MACC 2050: Reducing GHG emissions associated with Fertiliser and Manure Use

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Introduction

- Soils are an important source of greenhouse gas emissions – fertiliser, dung/urine, manure
- Soils can also lock up carbon through sequestration
- Need to better account for emissions & sequestration
- Soil management can significantly reduce emissions
- Research focusing on identifying management practices to:
  - Reduce soil emissions
  - Enhance carbon sequestration

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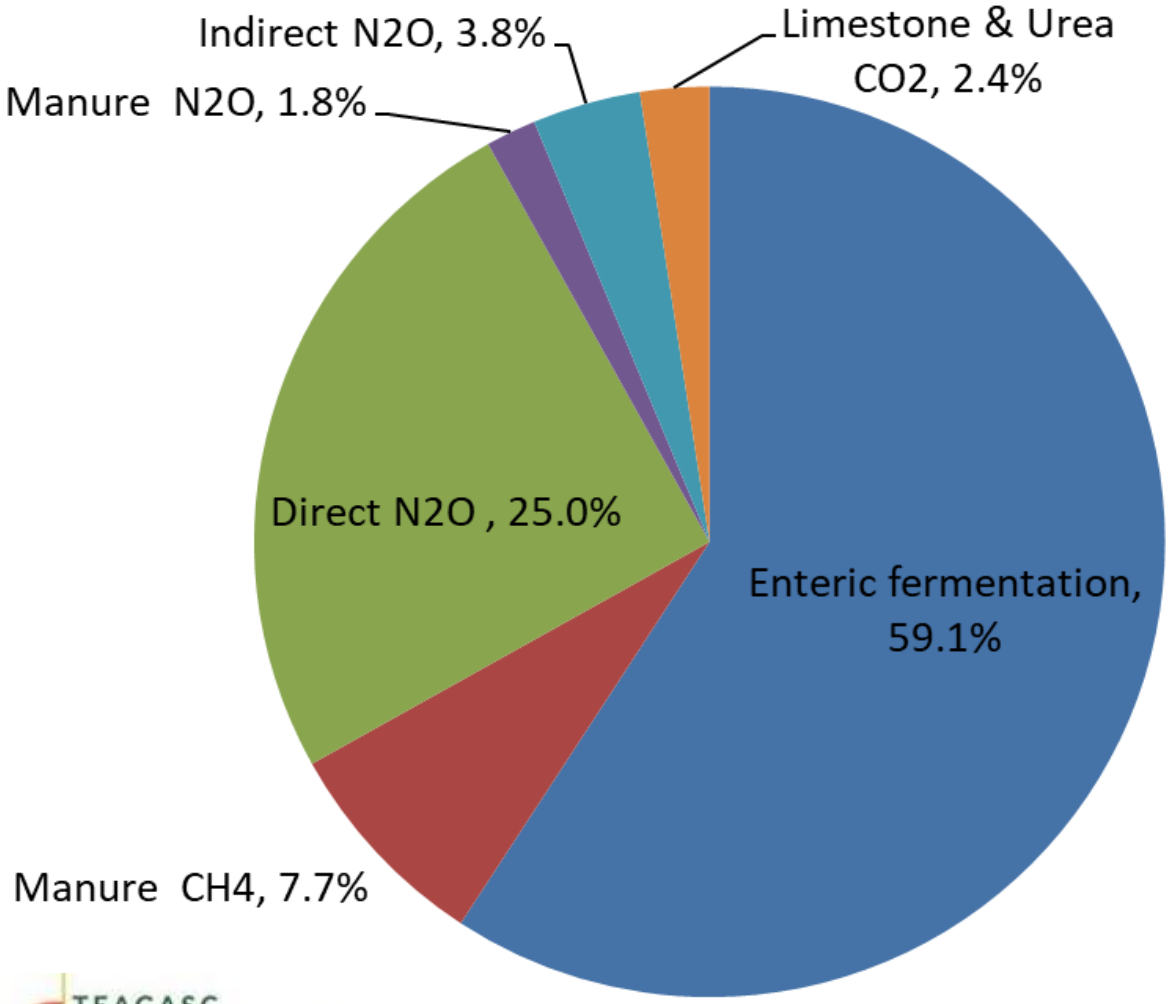
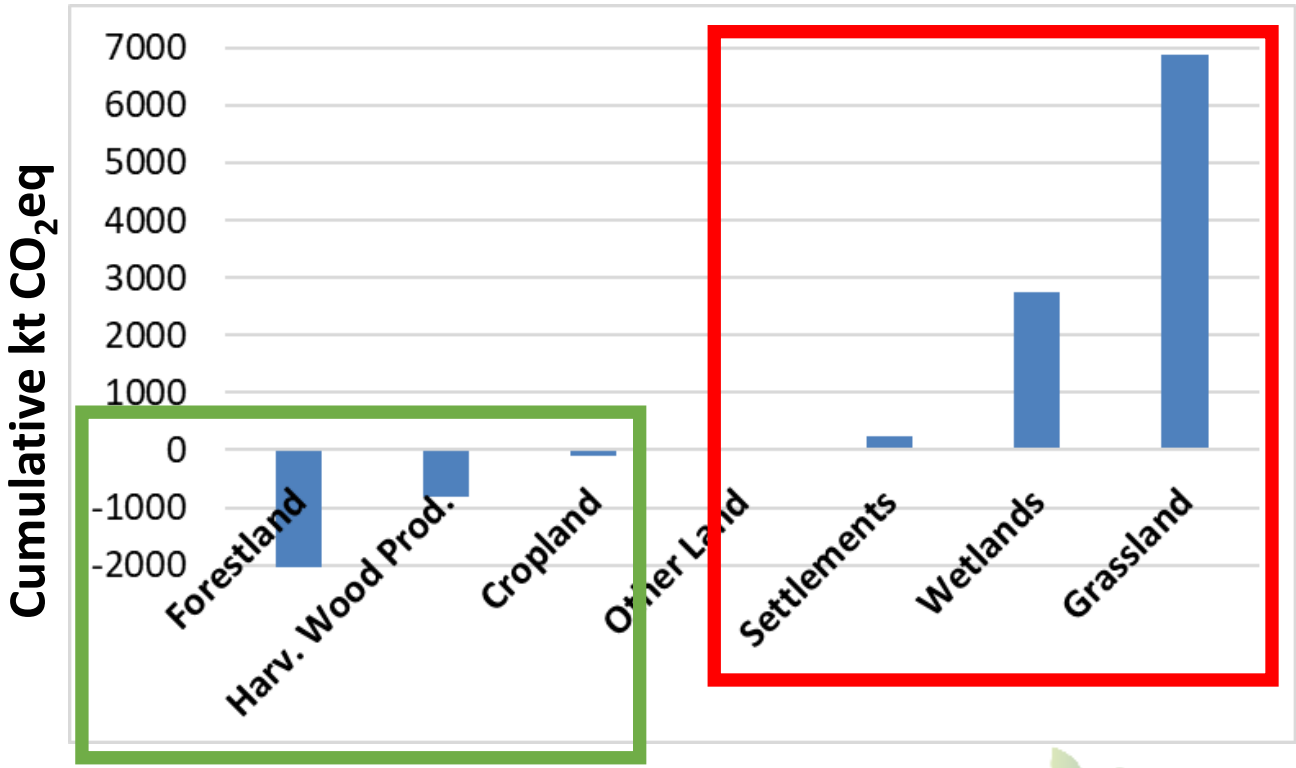
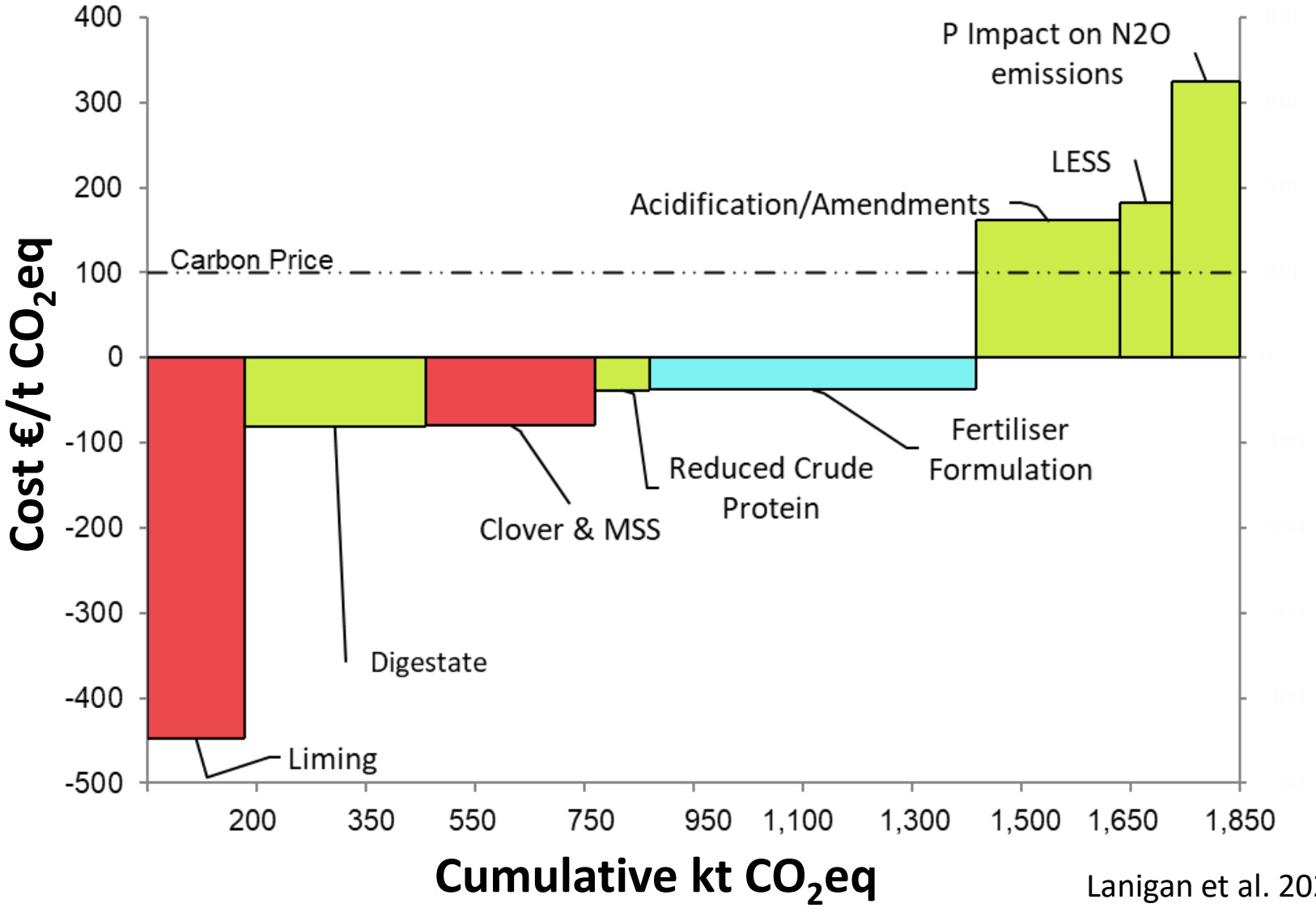
Agricultural & Land-Use Emissions 2020





EPA National Inventory Report 2022

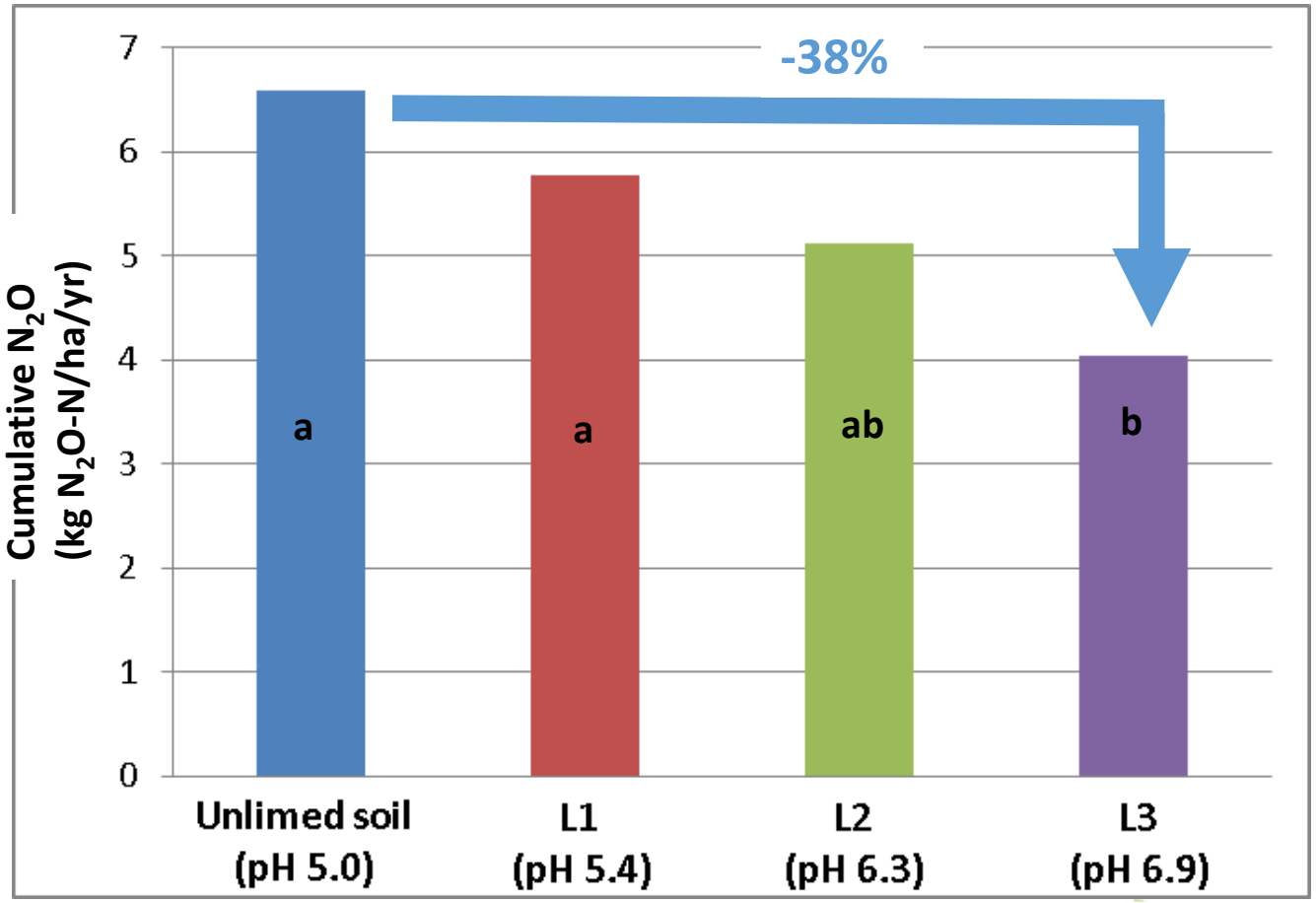
MACC - Reducing Soil N_2O Emissions



Lanigan et al. 2023

Optimising Soil pH

- Improving soil pH important for optimal crop/grass growth
- Replaces N fertiliser by 70 kg N/ha
- Helps establish clover grass & multispecies swards
- Improves nutrient use efficiency
- Can reduce soil N_2O emissions
- ? Effect on soil C sequestration



Žurovec et al. 2021. Agriculture, Ecosystems & Environment 311: 107319

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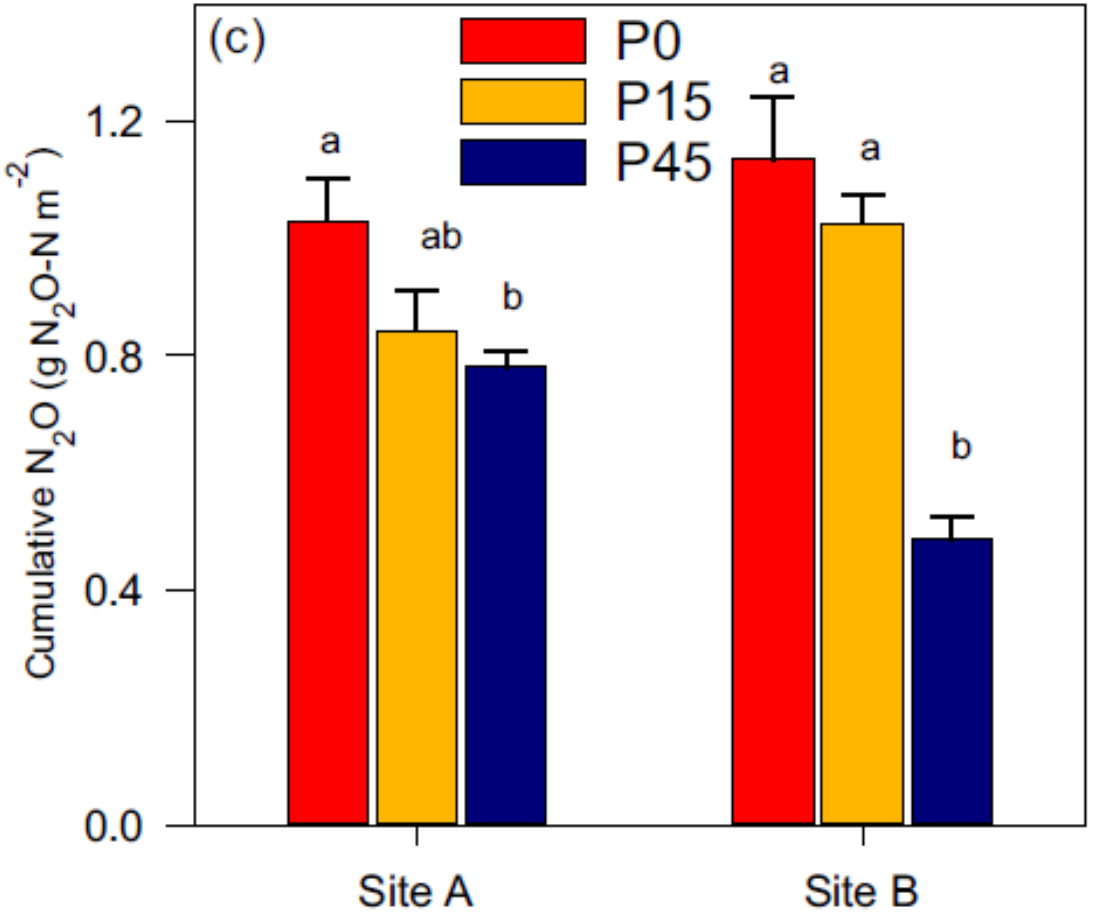
Optimising Soil P

- Soil P is important for crop/grass growth optimisation
- Long term P experiment (1995)
- Optimising soil P reduced emissions
  - 38% in lab studies
  - 42% in field studies
- P effects soil microbial community
- Effect of soil P on N and C cycling?
  - New ICONICA Project (Soil EJP)
  - Phosphorus effect emissions



Gebremichael et al. 2022 Scientific Reports 12.1: 2602.

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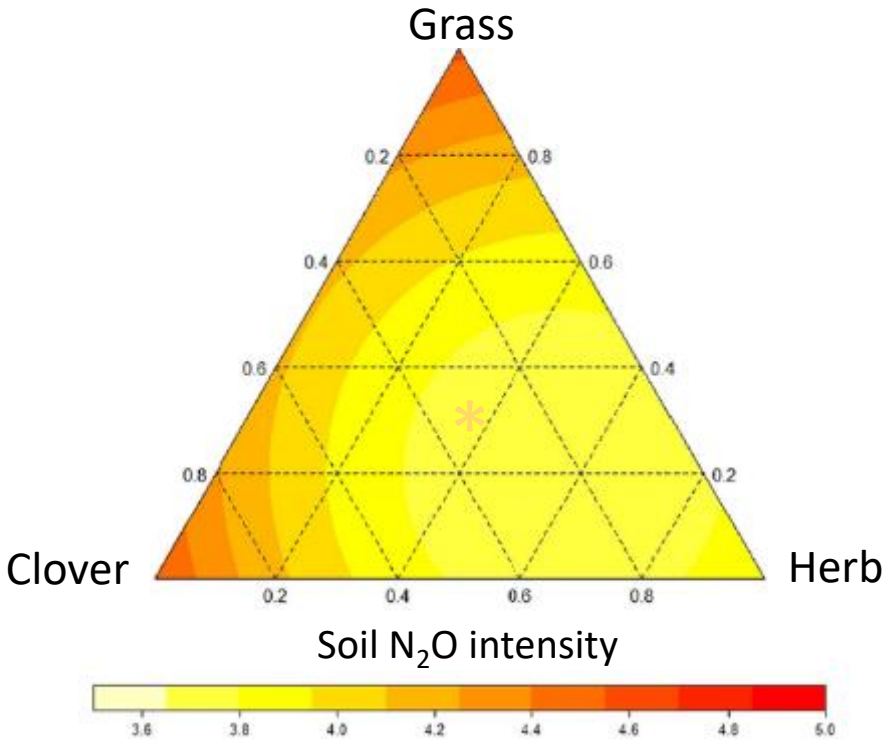
Clover and MSS

- Clover can fix 100-150 kg N/ha
- Soil P/pH important for establishment
- Replace chemical N reduces emissions
- Multispecies swards (MSS) have lower nitrate and emissions (plantain)
- Ongoing research
  - Soil C sequestration clover/MS swards
  - Biological nitrification inhibition
  - Soil health



Cummins et al. 2021 Sci. Tot. Env. 792: 148163.

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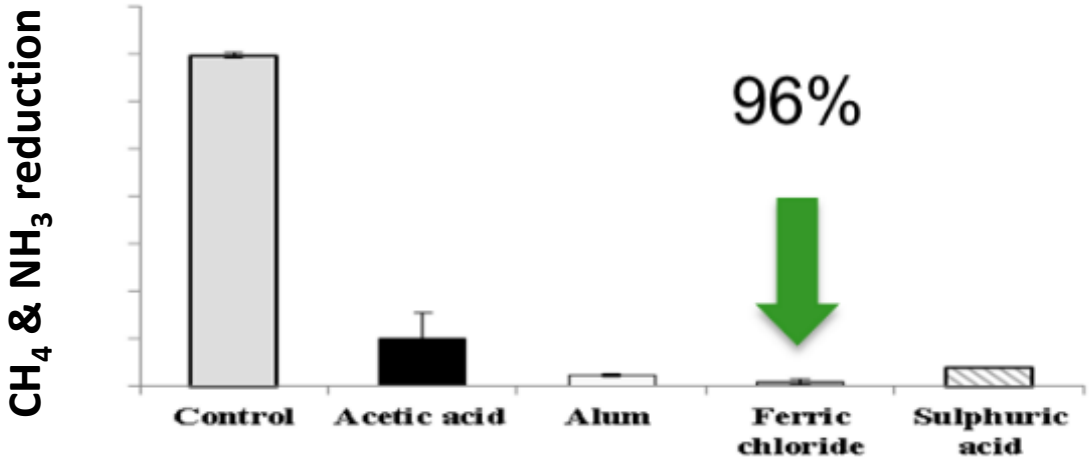
Emissions from Manure/Digestate

- Manure/digestate replaces N fertiliser
- Spring applied manure reduces emissions
- Low Emission slurry spreading – reduces emissions
- Slurry amendments reduce emissions
- Current research on
  - Slurry amendments & acidification
  - Dietary additives
  - Digestate from AD



Kavanagh et al. 2019 J. Cleaner Production 237, 117822

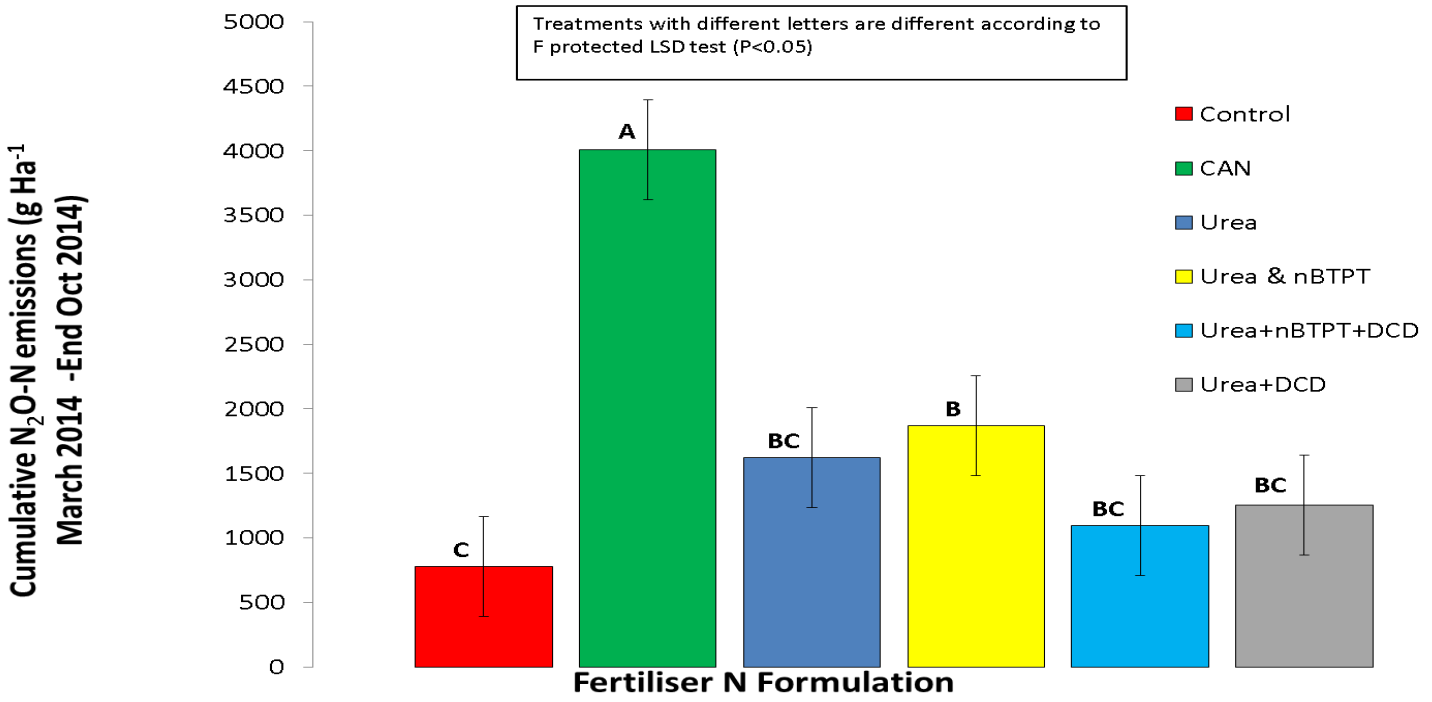
Fertiliser Formulation

Grassland - N_2O

- EF for CAN = 1.49%
- EF for urea = 0.4%
- EF for urea + NBPT = 0.4%
- EF for urea +NBPT+DCD =0.15%

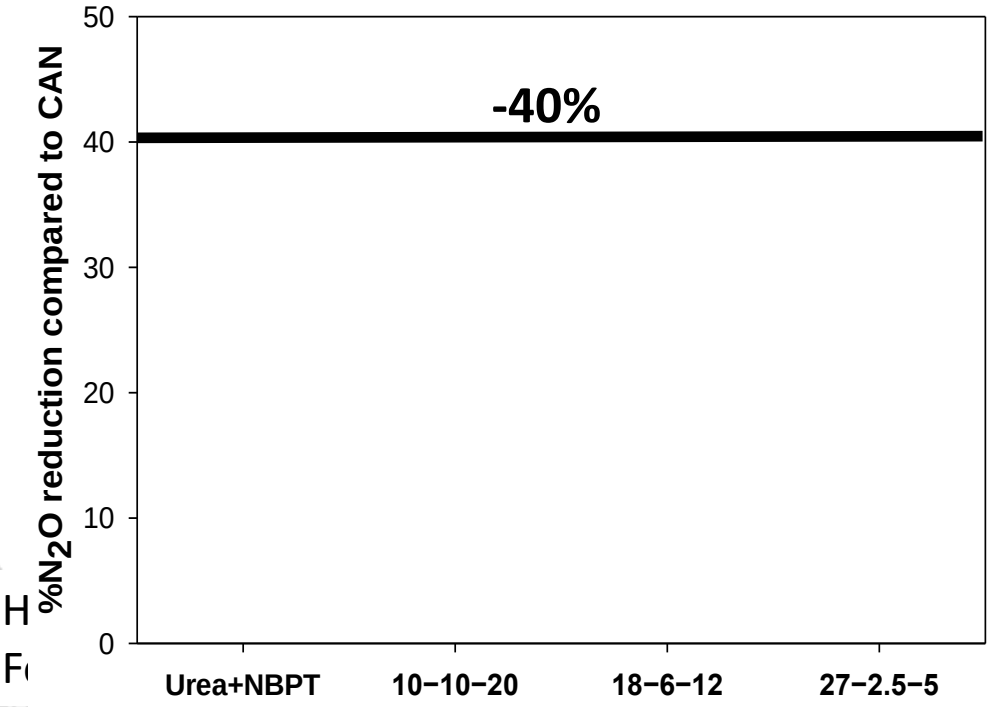
Grassland – NH_3

- CAN = 0.8%
- Urea = 15.5%
- Urea + NBPT = 3.3%



Fertiliser Formulation

- Protected urea
  - Grassland reduced emissions by more than 70%
  - No difference on tillage soil
  - Protected urea didn't reduce yield
- Nitrification inhibitors
  - Emissions = 0 N fertiliser -89%
  - Potential to further reduce emissions
- Mitigation measures
  - Manure spreading & acidification
  - Compound fertiliser

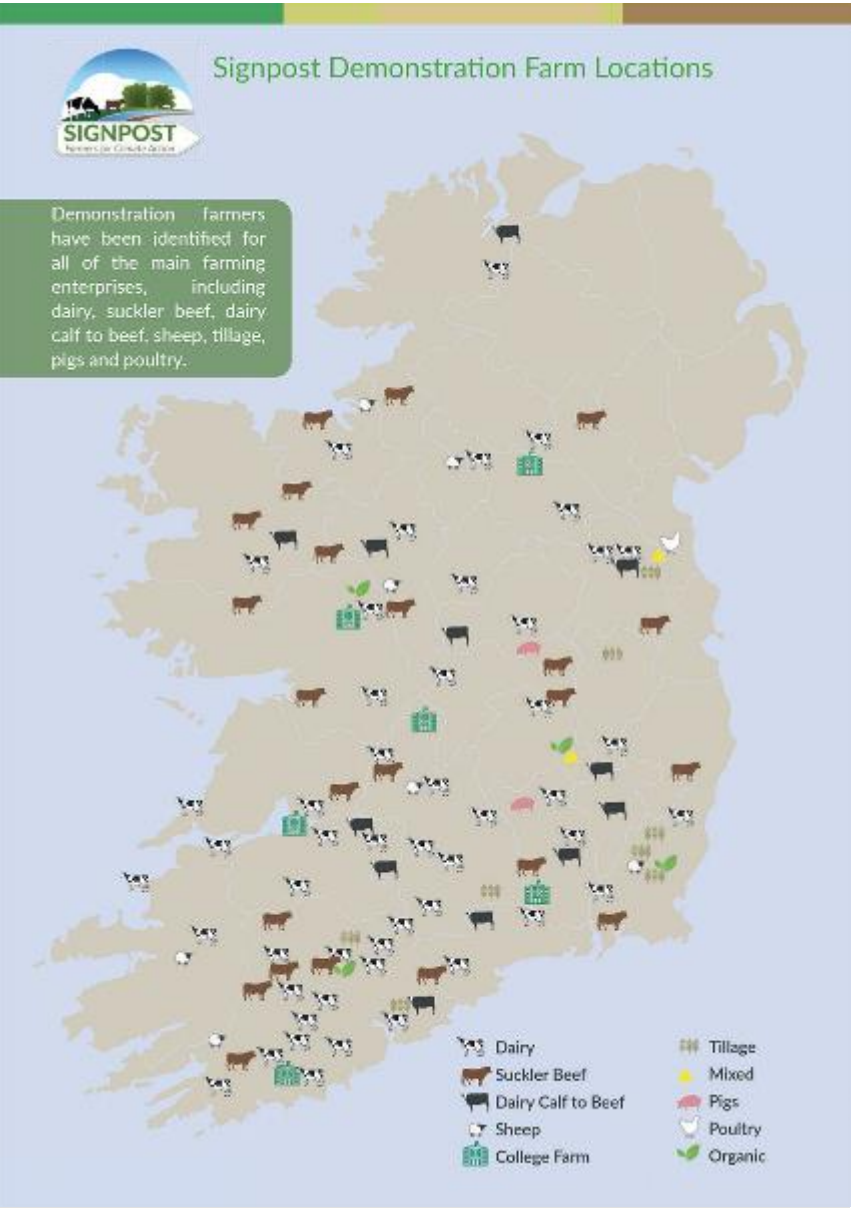


Gebremichael et al. 2021. *Agronomy* 11: 1712.

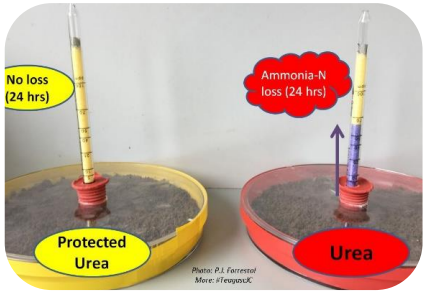
Inventory requirements

- GHG- IPCC – Field trials for minimum 365 days - must be peer reviewed. Can then be added to the Emission Factor Database (EFDB).
- Ammonia - UNECE BAT- Field trials for period of volatilisation – must be peer reviewed

Signpost Farms Programme



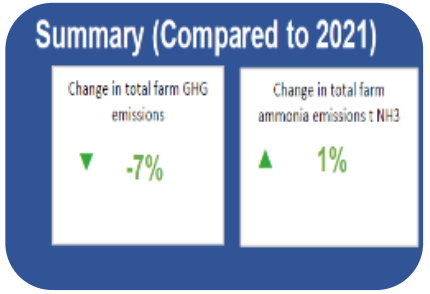
125 Signpost Farmers



Incorporate mitigation technologies

Share their experiences

Support on farm research



Track progress (NFS)

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Decision support

Summary

- Research has highlighted how agriculture can reduce soil emissions
- Reduce N fertiliser use – soil fertility, clover/MSS, improve manure use, LESS
- Investigating new measures – compound fertilisers, manure treatment, MSS
- Research to refine emission factors
- Investigate effect of soil type, land-use and management practices on emissions
- Investigated the effect of soil biology/soil health on emissions & carbon sequestration

Key Messages

- Agriculture's sectoral targets **can** be achieved using **very high adoption rates** of GHG mitigation measures as outlined in Pathway 2
- Reductions in N usage are ahead of schedule – 280.5kt N
- **Increased advisory and extension services** will be key to helping guide farmers and land-owners on the path to reduced GHG emissions in 2030 and towards climate neutrality
- The levels of uptake in P2 are beyond what advisory and peer-learning can deliver **alone – clear policies will be required**
- **Agriculture and land-use sourced energy substitution** can significantly contribute to energy sector decarbonisation
- **Continuing research and development** of both emission mitigation technologies and inventory adjustments remains a priority to expand and/or enhance the set of mitigation measures available to farmers in order to achieve **2050 Neutrality Targets**

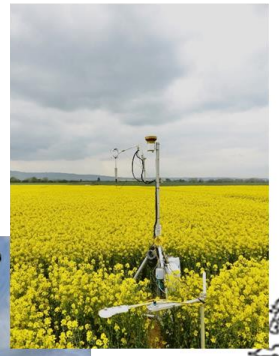
Acknowledgements

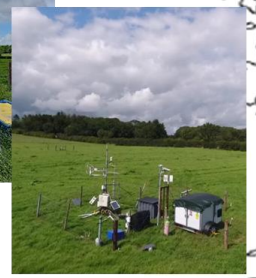
- The technical support provided by colleagues across Teagasc is was critical in delivering the research.
- This research was financially supported a wide range of funders and their support is gratefully acknowledged

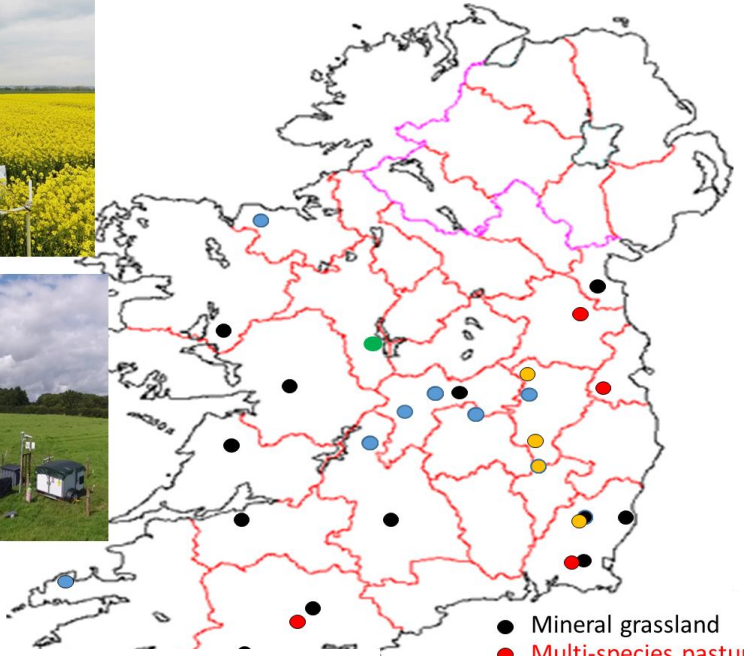
NASCO

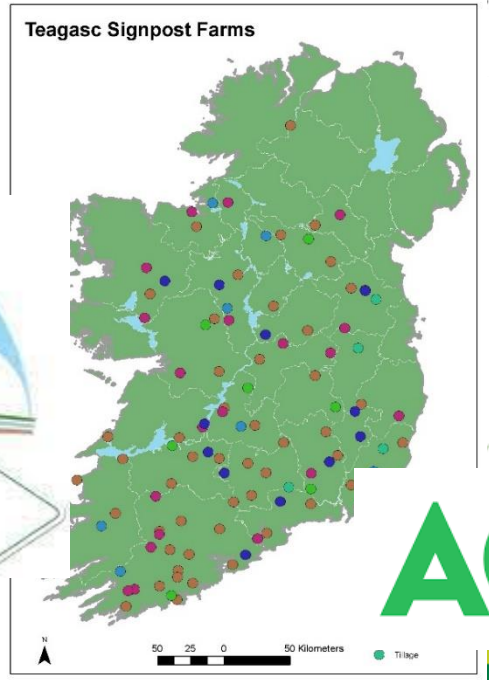
UPDATE

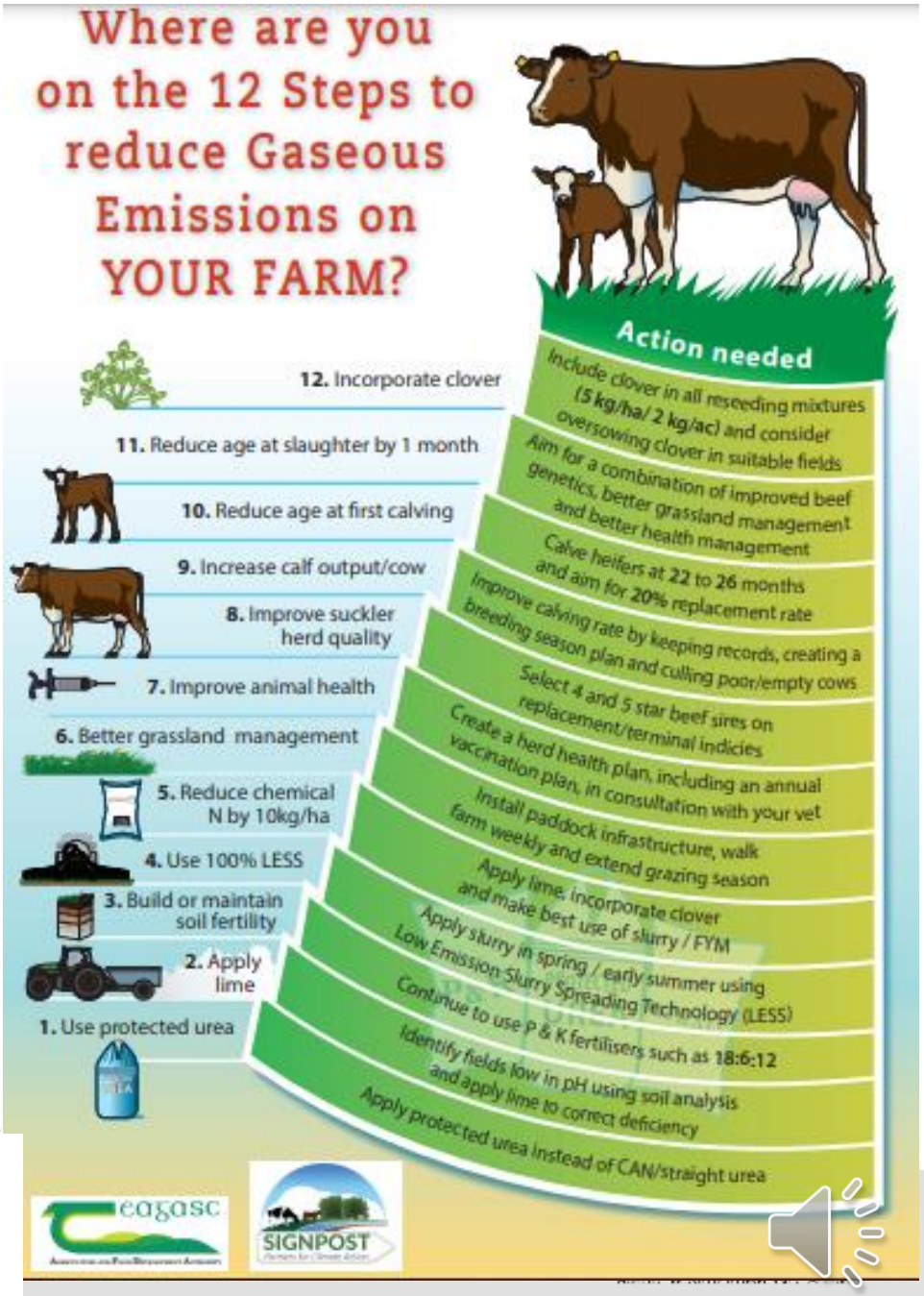
- 26 towers installed
- 2 left to be installed











SIGNPOST
Farmers for Climate Action

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