

# Reducing the Dairy Carbon Footprint

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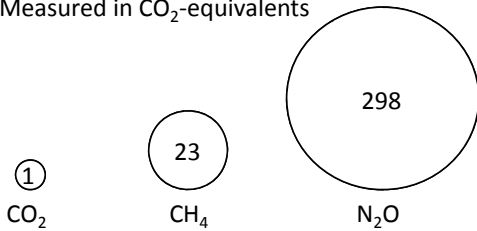
3<sup>rd</sup> Western Dairy Air Quality Symposium  
 April 15-16<sup>th</sup> 2009, Albuquerque, NM



What is a Carbon Footprint?

“Total GHG (greenhouse gas) emissions caused directly and indirectly by an individual, organization or state in a given time”

- Measured in CO<sub>2</sub>-equivalents

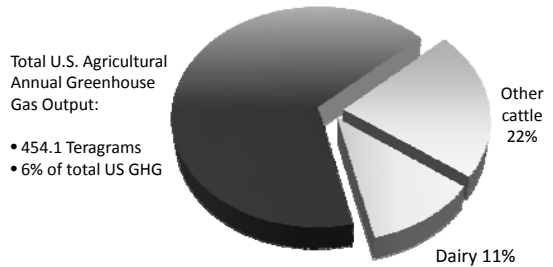


How do we reduce our carbon footprint?



Vegetarian Society (2008) <http://www.vegso.org>

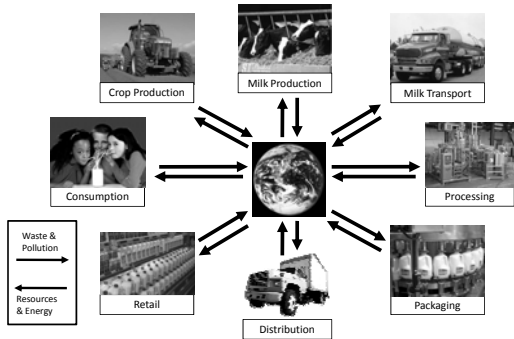
Dairy Production Contributes Less than 1% to the Total US Carbon Footprint



Note: 1 Teragram = 1 million metric tonnes

EPA (2008) Inventory of U.S. Greenhouse Gas Emissions and Sinks

### Which Area of the Milk Chain has the Biggest Environmental Impact?



### Why the Focus on the Dairy Farm?

On-farm milk production has the greatest opportunity to affect the carbon footprint of a gallon of milk:

- 80% to 95% of carbon footprint
- 75% of electricity a fuel use



### Scientific Efforts Have Focused on Reducing Animal and Farm Emissions

- ✓ Improve metabolic (feed) efficiency
- ✓ Improve nutrition
  - Ration balancing
  - Feeding management
- ✓ Improve cropping practices & technology
- ✓ Improve manure management
  - Storage
  - Processing
  - Application

**Great Things to Do!**



### Productive Efficiency is Not a New Concept

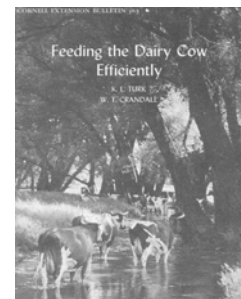
1927

"When the population of this country increases to 200,000,000 it should be easily possible for the additional supply of dairy products needed to be produced not by more, but by better dairy cows...."

The average milk production of US cows is about 4,500 pounds a year. If this were increased at a rate of 100 pounds a year, in 45 years the average milk production per cow would be doubled. The present number of cows could then supply sufficient dairy products at the present rate of consumption for considerably more than 200,000,000 people."

J.C. McDowell (1927) US Yearbook of Agriculture

1953



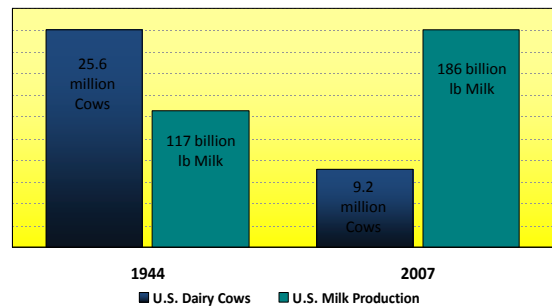
### Which Vehicle is More Environmentally Responsible?

	<u>Vehicle 1</u>	<u>Vehicle 2</u>	
Fuel Burned in 5 hrs:	70 gal	10 gal	} Process (Cow)
Distance Traveled:	350 mi (5 mpg)	350 mi (35 mpg)	
Passengers:	50	4	} Outcome (Milk)
People Miles:	17,500	1,400	
People MPG:	250	140	

**Winner**

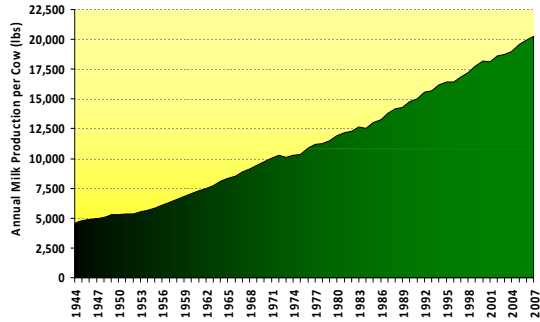
**Key: Evaluation Needs to be on Final Outcome! Not Just Individual Process Measures!**

### Improved Production Efficiency = More from Less = Sustainability



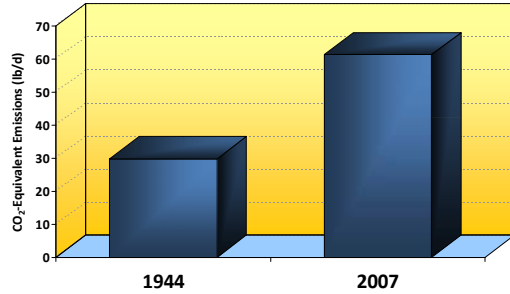
USDA-NASS (2008) <http://www.nass.usda.gov>

**U.S. Milk Productivity has Quadrupled since 1944**



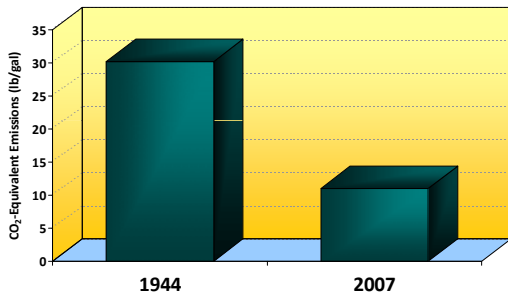
USDA-NASS (2007) <http://www.nass.usda.gov>

**Carbon Footprint of the Average U.S. Dairy Cow Has Doubled Since 1944**



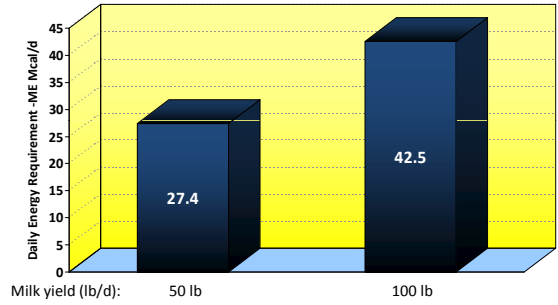
Adapted from Capper *et al.* (2008) ADSA-ASAS Annual Meeting, JDS 91 (E-suppl1) LB3

**Carbon Footprint of a Gallon of Milk Has Been Reduced by 2/3 Since 1944**



Adapted from Capper *et al.* (2008) ADSA-ASAS Annual Meeting, JDS 91 (E-suppl1) LB3

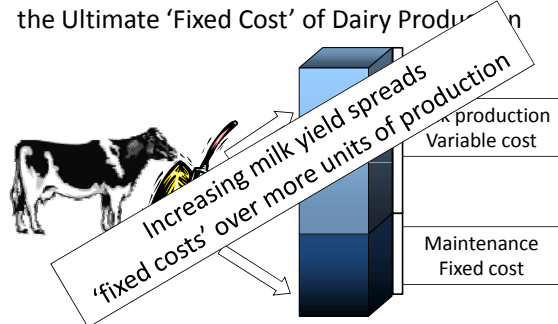
**High-producing cows need more resources – don't they?**



Adapted from Capper *et al.* (2008) CNC

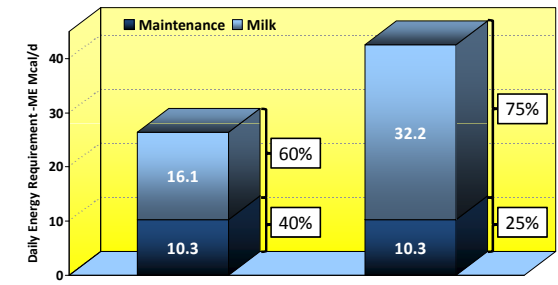
Based on 1,435 lb cow

**The Cow's Maintenance Nutrient Requirement is the Ultimate 'Fixed Cost' of Dairy Production**



Science, management, and genetics have not significantly changed the metabolic efficiency of maintenance

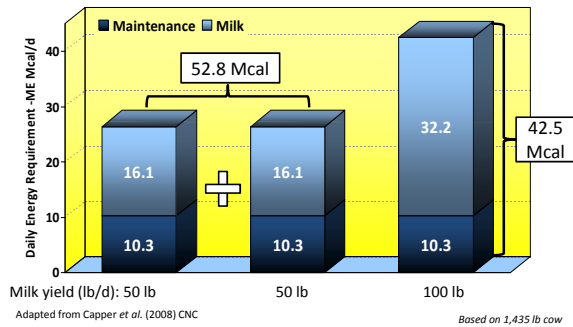
**Dilution of Maintenance is Key**  
"Reducing Nutrient Cost per Unit of Milk"



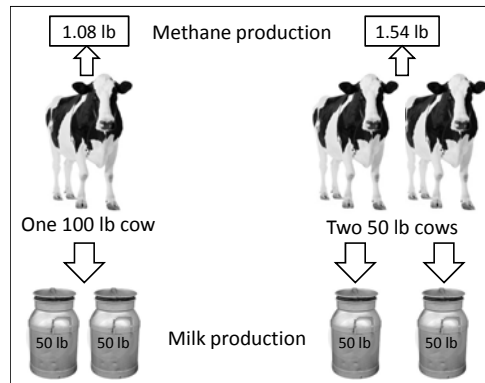
Adapted from Capper *et al.* (2008) CNC

Based on 1,435 lb cow

### Making 100 lb milk/day using low-producing cows requires more resources

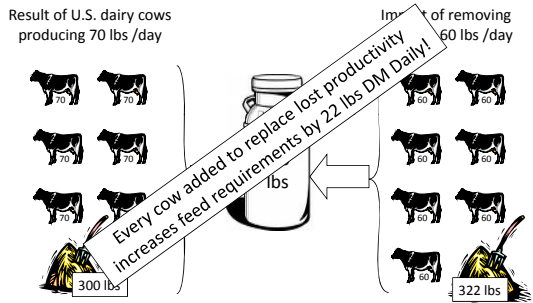


### More cows = more greenhouse gases

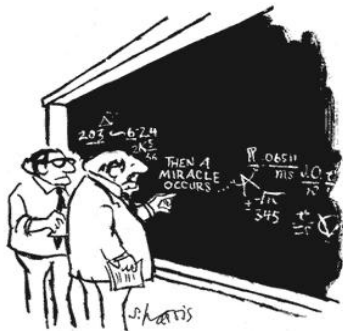
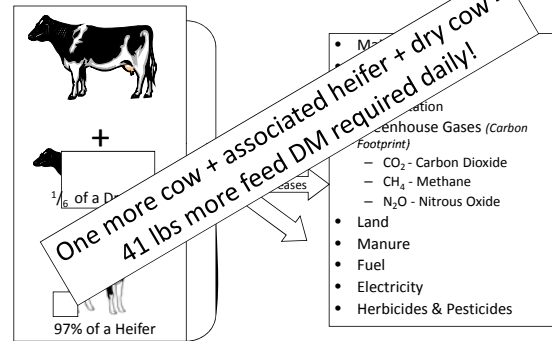


### Practical Advantage of Dilution of Maintenance

Reduced Milk Production Requires More Cows to Supply Equivalent Milk



### It Takes a Herd to Make Milk



"I THINK YOU SHOULD BE MORE EXPLICIT HERE IN STEP TWO."

© Sydney Harris; <http://www.nmsr.org/dddv.htm>

### Key Components of Cornell Study

- Founded on NRC<sub>2001</sub> nutrient requirements
- Impact assessed on industry-scale dairy production system (population) basis
  - Includes heifers, milking cows, dry cows and bulls
- Data sourced from peer-reviewed scientific publications and government reports
  - No undocumented assumptions
  - USDA milk and crop yields
  - USDA crop production inputs
- Includes animals, cropping, manure, fertilizer and fossil fuels as sources of GHGs and nutrient flows
- LCA evaluation

## 1 Million Cows Producing 10 More lbs of Milk Daily Reduces the Environmental Impact by 9% Annually

- 334,000 fewer animals (182,500 cows; 151,500 heifers) required to meet demand, therefore:
- 2.5 mil fewer tons of feed
- 540,000 acres (843 sq mi) less cropland (2 ½ size of NYC)
- Saves enough:
  - fuel to heat 15,700 households
  - electricity to power 14,600 households
  - water to supply 9,800 households
- 3.0 mil fewer tons of manure
- Reduces carbon footprint by 1.85 mil metric tons:
  - Removing 391,000 cars from the road
  - Planting 291 mil trees

Capper et al. (2008) PNAS

## Environmental Impact of 10 More lbs of Milk in an Average 150-Cow Herd

- 245 fewer tons of feed
- 53 fewer acres cropland
- 132,000 gal of water
- Reduces carbon footprint
  - 180 metric tons
  - Equivalent to removing 38 cars from the road annually
  - Equivalent to planting 28,375 trees annually



Adapted from Capper et al. (2008) PNAS

## Buying Milk from Herds Producing 10 More lbs of Milk Cuts Consumers' Annual Carbon Footprint

### Average U.S. family of 4:

- Consumes 274 gallons of milk annually to meet USDA recommended daily allowance (RDA) of three 8 oz glasses per day
- Reduces their carbon footprint by 345 lb of CO<sub>2</sub>
- Equivalent to planting **25 trees**



Adapted from Capper et al. (2008) PNAS

## What Does the Future Hold?

In 1800, one family farm could only supply food for one other family on average.

Conkin, P. (2008) 'A Revolution Down on the Farm'

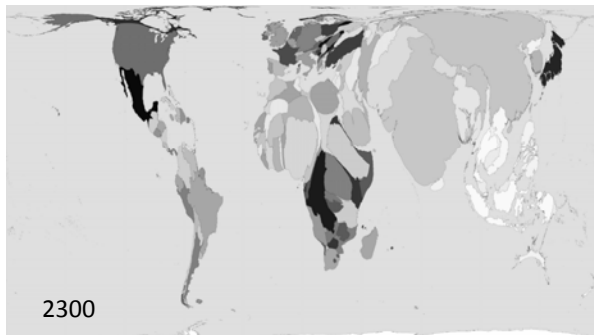
In the US today, with its highly efficient agriculture, farmers make up only 2% of our population, and each farmer can feed, on average, 125 other people.

Diamond, J. (2005) 'Collapse'

This year, some 900 million people – including 178 million children under 5 – are suffering from malnutrition, estimates the United Nations; every day 50,000 starve to death.

Begley, S. (2008) Feeding the 900 million: Let them eat micronutrients. *Newsweek*

## Where is Global Population Headed?



<http://www.worldmapper.org/>

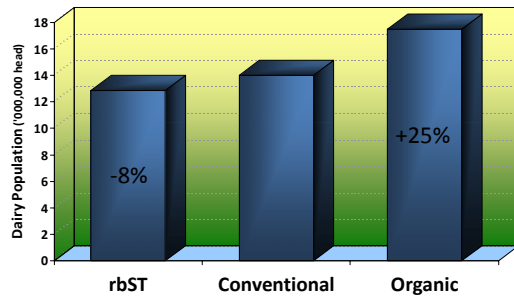
## Is Organic Farming the Solution?

Mr. Haerlin of the Greenpeace campaign made a strongly worded speech at conference here (Montreal Biosafety Conference, 2001). To an audience of scientists, he said that many scientists were liars and that "smarter science and smarter scientists" were needed to improve organic farming.

He was criticized by an African official of the United Nations Food and Agricultural Organization, who said, "Organic farming is practiced by 800 million poor people in the world because they can't afford pesticides and fertilizers -- and it's not working."

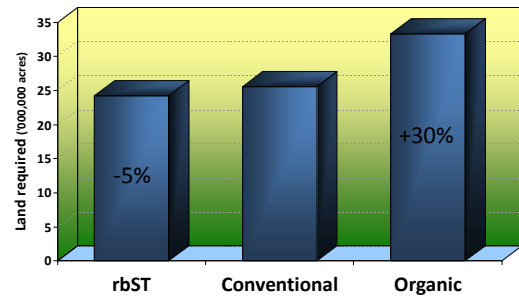
McNeil, D. (2000) Protests on New Genes and Seeds Grow More Passionate in Europe. *NY Times*

### The US Demand for Dairy Products Can Only Be Fulfilled via Improved Productivity



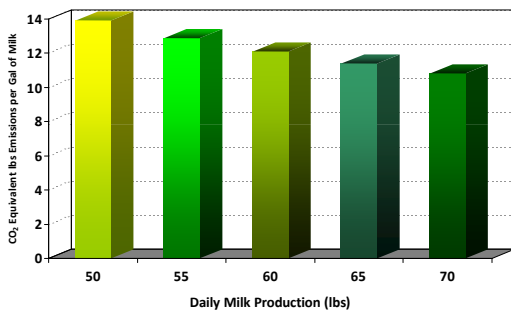
Capper et al. (2008) PNAS

### The US Demand for Dairy Products Can Only Be Fulfilled via Improved Productivity



Capper et al. (2008) PNAS

### Increased Production = Reduced Carbon Footprint per Gallon of Milk

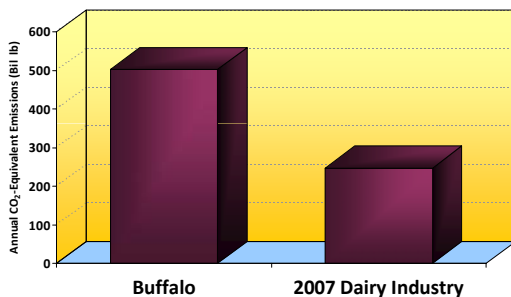


Adapted from Capper et al. (2008) PNAS

### Conclusions

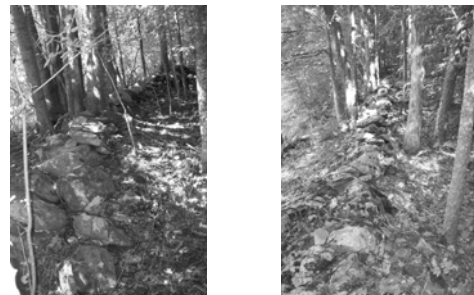
- ✓ Environmental impact must be assessed per unit of milk produced
  - ✓ On-farm milk production provides the major opportunity for improving environmental stewardship
  - ✓ Practices and technologies that increase milk production also reduce the carbon footprint, conserve resources, and improve agricultural stewardship
  - ✓ U.S. dairy industry has been decreasing the environmental impact of milk production for decades
- Sustainability = Producing more from less**

### Historical US Buffalo Population Had Double the Carbon Footprint of Today's Dairy Industry



Notes: 60 mil buffalo population prior to mass hunting in 1880; animals weighing 900 kg (M), 600 kg (F) and 300 kg (Y)  
Adapted from Roe, Frank; "The North American Buffalo", 1951, pp. 492-493

### What Do These Represent?



**Thank you!**

**Any Questions?**

For more information:

<http://tinyurl.com/DairyCarbonFootprint>