Reducing greenhouse gas emissions from dairy farming via feeding & breeding

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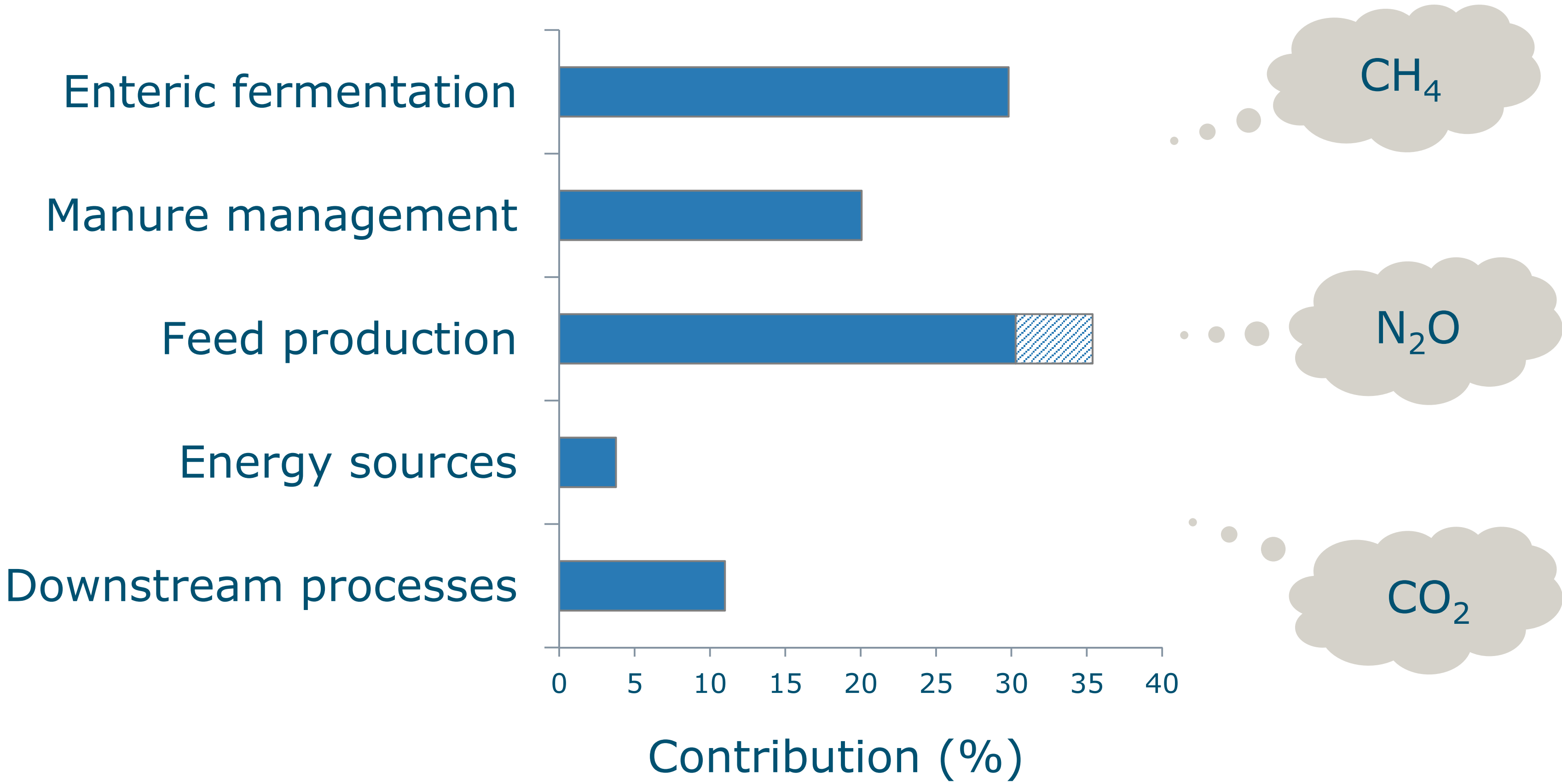
GHG emissions from dairy farming

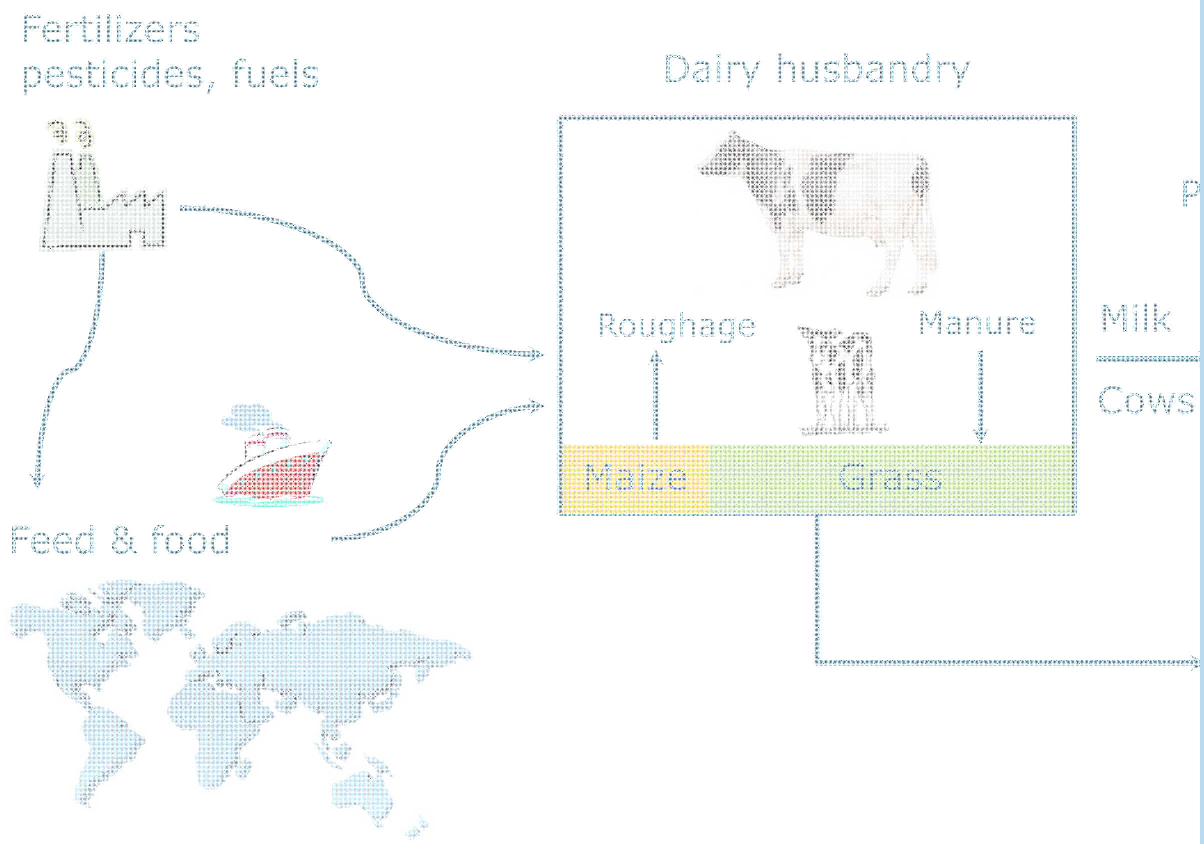
Dairy sector: 30% of global GHG emissions by livestock



Based on Van Middelaar et al. (2011) and Gerber et al. (2013).

How to assess net benefit of a strategy?

Integrated modelling at chain level



1. Linear Programming
   simulate changes in farm management

2. Mechanistic model
   predict changes in enteric CH_4 emission

3. Life cycle assessment
   account for all GHG emissions along the chain

$$CO_2\text{-e: } 1 \times CO_2 + 25 \times CH_4 + 298 \times N_2O$$

Reducing greenhouse gas emissions via feeding?

Which strategy is most cost-effective?

Aim 1

evaluate cost-effectiveness of three feeding strategies to reduce enteric CH_4 in dairy cows

using integrated modelling

Feeding strategies explored

Nitrate supplementation

- 1% of DM intake; 75% nitrate

Extruded linseed supplementation

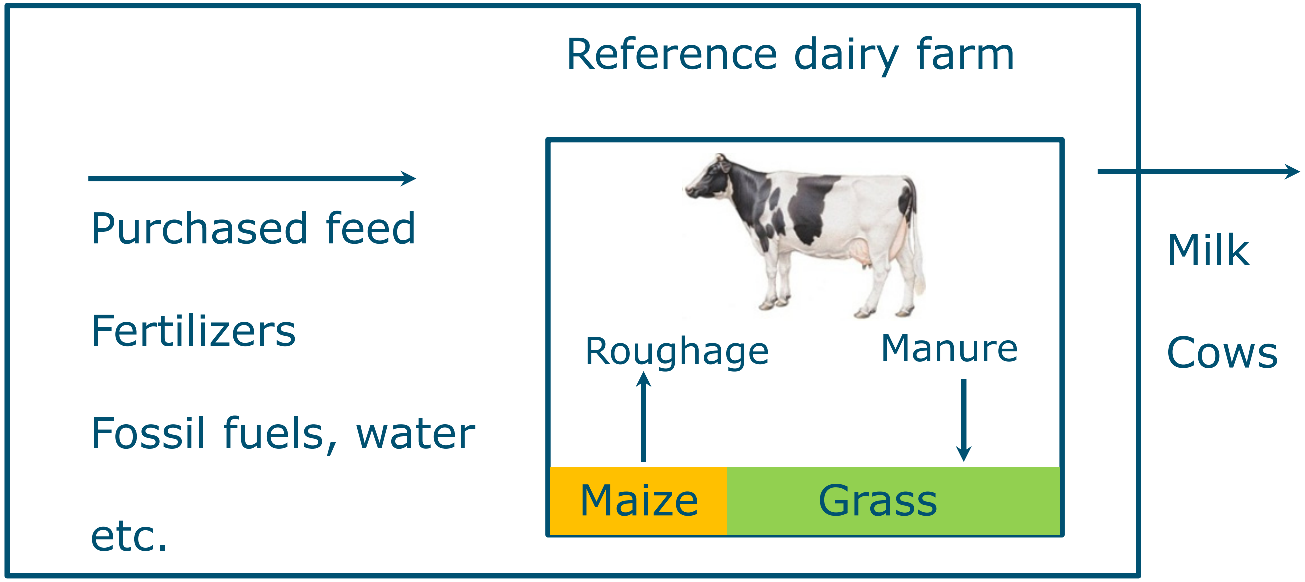
- 1 summer; 2 winter (kg/cow/d); 56% linseed

Less mature grass (silage)

- grazing: 1400 - 1700 kg DM/ha
- harvesting: 3000 - 3500 kg DM/ha

Method - feeding

Average farm: maximize labour income



- 45 ha
- 603 tonnes milk
- 76 cows; 49 young stock
- milk yield cow: 7968 kg/yr

Method - feeding

Average farm

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Introduction feeding strategy

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Optimize farm plan: maximize labour income

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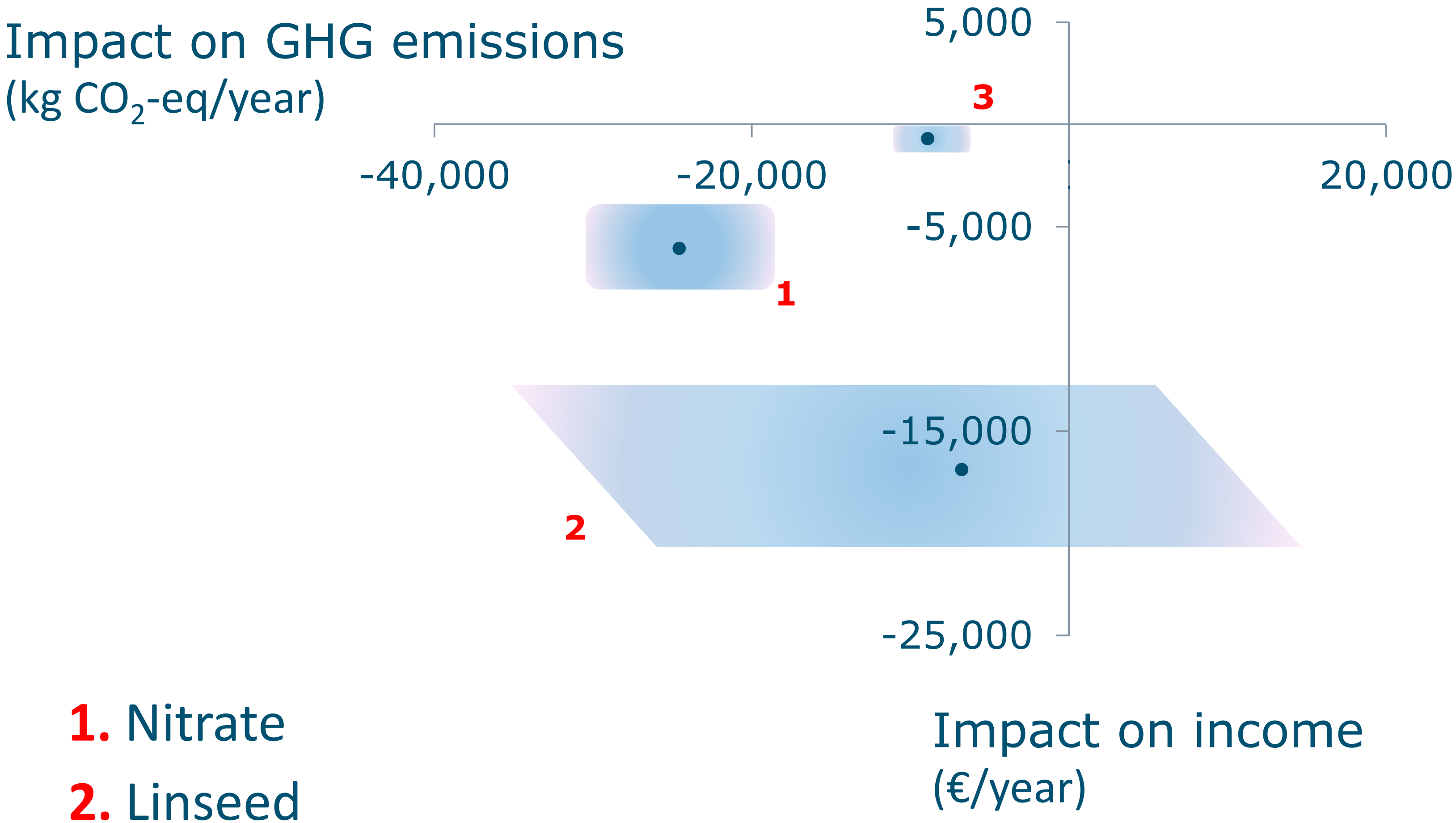
Difference income : difference GHGs

Results feeding strategies



1. Nitrate
2. Linseed
3. Younger grass (silage)

Van Middelaar et al. 2014

Reducing greenhouse gas emissions via breeding?

Increasing annual milk yield per cow

- Fewer animals to produce same amount of milk
- Dilution of GHGs from maintenance

Improving longevity

- Fewer female replacements needed

Reducing greenhouse gas emissions via breeding?

Which trait offers most potential?

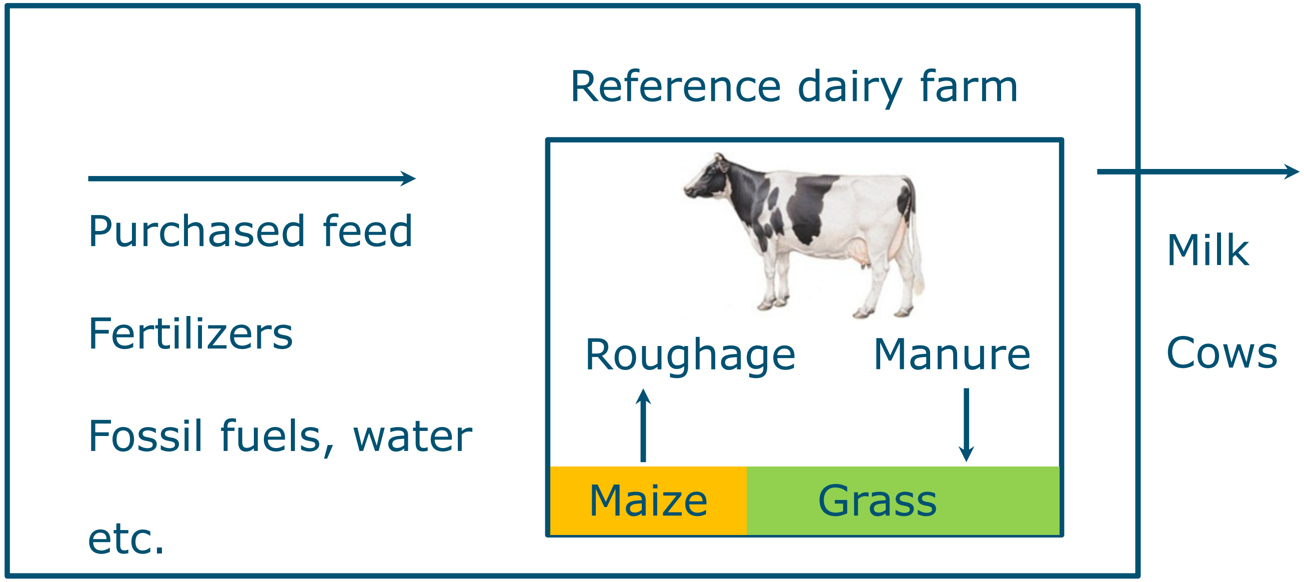
Aim 2

determine impact of increase of one σ_g in milk yield and longevity

using integrated modelling

Method - breeding

Farm 2020: maximize labour income



- 85 ha; all manure used on farm
- 168 cows; 100 young stock
- milk yield cow: 8758 kg/yr
- Replacement rate: 27%

Method - breeding

Future farm

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Increase σ_g of trait

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Optimize farm plan: maximize labour income

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Impact on GHG emissions

σ_g milk = 687 kg/y & σ_g longevity = 270 d

Results breeding strategies

GHG emissions (kg CO_2-eq/ton FPCM)	
Reference	882
Milk yield	-36
Longevity	-32

Economic value (EUR per cow/year)	
Milk yield	122
Longevity	82

Van Middelaar et al. 2014

Conclusions

- ✓ **Feeding & Breeding** offer potential to reduce GHG emissions at chain level
- ✓ **Feeding:** Nitrate largest reduction in emissions
  Reducing grass maturity most cost-effective
- ✓ **Breeding:** Milk yield more important than longevity
  Importance longevity increases with focus on GHG emissions

Thank you for your attention

Ministry of Infrastructure and the Environment

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GHG emissions method-1

kg CO_2-e/t FPCM*

	Ref
Animal emissions	
Enteric CH_4	445
Manure	118
On-farm feed	
Grass	67
Maize	37
Farm inputs	
Maize silage	24
Concentrates	118
Synthetic fertilizer	51
Other	23
Total	882

50% enteric CH4

Lower than literature

* FPCM = Fat-and-protein corrected milk

GHG emissions method-1

kg CO_2-e/t FPCM*

	Ref	Milk Yield
Animal emissions		
Enteric CH_4	445	-10
Manure	118	-5
On-farm feed		
Grass	67	+6
Maize	37	-14
Farm inputs		
Maize silage	24	+18
Concentrates	118	-28
Synthetic fertilizer	51	-2
Other	23	-1
Total	882	-36

Dilution

P application rates

Maize cheaper concentrates

* FPCM = Fat-and-protein corrected milk