

Effect of PICCMAT mitigation measures for CO₂ and N₂O at European Scale

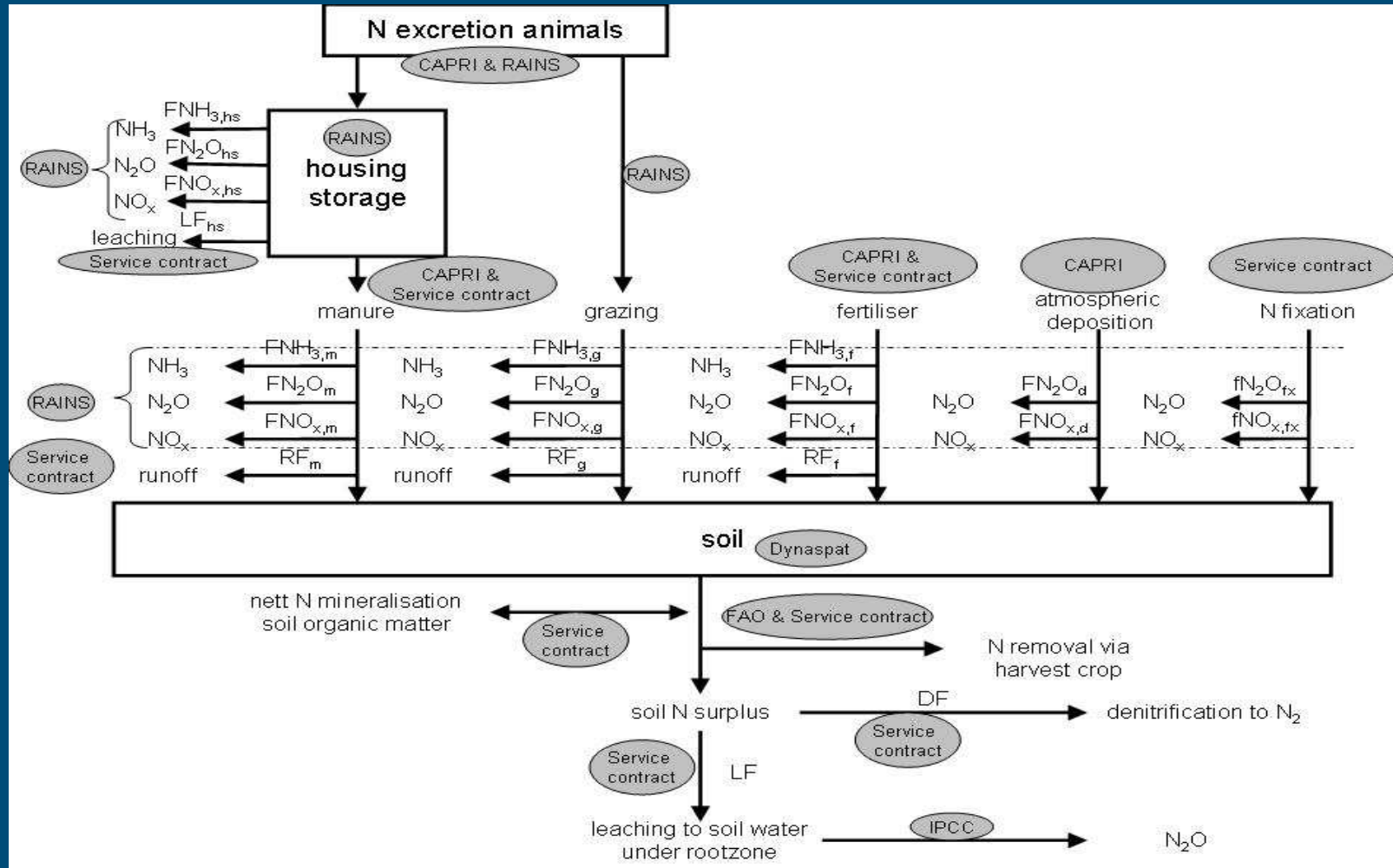
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MITERRA-Europe

- Developed to assess the effects and interactions of policies and measures in agriculture on N losses
- Based on existing models CAPRI (agricultural sector model) and RAINS (emission model)
- Supplemented with a N leaching module, a soil carbon module and a PICCMAT measures module
- Regional level in EU-27 (NUTS-2)
- Outputs: emissions of NH_3 , N_2O , CH_4 , NO_3 leaching, N and P balances and change in SOC with CO_2

MITERRA-Europe



Calculation rules for Soil Organic Carbon

- Carbon Tier1 method (IPCC), based on the Good Practice Guidance for Land Use, Land Use Change and Forestry
- SOC reference value based on climate and soil type
- Assign relative stock change factors
 - Land use (F_{LU}) (0.80 – 1.10)
 - Management (F_{MG}) (0.70 – 1.16)
 - Input (F_I) (0.91 – 1.38)
- $SOC = SOC_{REF} * F_{LU} * F_{MG} * F_I$

Mitigation CO₂ through soil management

Atmosphere

CO₂

N₂O

+

-

Soil C

Fertilization

Soil

Selected mitigation measures

	CO ₂	N ₂ O
■ Catch crops	+	-
■ Zero tillage	++	-
■ Reduced tillage	+	0
■ Residue management no removal	+	-
■ Residue management composting	+	+
■ Optimising fertilizer application	0	+
■ Fertilizer type	0	+
■ Rotation species	+	+
■ Adding legumes	+	+
■ Agroforestry	+	+
■ Grass in orchards and vineyards	+	+

PICCMAT and MITERRA-Europe results

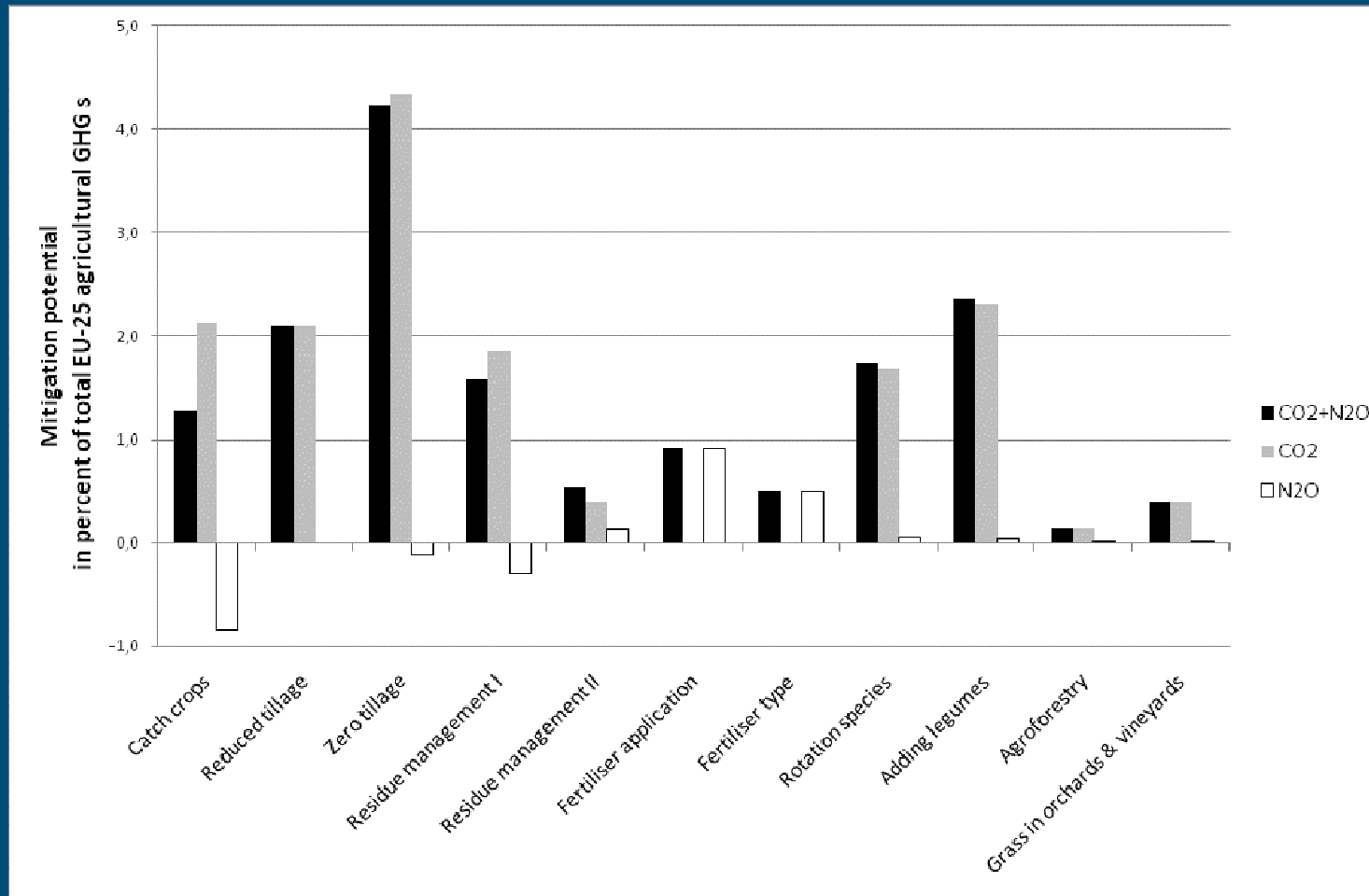
- Database (see table 1 Summary)
- Criteria for selection measures
- Effects of 11 measures calculated
 - CH₄ only marginal as livestock measures are excluded
 - Soil management of peat & organic soils excluded

Database and MITERRA-Europe calculations

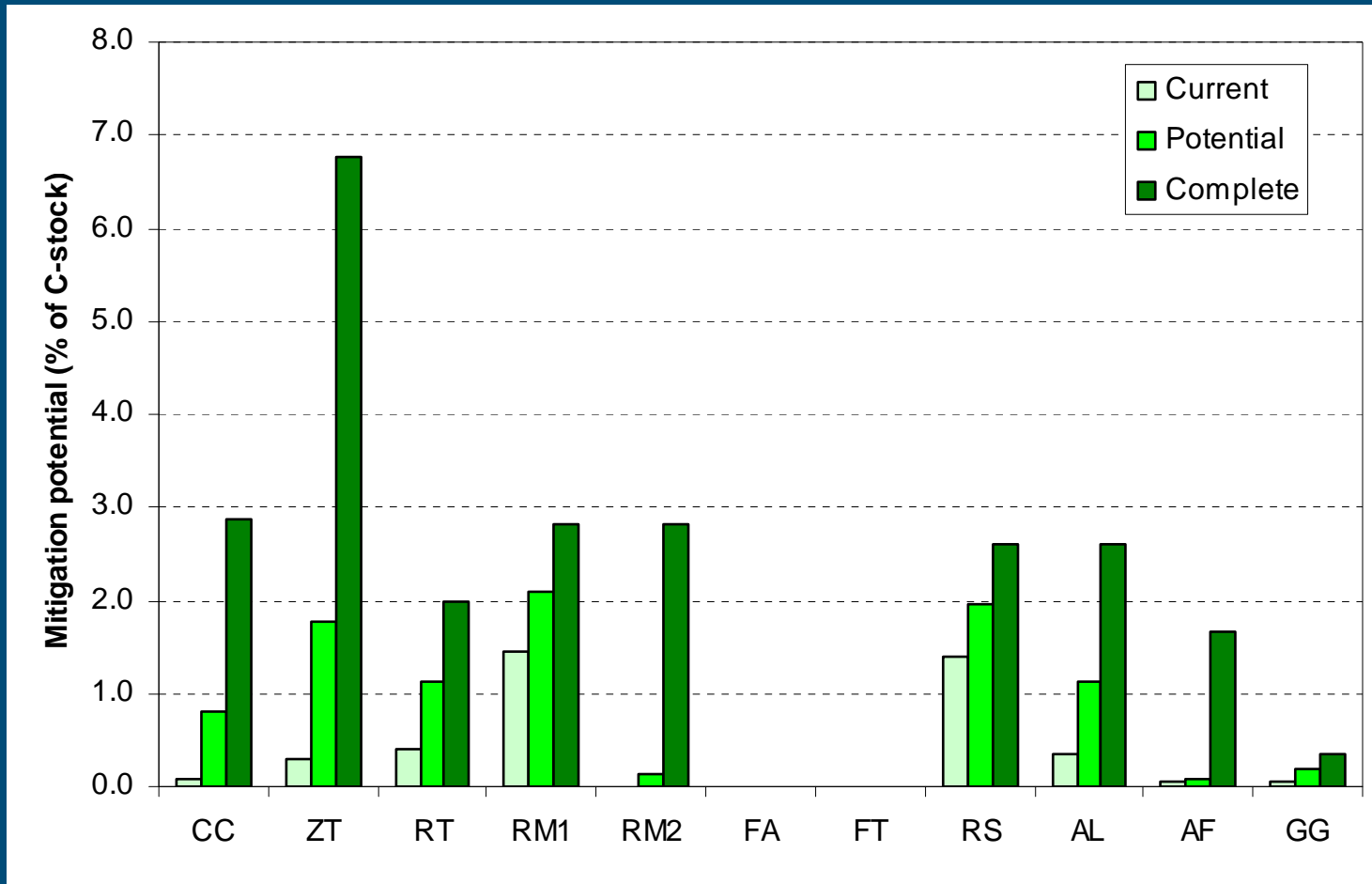
Table 1 Summary of PICCMAT mitigation practices

Management practices	Potential implementation cost ⁹	Probability of implementation ¹⁰	Global mitigation potential ¹¹ (Smith et al, 2008)			EU27 mitigation potential (MITERRA-Europe results)				Description of costs	Co-benefits and trade-offs
			CO ₂	H ₂ O	CH ₄	CO ₂	H ₂ O	CO ₂	H ₂ O		
			(tCO ₂ eq./ha/yr)			(MtCO ₂ eq./year)		(tCO ₂ eq./ha/yr)			
Catch crops	Low	High	0.29 - 0.88	0.10	0.00	9.7	--3.8	0.31	-0.12	Cost of legume seed only	Benefits water quality, soil erosion, pest control, soil productivity
Reduced tillage	Low	Medium (low in some areas)	0.15 - 0.70	0.02	0.00					Capital cost of buying or hiring new equipment. Costs decrease as more people do it. Potential for opportunity cost of lost production in areas less suited to reduced tillage via yield penalty	Benefits water conservation, soil quality, biodiversity, energy conservation. May increase fungal problems (and reduce yield) and increase need for herbicides due to reduced mechanical weeding
a. reduced tillage					9.6	0.0	0.25	0.00			
b. zero tillage					19.9	-0.5	0.96	-0.02			
Residue management	Low	High	0.15 - 0.70	0.02	0.00					No cost unless residues can be sold for other use (but usually low value)	Benefits water conservation, soil quality, biodiversity, energy conservation. May conflict with efforts to use residues as biomass for energy production
a. no removal					8.5	-1.3	0.35	-0.04			
b. composting and returning					1.8	0.64	0.38	0.12			
Extensification	Medium	Low	1.69 - 3.04	2.30	0.02					Opportunity costs of lost production	Benefits: soil quality, biodiversity, water quality
Fertiliser application	No	Medium (already done in some areas)	0.26 - 0.55	0.07	0.00	0.0	4.2	0.00	0.21	Should lower costs	Benefits water quality, biodiversity
Fertiliser type	Low	Medium (already done in some areas)	0.26 - 0.55	0.07	0.00	0.0	2.3	0.00	0.06	Should lower costs unless fertilizer replacement type is more expensive	

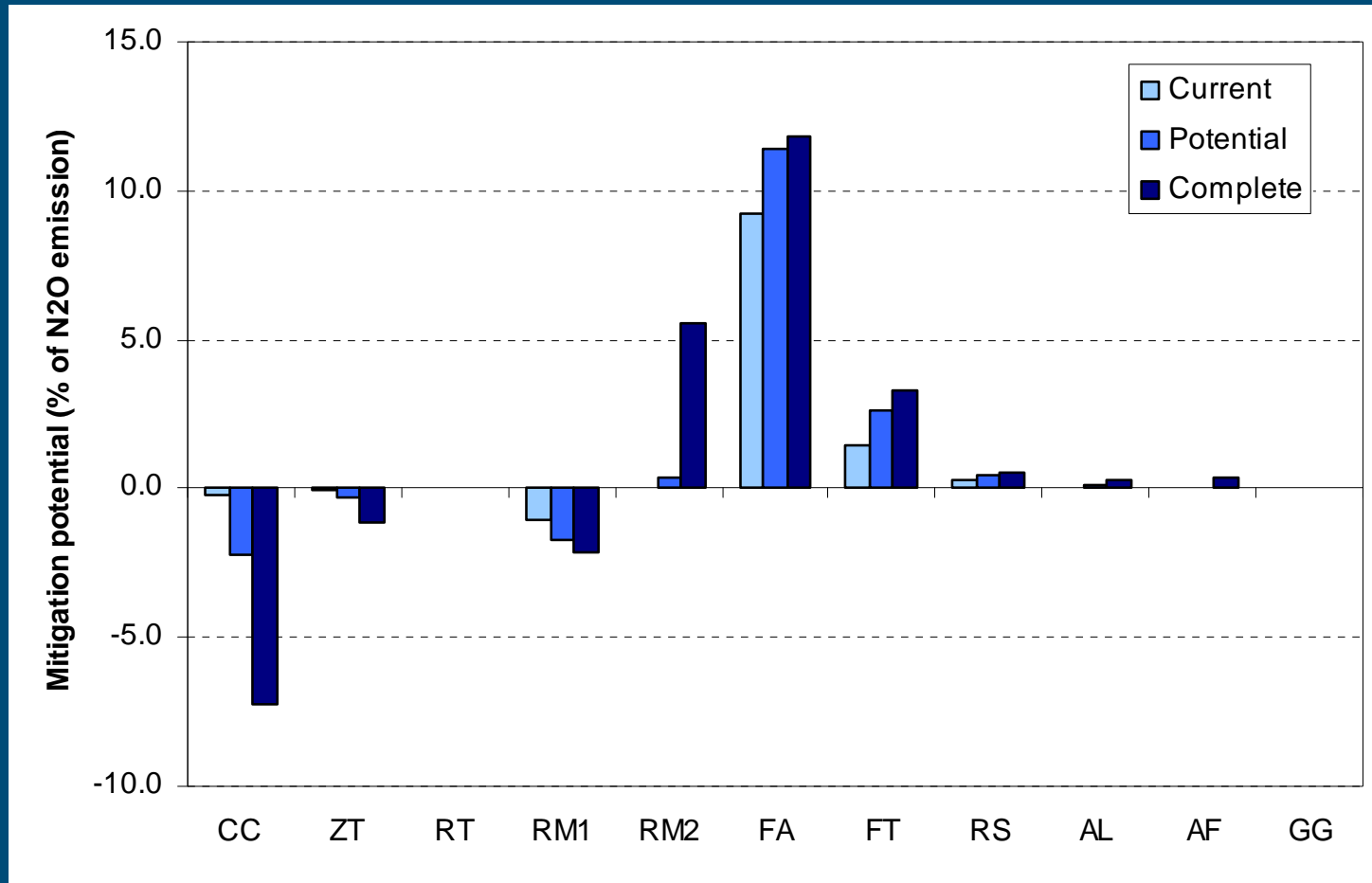
Mitigation potentials (% of agricultural GHG emission)



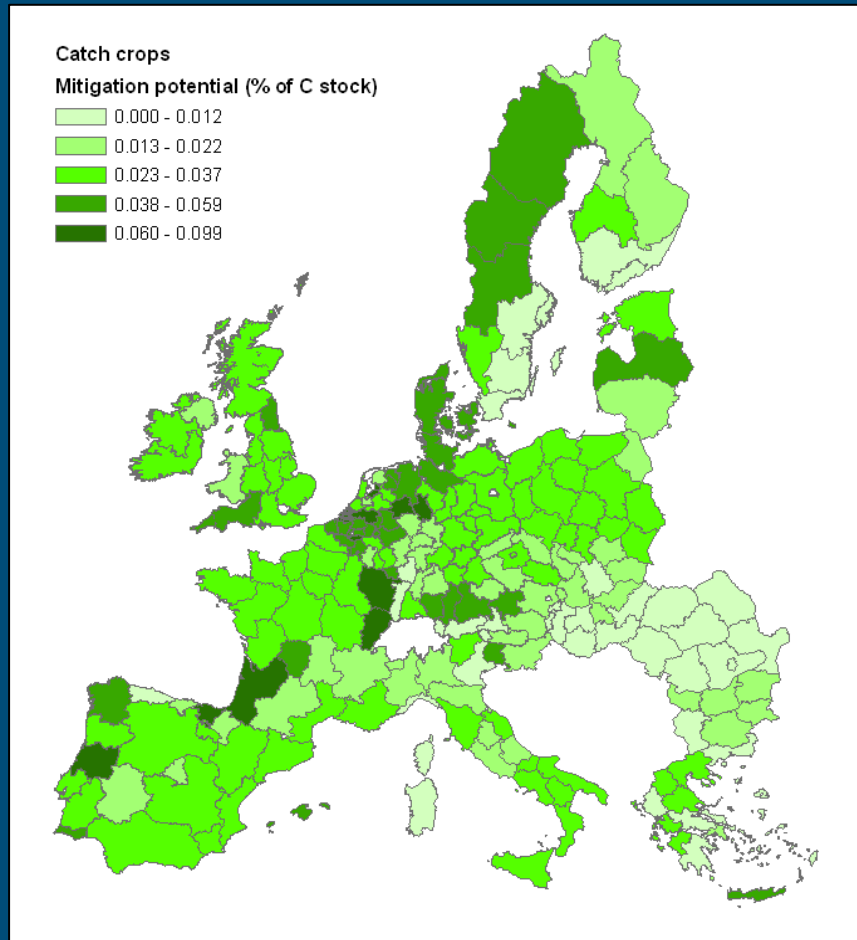
Mitigation potential for Carbon



Mitigation potential for Nitrogen



Cover crops

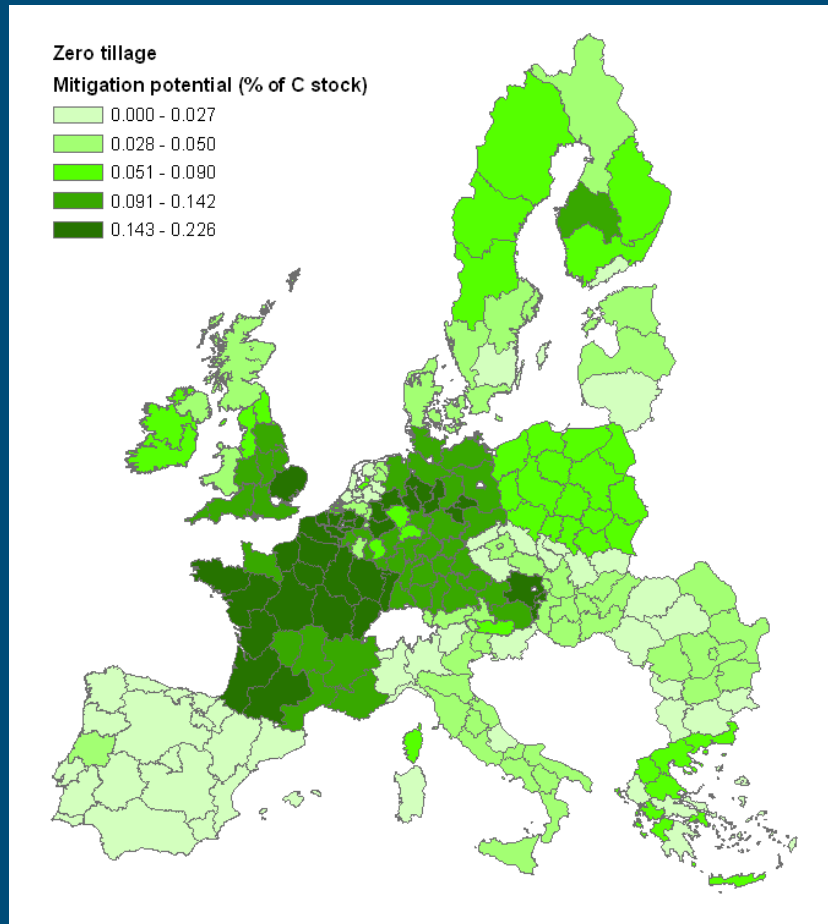


Mitigation potential:

9.7 Mton CO₂-eq for CO₂

-3.8 Mton CO₂-eq for N₂O

Zero tillage

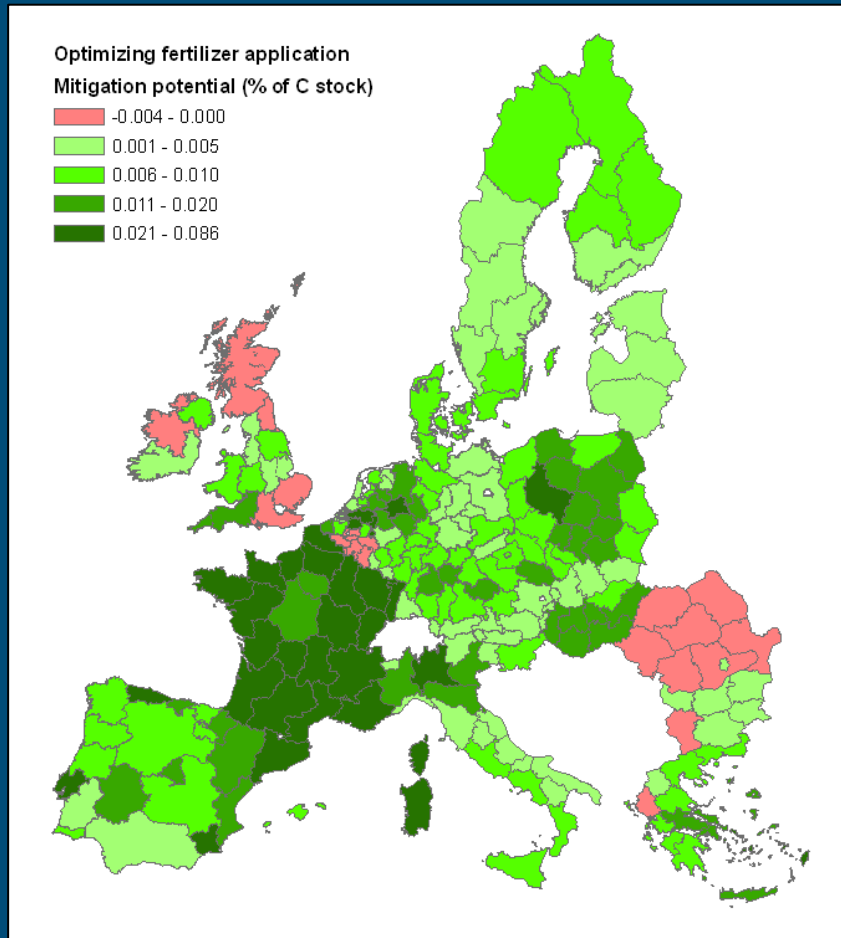


Mitigation potential:

19.9 Mton CO₂-eq for CO₂

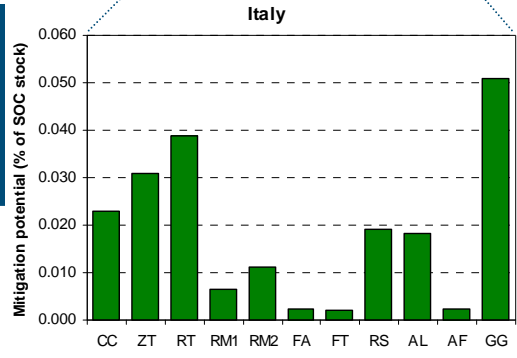
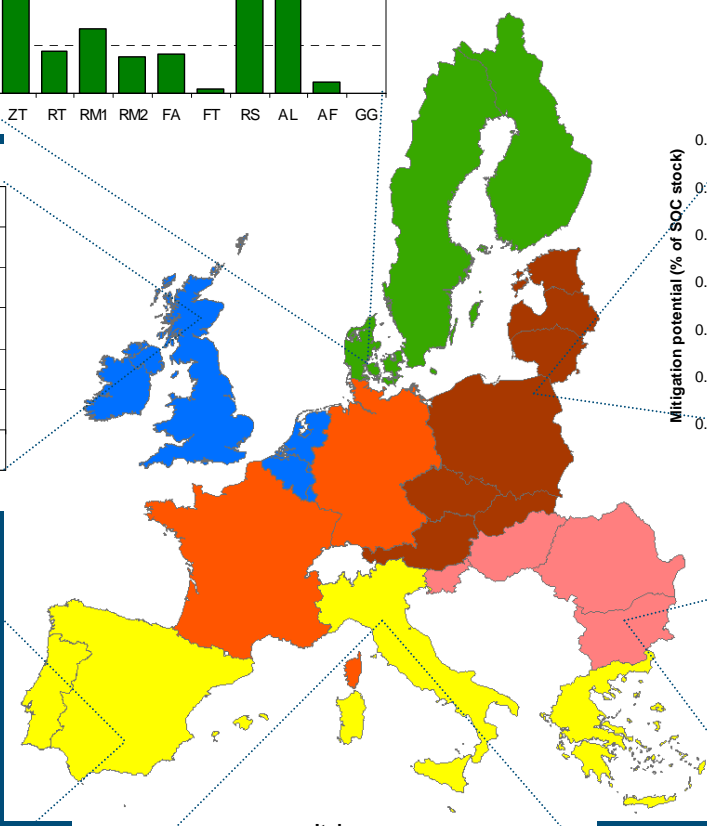
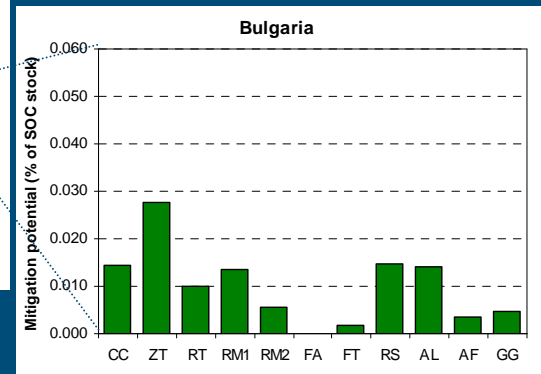
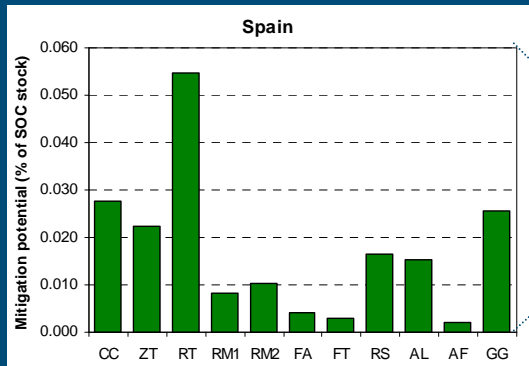
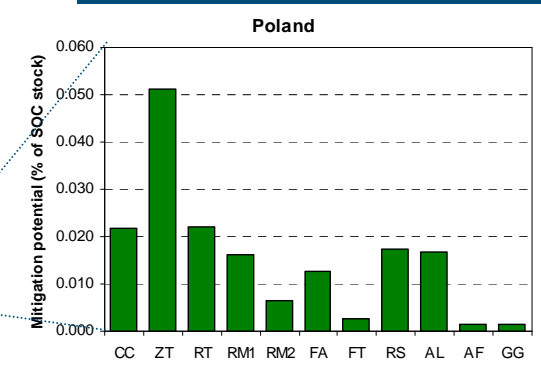
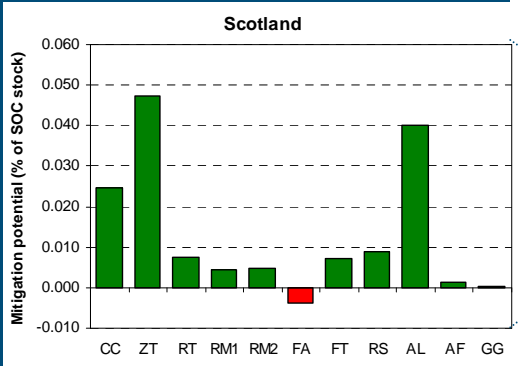
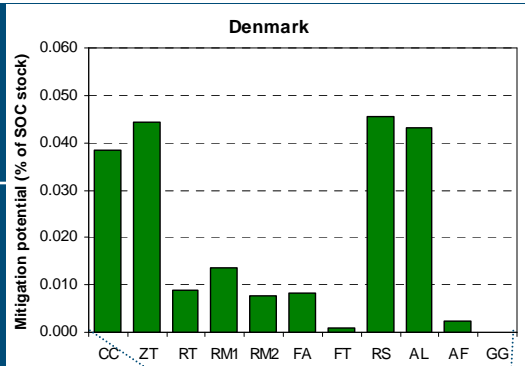
-0.5 Mton CO₂-eq for N₂O

Optimizing fertilizer application

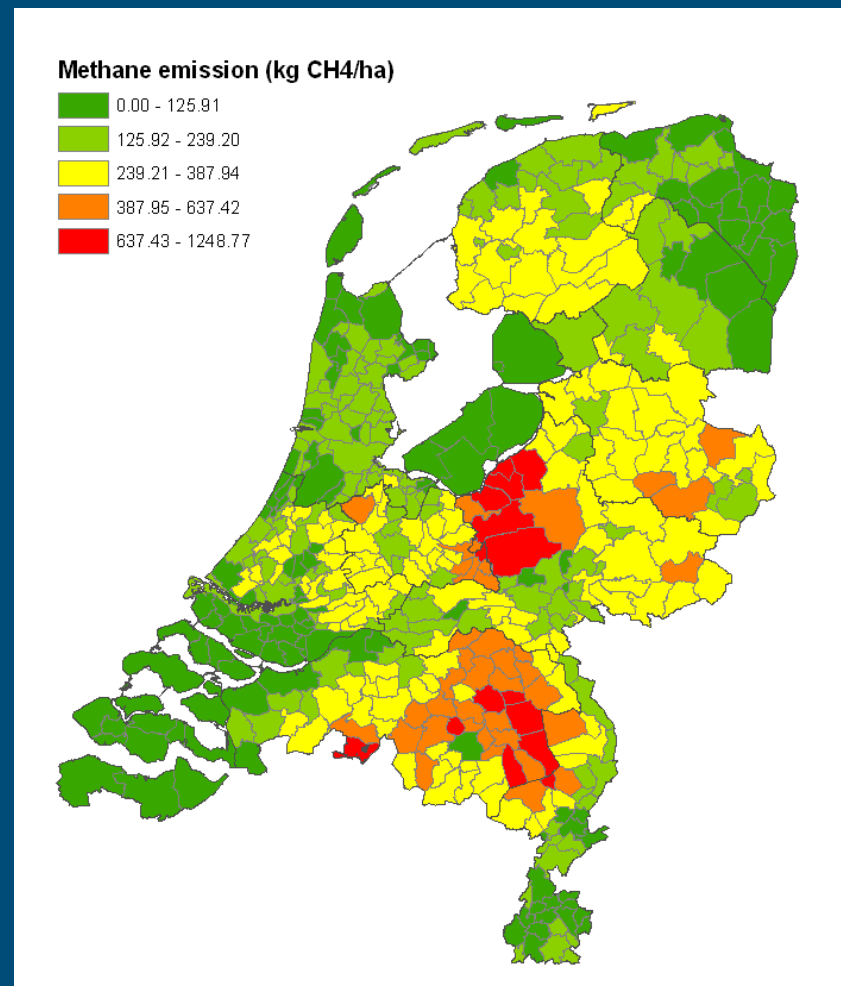
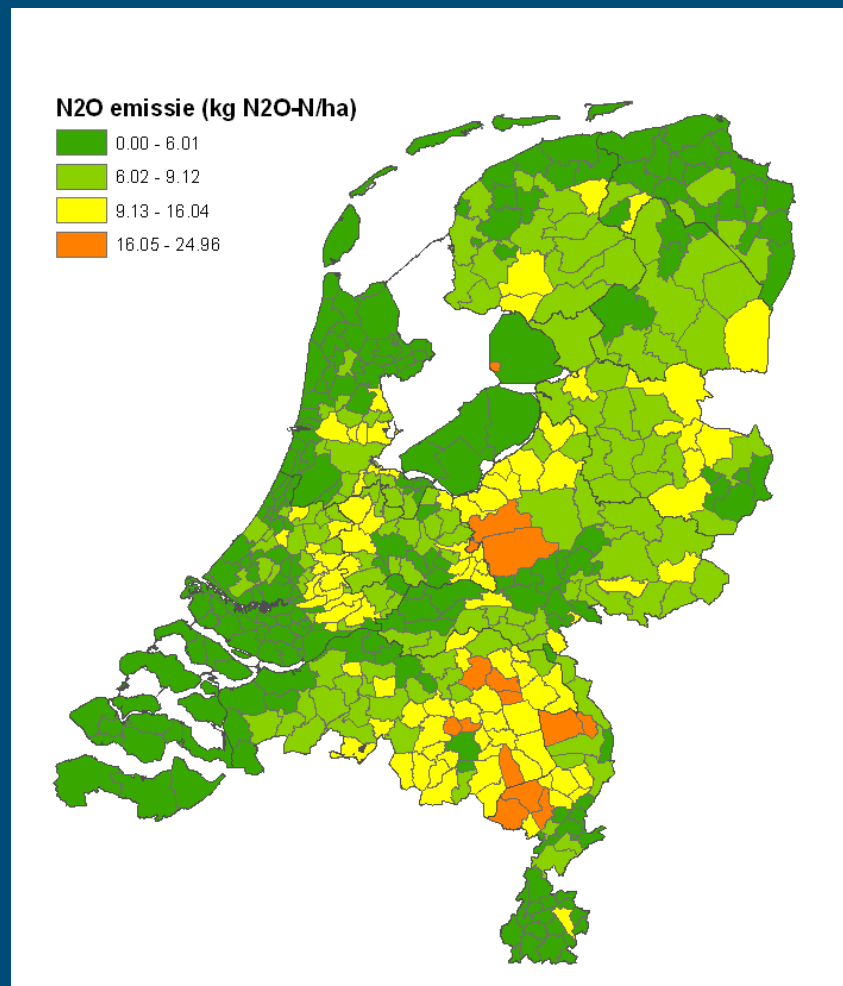


Mitigation potential:
4.2 Mton CO₂-eq for N₂O





N₂O and CH₄ emission in the Netherlands



Conclusions

- Combined effect of the 11 measures is a significant contribution to EU goals
- The potential across EU27 is as region specific as the measures
- The total estimated mitigation is 15% of agricultural GHG emissions in EU today
- Yet to achieve the full potential requires specific packages to be designed
- The preservation of existing carbon stocks is a top mitigation priority additional to the PICCMAT measures

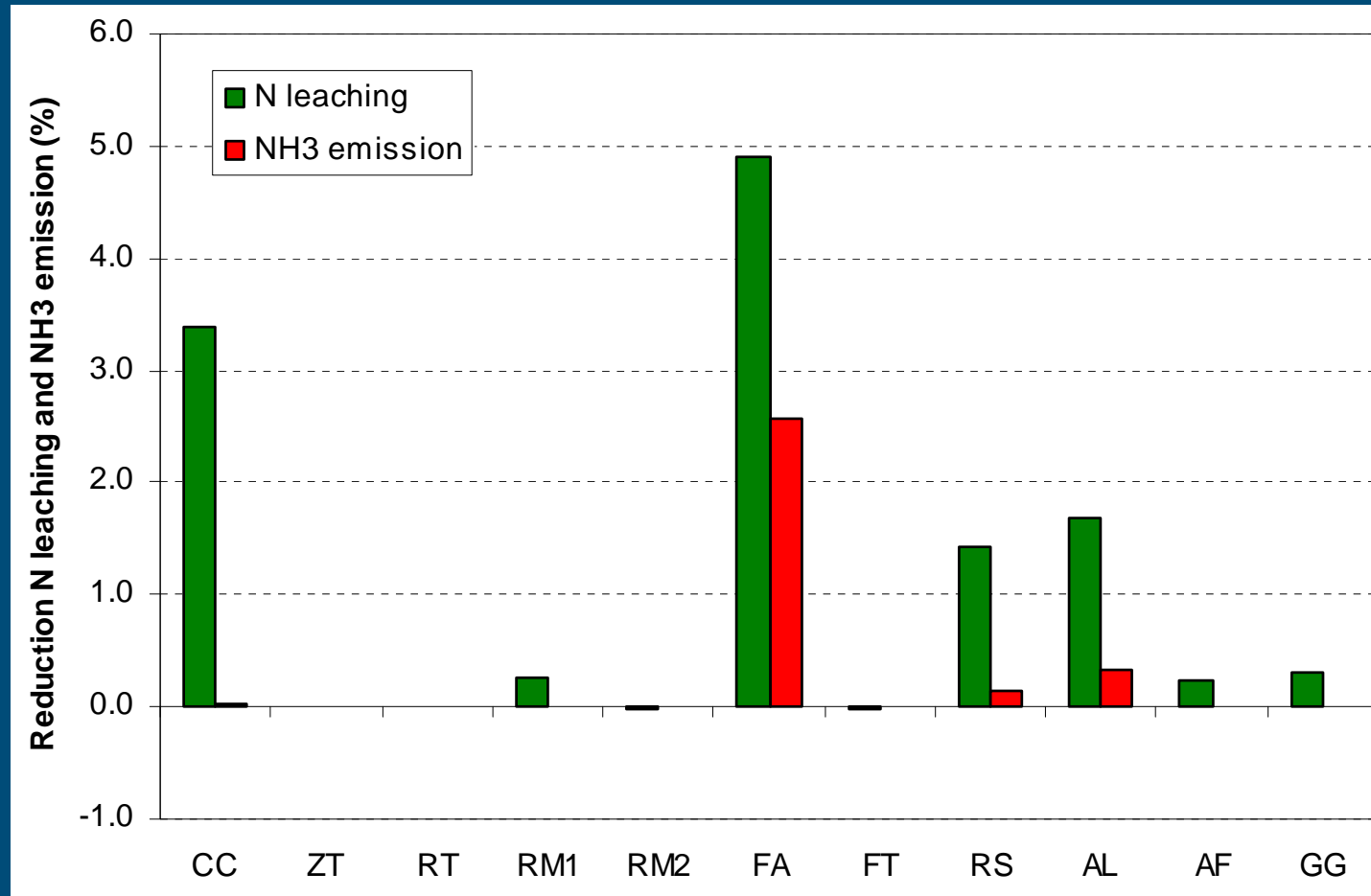
Thank you



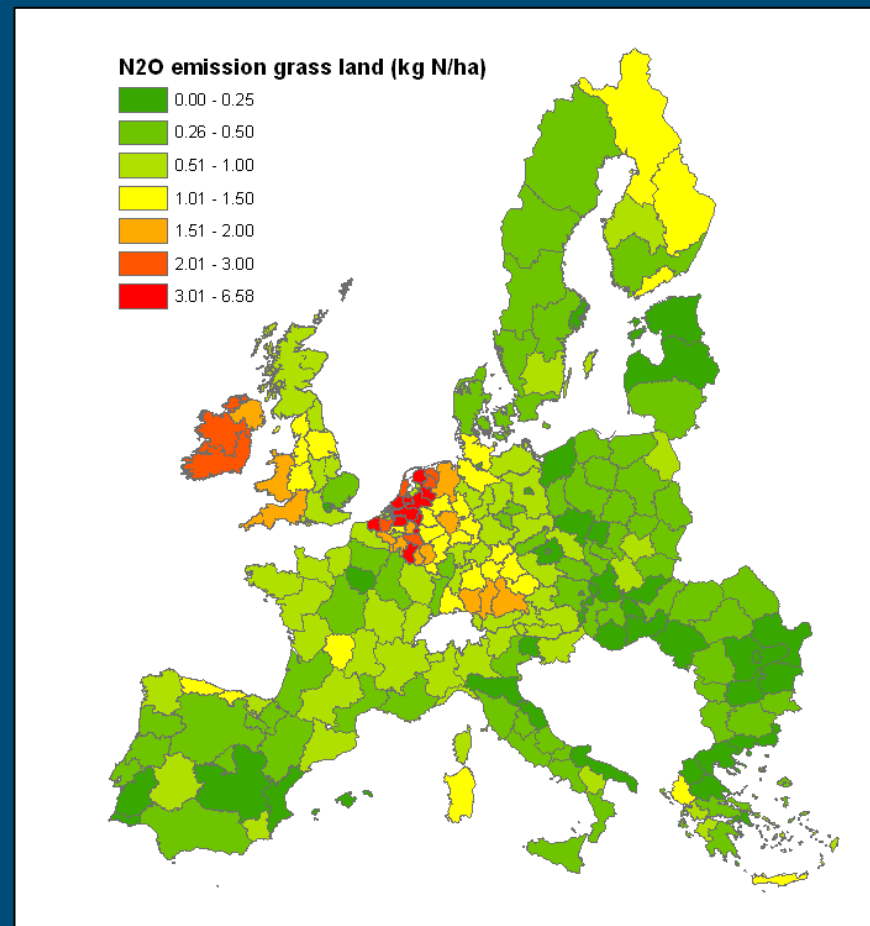
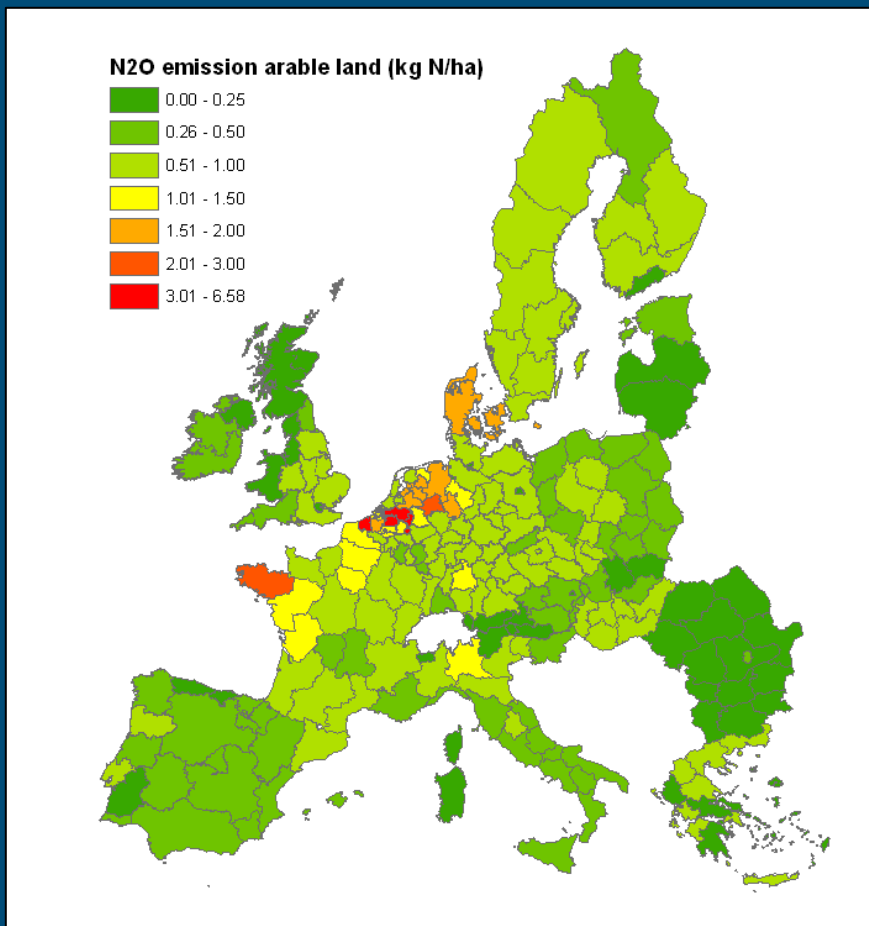
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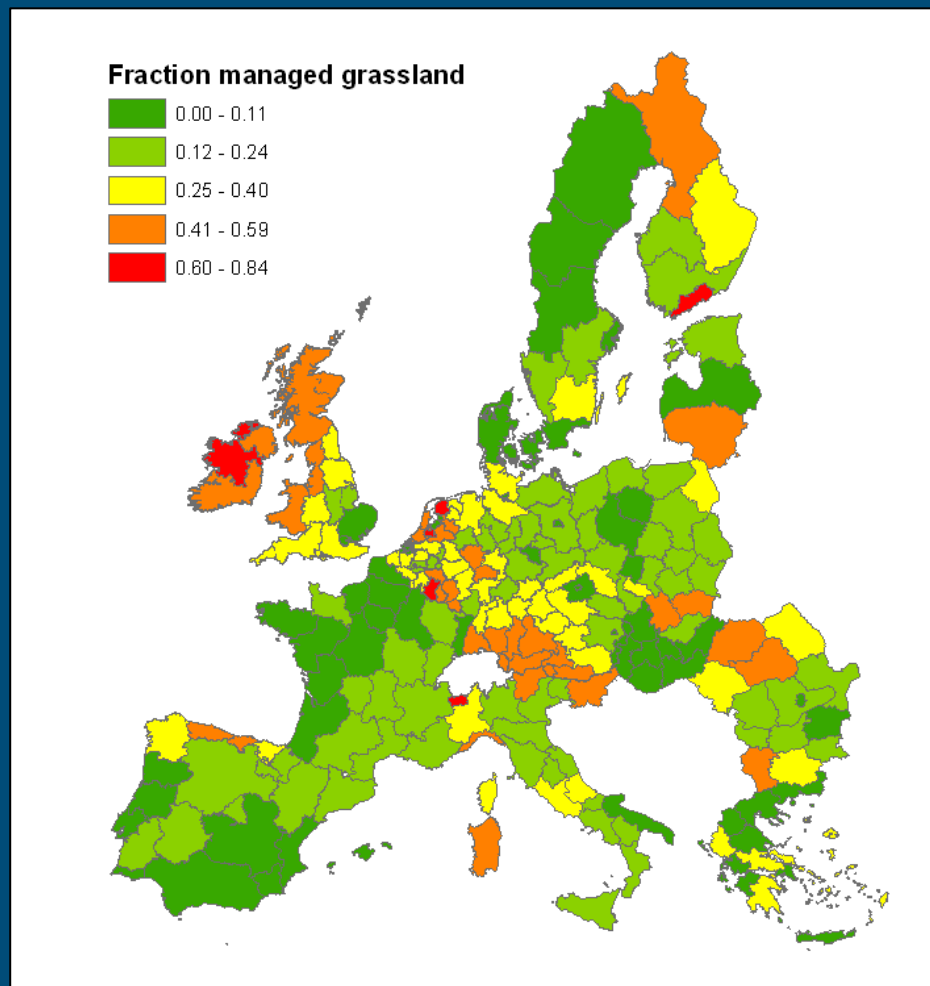
Effect on other environmental indicators



N₂O emissions from arable and grass land



Fraction managed grassland



Carbon sequestration in soils

