Mitigating farm livestock greenhouse gas emissions in the EU

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Data for EU 15 so that trend over time can be seen (Source UNFCCC)
EU 15 account for 88.5% of EU 25 agricultural GHG emissions (UNFCCC 2003 data)
Data for EU 15 so that trend over time can be seen (Source FAOSTAT)
EU 15 account for 90% of EU 25 cattle and 98% of EU sheep population (Source FAOSTAT)
Share of total EU agricultural GHG emissions attributed to enteric methane (2000)

- Other: 68%
- Enteric CH4: 32%
Breakdown of EU enteric methane emissions

- Beef: 39%
- Dairy: 52%
- Sheep: 9%
- Other: 32%

Share of total EU agricultural GHG emissions attributed to enteric methane (2000): 68%
Measures with potential to reduce emissions

- Policy
  - Luxembourg Agreement, Nitrates Directive

- Continued improvements in existing technologies
  - Improved animals through breeding, better feed conversion efficiency

- Additional changes in farm management practices applied specifically to reduce methane emissions
  - Feed more concentrates and less forage; younger slaughter of beef animals

- New technologies or new use of existing technology
  - e.g. feeding oils, propionate precursors, probiotics, plant extracts
  - These are at various stages of development
Measures with potential to reduce methane emissions considered in this analysis

- Improved productivity through breeding
- Lifetime management of beef cattle
- Replacing roughage with concentrate
- Improving forages / legume inclusion
- Feeding plant oils
- Feeding propionate precursors

- Policy considered separately
Factors to account for when calculating emissions reduction potential of any measure
A. Feasibility of measure

- Is the measure feasible in the EU?
  - Some measures are not permitted in the EU such as bST, monensin, growth hormones
- If measure is feasible, model value = 1
- If measure is not feasible, model value = 0
B. Technical availability for different animal types (dairy cows, beef cattle, sheep)

- Some measures not applicable to some animal types
  - Lifetime management of beef cattle (i.e. reducing age to reach slaughter weight) not applicable to dairy cows

- Some measures not applicable for all the animals’ life
  - Concentrate based measures only applicable during lactation with dairy cows
  - Where a measure requires daily administration or feeding, it is often difficult to apply to grazing beef cattle
C. Technical adoption feasibility

- Are farmers in a position to adopt the technology?
  - Knowledge, equipment, extension services, etc
- Not considered to be a limiting factor in EU
D. Proportional reduction in enteric emissions

- Review scientific literature to determine likely response to each measure

- Many gaps, so many assumptions
  - E.g. data for impact of feeding oils available for beef cattle, so extrapolated to dairy cows
  - Much research still needed to quantify scope of the measures
E. Proportion of animals that measure can be applied to

- Generally 100%
- If measure was already applied to some animals, then less than 100%
  - bST already used with one third of cows in N. America
  - Growth hormones already used on some cattle in many countries
  - Not an issue with measures considered for EU in this analysis
F. Adjust for non-additivity of individual measures

• Not much data in literature concerning simultaneous adoption of 2 or more measures

• Some evidence that some measures are not additive
  – ionophore antibiotics and oil supplementation

• Model attempts to account for non-additivity
Example of additivity of measures in action

- Consider two measures, each of which reduces methane by 20% when applied singly
  - If a cow produces 100 kg methane, measure one reduces this to 80 kg
  - If measure 2 is then applied, it reduces emissions by 20% of 80, not 20% of 100
    - Final emissions are 64 kg
- Model attempts to account for this
Summary of model used

Reduction in methane = sector emissions x A x B x C x D x E x F

A = measure feasibility (0 or 1)
B = technical availability (0 to 1)
C = technical adoption feasibility (scale of 0 to 1 based on milk yield, but 1 for all EU)
D = proportional reduction in methane (0 to 1)
E = proportion of animals that the measure can be applied to (0 to 1)
F = non-additivity adjustment factor (~ 0.6 for dairy cows, 0.5 for other cattle, 0.55 for sheep)
Assumptions in model

- Production is held constant over the period studied (i.e. milk quotas remain in place)
- Baseline emissions taken from Steele and Kruger (in preparation) with details at country level supplied by B. DeAngelo (US EPA)
  - Compiles emissions projections for each country from National Inventory Reports)
Potential of various measures to reduce enteric methane emission in the EU by 2030

- Feeding oil
- Replace rougage with concentrate
- Improved productivity through breeding
- Propionate precursors
- Improved forages
- Lifetime management - beef cattle

Total potential reduction with these measures = 43 Tg CO₂ equivalent

However cost of implementation and other barriers must be taken into account
Estimated cost per tonne CO$_2$ abated
(marginal cost, assume no investment cost)

• €0 – 25 per t CO$_2$
  – Improved productivity through breeding
  – Forage improvement
  – Lifetime management in beef cattle (??)

• €25 – 50 per t CO$_2$
  – Replacing roughage with concentrate
  – Feeding oils

• > €1,000 per t CO$_2$
  – Feeding propionate precursors
Possible reductions by 2030

• Propionate precursors too expensive unless technology changes

• If no other barriers, remaining measures could reduce enteric methane emissions by 31 Tg CO$_2$ equiv. (22.5% of current emissions)

• Some of these measures will be pursued by farmers but other measures will require various levels of incentives
Possible barriers to implementation

- Uncertainty regarding scope of measures to reduce methane
- Lack of obvious incentive to farmer
- Measurement and monitoring costs and difficulty of monitoring reductions
- High transaction costs per individual farmer
- Attitude to risk, need for new knowledge, availability of extension services
- Availability of extra oil, concentrates, etc
Effect of EU policy on animal emissions

• Luxembourg Agreement: reform of Common Agricultural Policy that saw support payments being decoupled from production

• Various analyses of impact of LA – recent one produced in Ireland by FARPI in March 2006 used here
  – http://www.tnet.teagasc.ie/fapri/
Summary of projections for EU to 2015 vs 2004

- Dairy cow numbers to decrease by 11% due to increase in yield combined with a ceiling on production
- Beef cow numbers to decline by 6%
  - Drop in dairy and beef cow numbers will reduce supply of calves by 9%
- Sheep numbers decline by 7%

- Dairy cows
  - numbers fall by 11%, but emissions/hd increase by 7.5% due to higher yield. Net reduction = 4%
- Non dairy cattle
  - emissions reduced by 8.5% due to fall in beef cow numbers and calf supply
- Sheep
  - emissions reduced by 7% due to fall in numbers
- Overall
  - Enteric methane emissions reduced by 6%
This reduction is due to improved productivity through breeding which was considered earlier as a strategy to reduce emissions.

Overall reduction is 4% if contribution from improved productivity through breeding in the dairy sector is not included.
Other policy impacts

• Nitrates Directive / Water Framework Directive
  – Likely to lead to some reductions in nitrogen fertilizer use, with resulting reductions in nitrous oxide emissions
  – May be some reduction in animal numbers, though difficult to say if there will be any decline additional to that forecast due to Luxembourg Agreement

• World Trade Agreement
  – Outcome uncertain
Conclusions

• Enteric methane accounts for 32% of EU agricultural emissions

• These emissions could be reduced by 22.5% but most of the measures involved have some cost for the farmer and other barriers to overcome

• Current predictions of the effect of the Luxembourg Agreement suggest that enteric methane emissions will reduce by 6% by 2015 as a result