Sustainability Heads Every Agenda

Judith L. Capper, PhD
Vita Plus Dairy Summit 2011, Wisconsin Dells, WI, Dec 6-8 2011

Source: Created by Dr. Judith L. Capper, Washington State University, 2011
The Global Livestock Industry is Under Threat

World Beef, Pork and Poultry Consumption: 1980 - 2050

Sources: Global Insight Demand Analysis to 2050; Bauman and Capper (2011) Southwest Nutrition and Management Conference, Tempe, AZ.
Environmental Working Group Suggests Carbon Footprint of Meat is Unfavorable

Source: Environmental Working Group (2011) "Meat Eater’s Guide to Climate Change and Health"

Carnegie-Mellon Study Claims Meatless Mondays Considerably Reduce Carbon Footprint

“Shifting less than one day per week’s worth of calories from red meat and dairy products to chicken, fish, eggs, or a vegetable-based diet achieves more GHG reduction than buying all locally sourced food.”

Meatless Mondays have Negligible Environmental Impact… and Lead to Further Questions

Dairy/Red Meat = 3.05% of US carbon emissions
Meatless Monday = 0.44% reduction in carbon emissions

What happens to consumer choice?
What replaces animal by-products?
What replaces meat/dairy?


Essential to Assess Environmental Impact per Unit of Output

Vehicle 1  Vehicle 2

Source: Created by Dr. Judith L. Capper, Washington State University, 2010
Essential to Assess Environmental Impact per Unit of Output

**Vehicle 1**

- 250 People MPG

**Vehicle 2**

- 140 People MPG

Sources: Created by Dr. Judith L. Capper, Washington State University, 2010

The Majority of Dairy Production’s Environmental Impact Occurs On-Farm

![Graph showing the percentage of carbon footprint for different stages of dairy production](source)

The Dairy Industry Must be Evaluated on a Production Basis, Not per Cow


The U.S. Dairy Farm Industry has Reduced its Total Carbon Footprint by 41% Since 1944


Environmental Impact Reduction due to Improved Productivity

Environmental Impact Reduction due to Improved Productivity

U.S. produces 59% more milk using 64% fewer cows

1944 2007

25.6 mil cows 186 bil lb
117 bil lb
9.2 mil cows


Supporting Population Must be Included - It Takes a Herd to Make Milk

- Feed
- Land
- Water
  - Intake
  - Irrigation
- Fertilizers
- Fossil Fuels
- Greenhouse Gases
  - CO₂ - Carbon Dioxide
  - CH₄ - Methane
  - N₂O - Nitrous Oxide
- Nutrient Excretion
- Manure

Source: Created by Dr. Judith L. Capper, Washington State University, 2010
Modern US Milk Production Has Considerably Lower Resource Use and Carbon Emissions

1860 U.S. Bison Population had Carbon Footprint Twice that of the 2007 Dairy Industry
Hormones are Portrayed as a Human Health Threat

Conventional Agriculture is Often Demonized

Organic Dairy Production Systems Have Lower Yields Than Conventional Systems

![Bar graph showing average milk yield (lb/yr) for Rotz et al., Sato et al., and Zwald et al.](Source: Capper et al. (2008) The environmental impact of recombinant bovine somatotropin (rbST) use in dairy production. PNAS 105:9668-9673)

Future U.S. Demand for Dairy Products Best Met via Improved Productivity

![Bar graph showing dairy population ('000,000 head) for rbST, Conventional, and Organic](Source: Capper et al. (2008) The environmental impact of recombinant bovine somatotropin (rbST) use in dairy production. PNAS 105:9668-9673)
Future U.S. Demand for Dairy Products Best Met via Improved Productivity

**Land required ('000,000 acres)**
- rbST: -5%
- Conventional: 0%
- Organic: +33%


**Carbon Footprint (million MT)**
- rbST: -6%
- Conventional: 0%
- Organic: +13%

Beverages Vary in Nutrient Density and Greenhouse Gas Emissions

<table>
<thead>
<tr>
<th>Beverage</th>
<th>Nutrient Density (%)</th>
<th>GHG Emissions g CO2/g product</th>
</tr>
</thead>
<tbody>
<tr>
<td>Milk</td>
<td>53.8</td>
<td>99</td>
</tr>
<tr>
<td>Orange Juice</td>
<td>17.2</td>
<td>61</td>
</tr>
<tr>
<td>Soy Drink</td>
<td>7.6</td>
<td>30</td>
</tr>
<tr>
<td>Oat Drink</td>
<td>1.5</td>
<td>21</td>
</tr>
<tr>
<td>Red Wine</td>
<td>1.2</td>
<td>204</td>
</tr>
<tr>
<td>Soda</td>
<td>0</td>
<td>109</td>
</tr>
<tr>
<td>Beer</td>
<td>0</td>
<td>101</td>
</tr>
<tr>
<td>Mineral Water</td>
<td>0</td>
<td>10</td>
</tr>
</tbody>
</table>

Nutrient Density Must Be Included When Assessing Environmental Impact

Maximizing Productivity Reduces Total Maintenance Costs & Resource Use

- Jersey cattle produce 12.5 lb cheese per 100 lb milk
- Reduced body mass compared to Holsteins
- Cheese yield and body mass interaction may reduce population maintenance


## Breed Characteristics Summary

<table>
<thead>
<tr>
<th></th>
<th>Holstein</th>
<th>Jersey</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Daily Milk Yield (lb)</strong></td>
<td>64.2</td>
<td>46.0</td>
</tr>
<tr>
<td><strong>Fat %</strong></td>
<td>3.8</td>
<td>4.8</td>
</tr>
<tr>
<td><strong>Protein %</strong></td>
<td>3.1</td>
<td>3.7</td>
</tr>
<tr>
<td><strong>Cheese Yield (lb/lb)</strong></td>
<td>0.101</td>
<td>0.125</td>
</tr>
<tr>
<td><strong>Calving Interval (mo)</strong></td>
<td>14.1</td>
<td>13.7</td>
</tr>
<tr>
<td><strong>Annual Turnover %</strong></td>
<td>34.5</td>
<td>30.0</td>
</tr>
<tr>
<td><strong>Expected # Lactations</strong></td>
<td>2.54</td>
<td>3.00</td>
</tr>
<tr>
<td><strong>Age @ First Calving (mo)</strong></td>
<td>26.1</td>
<td>25.3</td>
</tr>
<tr>
<td><strong>Heifer:Cow Ratio</strong></td>
<td>0.86</td>
<td>0.83</td>
</tr>
<tr>
<td><strong>Mature Cow Body Weight (lb)</strong></td>
<td>1,500</td>
<td>1,000</td>
</tr>
</tbody>
</table>

*Factors in blue are estimated as functions of data accessed; Source: DRMS, DairyMetrics™, www.drms.org, accessed Nov. 9, 2009*

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## Jersey vs. Holstein: Comparison of Resource Use and Environmental Impact

- **Jersey as Percent of Holstein:**
  - Milk: 81%
  - Animals: 109%
  - Body Mass: 74%
  - Water: 68%
  - Land: 89%
  - GHG: 80%

Environmental Savings in producing 500,000 MT Cheddar cheese: Jersey Breed Advantage

✓ 376 mi² Land
  • Size of Mt. Rainier National Park
✓ 66,564 million gallons of Water
  • Would supply 657,889 households annually
✓ 517,602 BTU of Energy
  • Would heat 6,335 households annually
✓ 1.71 million MT of CO₂
  • Equivalent to taking 336,888 cars off the road for a year


Impact of Performance Characteristics on Water Use for Cheddar Cheese Production

Breed Effect of Performance Characteristics on Water Use for Cheddar Cheese Production

<table>
<thead>
<tr>
<th>Component</th>
<th>Yield</th>
<th>Calving Interval</th>
<th>Age at 1st Calving</th>
<th>Milk Yield</th>
<th>Herd Life</th>
</tr>
</thead>
<tbody>
<tr>
<td>Body Weight</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>% Change</td>
<td></td>
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</tbody>
</table>


Practices That Reduce Enteric Methane per Cow May Also Reduce Productivity

Stonyfield Farm takes on cow burps with first North American program

Simultaneously increases nutritional value of the milk & fights global warming

“...The pilot program works by feeding cows a diet high in natural omega-3 sources, such as alfalfa, flax, and grasses... Stonyfield Farm has been able to reduce the enteric emissions from the cows by as much as 18%, an average of 12%.”

Last Accessed May 3, 2010
Practices That Reduce Enteric Methane per Cow May Also Reduce Productivity

Rumen Bacteria

Methane

Forage

Omega-3

Fatty acids

3.7% fat
3.1% protein
67.1 lb FCM*

Source: Created by Jude Capper, Washington State University. *FCM = 3.5% fat-corrected milk = (0.432 x milk lb) + (16.23 x fat %)

Altered fatty acids

3.2% fat
3.1% protein
60.7 lb FCM*
10% reduction

Source: Created by Jude Capper, Washington State University. *FCM = 3.5% fat-corrected milk = (0.432 x milk lb) + (16.23 x fat %)
Carbon Footprint Highlighted by FAO Report –
Negative Data Produced Positive Results

A Negative Correlation Exists Between Milk
Yield and Carbon Footprint


Silent But Deadly

Did you know that farmed animals produce more greenhouse gas emissions (19%) than the world's entire transport system (13.5%)? Or that nitrous oxide from animal manure is around 300 times as damaging to the climate as carbon dioxide? Or that methane (cow and sheep farts/burps to you and me) has 23 times the global warming impact of carbon dioxide?

Makes you think doesn’t it?
Real Life Challenge:
Meeting China’s New 2008 RDI for Milk

- Chinese Recommended Daily Intake (RDI) of milk raised to 10.6 oz
- Represents a three-fold increase in the Chinese RDI
- 10.6 oz is a modest requirement, only 44% of the US RDI
- Average milk yield of Chinese cattle: 24 lb/d

Social Sustainability Remains a Huge Challenge

Source: Maggie Suisman http://www.maggiesuisman.com/factory.html
Conclusions

✓ Improving productivity is a key factor in mitigating the environmental impact of dairy production

✓ Milk yield is a key indicator of efficiency

✓ Body weight, milk component yield and other productivity factors also significantly affect environmental impact

✓ Environmental impact must be assessed on a scientific rather than a “touchy-feely” basis

Source: Created by Dr. Judith L. Capper, Washington State University, 2011

Thank you!

In honor of Earth Day, she vowed to release no methane for 24 hours.


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