Hur stoppa ökningen av N_2O i atmosfären?

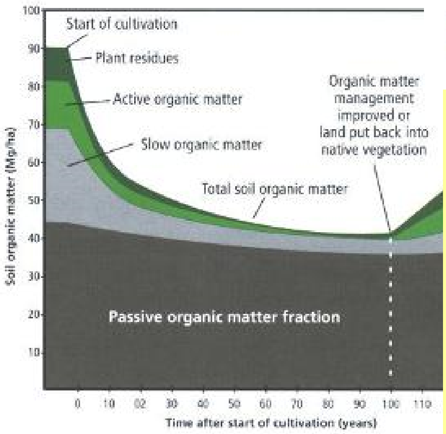
Nr-cycle connected to C-cycle

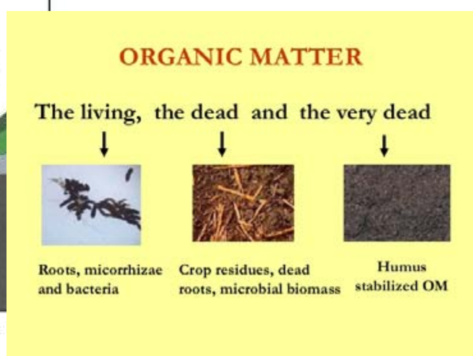


GÖTEBORGS UNIVERSITET

Kol – Kväve kvot, mått på bördighet
C/N



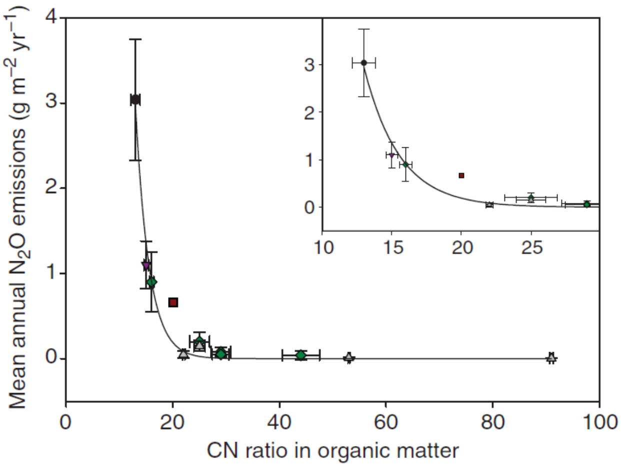




GÖTEBORGS UNIVERSITET

GÖTEBORGS UNIVERSITET

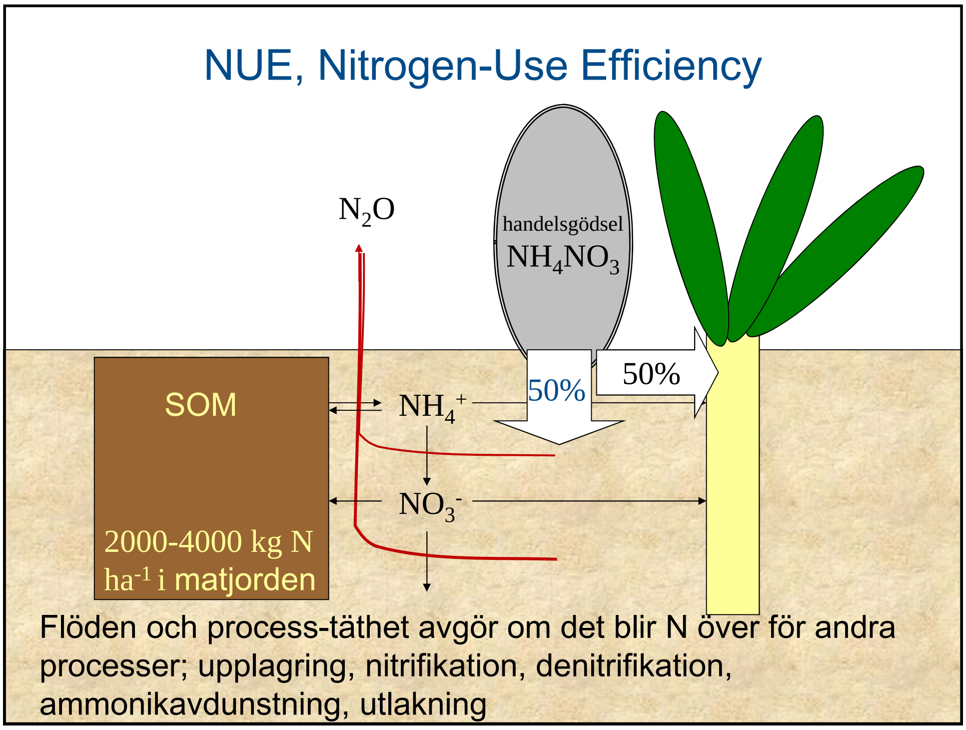
Skog på organogen mark

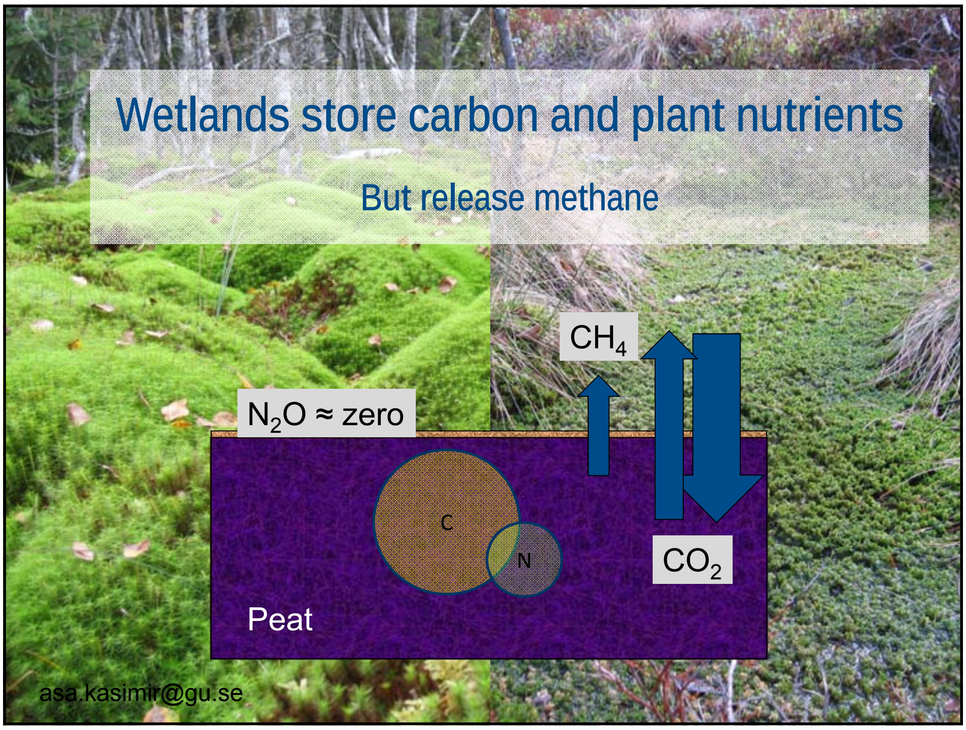


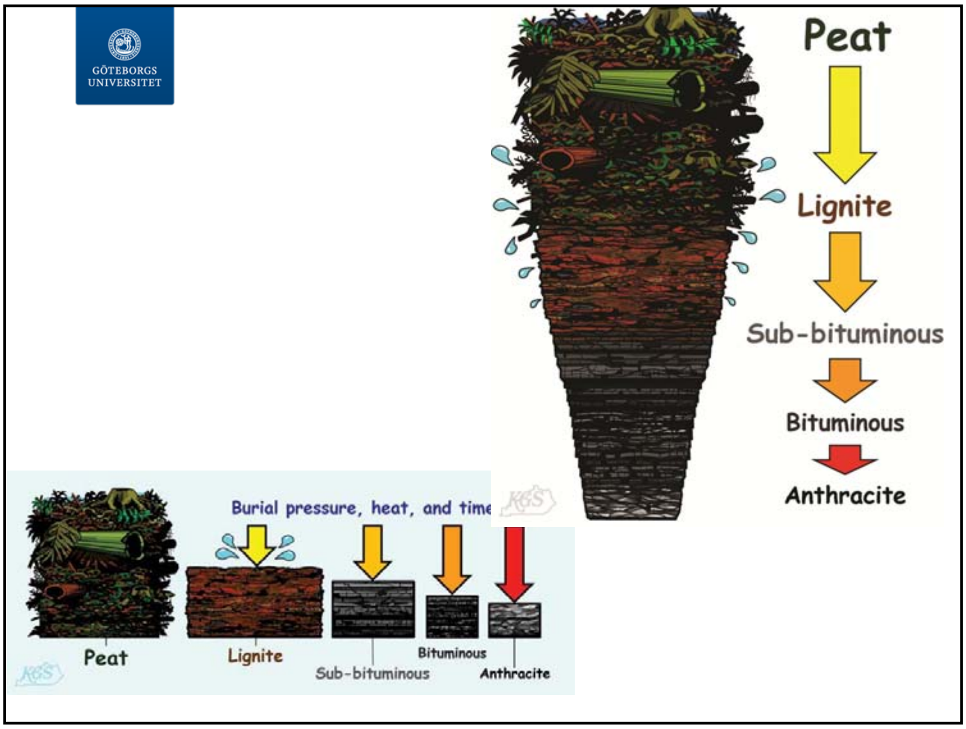
Global Change Biology (2005) **11**, 1142–1147, doi: 10.1111/j.1365-2486.2005.00973.x

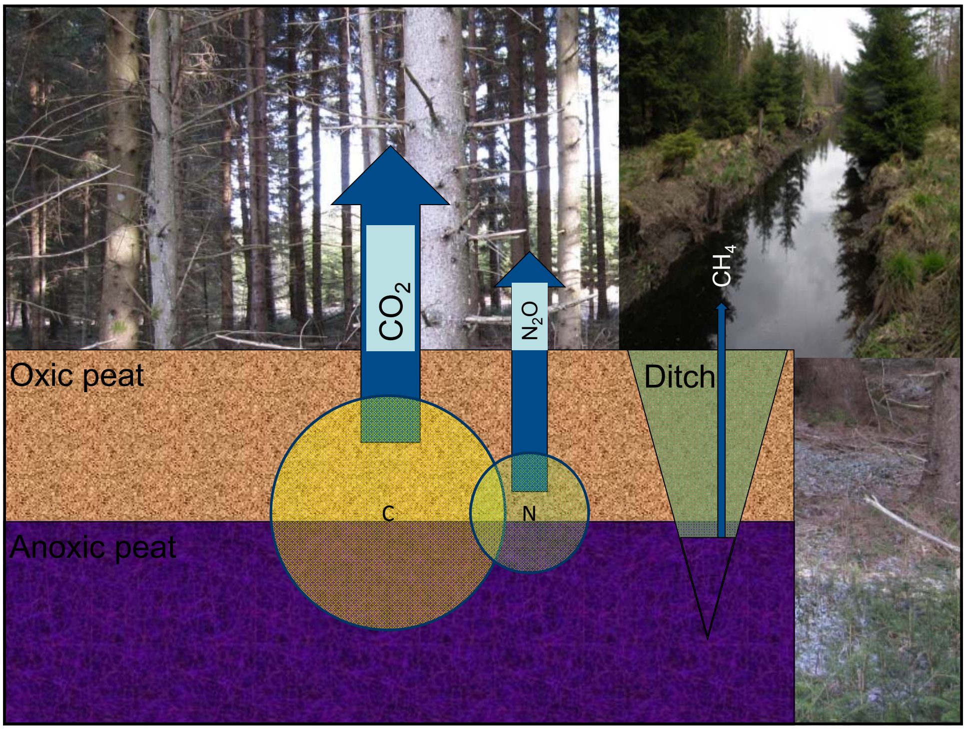
Soil CN ratio as a scalar parameter to predict nitrous oxide emissions

LEIF KLEMEDTSSON*, KARIN VON ARNOLD†, PER WESLIEN* and PER GUNDERSEN‡


NUE, Nitrogen-Use Efficiency
N_2O
handelsgödsel
NH_4NO_3
SOM
NH_4^+
50%
50%
NO_3^-
2000-4000 kg N
ha^{-1} i matjorden
Flöden och process-täthet avgör om det blir N över för andra processer; upplagring, nitrifikation, denitrifikation, ammonikavdunstning, utlakning


Wetlands store carbon and plant nutrients
But release methane
CH_4
N_2O ≈ zero
C
N
CO_2
Peat
asa.kasimir@gu.se


GÖTEBORGS UNIVERSITET
Peat
Lignite
Sub-bituminous
Bituminous
Anthracite
Burial pressure, heat, and time
Peat
Lignite
Sub-bituminous
Bituminous
Anthracite


CO2
N2O
CH4
Oxic peat
Ditch
C
N
Anoxic peat

GÖTEBORGS UNIVERSITET

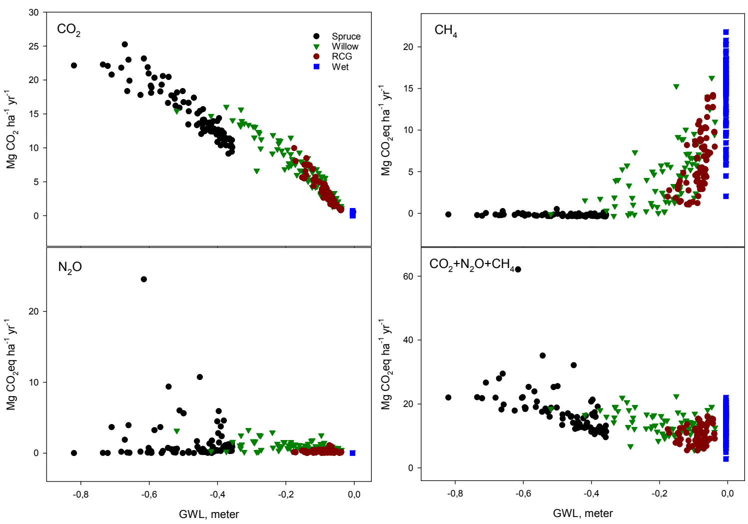
Four scenarios modelled by Coup

aim; to assess emissions and economy

•80 year rotation

1. Spruce, GWL ~40 cm depth (business as usual scenario),
2. Salix, GWL ~20 cm depth,
3. Reed Canary Grass, GWL ~10 cm depth,
4. Rewetting, GWL in the soil surface (~0 cm)

GÖTEBORGS UNIVERSITET

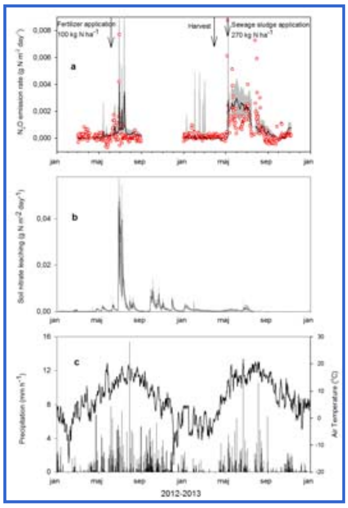


GÖTEBORGS UNIVERSITET

Nitrous oxide and nitrate losses in willow cropping on clay soil investigated by COUP modelling

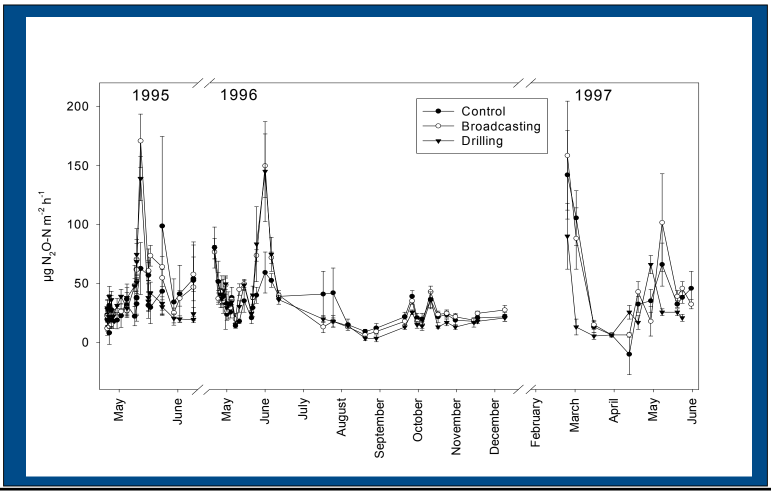
Hongxing He, Per-Erik Jansson, Anna Hedenrud, Sophie Rychlik, Per Weslien, Leif Klemedtsson and Åsa Kasimir

1. N_2O was mainly produced by nitrification in the soil surface. regulated by soil water, N addition and N uptake by plants.
2. To minimize N_2O emissions related to biomass gain - fertilizer or sewage sludge should be added carefully.



N_2O från Sandjord, Mellby i Halland.

- Två led med 120 kg N ha^{-1} år^{-1}, Kalcium Ammonium Nitrat, och en ogödslad kontroll.
- Samma emission från alla led: 2 kg N_2O-N ha^{-1} år^{-1}.
- Markens brukningshistoria avgörande, inte gödslingen.



Spannmål odlad på mineraljord i norra Europa

Medelemission
kg N_2O-N ha^{-1} yr^{-1}

Ogödslat: 2,2 ± 0,3
Gödslat 3,4 ± 0,7

Logården: 0,9 ± 0,1

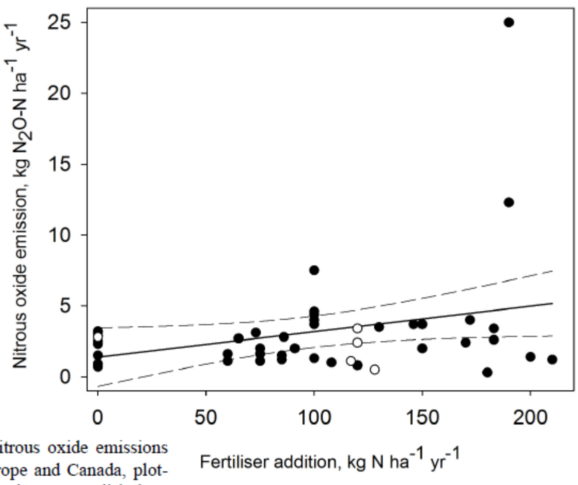
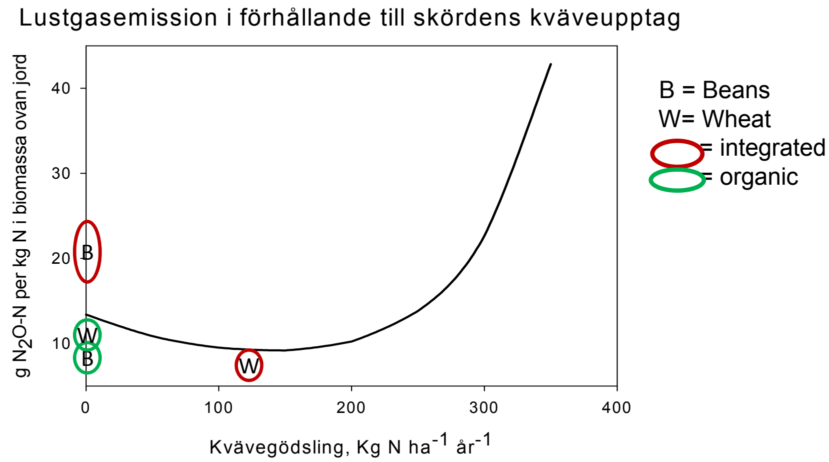


Fig. 4. Compiled measurement data on nitrous oxide emissions from cereal and rape crops in northern Europe and Canada, plotted against N fertiliser addition. White spots denote Swedish data. Linear regression and 95 % confidence interval; emission of N_2O-N = 1.4 + (0.02 · N in fertiliser), $r^2 = 0.08$ and $P = 0.049$.

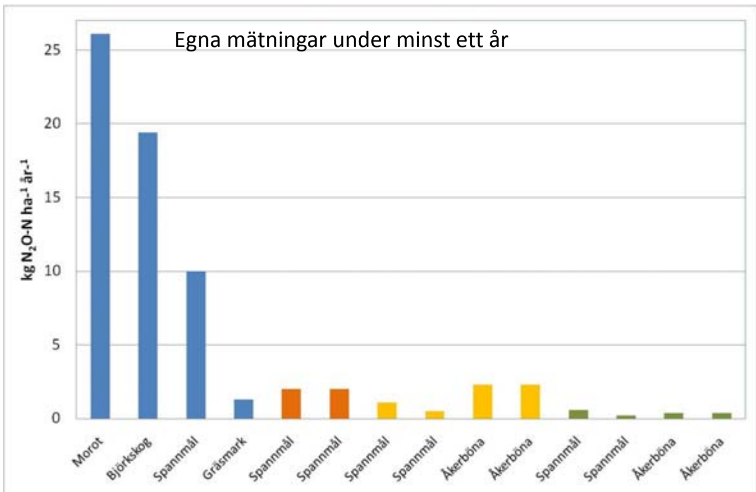
Kasimir Klemedtsson & Smith, 2011 Biogeosciences

N_2O intensity, + Logården data



efter Van Groenigen et al. 2010, Towards an agronomic assessment of N_2O emissions: a case study for arable crops. European Journal of Soil Sciences

Kvävefrigörelse har stor betydelse



Organogen jord

Sandjord

Lerjord integr. odling

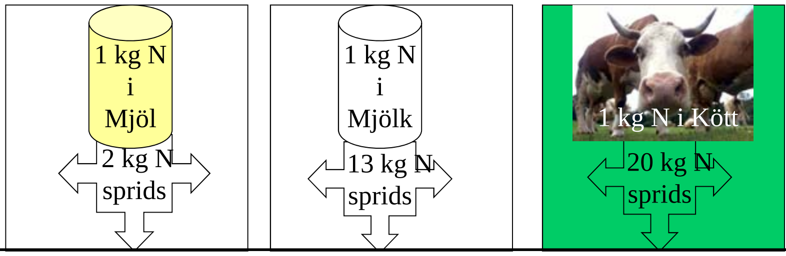
Lerjord ekologisk odling

Produktion styr

Bleken and Bakken, 1997:

Mängd N som behöver tillsättas i primärproduktionen för att erhålla en produkt som innehåller 1 kg N:

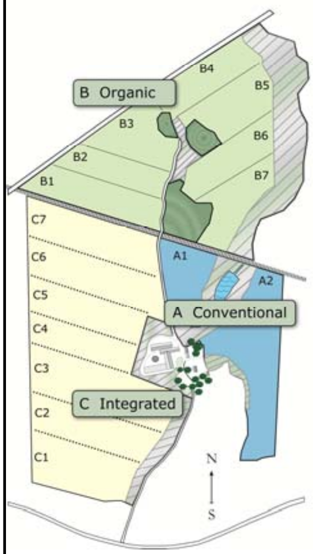
1 kg N i Produkt	Kg kväve till åker:
Grönsaker och spannmål	3 kg N
Mjölkprodukter	14 kg N
Köttprodukter, ätbara delar	21 kg N



Åtgärder i jordbruket

- Effektiv kväveanvändning?
- Dränera kontra blötlägga?
- Kan ökad organisk halt i jorden vara en väg att hålla låg N_2O emission?
- Andra åtgärder?

Logården experimental farm



Organic	Integrated
Spring Wheat	Spring Wheat
Green Manure Ley	Green Manure Ley
Winter Oil Seed Rape	Green Manure Ley
Winter Wheat	Winter or Spring Rape
Green Manure Ley	Winter Wheat
Winter Rye	Oats
Field Beans	Field Beans


Manual Chambers