A Pathway to Methane and Nitrous Oxide Mitigation Discovery for Pastoral Agriculture in New Zealand

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Emission levels and New Zealand's GHG policy for agriculture

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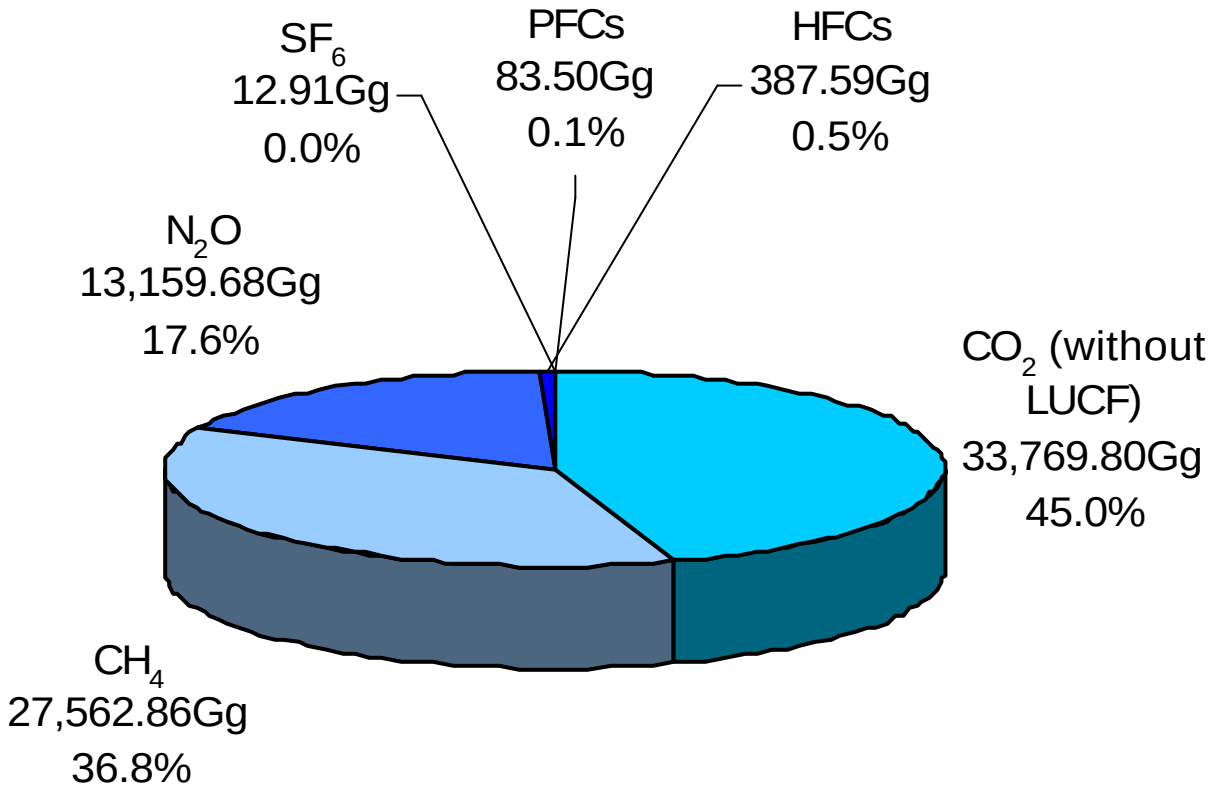
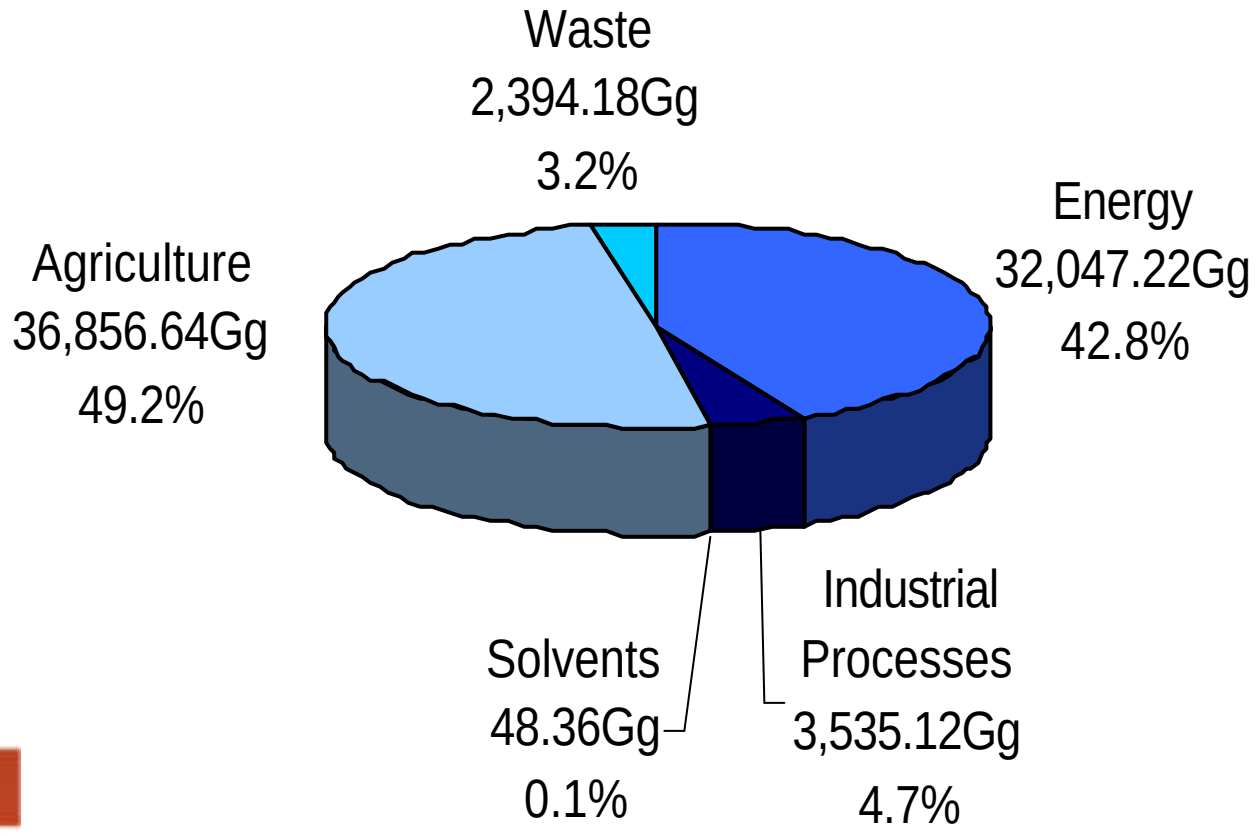
Emissions by gas in 2002



Emissions by sector in 2002

(Total emissions 74,976.34 Gg)



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Policy for agriculture

- No signatories to the UNFCCC are known to be applying carbon charges on agricultural non-CO_2 emissions
- There are currently few practical mitigation options for extensively grazed pastoral systems
- There are major GHG measurement difficulties

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Policy for agriculture

- As a consequence, agriculture in NZ will be exempt from a charge on methane and nitrous oxide emissions
- Instead, the sector has been asked to work with the Government to invest in research into methane and nitrous oxide mitigation technologies and practices
- An agreement has been signed between the Government and agricultural sector bodies - co-coordinated through the Pastoral Greenhouse Gas Research Consortium
- Farmers will, however, face a carbon charge on energy emissions from 2007

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A framework for considering agricultural methane and nitrous oxide mitigation options

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Mitigation of ruminant methane

- Enteric methane arises as a by-product of the fermentation of feed in the rumen
- Micro-organisms break down feed to produce VFA's, CO_2 & hydrogen
- Methanogens synthesize methane from hydrogen
- Between 2-15% of energy consumed in feed is lost as methane

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Mitigation of ruminant methane emissions

Animal

Genetics (variation between animals - 14-26 gms/kg dm intake)
Nutrition
Production system

Microbial

Direct modification of microbial processes
Methanogens
Protozoa
Acetogens
Phage
Vaccination (up to 8%)
Monensin (up to 10%)
Medium chain fats

Plant

Plant extracts
Plant species
(tannins - up to 10 %)

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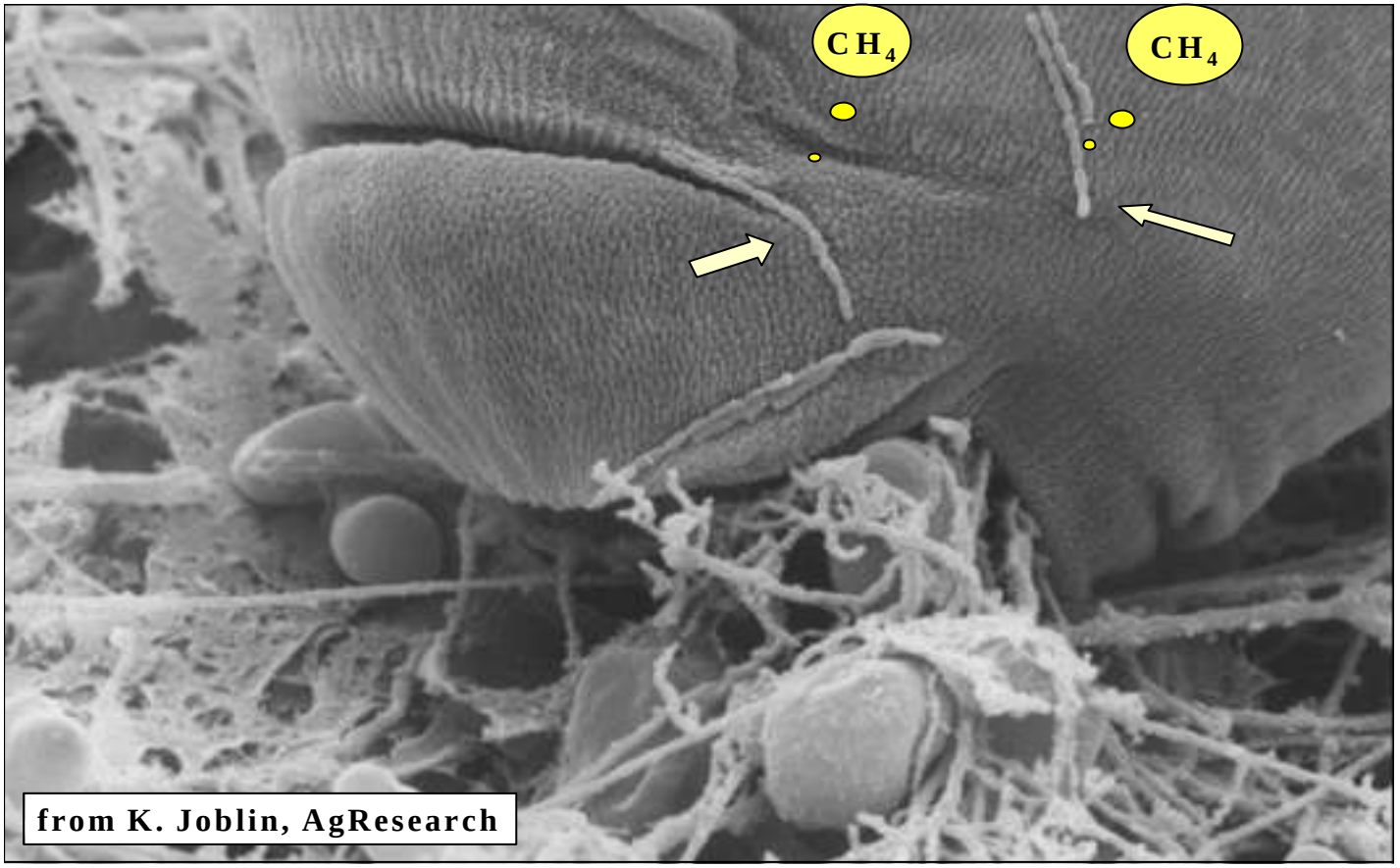
Methanogen



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Nitrous oxide mitigation options

- **Reduce the amount of excreta N**
  - Replace N boosted grass with maize silage
  - High sugar grasses
  - Shift N balance from urine to dung
- **Increase N efficiency of excreta and N fertiliser**
  - Restricted grazing of dairy and beef animals
  - Effluent utilisation on dairy farms
  - Nitrogen fertiliser timing, rates and forms
  - Nitrification inhibitors
- **Avoid anaerobic soil conditions**
  - Improve drainage
  - Avoid compaction

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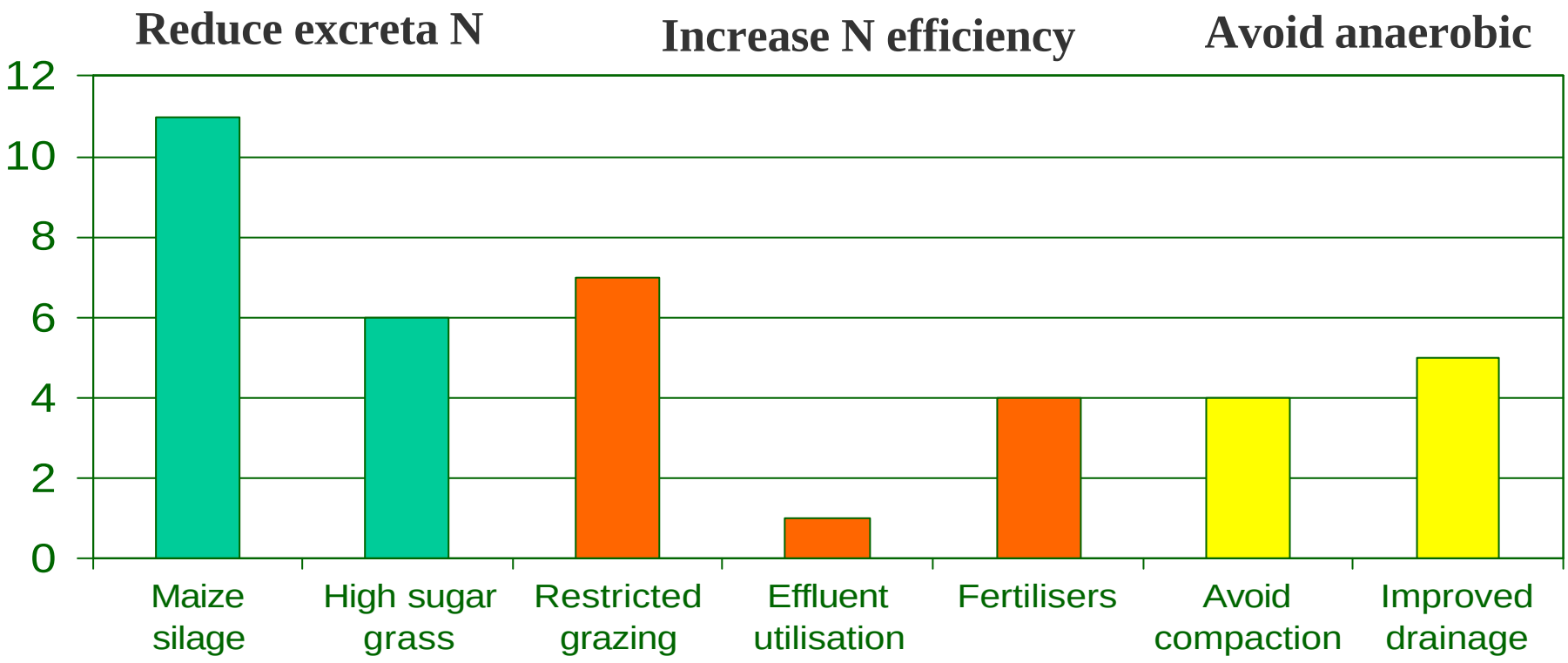
N_2O reduction potential by 2010 (%)



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The development of a government/industry research partnership

Pastoral Greenhouse Gas Research Consortium Strategy

- **Established in November 2002**
- **To develop one or more greenhouse gas mitigation solutions that can be implemented within New Zealand's agricultural industries.**
  - **That are practical, in terms of overall economics, product safety, and animal safety, and will produce sustainable results that are accepted by the international regulatory authorities and our customers**
  - **Reduce GHG production by 20% compared to what business as usual would have been**

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New research on an old technology used in a new way

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Urine patches are the main sources of nitrous oxide emissions in a grazed pasture

- **Research by Lincoln University and Ravensdown Fertiliser Co-operative Ltd shows that direct and indirect nitrous oxide emissions can be significantly reduced by using a new nitrification inhibitor technology based on Dicyandiamide (DCD) and called *'eco-n'***

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Summary of 3 years lysimeter results

- Up to 80% reduction in nitrous oxide losses
- Up to 60% reduction in nitrate losses
- Up to 33% lift in pasture production
- Up to 65% decrease in cation loss
- Current research is continuing under practical farm conditions

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Conclusions

- **A number of options are available**
  - But there is no simple single solution
- **A package of measures is required**
- **Options need to be evaluated at farm scale and for all three major GHGs collectively**
- **GHG measurement will continue to be an issue**
- **National inventories need to evolve so that they reflect mitigation solutions**
- **Countries need to work together to resolve these difficult technical issues**

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Final thought

Mitigation options

or

smart sustainable agriculture?

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Thank you!

New Zealand-farmed red deer being measured for methane emissions

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Outline of Presentation

- Emission levels and NZ's GHG policy for agriculture
- A framework for considering agricultural methane and nitrous oxide mitigation options
- The development of a government/industry research partnership
- New research on an old technology used in a new way

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Mitigation research approach

Split into three areas

- methane
- nitrous oxide
- GHG measurement, improved national inventories and process/systems modelling

Projects separated into:

- Discovery
- Proof of concept
- Development/on farm testing
- Technology transfer/commercialisation

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Policy for agriculture

- The agricultural sector is the largest export sector in the NZ economy
- It is dominated by ruminant animals farmed in low energy intensity pastoral systems
- New Zealand agriculture has the lowest agricultural support in the OECD at 1%. OECD average 31%

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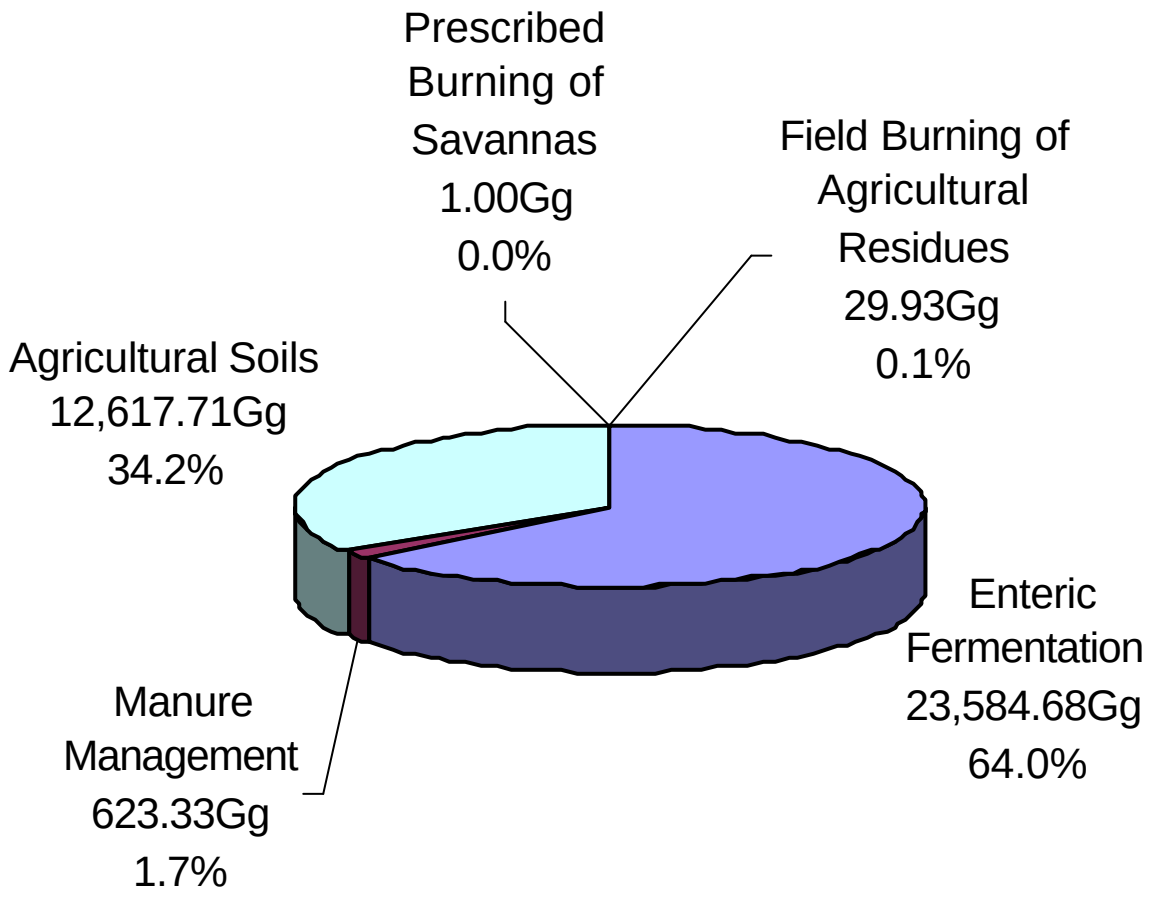
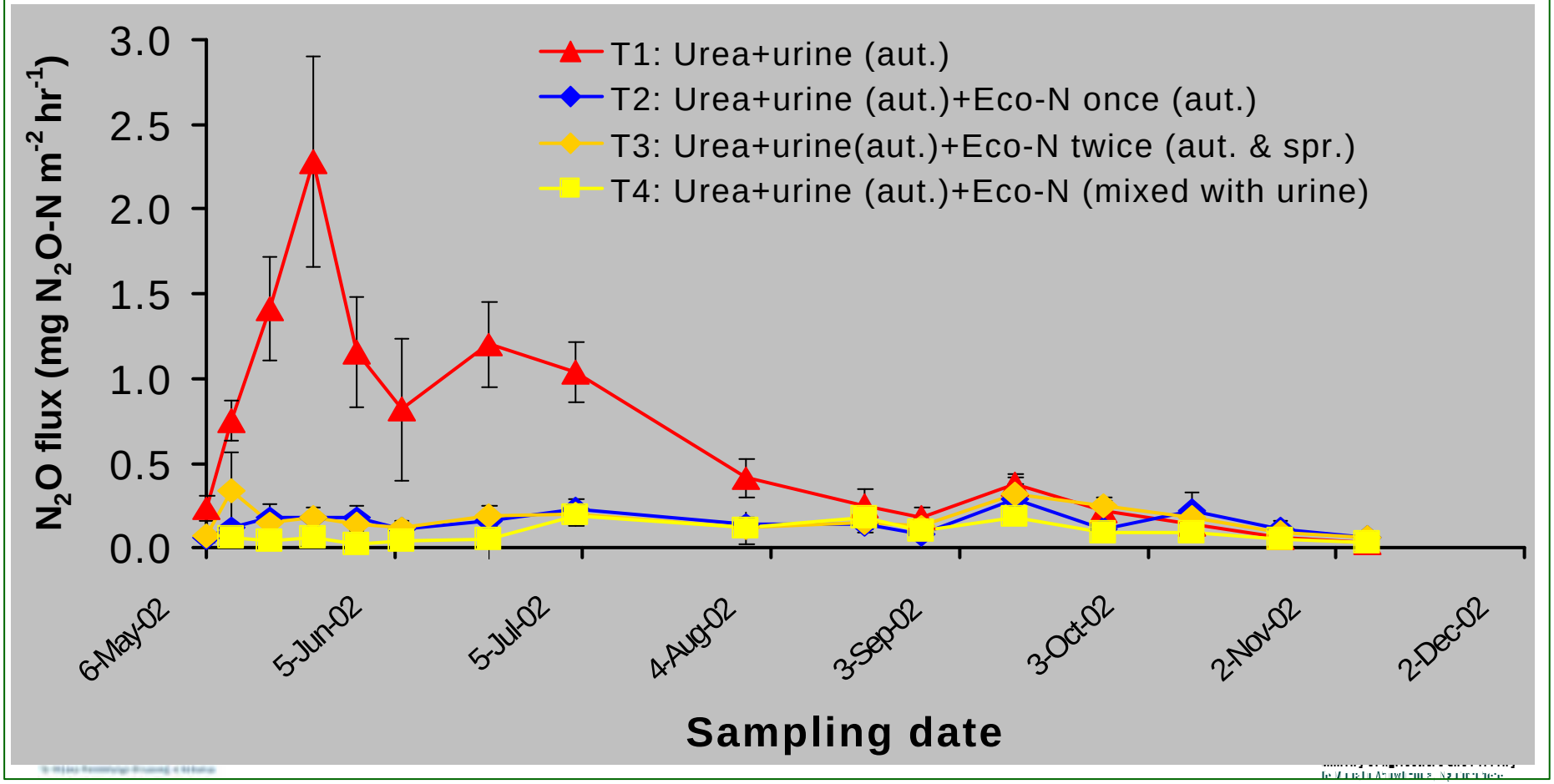
Agricultural Sector Emissions 2002



Direct nitrous oxide emissions: reduced by 80%



Mitigation options in pastoral agriculture

Need to consider

- Animal factors
- Microbial factors
- Plant factors
- Soil factors

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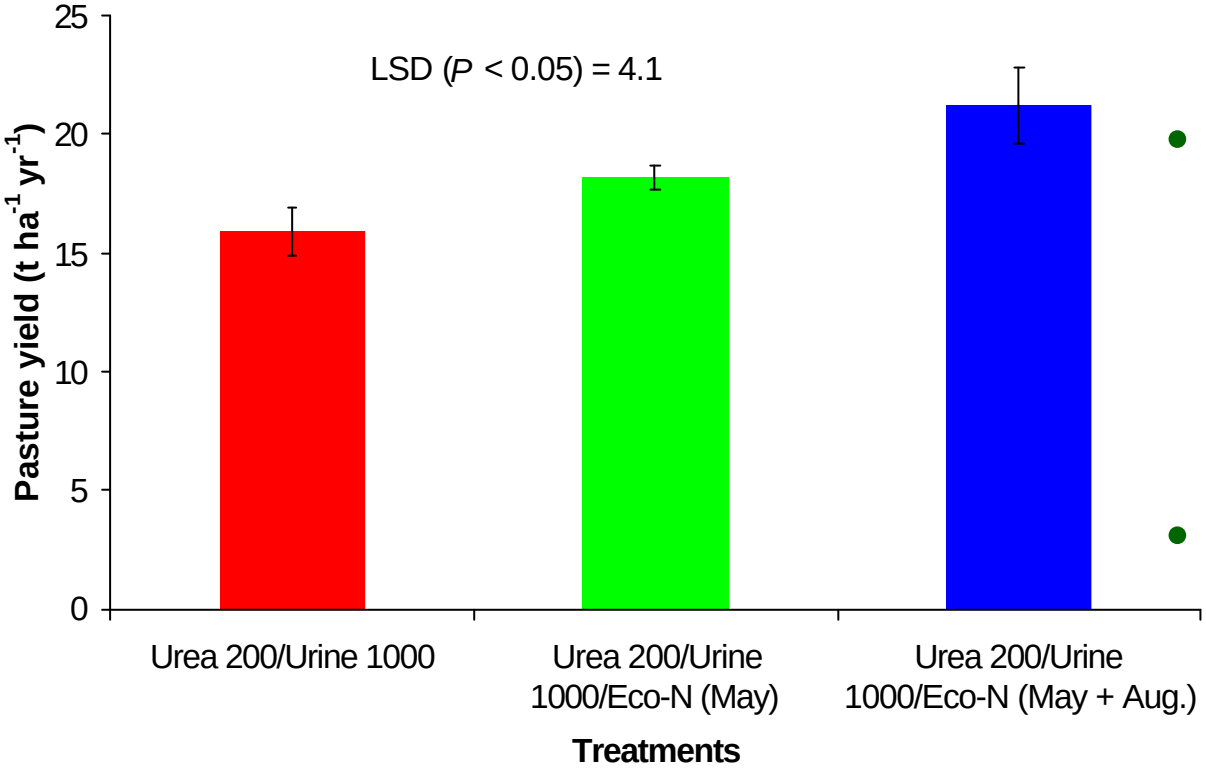
Conserving N grows more pasture



- **Herbage DM increased by 15-33%**
- **Statistically significant control vs. 2x application**

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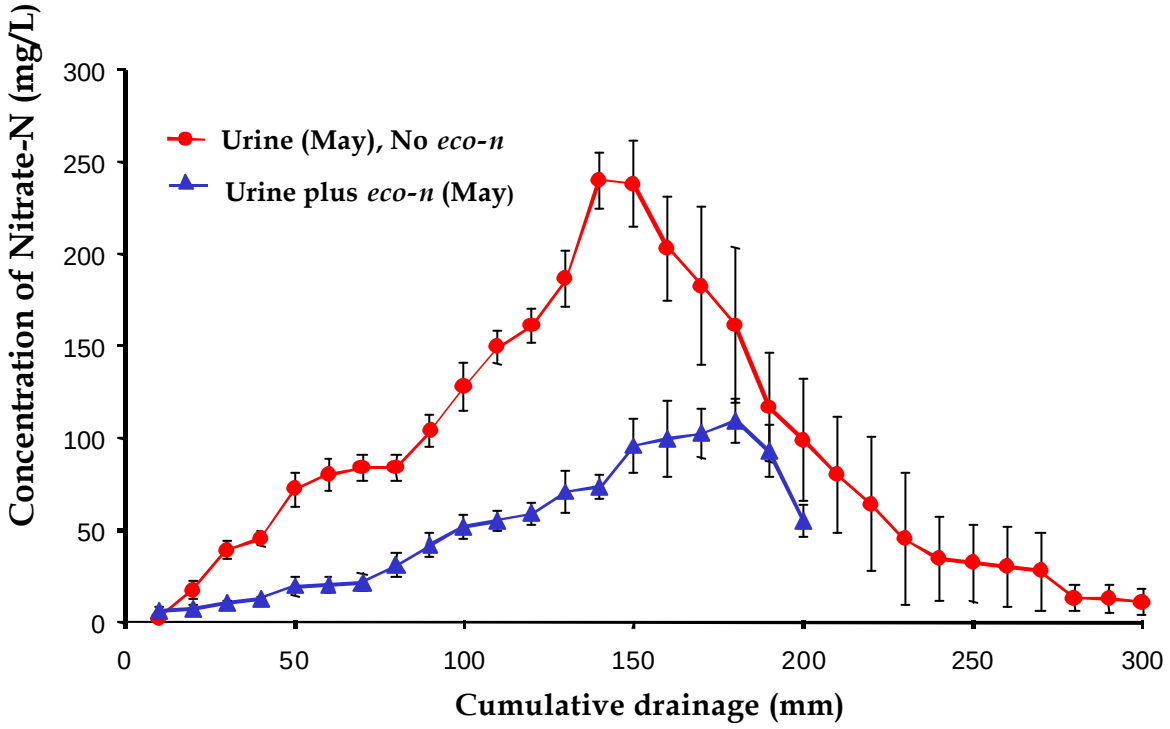
Indirect nitrous oxide emissions:
nitrate leaching losses reduced by 60%



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Nitrification inhibitors (e.g.DCD) reduce the activity of nitrifying bacteria.