# Is feeding more maize silage to dairy cows a good strategy to reduce greenhouse gas emissions?

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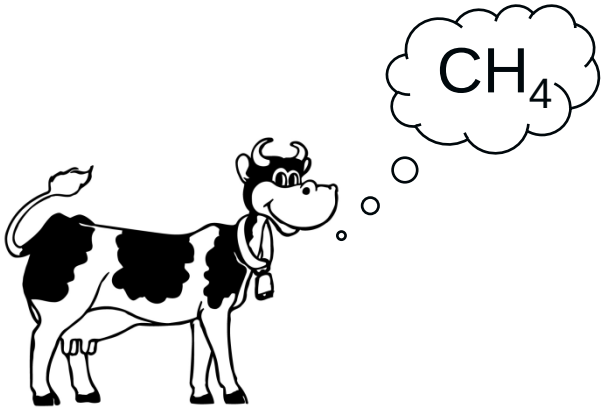
# Background

Livestock sector: 18% global greenhouse gas emissions

How to reduce GHG emissions from milk production?

# Background




± 50% of total GHG emissions in milk production

Feeding strategies for reducing enteric $CH_4$ emission

- Replacing grass silage for maize silage

# Background

$CO_2 + N_2O$


$CO_2$

X



$CH_4$

?

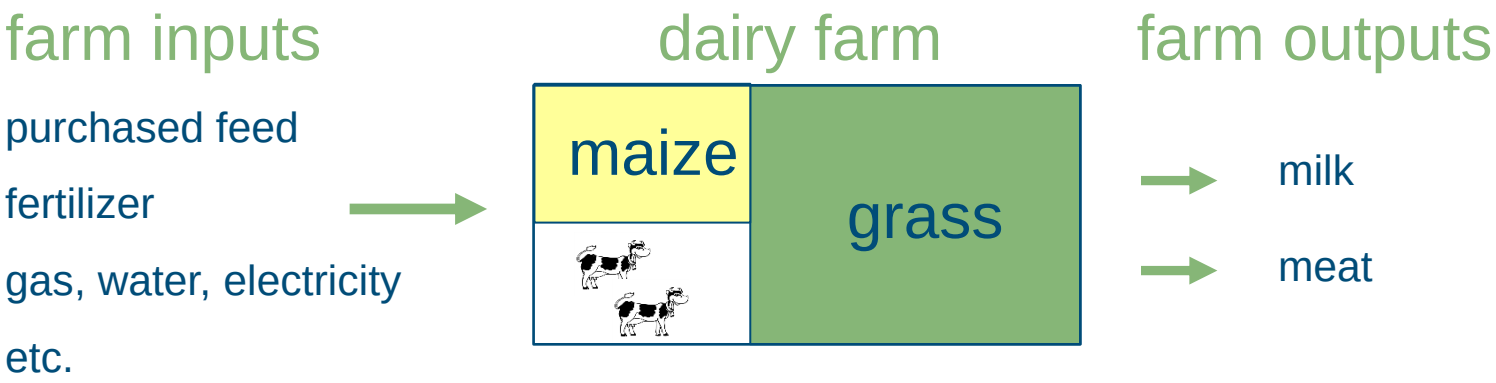
$CO_2$ (1) + $CH_4$ (25) + $N_2O$ (298)

# Methods – linear programming

## Reference farm

- Average Dutch dairy farm on sandy soil (FADN, 2009)
- Economic optimization

Farm plan reference farm



# Methods – linear programming

## Farm plan reference farm

+ maize silage 1 kg DM/dairy cow/day

- grass 1 kg DM/dairy cow/day

↓

Economic optimization

↓

Farm plan farm with maize silage strategy

Increasing maize silage effects farm-plan

- Ploughing grassland for maize land
- Type and amount of concentrates
- Fertilization
- ...

# Methods – calculating emissions


$CO_2 + N_2O$

Life Cycle Assessment

Mechanistic model for enteric $CH_4$ emission

Bannink et al., 2006

Mechanistic model for $CO_2$ and $N_2O$ emissions from ploughing grassland

ICBM by Andrén & Kätterer; Vellinga *et al.*, 2004

$CO_2 + CH_4 + N_2O$

# Results

## Reference farm

- 76 dairy cows, 640 ton FPCM/yr
- 46 ha land – 70% grass & 30% maize

- Reference farm → 70% grassland
- Derogation regulation!
- Replacing grass for maize ... NO OPTION !

## Reference farm (120% intensified)

- 76 dairy cows, 640 ton FPCM/yr
- 35 ha land – 79% grass & 21% maize

# Results – animal perspective


| **Ration (dairy cow/day)** | Winter | | Summer | |
|---|---|---|---|---|
| | **Ref.** | **Maize** | **Ref.** | **Maize** |
| Grass (kg DM) | - | - | 10.0 | 9.0 |
| Grass silage (kg DM) | 4.1 | 3.1 | - | - |
| Maize silage (kg DM) | 5.2 | 6.2 | 3.9 | 4.9 |
| Concentrates standard (kg) | 7.0 | 5.7 | 5.1 | 4.3 |
| Concentrates extra protein (kg) | 1.0 | 2.2 | - | 0.9 |
| **Enteric $CH_4$ emission** | | -15 | | -7 |
| g $CH_4$/dairy cow/day | 395 | 380 | 483 | 476 |

8.4 ton FPCM/dairy cow/yr

Reduction: 0.48 kg $CH_4$/ton FPCM

**11 kg $CO_2$-eq/ton FPCM**

From an animal perspective feeding more maize silage is an effective strategy to reduce GHG emissions

# Results – farm perspective

| Farm plan | | | Net change |
|---|---|---|---|
| | Ref. | Maize | $CO_2$-eq/ton FPCM |
| Dairy cows (#) | 76 | 76 | - 11.2 |
| FPCM production (ton/yr) | 640 | 640 | |
| Grassland (ha) | 28 → | 25 | - 5.6 |
| Maize land (ha) | 7.5 → (3) | 10.5 | + 4.6 |

Ploughing grassland for maize land → **32.5 kg $N_2O$-N/ha**
→ **47.5 ton $CO_2$-C/ha**

Annual emission reduction: 12 kg $CO_2$-eq/ton FPCM

Total non-recurrent emissions: 845 kg $CO_2$-eq/ton FPCM

# Results – life cycle perspective

Cor

Artificial

**Annual emission:**

- 17.9 kg $CO_2$-eq/ton FPCM

**Non-recurrent emission:**

+ 845 kg $CO_2$-eq/ton FPCM

**Carbon payback-time:**

845/17.9 = 47 years

(kg $CO_2$-eq/ton FPCM)

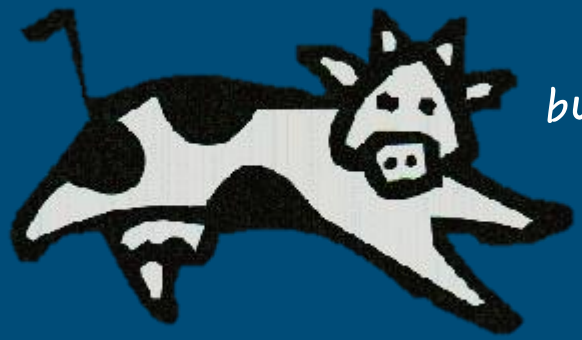
# Conclusions

Is feeding more maize silage to dairy cows a good strategy to reduce GHG emissions?

- Strategy not feasible in practice for most Dutch dairy farms
- On highly intensified farms, carbon payback-time of strategy is 47 years

→ animal perspective ≠ life cycle perspective!

# Thank you for your attention!

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