Greenhouse gas emissions and land use: carbon source and sink

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Technical seminar on GHGs and dairy cow genetics

17th June 2014

Outline of talk

- AFBI’s research on GHG emissions
- GHG mitigation strategies, particularly for nitrous oxide
- Potential for carbon offsetting
- Carbon sequestration by grassland soils
- Conclusions

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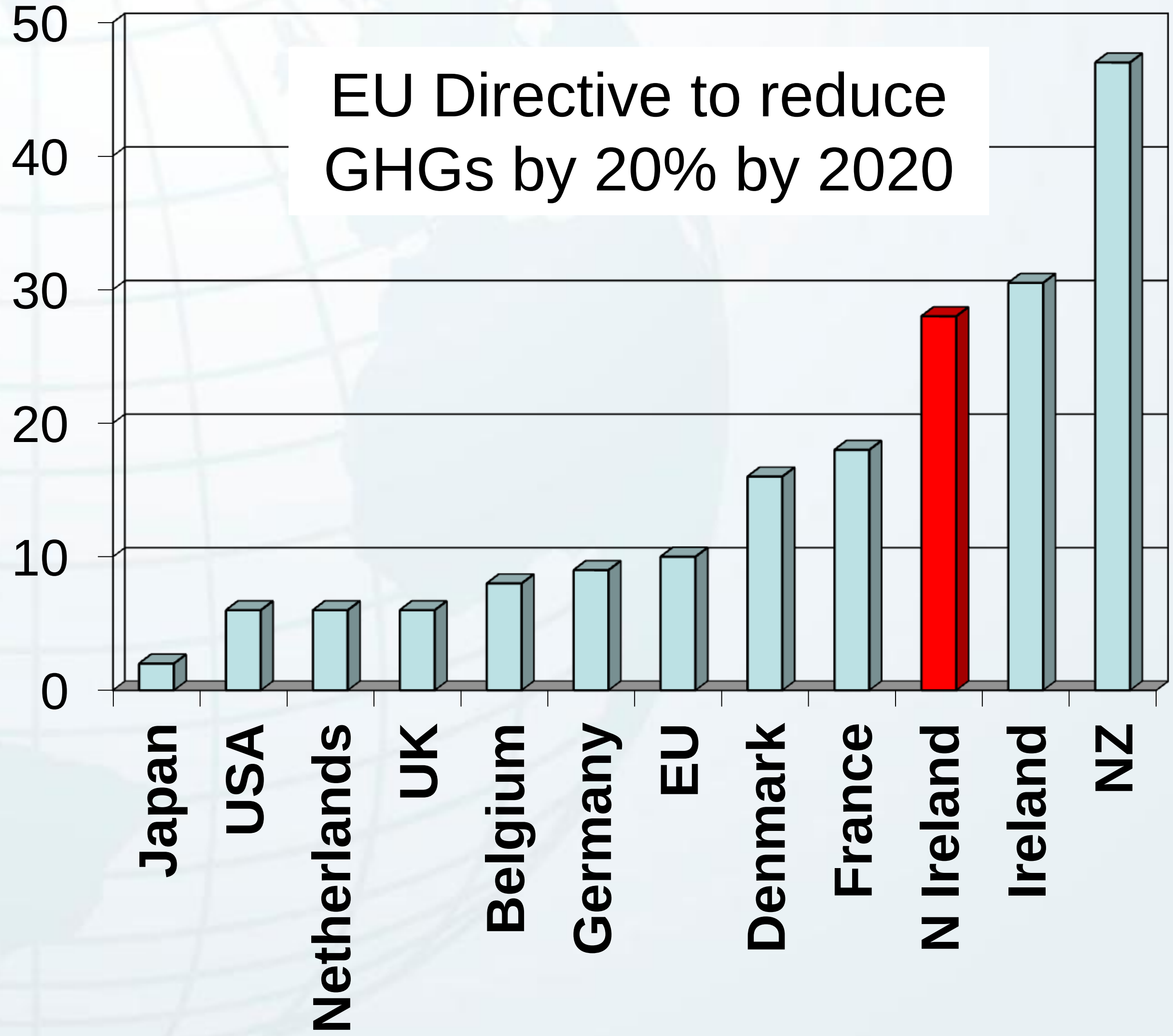
Emissions from agriculture as a % of total national emissions of GHGs



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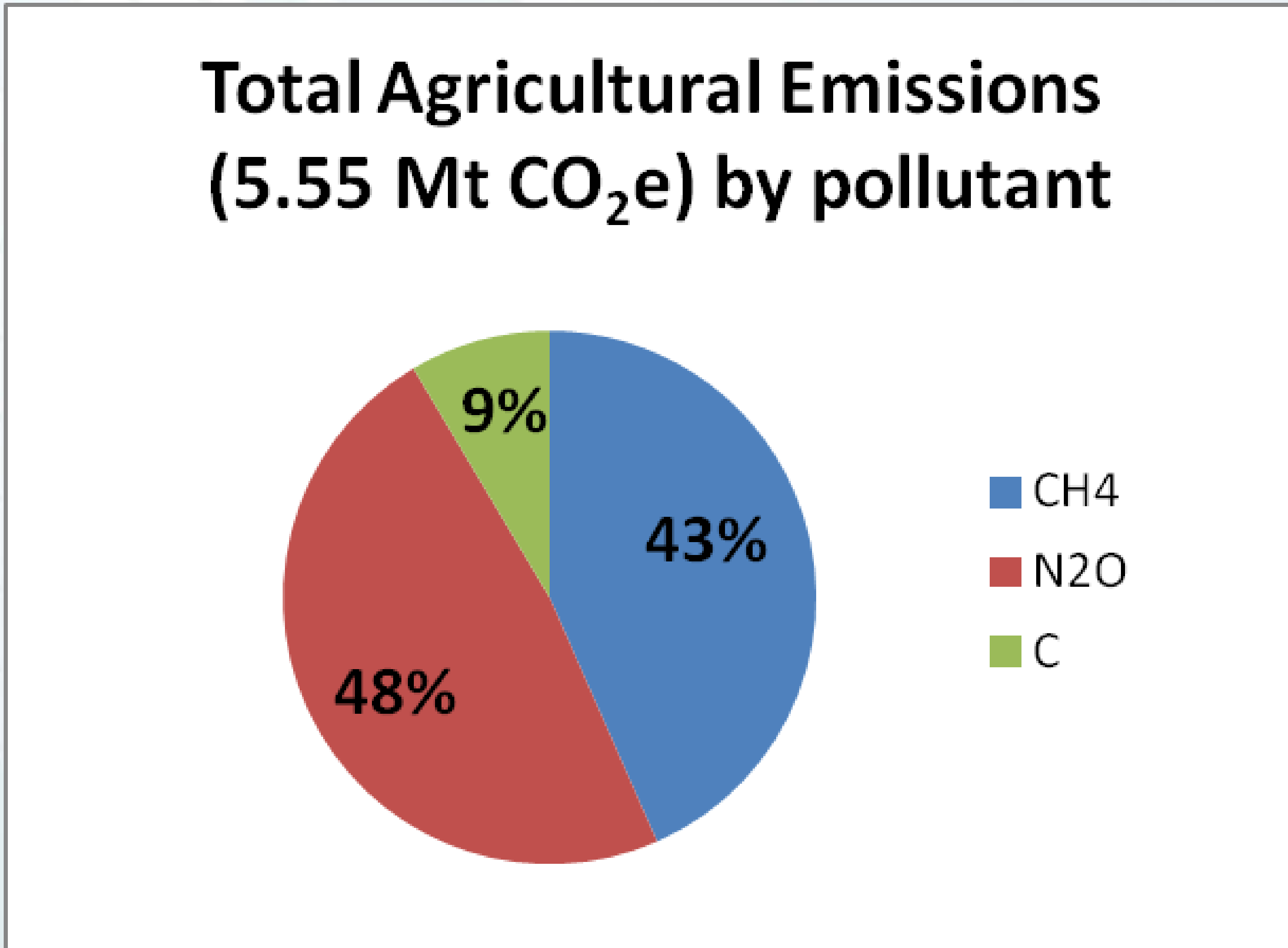
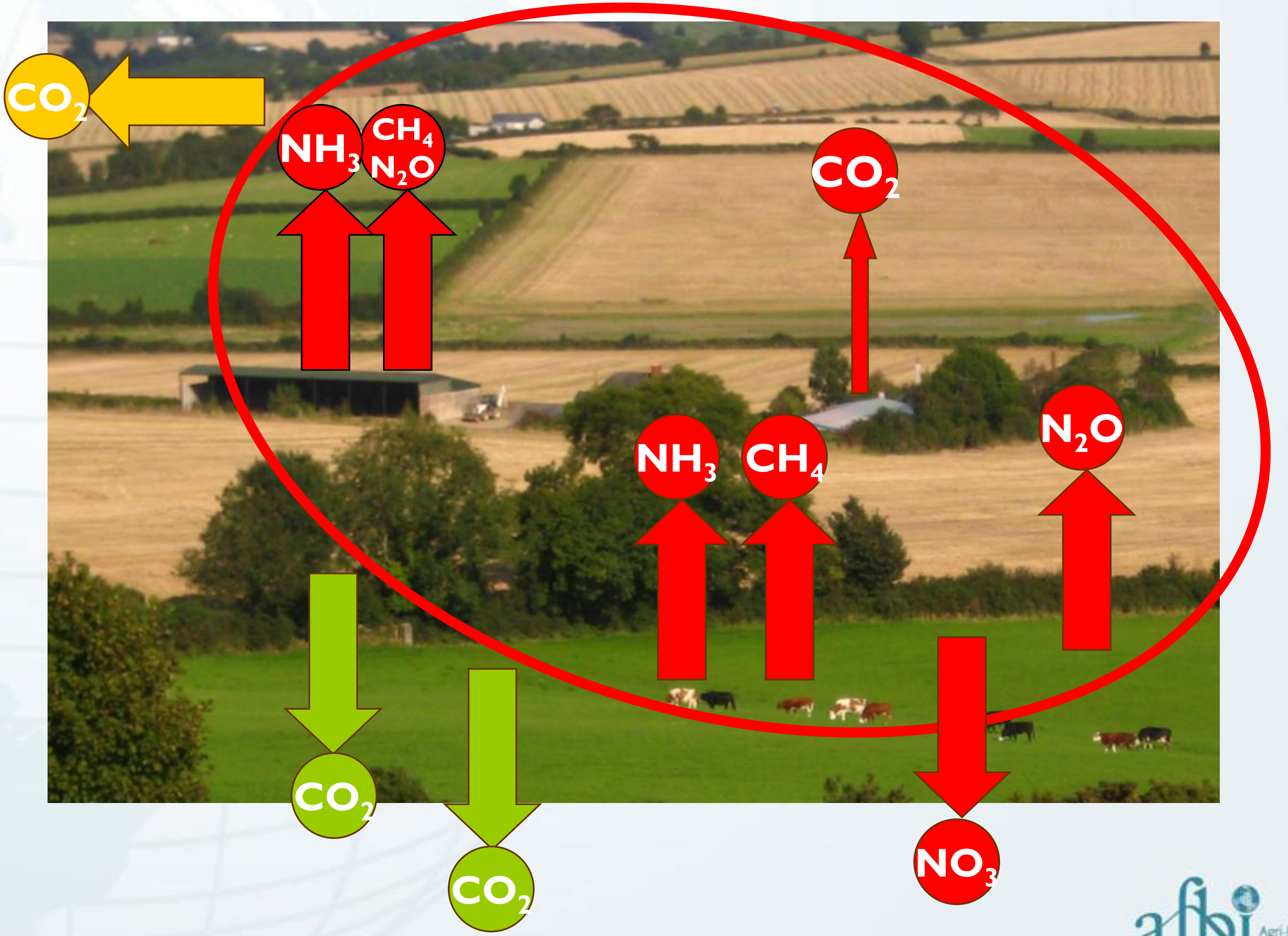
Northern Ireland Agriculture GHG Statistics, 2011



(Source: NAEI, 2013)

Emissions vs offsetting



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AFBI's GHG Research

- GHG emissions from agriculture
  - Provide information and tools to monitor GHG emissions accurately and enable mitigation strategies to be recognised
  - Through research, develop mitigation strategies to progress towards lower carbon intensity systems
  - Integrated research and technology transfer to help direct the industry towards agreed goals
- Enhancing carbon sequestration
- Land-based renewable energy
  - Research to underpin increased land-based renewable energy production from the agri-food sector

Department of Agriculture and Rural Development www.dardni.gov.uk

defra Department for Environment Food and Rural Affairs

AgriSearch NI Farmer Funded Research

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Provide tools to monitor GHG emissions accurately

- Current agriculture inventory is based on the use of standard emission factors for livestock, manures and fertilisers (large uncertainty)

- Ongoing research is producing more accurate GHG emission factors based on the variations which occur between different classes of livestock, livestock diets, soils and manures and fertiliser

- This will allow accurate base line emissions to be determined and thus provide the basis for the industry to gain recognition for mitigation strategies adopted

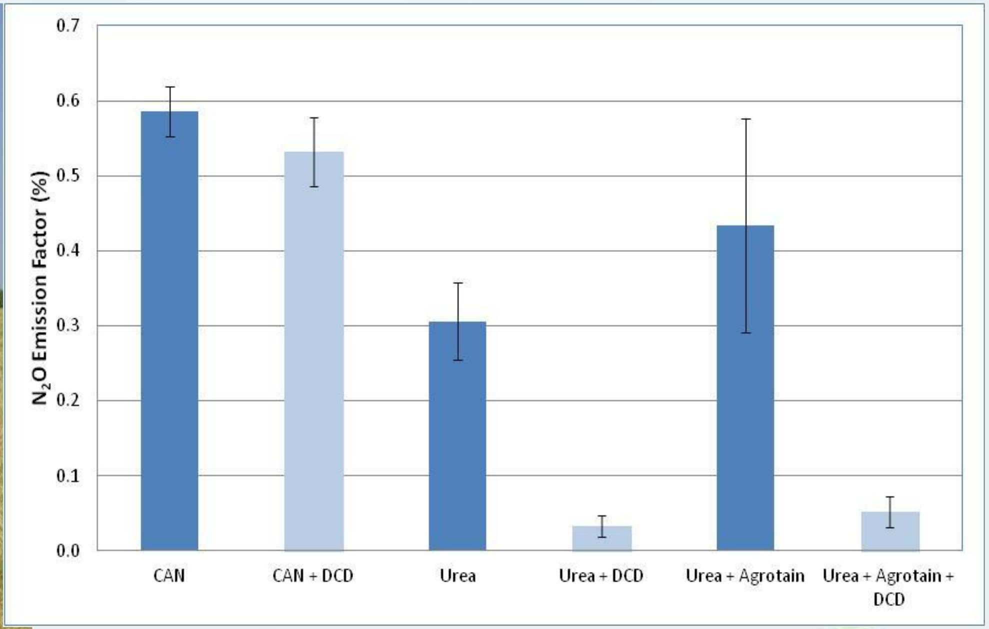
- AFBI is developing, testing and validating online GHG calculators

Agricultural
UK GHG PLATFORM

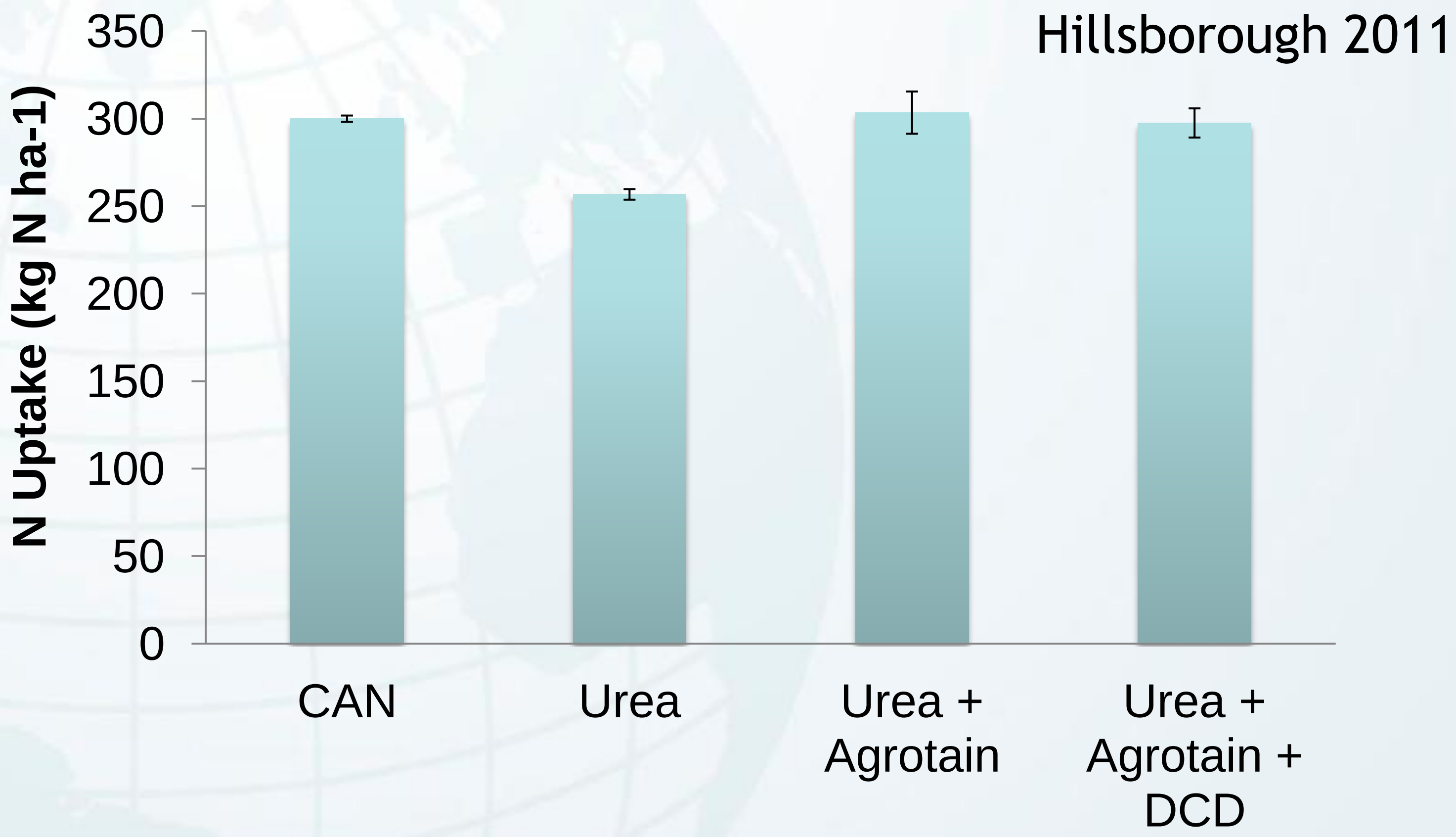
GHG mitigation approaches under investigation

Range of approaches being investigated:

- Nutritional and management factors under evaluation e.g. improved forage quality, new transition cow management techniques
- Improved livestock genetics
- New slurry management techniques and new fertiliser types

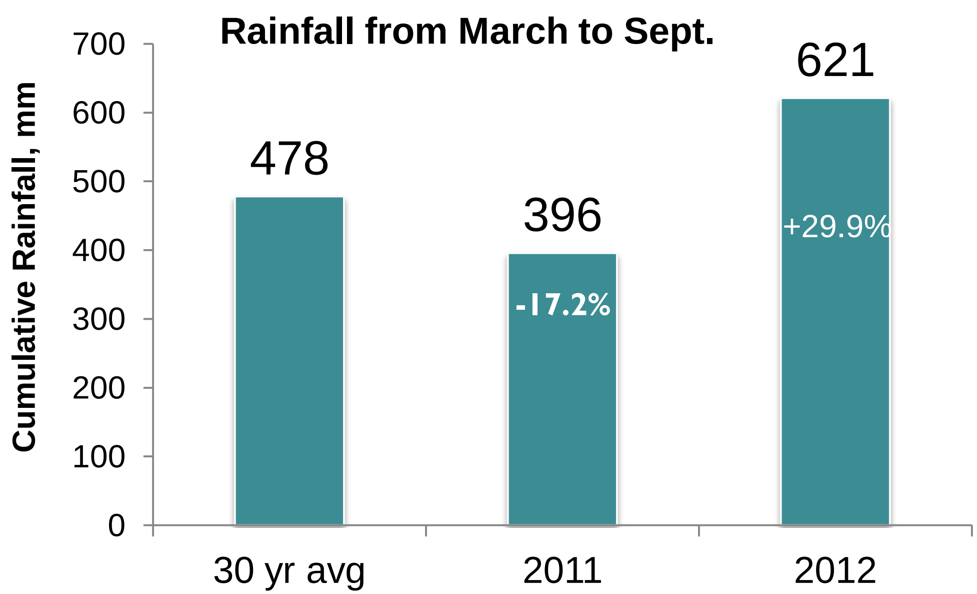


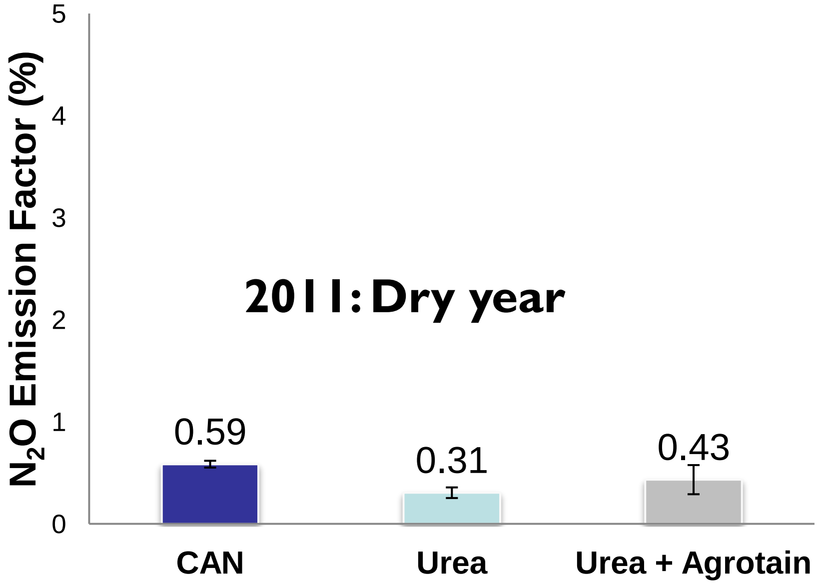
N uptake of grass

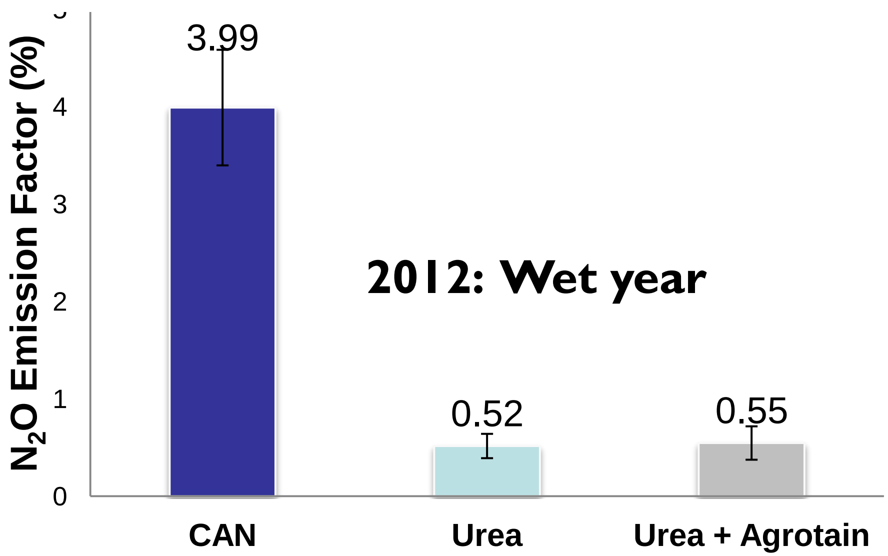


Urea is significantly lower (*$P<0.01$, LSD=26 kg N ha^{-1}*)

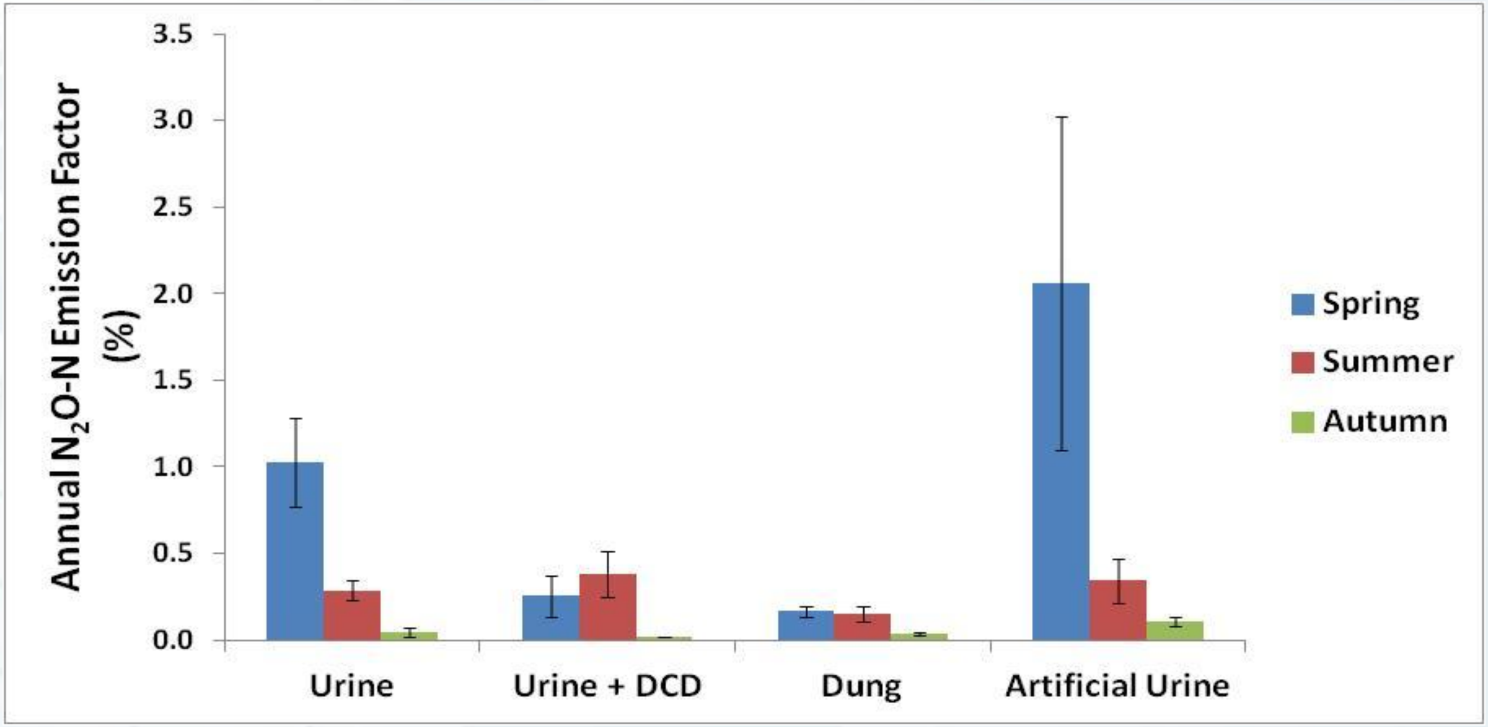
N_2O emissions from fertiliser in dry year vs wet year







Annual N_2O EFs from urine and dung (2012)



- Huge seasonal variation – N_2O emissions in Spring>Summer>Autumn (overall: $P<0.001$)
- N_2O EFs from urine were 1.02, 0.28 & 0.05% in spring, summer and autumn, respectively
- N_2O emissions from artificial urine were greater that real urine, particularly in the spring
- N_2O EFs from dung were 0.17, 0.15 & 0.04 in spring, summer and autumn, respectively
- DCD reduced N_2O emissions from urine by 75% & 50% in spring & autumn respectively, but was not effective in summer (rainfall 2.8 times 30 year average)
- Supports disaggregating the IPCC EF of 2% for cattle excreta by excreta type

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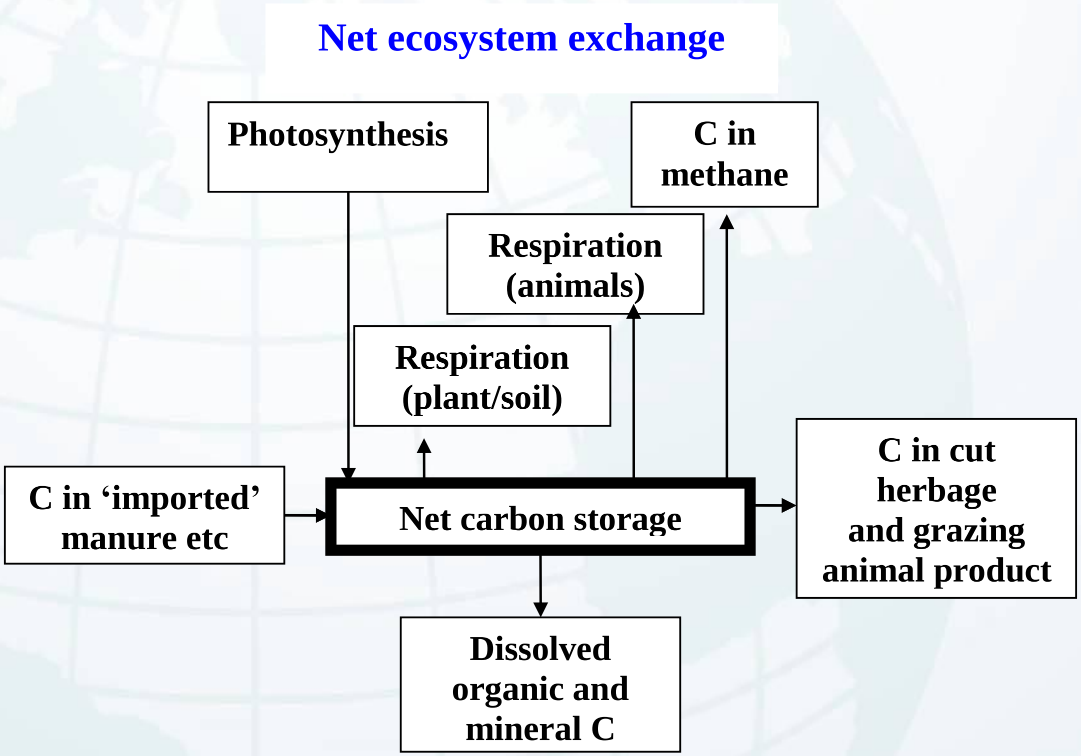
Investigating potential for carbon offsetting

- C sequestration in grassland soils
- Land based renewable energy
  - Anaerobic digestion – co-digestion
  - Biomass crops (e.g. SRC)

Carbon storage in the soil



Land use change - long term effect on C sequestration (t C/ha/yr)

	Mean
Permanent grass to crops	-2.57
Permanent grass to temporary grass	-2.12
Crop to permanent grassland	0.82
Crop to temporary grassland	0.08
Temporary grass to permanent grass	2.12
Temporary grass to crops	-0.42

Negative denotes loss of C

Smith et al. (2010)

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Measuring and Monitoring Carbon Sequestration

Comparison of carbon content of soil under an Energy crop (Hillsborough, 2013).

Soil CO_2 flux system used to measure CO_2 concentration (Hillsborough, 2013).

Carbon flux estimation using Eddy Covariance. Measures total ecosystem fluxes of carbon (Hillsborough, 2013).

CO_2 exchange measured using controlled transparent perspex chambers (Hillsborough, 2014).

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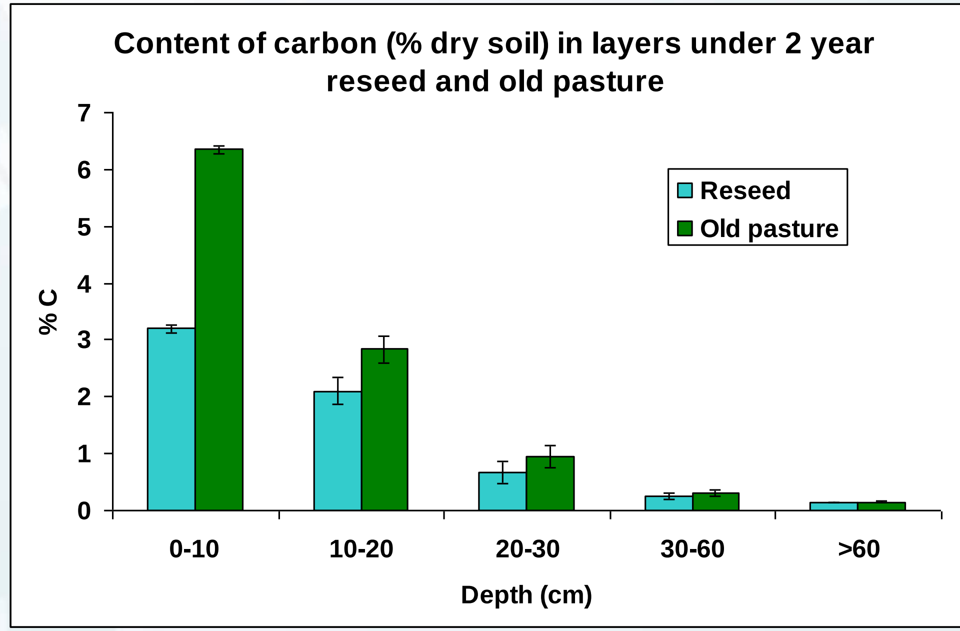
Further details on these research projects contact Dr Rodrigo Olave at AFBI Hillsborough

Comparison in C content of soil under a young and old sward (Saintfield House Estate, August 2011)



- Greatest difference in C content between the old and young sward is in the top10 cm of soil
- Old sward has almost double the C content of the young sward in that layer)

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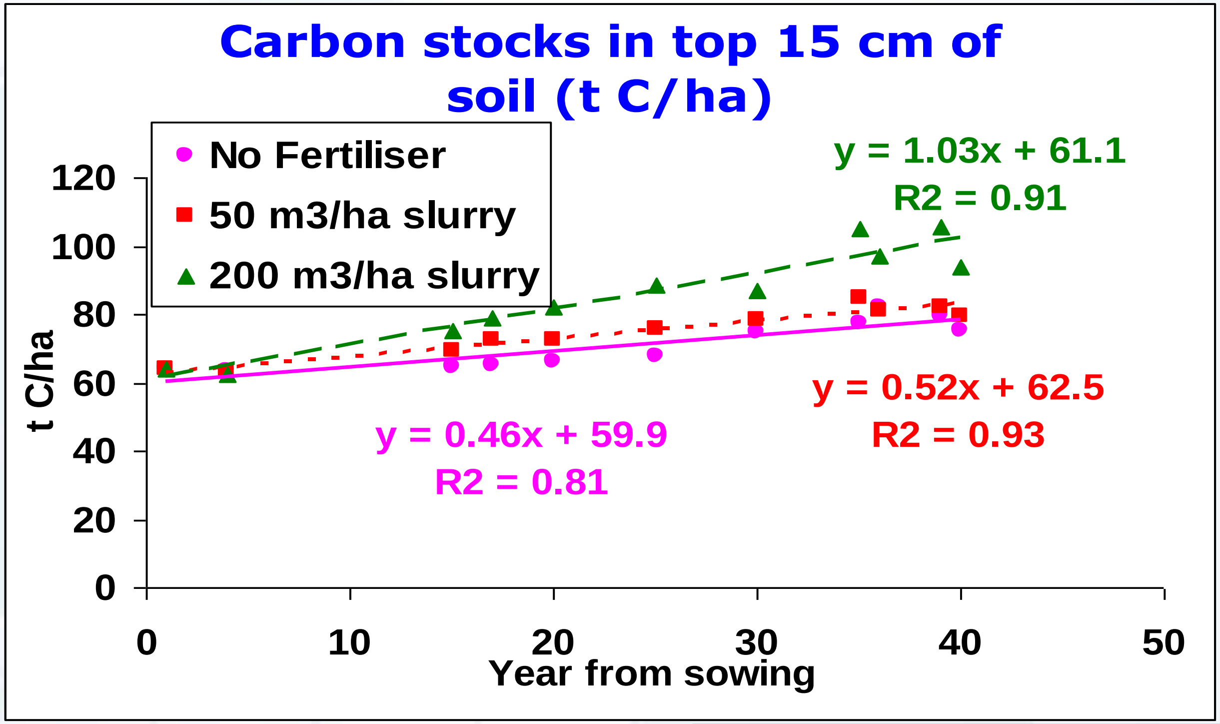
C sequestration : Archived soils

Carbon content measured in archived soil samples from:

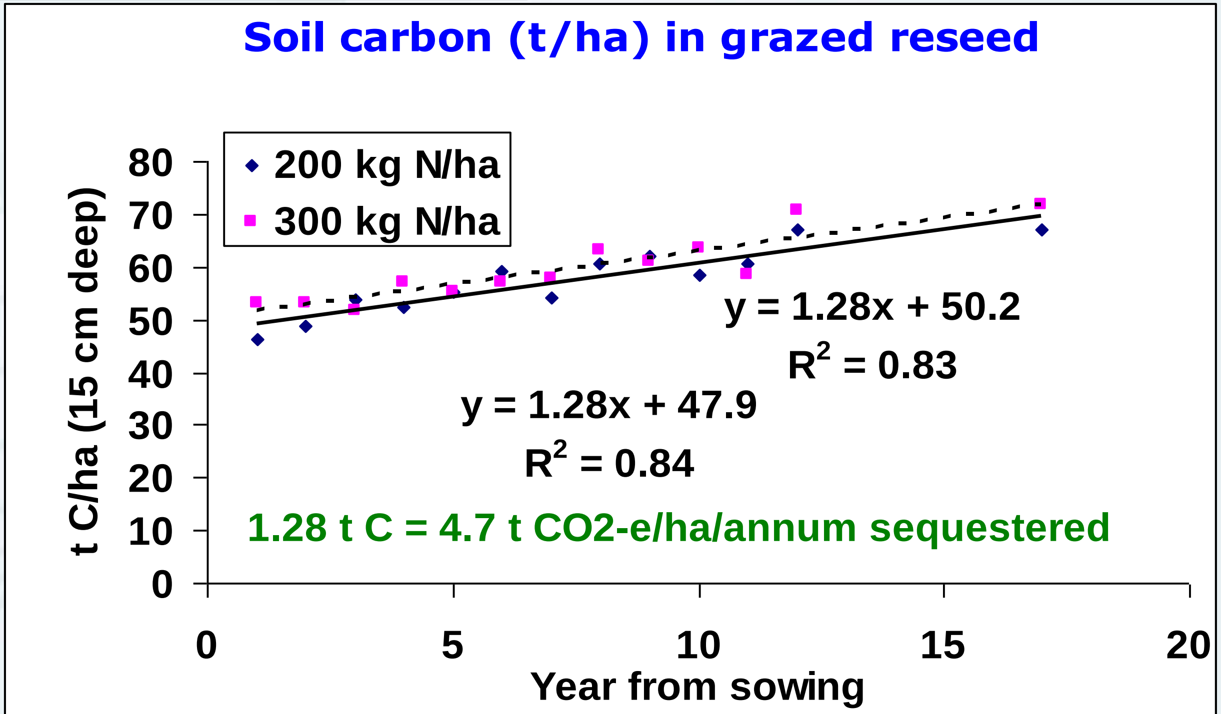
- Long term slurry rate trial – 40 years (3 of 8 treatments)
- N fertiliser grazing trial – 17 years (average of 2 of 6 treatments)

C content converted to C stored in top 15 cm of grassland soil



Slope of line = rate of C sequestration

Good linear fit in both experiments suggests ‘saturation’ of C in soils has not been reached



Conclusions (1)

- IPPC default N_2O EF for fertiliser N is 1% (used in GHG calculators)

- N_2O EFs for CAN range from 0.59% (dry conditions) to 3.99% (wet conditions)

- N_2O EFs from urea based fertilisers are lower than CAN, particularly when wet

- Replacing CAN with amended urea is an effective mitigation strategy to reduce N_2O emissions, whilst maintaining grass production

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Conclusions (2)

- Current estimate for C sequestration in NI carbon calculators is 0.7 t C/ha/yr for permanent grass (no adjustment for grass reseeds)
- For well managed grassland, data in NI suggests C sequestration is 0.5 to 1.28 t C/ha/yr
- GHG calculator will evolve as science develops and gaps in knowledge are addressed
- Uncertainty about saturation (C content equilibrium) causing difficulties in predicting rates of sequestration
- Do grassland soils act as a perpetual sink for carbon?
- More research is needed!

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Thank you for your attention

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