

# Sustainable production of dairy farm systems

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# Sustainability

Profitable and environmentally friendly

## **Unprofitable farms**

- Run out of business

## **Environmental efficient**

- Good balance input/output of nutrients

## **Several nutrients are of interest**

- This study: Greenhouse gases vs. profitability

## **Inefficient, more wasteful farms**

- Destined to be unsustainable

## **Increased productivity**

- Likely improves efficiency and environment

# Introduction

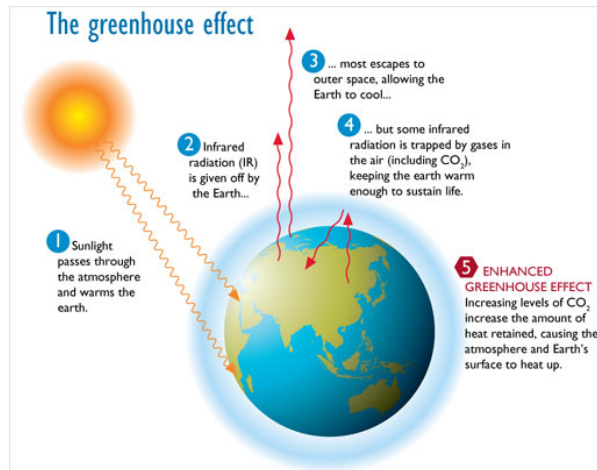
GHG emissions need to be reduced

## 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

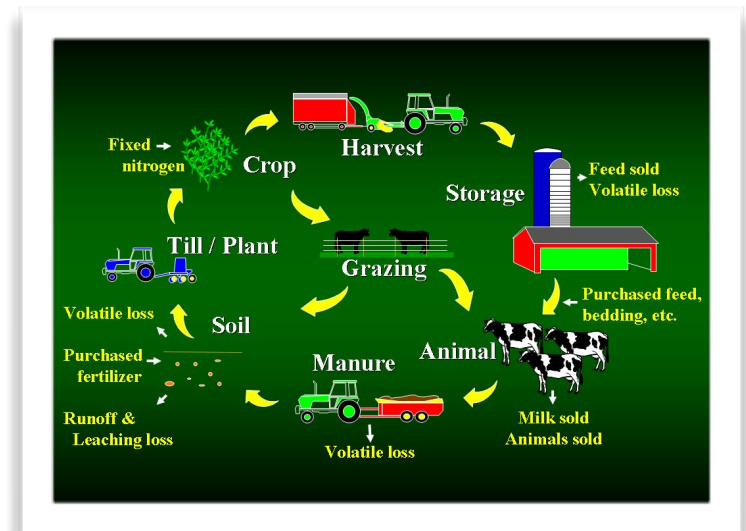
- Field trials are unpractical or impossible

## 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

### Wisconsin official lists of dairy cattle milk producers

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

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



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: \_\_\_\_\_

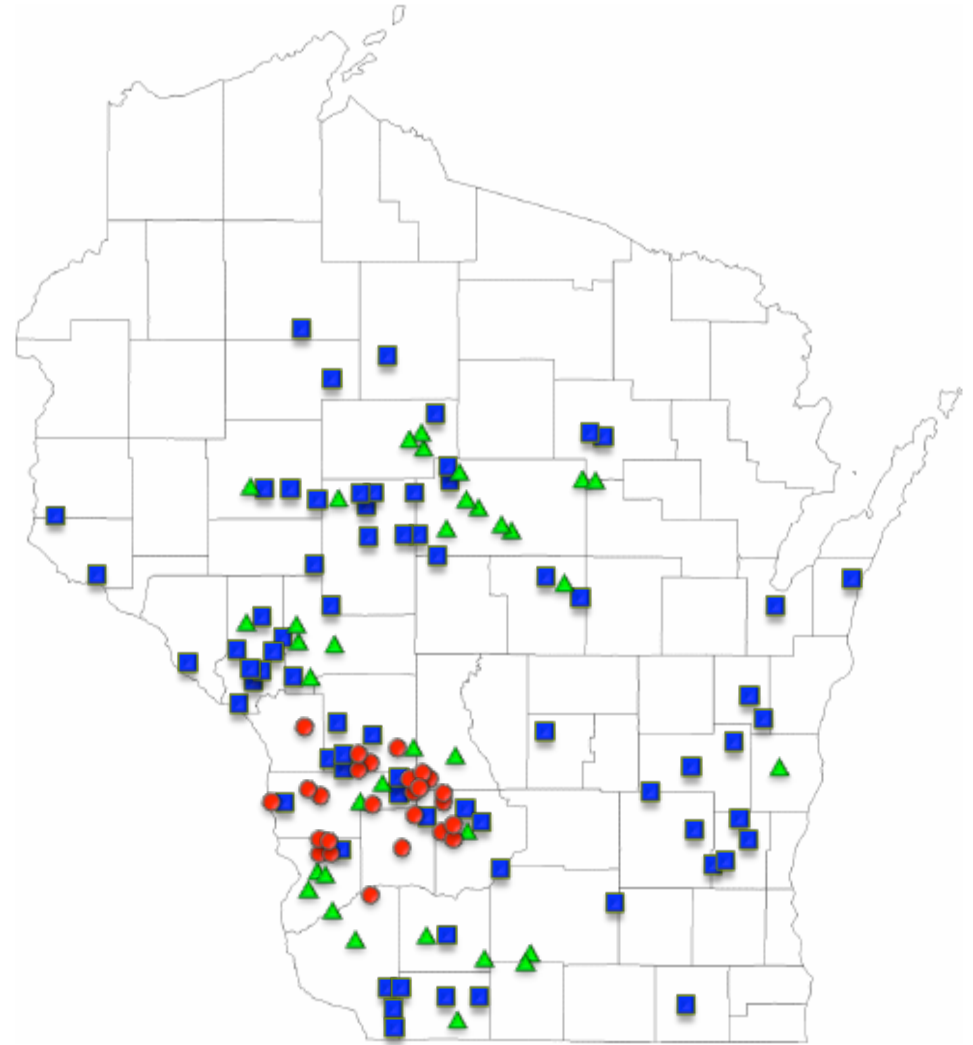
FARMER ID#: \_\_\_\_\_

# 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**

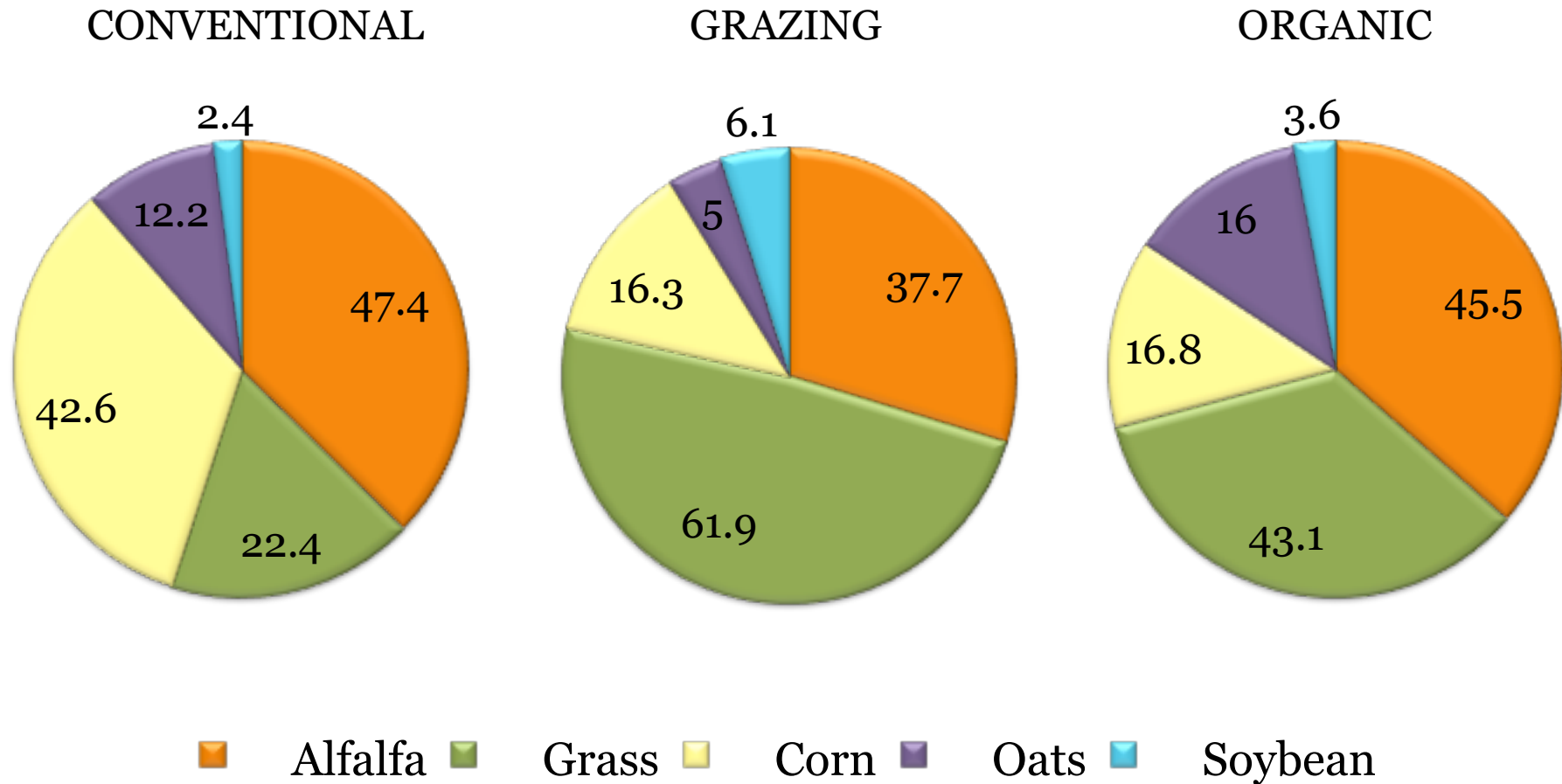
- 127 ha
  - 79 ha owned
  - 48 ha rented
- 85 adult cows (milking and dry)

	Scaled	CON	GRA	ORG
# cows	85	<b>128</b>	<b>94</b>	74
Hectares	127	<b>162</b>	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

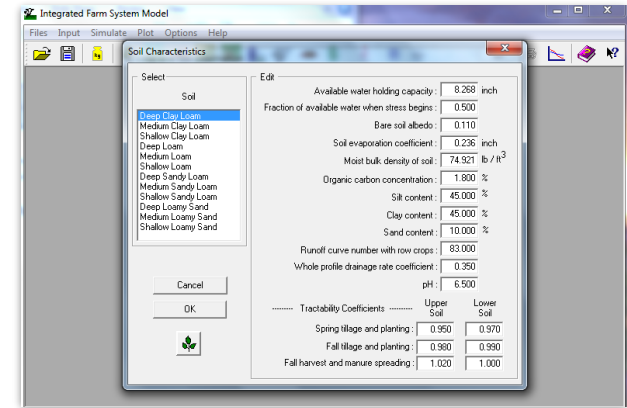


# Materials and methods

## 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 and sources at the farm level**

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








# 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 <sub>2</sub> eq/kg milk)	0.58	0.66	0.87
Net emission (kg CO <sub>2</sub> eq/yr)	476,623	405,565	454,780

# Results






## Management strategies: CONVENTIONAL

						
	0	1	2	3	4	5
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	<b>7,005</b>	-802	-3,536	3,180	-4,641
Net return to management (\$/1,000 kg milk)	28.9	<b>8.4</b>	0.2	-4.3	3.8	-4.6
Net emission (kg CO <sub>2</sub> eq/kg milk)	0.58	-0.16	-0.15	-0.08	<b>-0.18</b>	<b>-0.18</b>
Net emission (kg CO <sub>2</sub> eq/yr)	476,623	-126,959	136,289	-60,550	-148,829	<b>-157,555</b>








# Results

## Management strategies: GRAZING

						
	0	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	<b>-14.3</b>
Net emission (kg CO <sub>2</sub> eq/kg milk)	0.66	-0.17	<b>-0.18</b>	0.04	-0.13	<b>-0.15</b>
Net emission (kg CO <sub>2</sub> eq/yr)	405,565	-86,729	-81,796	24,506	-65,447	-60,282

# Results

## Management strategies: ORGANIC

						
	0	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	<b>605</b>	-4,855	-14,793	-4,403
Net return to management (\$/1,000 kg milk)	<b>112.9</b>	-23.1	-9.2	-9.2	-32.3	-17.9
Net emission (kg CO <sub>2</sub> eq/kg milk)	0.87	-0.23	<b>-0.25</b>	0.06	-0.18	-0.20
Net emission (kg CO <sub>2</sub> eq/yr)	454,780	<b>-102,405</b>	-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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United States Department of Agriculture  
National Institute of Food and Agriculture





Muito obrigado



Início ▾

Ferramentas

Projetos

Publicações

Apresentações

Ligações



## Melhorar a relação custo-eficiência e rentabilidade



Este site foi concebido para apoiar a pecuária leiteira a tomada de decisões com foco no modelo baseado em pesquisas científicas. O objetivo final é fornecer ferramentas de apoio à decisão informatizado user-friendly para ajudar os produtores de leite melhorarem o seu desempenho econômico, juntamente com a gestão ambiental.



UW-Dairy Management  
Decision Support TOOLS

### Universidade de Wisconsin

University of Wisconsin - Madison

UW - Extensão Cooperativa

UW - Dairy Science

Gado de Leite Reprodução

Gado de Leite Nutrição

Qualidade do leite

UW Dairy Nutrient

Entender os mercados lácteos

UW Centro de Rentabilidade Dairy

### Últimos Projetos

Melhoria da sustentabilidade Dairy Farm  
Genomic Selection e gerenciamento de  
rebanho

Reprodução Dairy Ferramentas de Apoio à  
Decisão

Estratégias de Suplementação Pasto

Melhorar Dairy Cow Fertilidade

### Contato



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Victor E.Cabrera, Ph.D.



### Ligação úteis

[Programa Dinheiro Repro](#)

#### Tweets

 Siga



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19 de setembro

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26 de agosto

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