Dairy Management

WISCONSIN
UNIVERSITY OF WISCONSIN–MADISON

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UW Extension
University of Wisconsin-Extension

Implementation of greenhouse gas mitigation strategies on organic, grazing and conventional dairy farms

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USDA

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NIFA

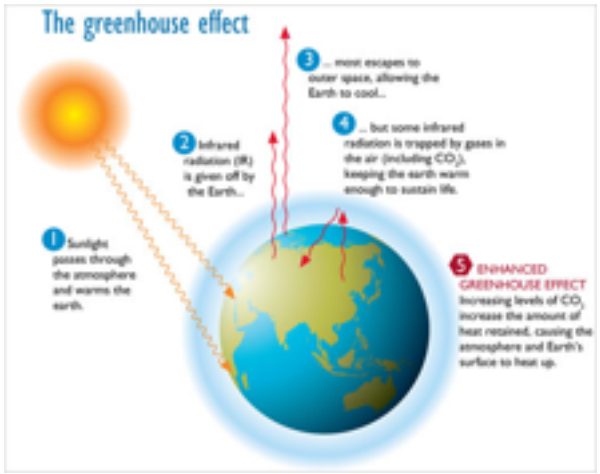
IFSA - Europe, Berlin, 1-4 April 2014

Introduction

GHG emissions need to be reduced

Milk production

- Estimated to be responsible of 4% of anthropogenic GHG



Livestock operations

- One of largest sources of agricultural GHG

Whole farm system approach

- High interaction among system components

Introduction

Simulation is a powerful tool

Feasible research enterprise

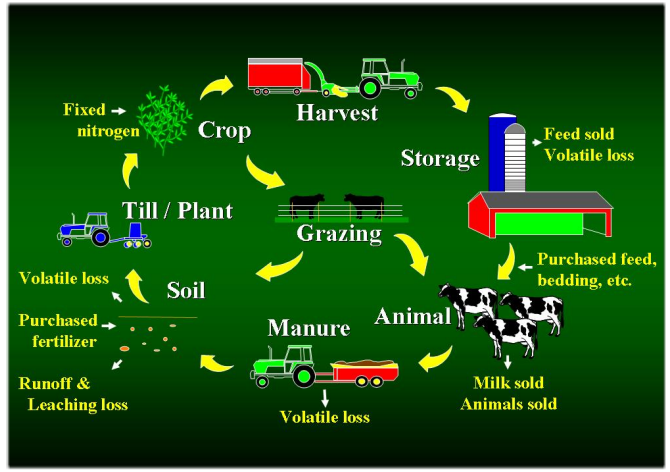
- Field trials are unpractical or impossible

Projections and trends

- More valid than precise numbers

Scenario analysis

- Allows to respond “what-if” questions



Objectives

Can GHG emissions be economically reduced?

Compare GHG emissions and economics among dairy farm systems

- Organic
- Grazing
- Conventional

Organic Dairy

Asses the impact of management strategies on GHG emissions and net return

- Feeding strategies
- Manure management

Materials and methods

Surveying

Interdisciplinary and comprehensive questionnaire (year 2010)

- Farm structure
- Labor
- Herd management
- Feeding
- Cropping
- Economics

Feeding Strategies on Wisconsin Dairy Farms: Economic, Production, and Environmental Outcomes

USDA United States Department of Agriculture National Institute of Food and Agriculture

NSF National Science Foundation

UW Extension

Participation in the study is **voluntary**. All answers to questions in this survey will be kept ***strictly confidential***, and the results will only be used in statistical summaries. Individual farm information will not be identified in any publication. University of Wisconsin-Madison, Social and Behavioral Sciences, IRB Protocol Number SE-2009-0401.

Consent forms need to be signed prior to the start of the interview

We welcome your comments and suggestions
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ENUMERATOR:

DATE OF SURVEY:

SURVEY STARTING TIME: SURVEY ENDING TIME:

FARMER ID#:

Wisconsin official lists of dairy cattle milk producers

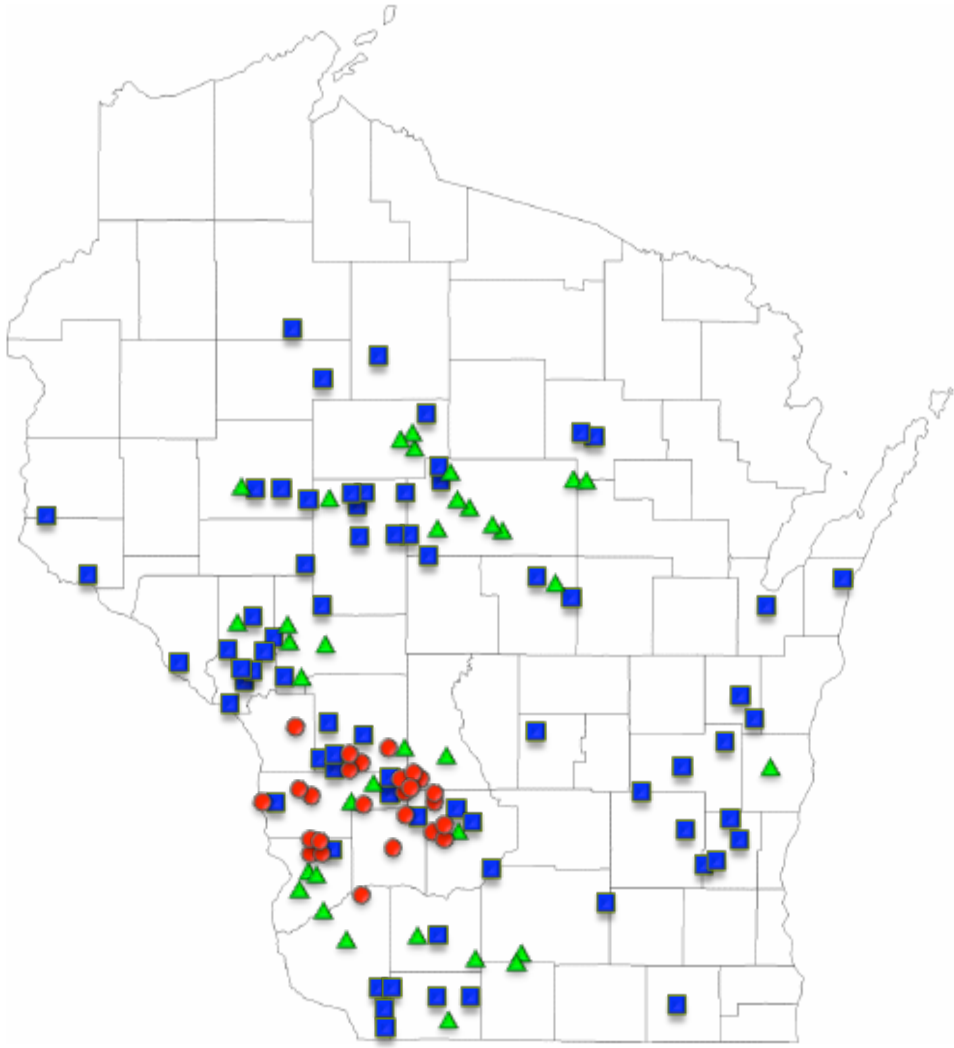
- Organic = certified
- Grazing >30% DMI pasture
- Conventional = others

Materials and methods

Surveyed farms (Wisconsin)

Farms used for defining representative farms

- 69 organic
- 30 grazing
- 27 conventional



Materials and methods

Scaled farms

All farms in a system were scaled to averages

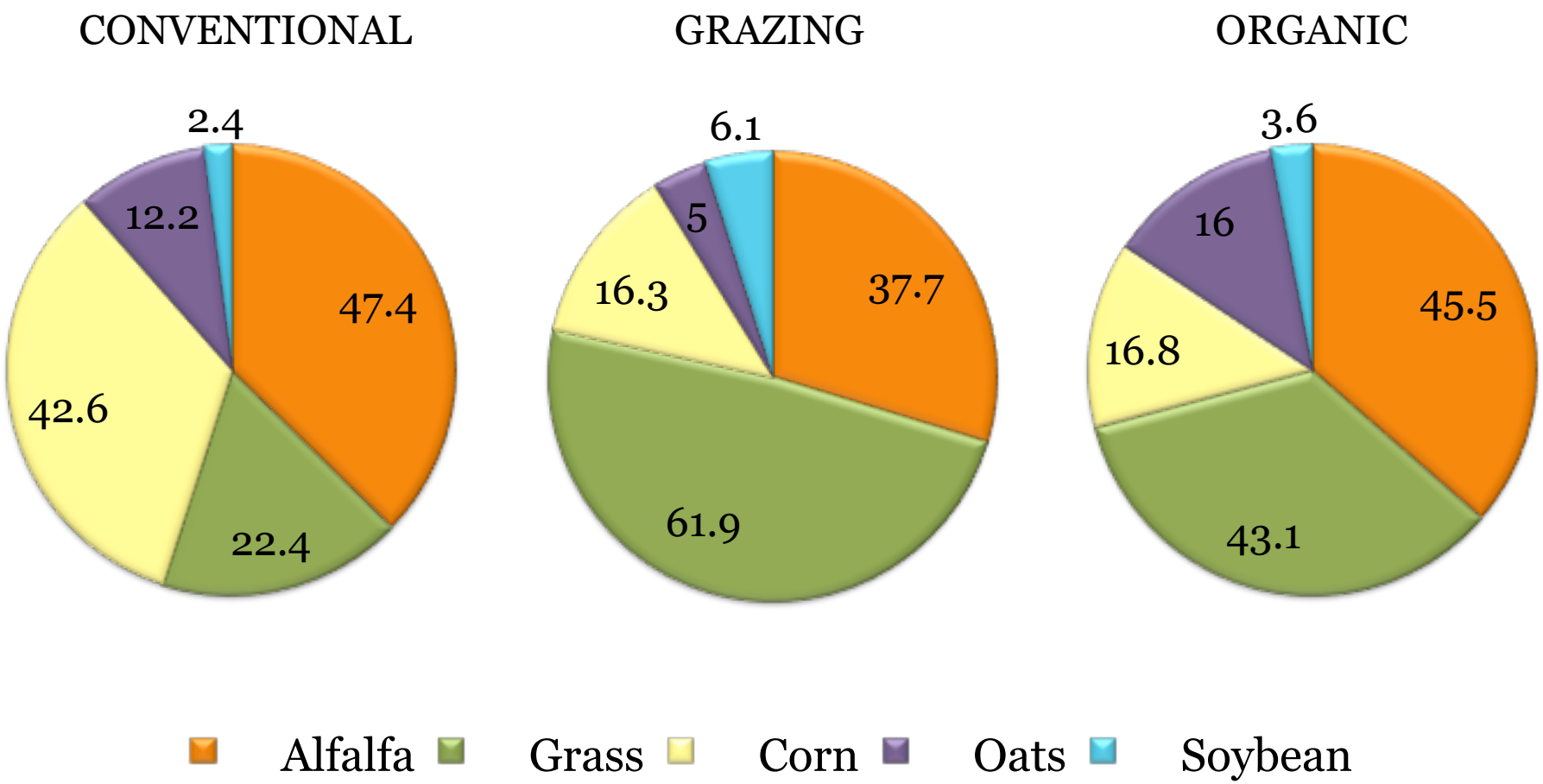
- 127 ha
  - 79 ha owned
  - 48 ha rented

- 85 adult cows (milking and dry)

	Scaled	CON	GRA	ORG
# cows	85	128	94	74
Hectares	127	162	121	119

Materials and methods

Simulated farms



Materials and methods

Simulated farms

	CON	GRA	ORG
First lactation cows (%)	36	30	31
Milk production (L/cow per year)	9,820	7,256	6,159
Milk price ($/hL)	35.99	37.52	56.20
Grazing strategy	Older heifers and dry cows	All weaned animals	All weaned animals
Housing facilities	Free stall barn	Tie stall barn	Tie stall barn
Manure storage	Top-loaded lined earthen basin	No storage (daily haul)	No storage (daily haul)

Materials and methods

Management strategies for CONVENTIONAL

Scenarios

1. Grazing to lactating with no decrease in milk production
2. Grazing offered to lactating cows with 5% decrease in milk production
3. Incorporation of manure the same day of application and addition of a 12-month covered tank
4. Combination of scenarios 1 and 3
5. Combination of scenarios 2 and 3

Materials and methods

Strategies for ORGANIC and GRAZING

Scenarios

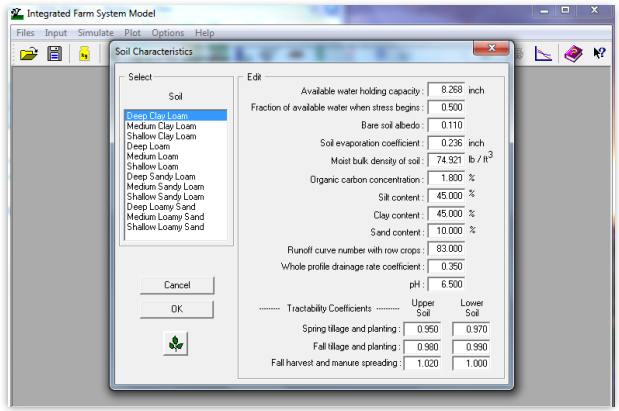
6. Decrease forage to grain ratio with a 5% increase in milk production
7. Decrease forage to grain ratio with a 10% increase in milk production
8. Incorporation of manure the same day of application and addition of a 12-month covered tank
9. Combination of scenarios 6 and 8
10. Combination of scenarios 7 and 8

Materials and methods

Integrated Farm System Model (IFSM)

Integrates major biophysical processes in a dairy farm

1. Livestock
2. Crops
3. Grazing
4. Weather
5. Machinery
6. Feed storage
7. Soils
8. Manure and nutrient
9. Economics
10. Tillage and planting



GHG sink an sources at the farm level

- Housing
- Manure storage
- Feed production
- Grazing
- Fuel combustion
- Secondary sources

Integrated System Farm Model

farm parameters

machinery file

output files

read input

initialization

setup machinery

start

weather data

read weather data

spring operations

crop growth

crop harvest

storage

cow feeding

cow management

manure handling

fall operations

economic analysis

another year?

yes

no

results

harvest

crop

storage

feed

grazing

till

cows

fertilizer

milk

soil

manure

Results

Baseline outcomes: Farm system differences

	CON	GRA	ORG
Milk production	9,735	7,256	6,159
Feed costs ($)	182,124	134,133	149,744
Total income ($)	357,151	288,603	350,185
Net return to management ($)	23,895	14,439	59,120
Net return to management ($/1,000 kg milk)	28.9	23.4	112.9
Net emission (kg CO_2 eq/kg milk)	0.58	0.66	0.87
Net emission (kg CO_2 eq/yr)	476,623	405,565	454,780

Results

Management strategies: CONVENTIONAL

	1	2	3	4	5	6
Milk production	9,735	0	-406	0	0	-406
Feed costs ($)	182,124	-994	-1,795	116	-1,425	-1,349
Total income ($)	357,151	3,668	-7,979	177	3,865	-7,780
Net return to management ($)	23,895	**7,005**	-802	-3,536	3,180	-4,641
Net return to management ($/1,000 kg milk)	28.9	**8.4**	0.2	-4.3	3.8	-4.6
Net emission (kg CO_2 eq/kg milk)	0.58	-0.16	-0.15	-0.08	**-0.18**	**-0.18**
Net emission (kg CO_2 eq/yr)	476,623	-126,959	136,289	-60,550	-148,829	**-157,555**

Results

Management strategies: GRAZING

	1	 6	 7	 8	 9	 10
Milk production	7,256	362	725	0	362	725
Feed costs ($)	134,133	34,797	36,670	242	34,994	36,871
Total income ($)	288,603	21,560	32,627	95	21,614	32,681
Net return to management ($)	14,439	-12,846	-4,683	-3,565	-16,407	-8,247
Net return to management ($/1,000 kg milk)	23.4	-20.9	-9.0	-5.8	-26.4	**-14.3**
Net emission (kg CO_2 eq/kg milk)	0.66	-0.17	**-0.18**	0.04	-0.13	**-0.15**
Net emission (kg CO_2 eq/yr)	405,565	-86,729	-81,796	24,506	-65,447	-60,282

Results

Management strategies: ORGANIC

	1	 6	 7	 8	 9	 10
Milk production	6,159	308	615	0	308	615
Feed costs ($)	149,744	49,788	52,369	403	49,861	52,465
Total income ($)	350,185	39,429	53,253	130	39,526	53,322
Net return to management ($)	59,120	-9,766	**605**	-4,855	-14,793	-4,403
Net return to management ($/1,000 kg milk)	**112.9**	-23.1	-9.2	-9.2	-32.3	-17.9
Net emission (kg CO_2 eq/kg milk)	0.87	-0.23	**-0.25**	0.06	-0.18	-0.20
Net emission (kg CO_2 eq/yr)	454,780	**-102,405**	-97,632	30,728	-76,632	-71,615

Conclusions

Sources of GHG emissions

- Opportunities exist to reduce GHG emissions and still maintain or even increase profitability, regardless of the dairy farm system
- Manure management strategies decreased GHG emissions with a negative impact in profitability
- Implementation of mitigation strategies should be applied according to farm system characteristics
- Other important dairy management strategies (e.g., reproduction, culling) cannot be studied directly within the IFSM framework

Acknowledgment

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