# Australian Agricultural Contributions to Greenhouse Gasses

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*Greenhouse in Agriculture*

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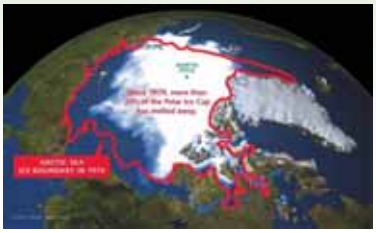
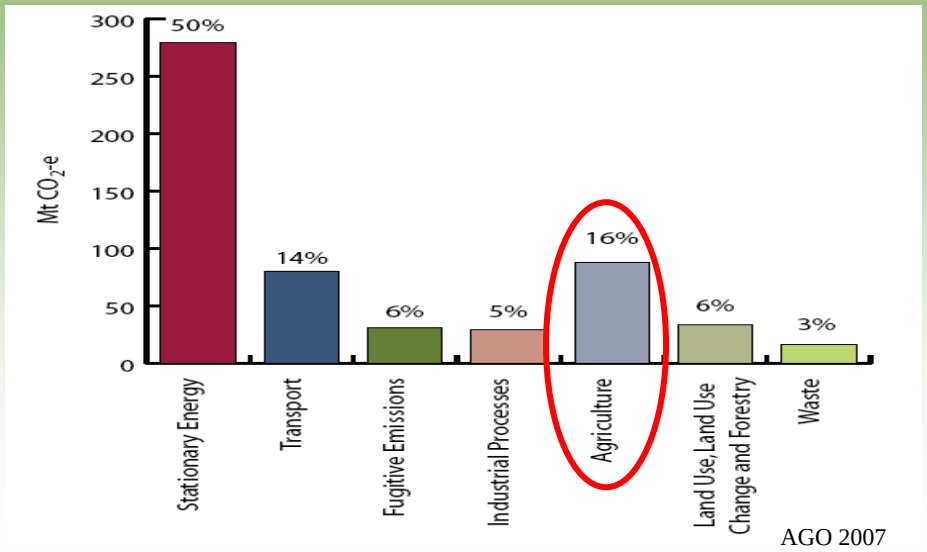
## Intergovernmental Panel on Climate Change
## *4th Assessment Report*

- Consensus view of +2500 climate scientists
  - CC is occurring
    - More rapidly than previously thought
    - > 90 % probability - is due to human activities
  - $CO_2$, $CH_4$ and $N_2O$
    - Highest in recorded and inferred history
  - Primarily due to:
    - Fossil fuels, agriculture and land-use changes

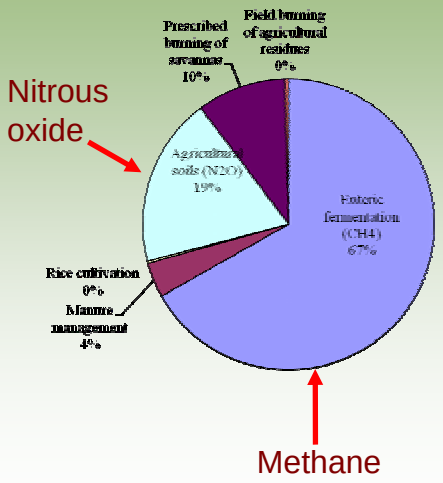


# Greenhouse Gas Emissions by sector Australia 2005




AGO 2007

# Greenhouse Gas Emissions Agriculture Australia 2005




- Agriculture
  - 60% of all methane
  - 85% of all nitrous oxide

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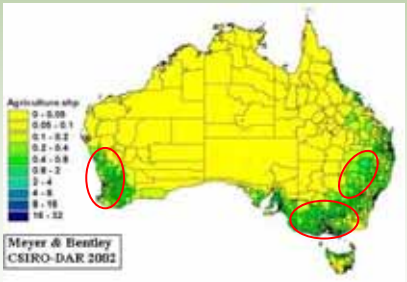
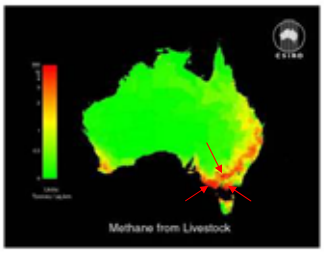
# Spatial Intensity of Methane and Nitrous Oxide from Agriculture

***Nitrous Oxide from Agriculture***
***(kg N/ha/yr – all sources)***



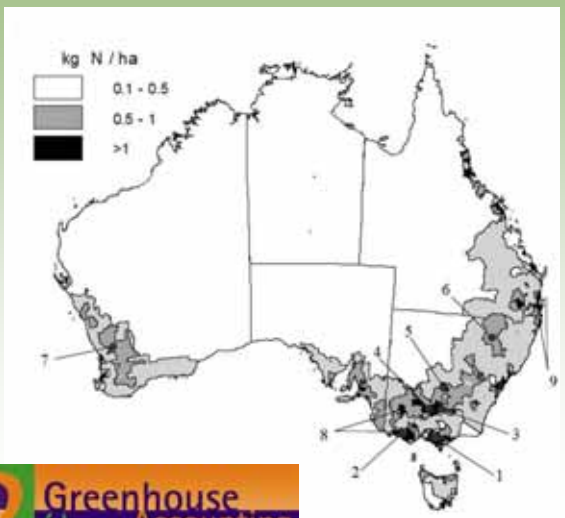

***Enteric Methane***
***(t/sq km)***




Greenhouse in agriculture

Methane
1. Dairy cows
2. Beef / Sheep

Nitrous oxide
3. Wheat
4. Irrigated Dairy Pasture
5. Irrigated Maize
6. Irrigated Cotton
7. Wheat
8. Mixed Farming Systems
9. Sugar cane




Greenhouse Accounting
CRC

## Methane emissions from dairy cattle

- Shorter lifetime in atmosphere and high GWP (23)
- A significant loss of energy

| Animal Class | Methane (kg/year) |
|---|---|
| Mature ewe | 10 to 13 |
| Beef steer | 50 to 90 |
| Dairy cow | 90 to 146 |

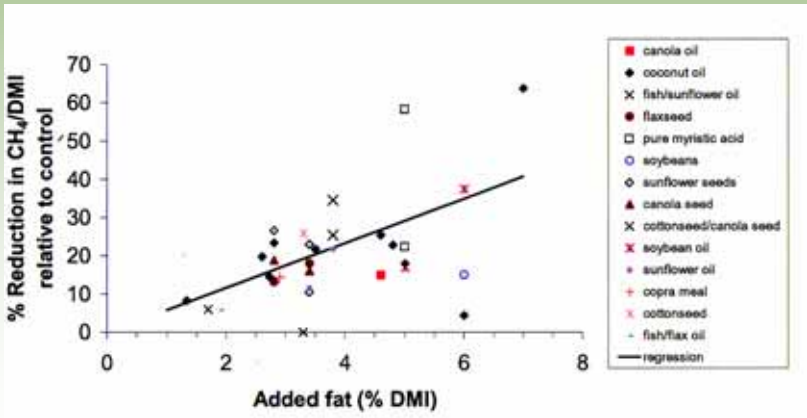
## Methane Abatement

- Improving Animal Genetics
  - Up to 20% difference
  - Evaluate high & low FCE /NFI
- Nutrition and Feed management
  - Spring vs summer pasture
  - Up to -37% difference
- Animal Management
  - Reducing unproductive animal numbers
- Longer-Term options
  - Vaccination, microbial intervention

Eckard & Grainger 2006

# Oil Supplements

- 6% less methane / 1% added fat




Beauchemin, Grainger *et al. 2007*

# Dietary Supplements

- Oil + Summer Pasture
  - Milk Solids +16%
  - Methane (g/day) -12%
  - Methane /kg MS -21%
- Tannin + Spring Pasture
  - Methane (g/day) -14 to -29%
  - Urine N -45 % to -59%
  - Faeces N +18% to +21% increase

Grainger *et al. 2007*

## Potential Source of Oils for Livestock

| Item | % oil |
|---|---|
| Cooked potato chips | 18 |
| Soybean pollard | 10 |
| Ensiled grape marc (including tannin) | 16 |
| Brewers grains | 8 |
| Safflower meal | 12 |
| Palm kernel meal | 10 |
| Tomato pomace | 15 |
| Hominy meal | 10 |
| Bakery waste (dried) | 13 |
| Linseed meal | 11 |
| Citrus pulp (wet) | 10 |
| Naked oats | 15 |
| Sunflower seeds | 58 |

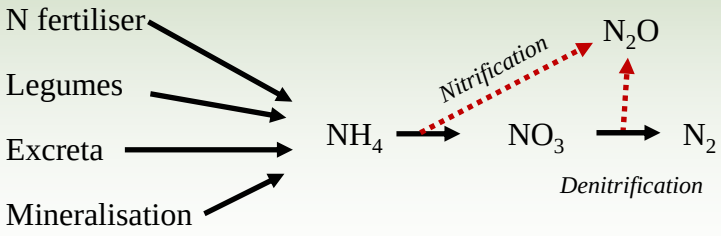
Grainger *et al. 2007*

## Nitrous Oxide

- Global warming potential
  - 297 x $CO_2$
  - Long residence time in atmosphere
- Inefficient use of nitrogen
  - Total N lost
    - Cropping - 20 to 50%
    - Grazing - 40 to 60%

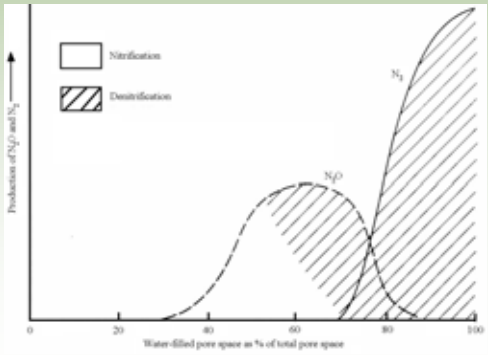
## Nitrous Oxide - Production in Soils

- Microbial process
- Warmer and more anaerobic (wet) soils



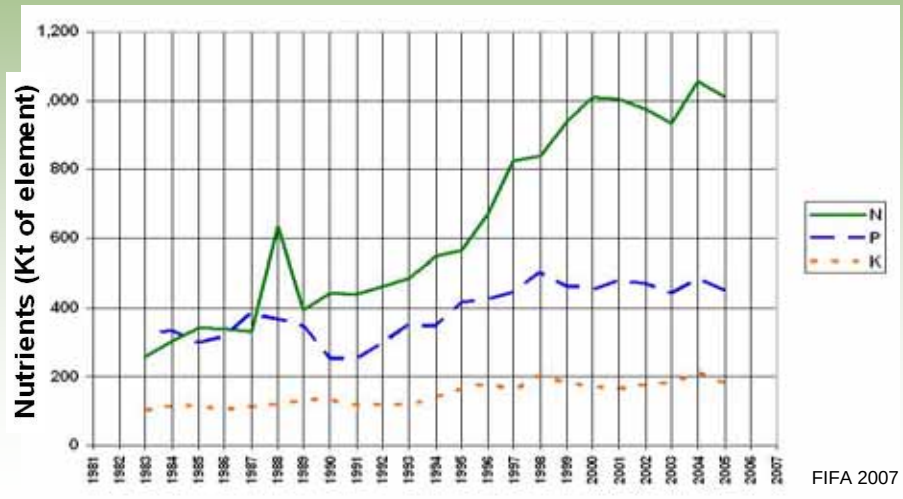

## Nitrous Oxide - Drivers

- Substrate availability
  - C and N ($NO_3$)
- Soil Temperature
- Anaerobicity
  - WFPS




Granli & Bøckman 1994

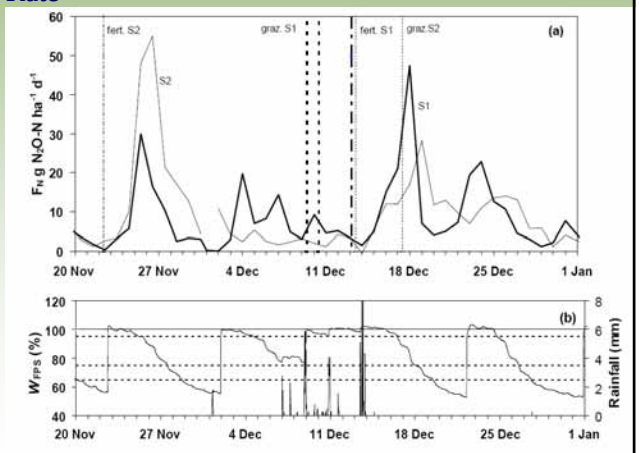
# Nitrogen Fertiliser trends in Australia




FIFA 2007

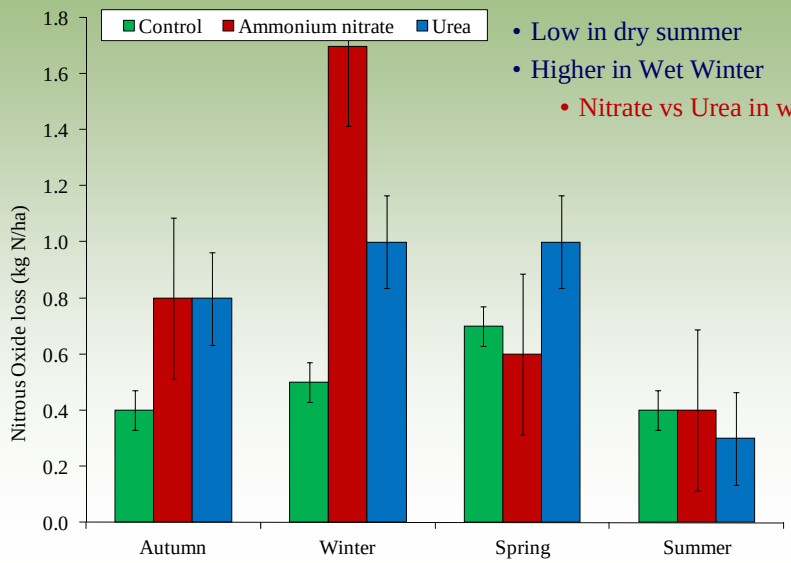
# Daily $N_2O$ fluxes
# Irrigated dairy pastures in Victoria

- $N_2O$ flux 2-3 days after irrigation, for 1-2 days
- Annual $N_2O$ Emission Rate
  - Zero 1.4 kg N/ha
  - 150 kg N 2.0 kg N/ha
  - 200 kg N 4.0 kg N/ha




Phillips *et al.* 2006

# N Source in winter rainfall
# Dairy Pastures

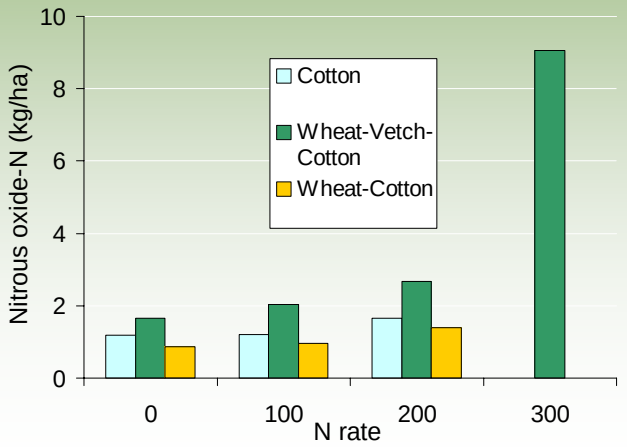



- Low in dry summer
- Higher in Wet Winter
  - Nitrate vs Urea in wet soils

Eckard *et al.* 2002

# N Rates on Irrigated Cotton

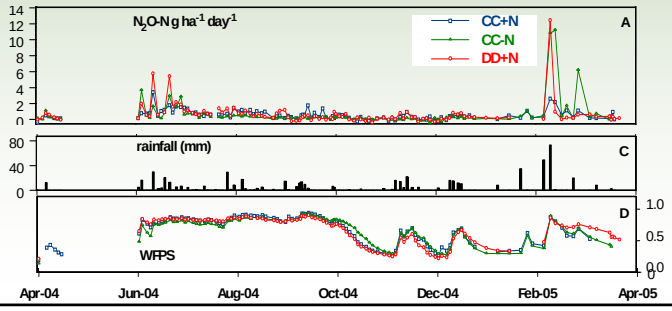
- Rate exceeds plant requirement
  - High $N_2O$ losses




Grace *et al. 2007*

## Annual $N_2O$ Emissions from Winter Wheat

- Cunderdin — 0.09 – 0.11 %
- Rutherglen — - 0.05 – 0.1 %
- Low $N_2O$ emissions
  - N matched to plant demand
  - Applied in Cool Season




Barker-Reid *et al. 2007*

## Stubble Management in Irrigated Maize

- Stubble burning + 300N
  - 2.8% of N
- Stubble retention + 300N
  - 1.6% of N
  - >40% lower

Galbally, Meyer *et al. 2006*

## Improving National Estimates

- Revised National Inventory for 2004
  - From 1.25% of all N fertiliser to…

| Production System | Emission Factor (% applied N) |
|---|---|
| Irrigated pasture | 0.4 |
| Irrigated crop | 2.1 |
| Non-irrigated pasture | 0.4 |
| Non-irrigated crop | 0.3 |
| Sugar cane | 1.25 |
| Cotton | 0.5 |
| Horticulture/vegetables | 2.1 |

Galbally *et al. 2005*

## Managing Nitrous Oxide from N fertiliser

- Fertiliser management:
  - Rate, Timing, Source and Placement
  - Water use / Irrigation management
- Soil management:
  - Conserving soil structure
  - Stubble retention
- Fertiliser formulation
  - Nitrate vs Ammonium in wet soils
  - New Market for
    - Controlled release
    - Nitrification inhibitors

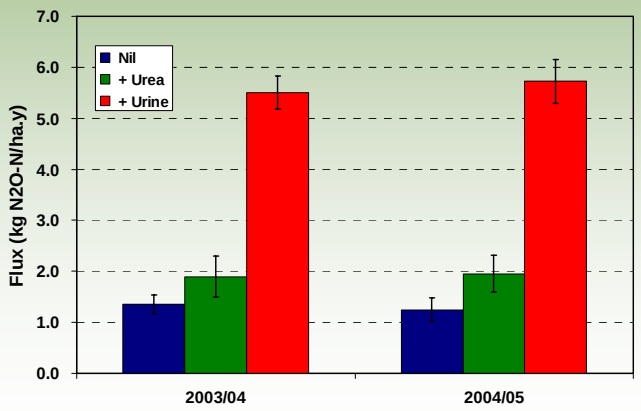
## Nitrous Oxide
## Best Management Practices

- BMPs incorporated into:
  - FERTCARE®
  - EMS
  - Existing BMP manuals
- New AGO ‘guidelines’


## Urine - The “wild-card” problem

- Cows excrete 75 - 80% of N ingested
- N rates in a urine patch 1000 -1300 kg N/ha eq
  - 3 to 4 years to fully cover pasture
  - 40 to 60% of N excreted is lost!

# Annual $N_2O$ Emissions from urine on dairy pastures in Victoria




Kelly *et al;*. 2007

# Urine N Management

- Nitrification inhibitors
  - 60 - 80% reduction in $N_2O$
  - Increased pasture production 15%?
  - Emissions Trading Incentive?
    - New Zealand Inventory
- Dietary Supplements
  - Tannin, salts, inhibitors
  - Balancing CP:ME
- Grazing Management
  - Wet season, Stand off pads
  - Irrigation and drainage

De Klein and Eckard 2007

# In Summary

- A carbon-constrained future
- New incentive for
  - Nitrification Inhibitors
  - Controlled release products
- Improving efficiency in Agriculture

Greenhouse
in agriculture

www.greenhouse.unimelb.edu.au

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