Enteric and manure emissions from dairy cattle fed grass silage- or maize silage-based diets

CEDERS project

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FACCE ERA-GAS
MONITORING & MITIGATION OF GREENHOUSE GASES FROM AGRI- AND SILVI-CULTURE

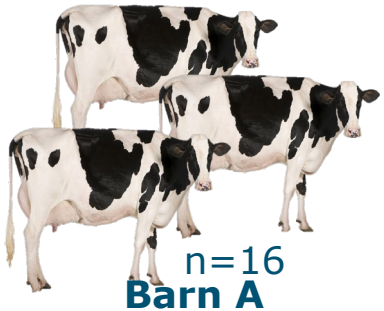
Objectives

1. Evaluate potential trade-offs between enteric CH_4 emission and CH_4 emission from manure
2. Evaluate whether the effects in CH_4 emissions may cause a trade-off or have a synergistic effect towards nitrogenous emissions (NH_3 and N_2O)

Animals

N=64

parity, lactation stage and milk yield



n=16
Barn A

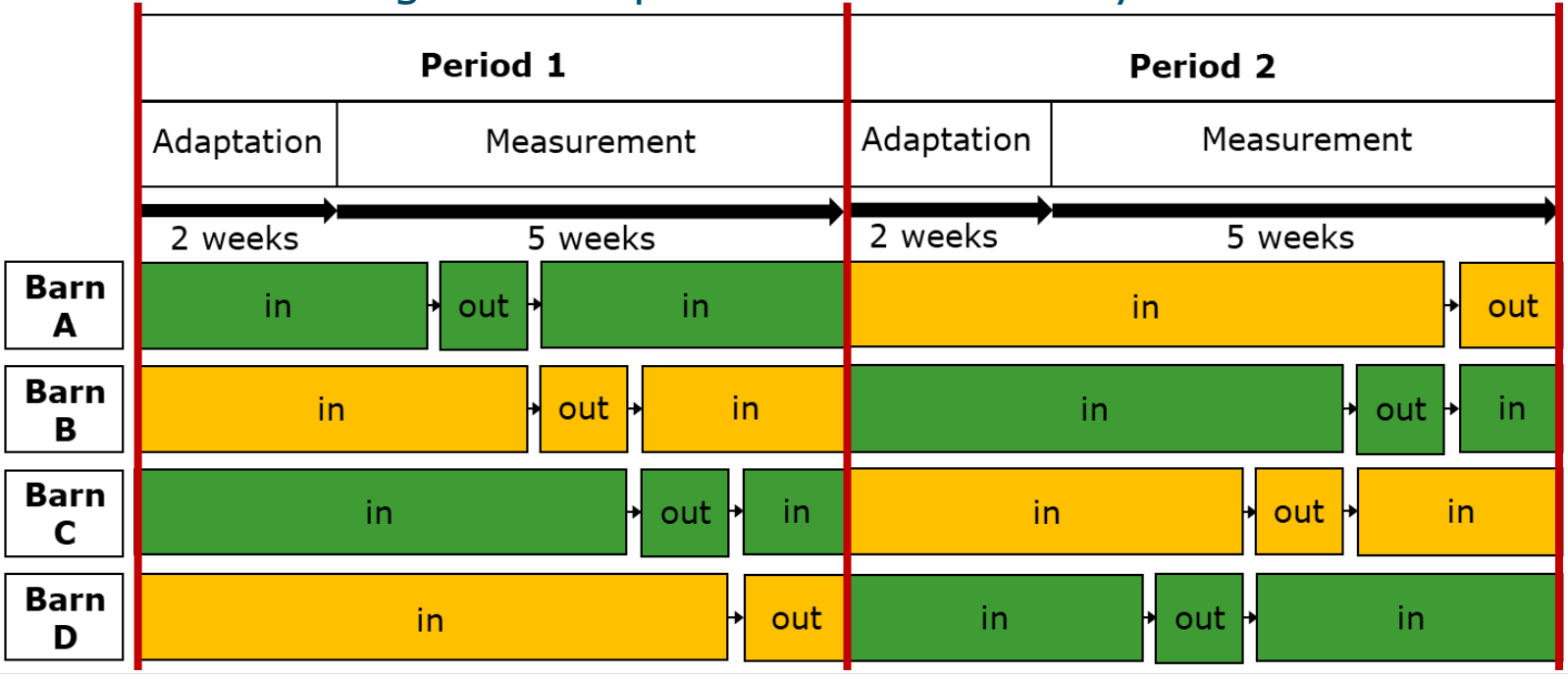
n=16
Barn B

n=16
Barn C

n=16
Barn D

Experimental timeline

Cross-over design with 2 periods and 2 dietary treatments



Dietary treatments

g/kg DM	GS	MS
Organic matter (OM)	900	929
Crude protein (CP)	172	135
NDF	366	373
Starch	90	208
NE_L (MJ/kg DM)	6.7	6.6

Gas measurements

In each barn, ventilation rates were measured as well as concentrations of CH_4, NH_3 and N_2O in sampled air with a Picarro G2508 multi-gas analyzer

- Corrected for background (cows absent for milking)
- Measurements without cows → after plateau is reached
- Manure emissions → expressed relative to total and experimental manure

Results: cow performance

	GS	MS
Milk yield (kg/d)	26.8	26.4
Fat- and protein-corrected milk yield (kg/d)	30.7[a]	28.4[b]
Milk fat content (g/100 g)	5.05[a]	4.59[b]
Milk protein content (g/100 g)	3.68[a]	3.56[b]
Milk urea content (mg/dL)	19.5[a]	11.6[b]
Feed efficiency (kg FPCM / kg DMI)	1.33[a]	1.24[b]

Results in line with

- decreased dietary CP content from 17.2% (GS) to 13.5% (MS)
- increased dietary starch content from 9.0% (GS) to 20.8% (MS)

Results: nutrient intake and digestibility

	GS	MS
Intake (kg/cow/d)		
Dry matter	23.1	22.9
Organic matter	20.8	21.3
Crude protein	3.96[a]	3.09[b]
Starch	2.08[a]	4.78[b]
Apparent total tract digestibility (%)		
NDF	79.0[a]	57.5[b]
Starch	98.8	99.1

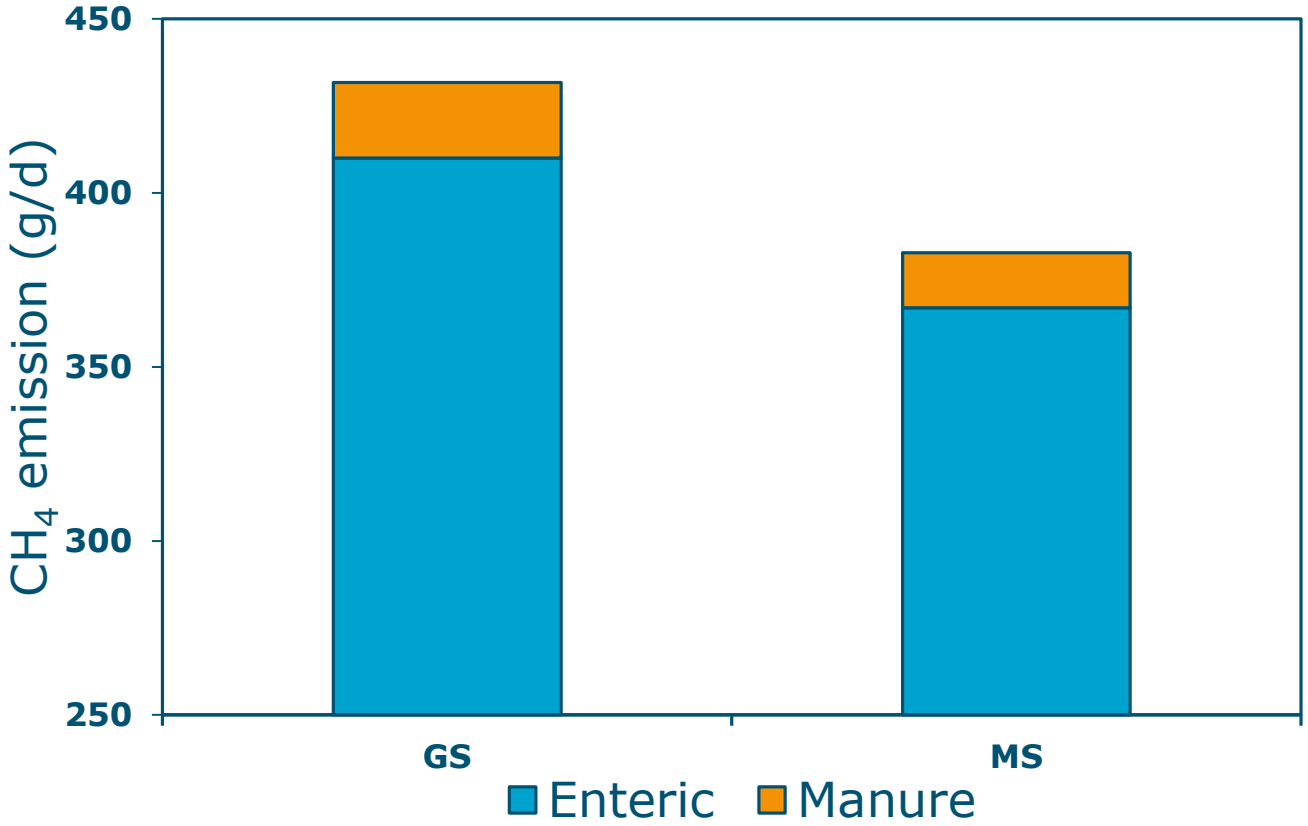
Results: nutrient excretion

	GS	MS
Excretion (kg/cow/d)		
Dry matter	6.34	7.57
Organic matter	4.53[a]	6.14[b]
Nitrogen	0.523[a]	0.376[b]
NDF	1.75[a]	3.56[b]
Starch	0.024[a]	0.044[b]

Results: enteric and manure CH_4 emissions

- Enteric CH_4 emission was lower for the MS diet compared with the GS diet (-11%)
- Manure CH_4 emission was not affected by diet

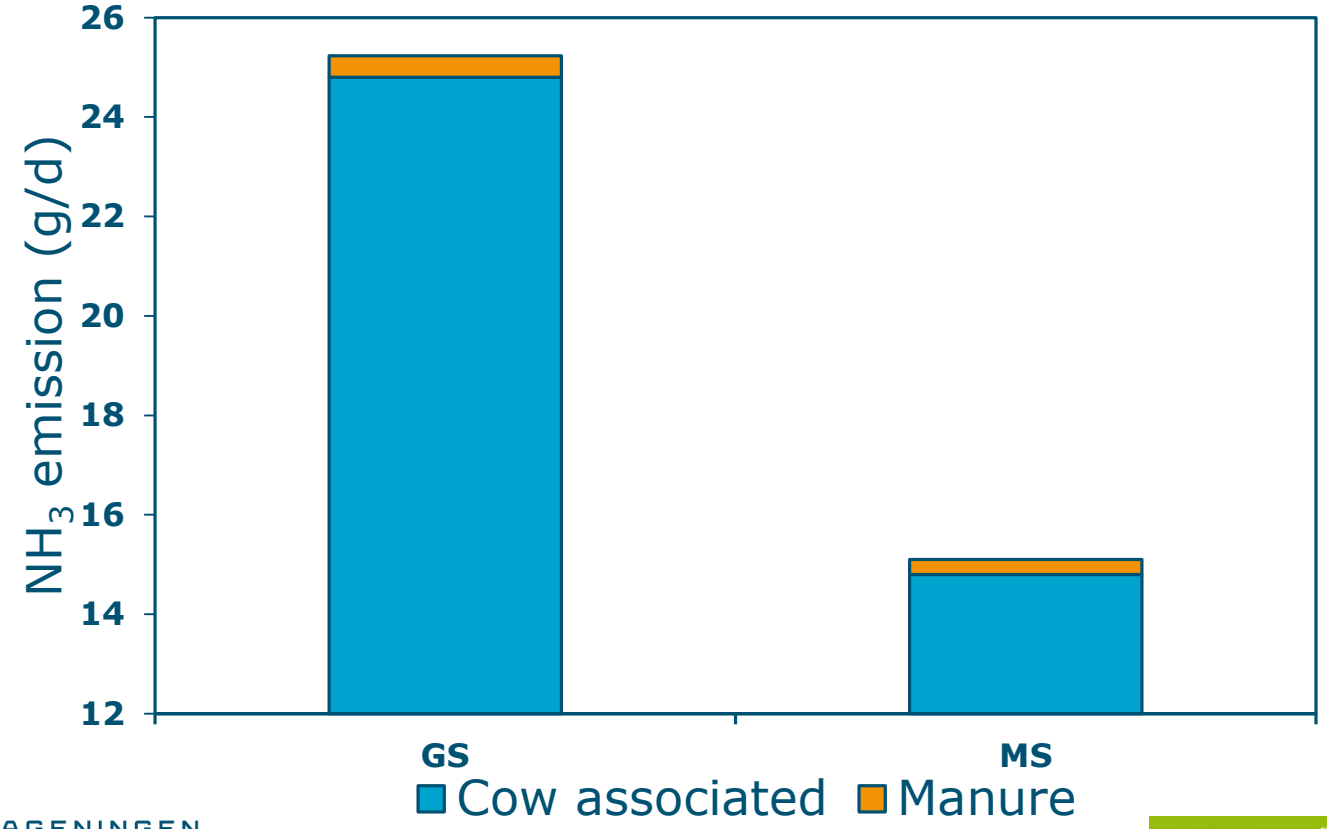
Results: enteric and manure CH_4 emissions



Results: nitrogenous emissions – NH_3

- Cow associated NH_3 emission was lower for the MS diet compared with the GS diet (-40%)
- Manure NH_3 emission tended to be lower for the MS diet compared with the GS diet

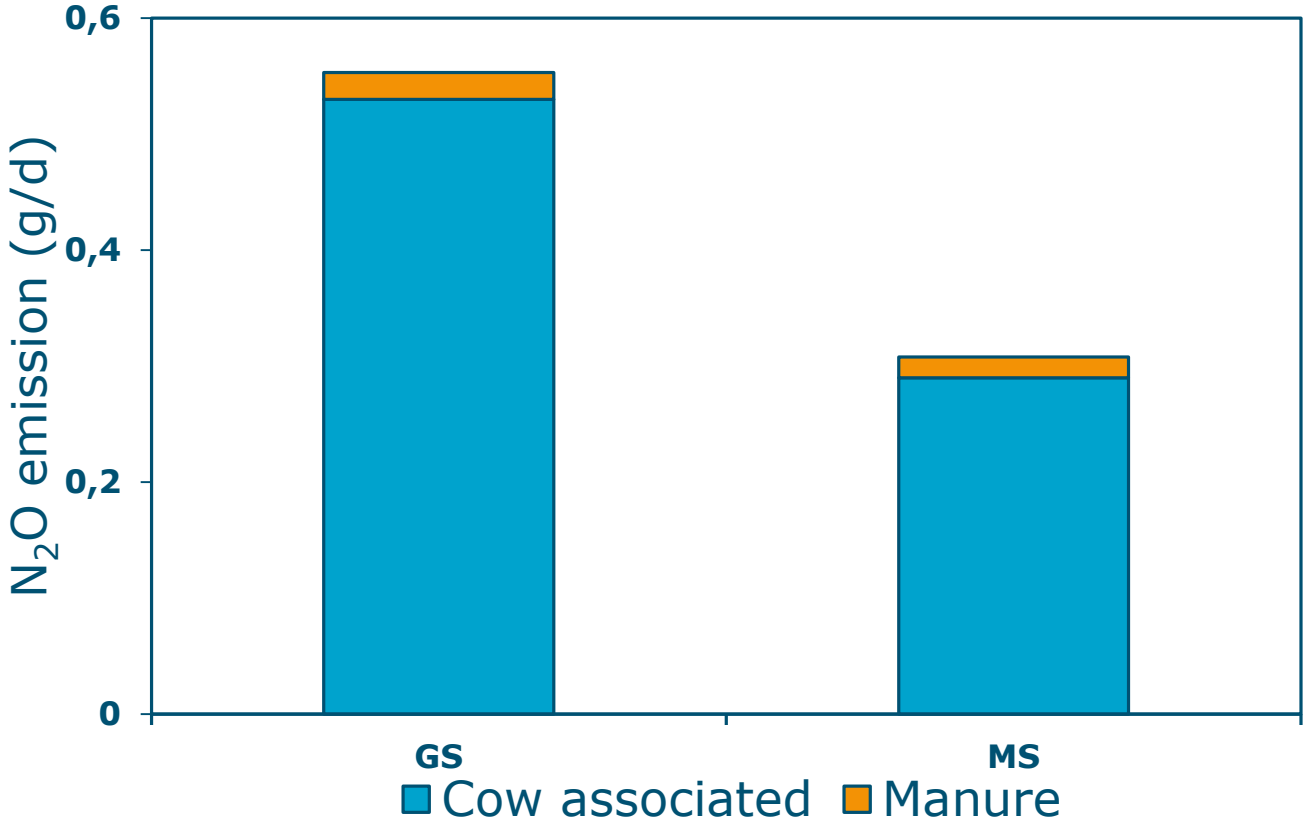
Results: nitrogenous emissions – NH_3



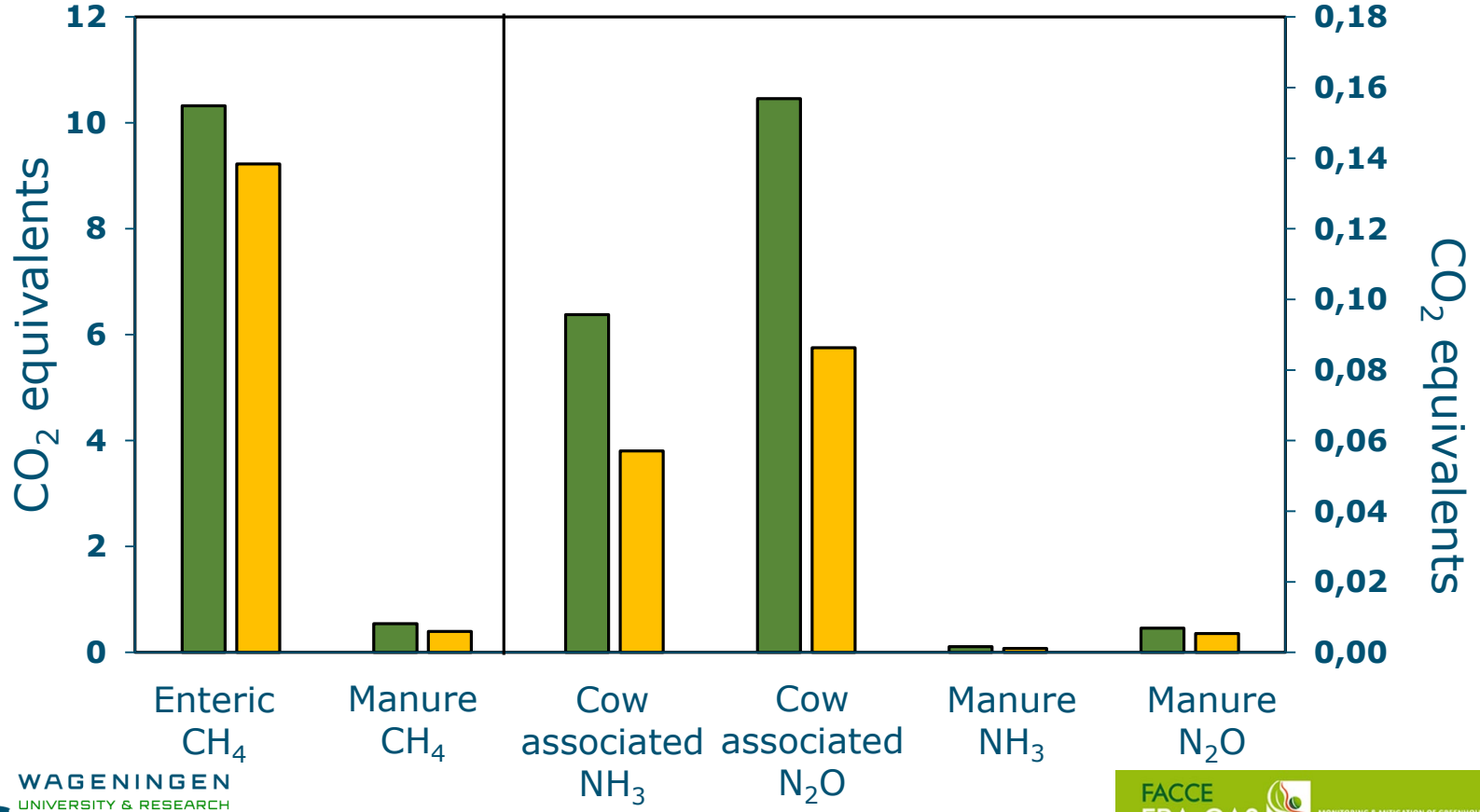
Results: nitrogenous emissions – N_2O

- Cow associated N_2O emission was lower for the MS diet compared with the GS diet (-45%)
- Manure N_2O emission was not affected by diet

Results: nitrogenous emissions – N_2O



Results: GHG balance



Take home messages

In this short-term study:

- No trade-off between enteric and manure CH_4 emissions
- Synergistic effects for CH_4 and nitrogenous emissions

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