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

Corina van Middelaar - Animal Production Systems Group, WUR
Jan Dijkstra, Paul Berentsen & Imke de Boer




WAGENINGEN UNIVERSITY
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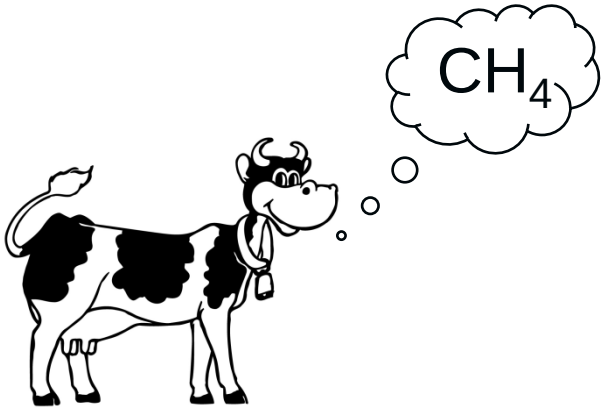
Background

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

?

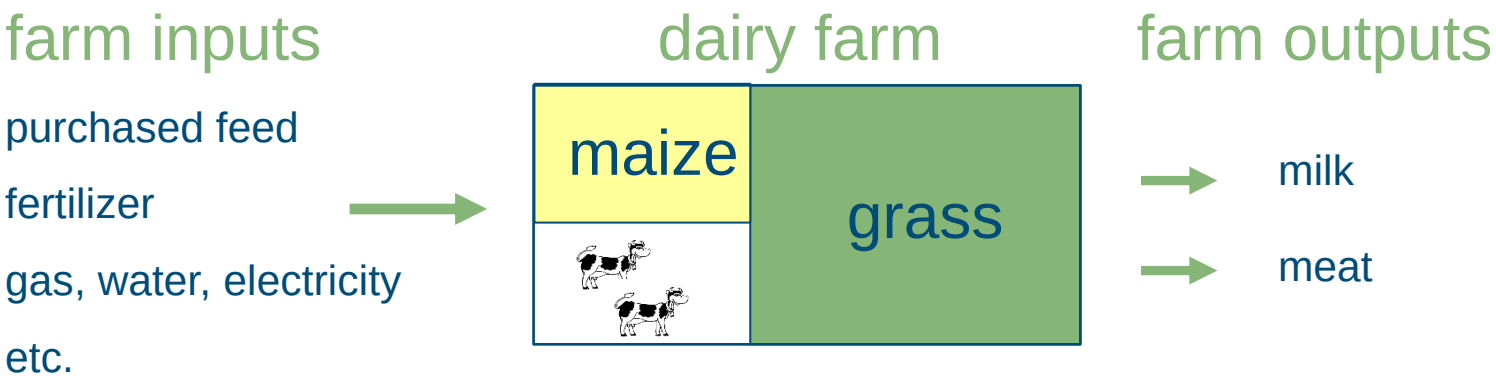
CO_2 (1) + CH_4 (25) + N_2O (298)

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)

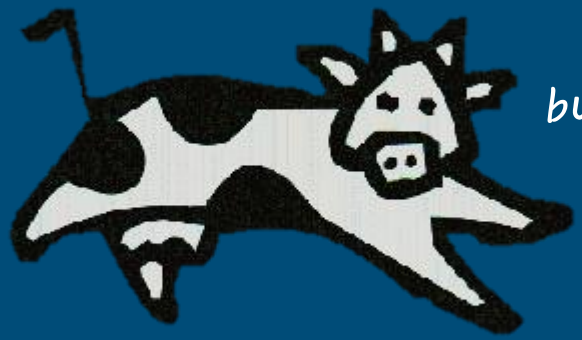
Conclusions

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!



corina.vanmiddelaar@wur.nl