Using values economics to add mitigation of greenhouse gases to dairy selection tools

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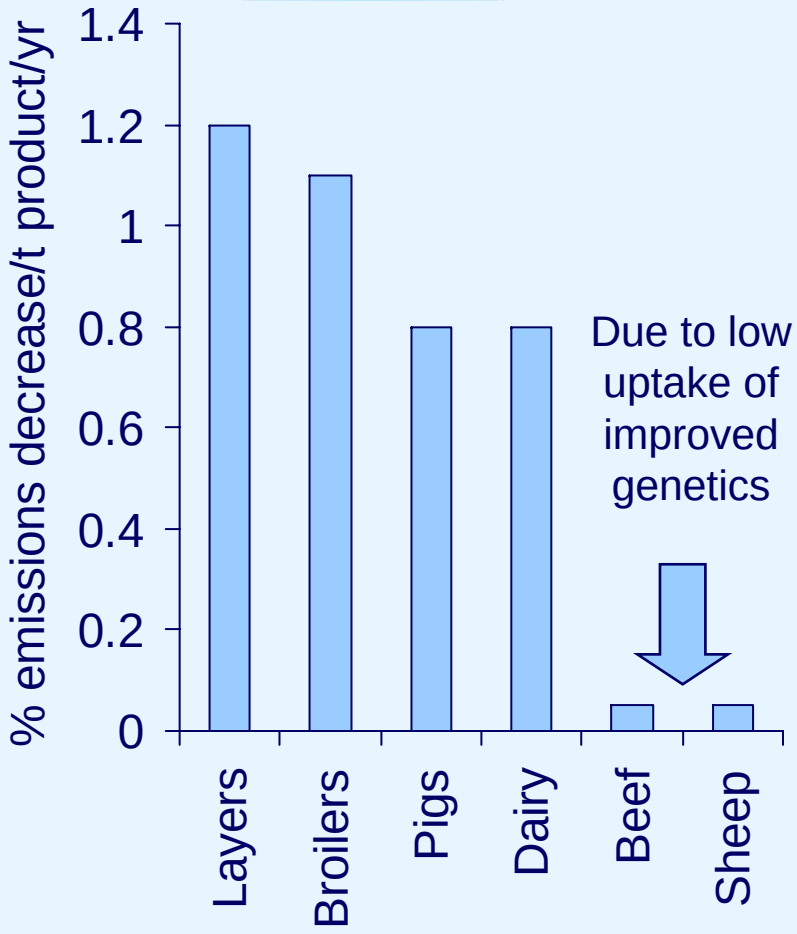
SAC

Background

- Many sectors of the economy already have GHG reduction targets
  - Not yet the case in agriculture
- Tools need to be developed to help livestock systems meet future targets
  - Genetic selection is one of these tools

Genetic improvement in livestock

- Livestock breeding has played a major role in productivity improvement
  - Fewer animals required for given production level
  - Higher productivity ⇒ higher gross efficiency by diluting maintenance costs
  - Selection on improved feed conversion efficiency
- Beneficial effect on reducing the emissions per unit of product



Jones et al., EAAP, 2008

Objective

- To examine how greenhouse gases could be included in the breeding goal for dairy cattle

Dairy breeding goal (£PLI)

- The current breeding goal is farm profitability
  - Includes the impact of production and fitness traits on system profitability
  - Traits are combined in an index by weighting trait breeding values by their relative economic value (i.e., their impact on net farm income)

£PLI

- - £0.027 X Milk PTA
- + £0.8 X Fat PTA
- + £1.71 X Protein PTA

Production

- + £25.4 X Lifespan PTA
- - £0.19 X SCC PTA
- + £1.81 X Mammary PTA
- + £1.13 X Locomotion PTA
- - £0.35 X Calving Interval PTA
- + £2.16 X Non Return Rate PTA

Fitness

DairyCo breeding+

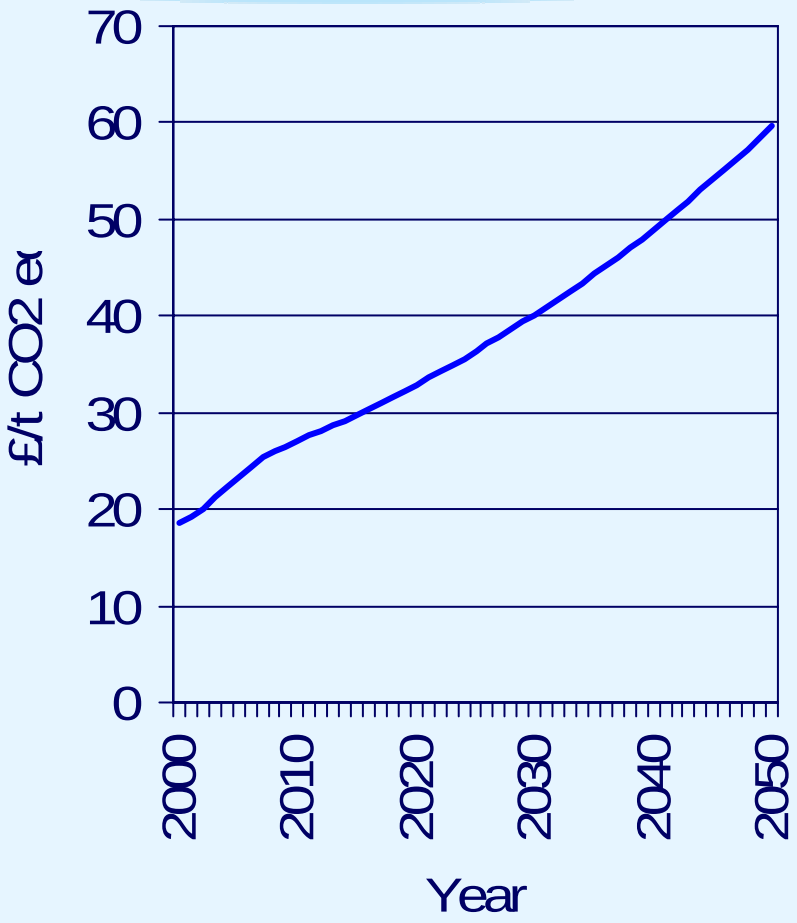
Released Aug 2007

Dairy breeding goal (£PLI)

- The current breeding goal is farm profitability
  - Includes the impact of production and fitness traits on system profitability
  - Traits are combined in an index by weighting trait breeding values by their relative economic value (i.e., their impact on net farm income)
  - Economic techniques being used to value GHG emissions

Economics of emissions

- Shadow price of carbon: Damage costs of climate change caused by each additional t of GHG emitted
  - Current: £26.50/t CO_2 eq.
- Figures being used by the UK government to assess policies & mitigation options
- Can be incorporated into the economic index framework



Economics Group, Defra, December 2007

Dairy system emissions

- Biological and herd assumptions of national dairy index (£PLI) used
  - 125 cows
  - Approx 1 million kg milk
  - Summer grazing, winter indoors
- IPCC Tier II/III methodology used to estimate CH_4 and N_2O emissions
- Shadow price of carbon used to estimate costs to farm

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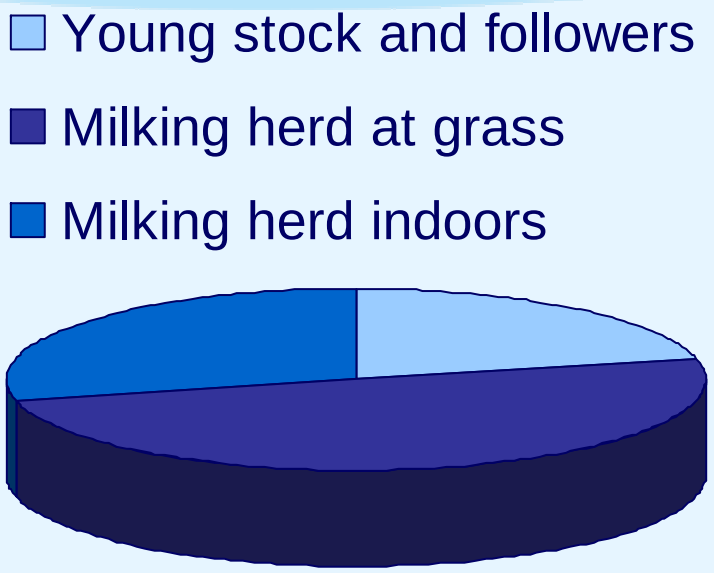

- 501.5 t CO_2 eq. from enteric fermentation
- Shadow cost to herd of £13,289/year (1.24p/milk kg)

Adding to an economic index

- Goal trait: Minimise shadow cost of carbon to the herd by improving milk yield to reduce methane emissions at a fixed herd output
- Index trait: Milk yield
- Relative economic value: Effect on shadow cost to the herd by improving milk yield/cow by 1 unit
  - fewer milking cows and followers required

Calculating milk relative economic value (REV) accounting for GHG

- Biological and herd assumptions of national dairy index (£PLI) used
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  - Approx 1 million kg milk
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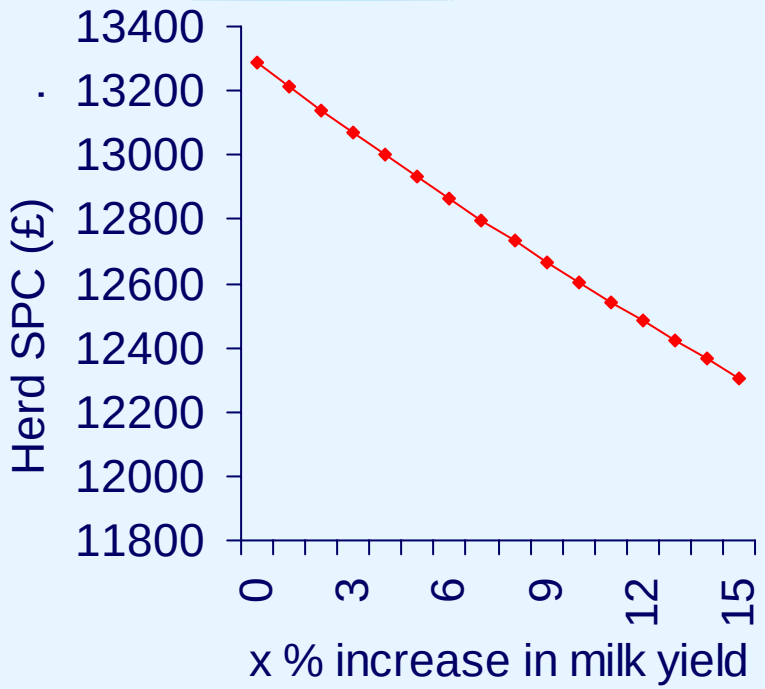

- **<u>REV: £0.012/unit milk</u>**

£PLI: Shadow price of carbon

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Fitness

- +£0.012 X Milk PTA

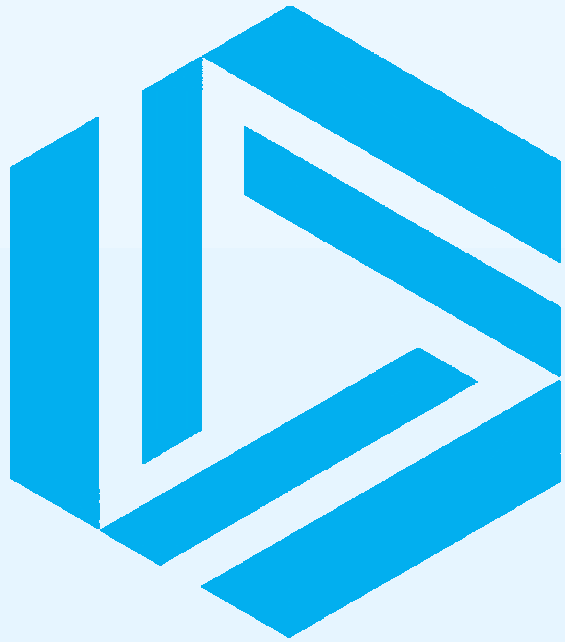
Environment

Considerations

- Other traits have indirect effect on emissions
  - Longevity/fertility could be considered in this framework
- Variation within and between systems
  - Temporal variation, spatial/mgmt variation
  - Feeding system will have an effect on REV
- Direct selection for emissions?
  - Currently limited by lack of measurements & tools

Conclusions

- Selection for production efficiency and broader breeding goals can (and has) lower emissions
  - Breeding goals that include efficiency traits can help to select for reduced emissions
- Current breeding goals can be developed to consider wider environmental issues



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