Modeling Impact of Feeding & Manure Management Strategies on Wisconsin Organic, Conventional and Grazing Farms to Mitigate Greenhouse Gas (GHG) Emissions

M. Dutreuil[1], M. Wattiaux[1], R. Gildersleeve[2*], and V.E Cabrera[1]

[1]Department of Dairy Science, University of Wisconsin-Madison; [2]University of Wisconsin-Extension; *rhonda.gildersleeve@ces.uwex.edu

Introduction

- Dairy farms are encouraged to consider management strategies that reduce their environmental footprint while remaining profitable.
- Simulation models can be used to identify potential environmental and economic outcomes of changes to feeding and manure management strategies on organic, conventional, and grazing farms for mitigating greenhouse gas emissions.

Objectives

- Compare GHG emissions and economics on WI organic, conventional and grazing dairy farms using survey data and the Integrated Farming Systems Model (IFSM).
- Use IFSM to assess the impact of different feeding and manure management strategies on GHG emissions and farm profitability.

Materials & Methods

- Data from 2010 production year were collected from 69 organic, 27 conventional, and 30 grazing dairy farms and used to characterize three Wisconsin dairy farm systems. A brief description of each system simulated is provided in Table 1. For comparisons, data were scaled to an average farm in terms of land area, number of adult cows, as well as soil type (medium clay loan) and daily weather patterns.
- During simulation, feeding strategies with potential to reduce GHG were identified for each farm system, while the effects of the same manure management strategy to minimize GHG emissions was applied to all three systems. Combinations of feeding strategy + manure management were also simulated.

Table 1. Characteristics of 3 WI dairy farm systems simulated.

	Conventional	Grazing	Organic
Land base, acres	314	314	314
Alfalfa, %	37.3	29.7	35.8
Grass, %	17.6	48.8	34.0
Corn, %	33.6	12.8	13.2
Oats, %	9.6	3.9	12.6
Soybean, %	1.9	4.8	2.8
Organic buffer, %	--	--	1.6
# Lactating Cows	85	85	85
Lbs milk produced/cow/yr	22,360	16,550	14,024
Milk price, ($/cwt)	15.76	16.47	24.67
Grazing strategy	Older heifers and dry cows	All cows during grazing season	All cows during grazing season
Housing facilities	Free stall barn	Tie stall barn	Tie stall barn
Manure storage	Top-loaded lined earthen basin	Daily haul	Daily haul

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Results

Table 2. Comparison of production, economic effects and greenhouse gas emissions for management changes simulated on the 3 farm systems.

Conventional Farm	Base Farm	Add Grazing (1) -0% Milk	Add Grazing (2) -5% Milk	Change Manure Management [B]	Add Grazing (1) & Manure Mgt	Add Grazing (2) & Manure Mgt
Annual milk production (lbs/cow)	21,417	21,417	20,524	21,417	21,417	20,524
Grazed forage consumed (tons DM)	104	143	142	105	144	143
Net return to management ($/cow)	281	**364**	272	240	**319**	227
Net emission (tons/year)	524	**385**	**374**	458	**361**	**351**
Grazing Farm	**Base Farm**	**Reduce F:G [A] +5% Milk**	**Reduce F:G [A] +10% Milk**	**Change Manure Management [B]**	**Reduce F:G +5% Milk & Manure Mgt**	**Reduce F:G +10% Milk & Manure Mgt**
Annual milk production (lbs/cow)	15,963	16,760	17,558	15,963	16,760	17,558
Grazed forage consumed (tons DM)	424	291	294	424	290	294
Net return to management ($/cow)	170	19	115	128	-23	73
Net emission (tons/year)	446	**351**	**356**	473	**374**	**380**
Organic Farm	**Base Farm**	**Reduce F:G [A] +5% Milk**	**Reduce F:G [A] +10% Milk**	**Change Manure Management [B]**	**Reduce F:G +5% Milk & Manure Mgt**	**Reduce F:G +10% Milk & Manure Mgt**
Annual milk production (lbs/cow)	13,550	14,227	14,903	13,550	14,227	14,903
Grazed forage consumed (tons DM)	295	228	230	294	228	229
Net return to management ($/cow)	696	581	**703**	638	521	**644**
Net emission (tons/year)	500	**388**	**393**	534	**416**	**421**

Simulation Scenarios: *Add Grazing (1) and (2)* were feeding strategies that added grazing to lactating cow diets on the confinement farms; *Reduce F:G [A]* was a feeding strategy change from high to low Forage:Grain ratios for lactating cows on the grazing and organic farms (ca. 88% to ca. 68% forage); *Change manure management [B]* was incorporation of manure into soil on the same day of application and addition of 12-month covered tank storage to limit GHG emission for all 3 farm systems.

Figure 1. Feed costs and income of the simulated conventional, grazing and organic WI dairy farms.

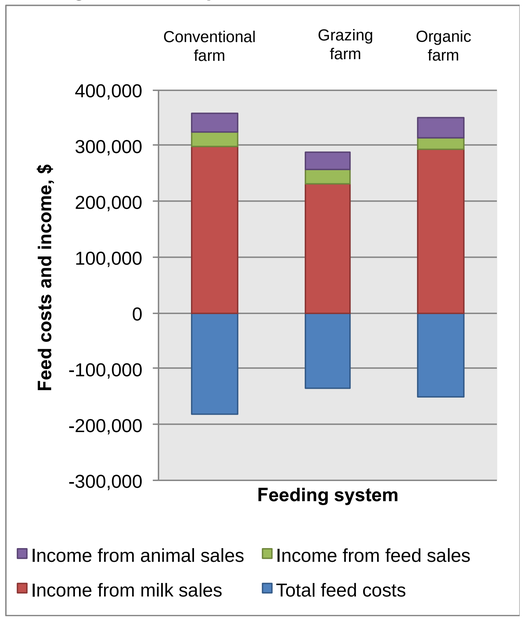
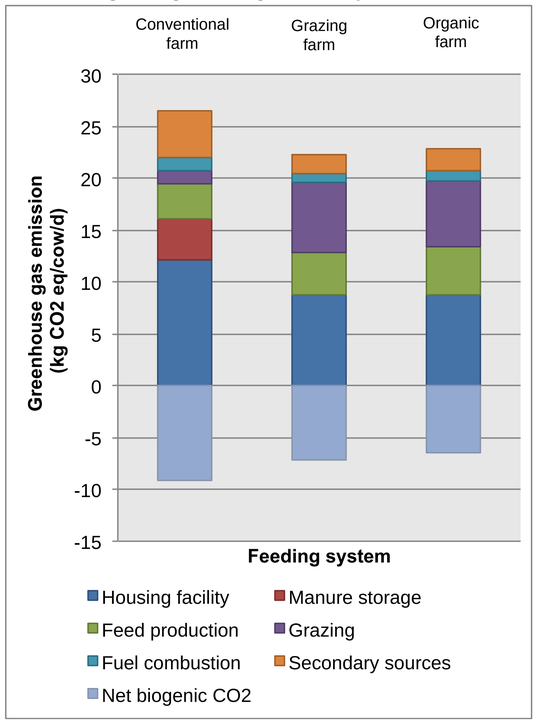


Figure 2. GHG emission sources on the simulated Wisconsin conventional, grazing and organic dairy farms.



Conclusions

- Changes in feeding and manure management strategies applied during simulation were effective in reducing GHG emissions for all farms, but had different economic impacts, depending on farming system.
- Simulations demonstrate that feeding and manure management strategies can be identified to mitigate GHG emissions while retaining profitability, but need to be tailored to fit the unique characteristics and needs of each farm system.