Improving Environmental Sustainability of the Dairy Cow

Dr. Judith L. Capper

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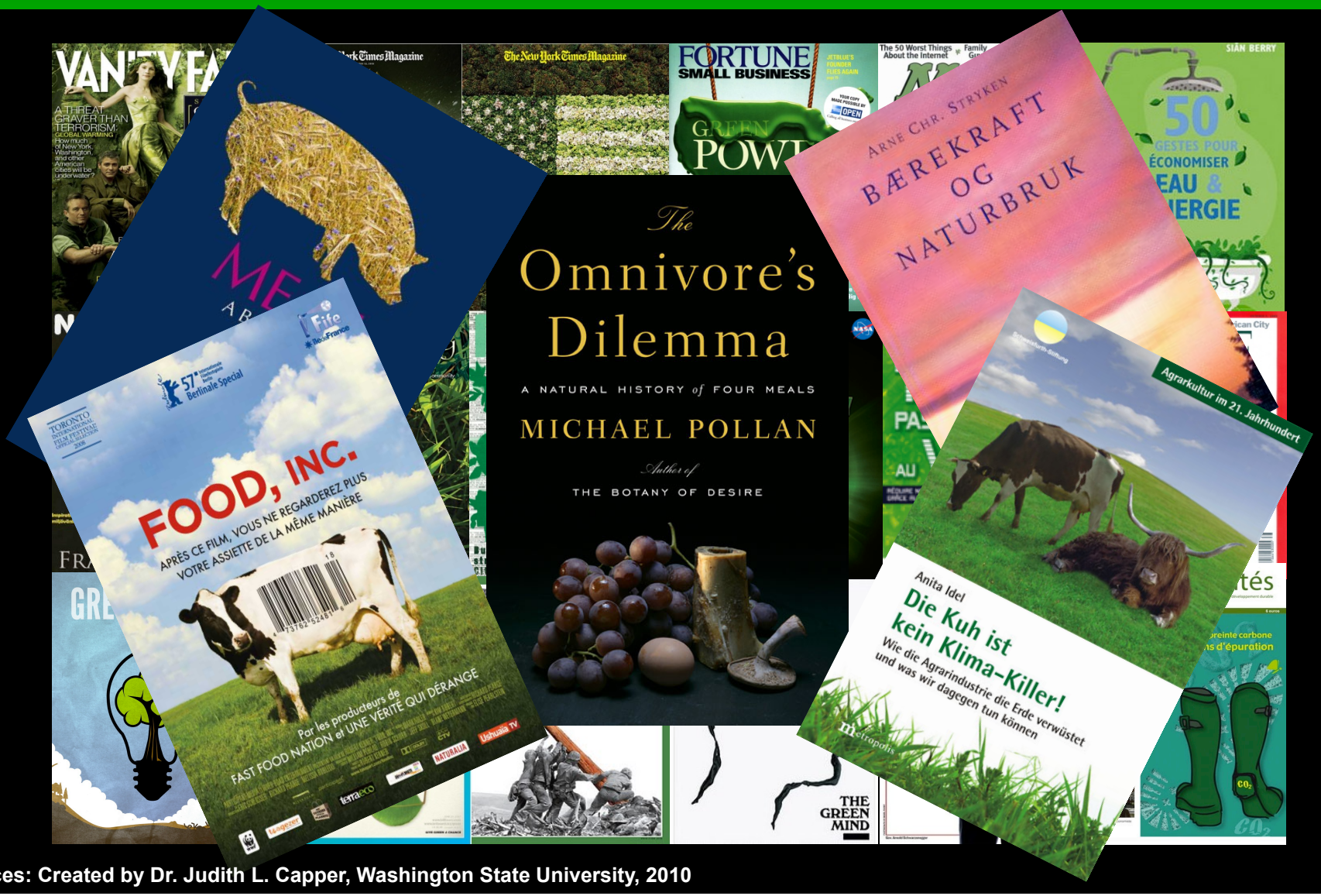
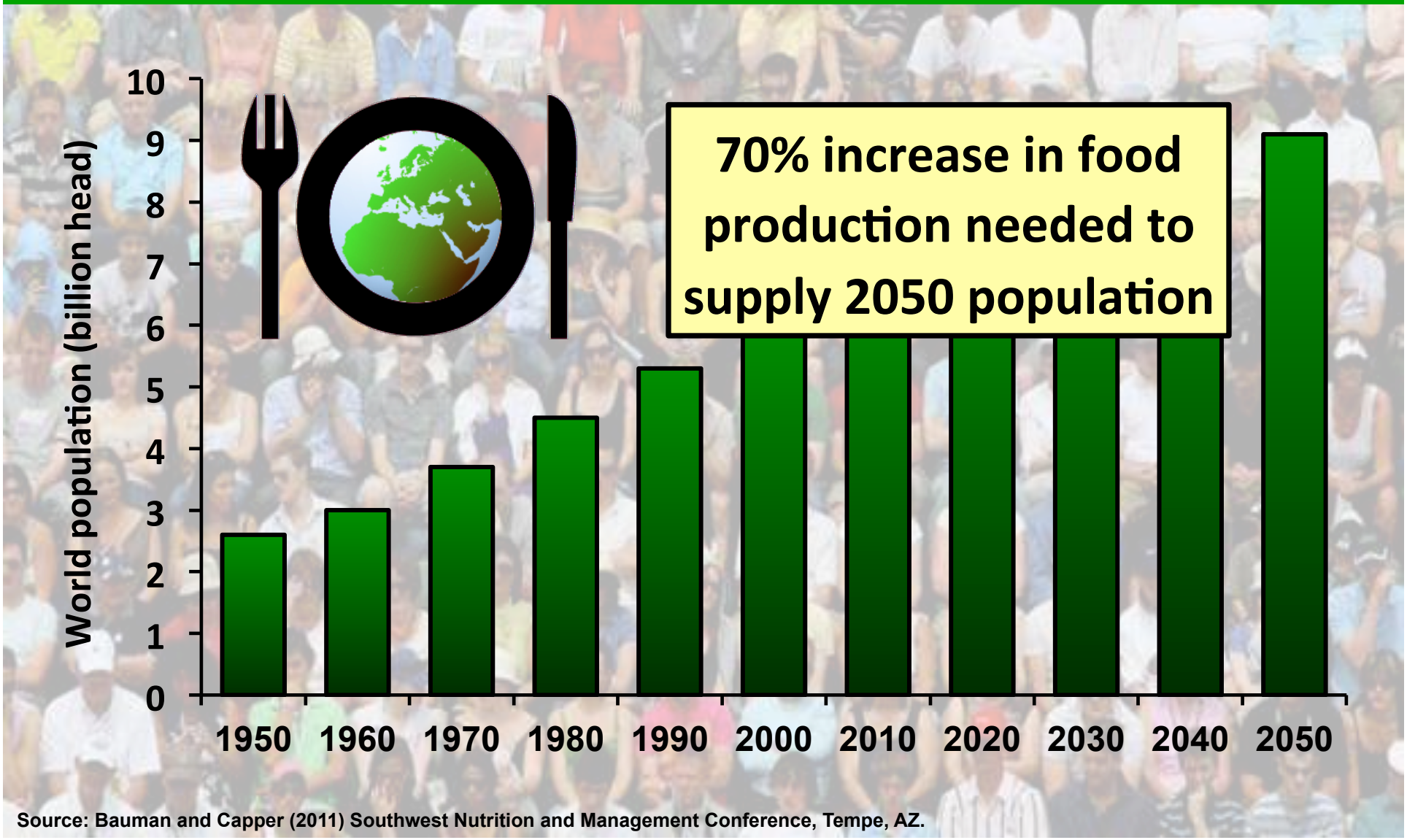
Sources: Created by Dr. Judith L. Capper, Washington State University, 2010

Sustainability Heads Media Agendas



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

Global Population Increase Necessitates Food Production Increase



Source: Bauman and Capper (2011) Southwest Nutrition and Management Conference, Tempe, AZ.

The Global Livestock Industry is Under Threat

Sources: http://culturemap.com/newsdetail/09-03-10-is-sex-in-the-shower-killing-our-water-supply-relax-beef-production-is-a-bigger-culprit/; http://animals.change.org/blog/view/save_the_animals_save_the_planet_blog_action_day_09_climate_change PETA (2010) http://www.peta.org/mc/ads/PAMpartsPETA300.jpg and http://www.goveg.com/environment-globalwarming.asp

Essential to Assess Environmental Impact per Unit of Output

	Vehicle 1	Vehicle 2	
Fuel burned in 5 hours	265 litres	38 litres	**Production Process**
Distance traveled	563 km	563 km	
Km per litre (KPL)	2.1	14.8	
Passengers	50	4	**Output**
People km	28150	2252	
People KPL	**106**	**59**	

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

Essential to Assess Environmental Impact per Unit of Output

Vehicle 1

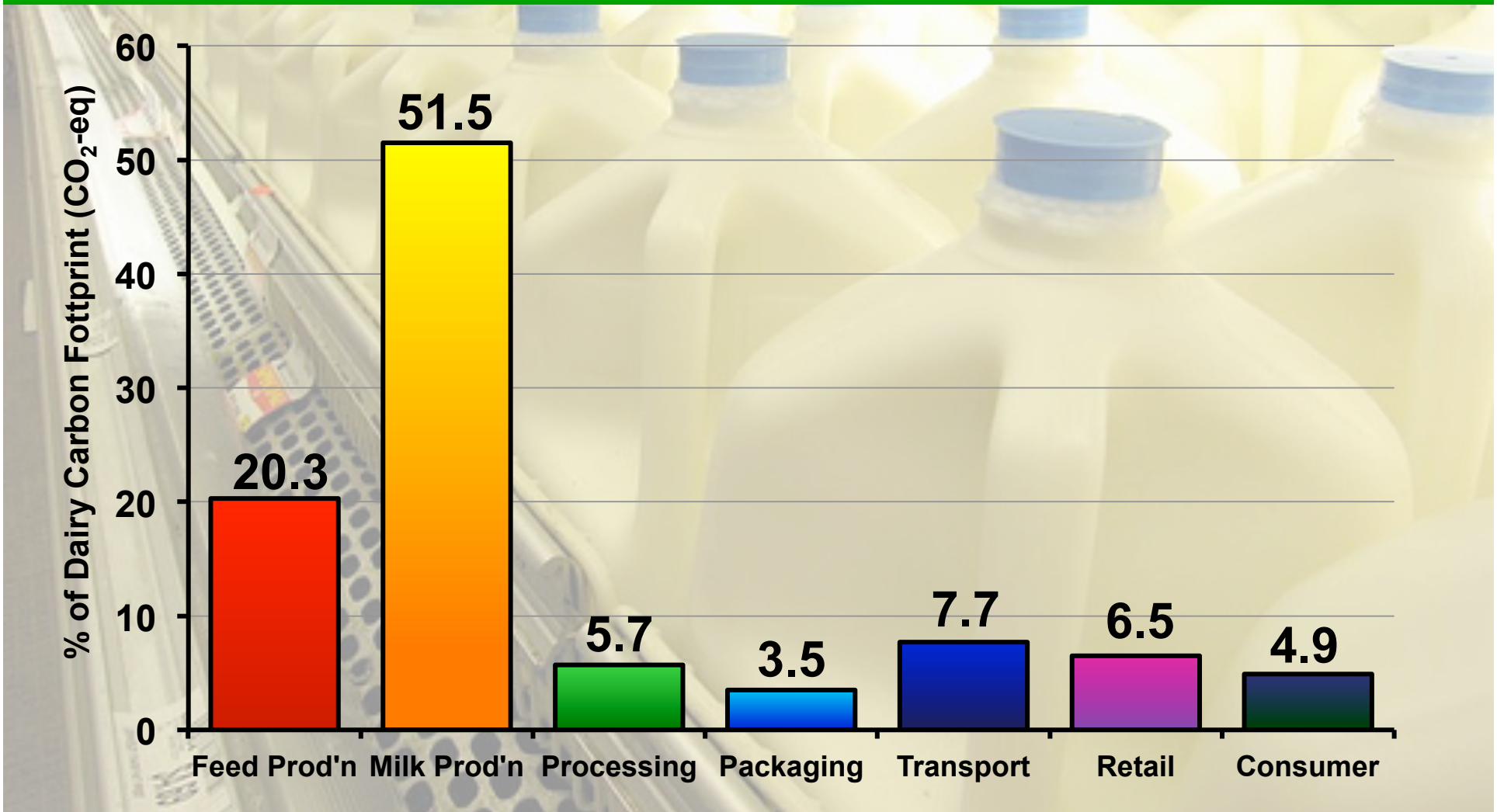
106 People KPL

Vehicle 2

59 People KPL

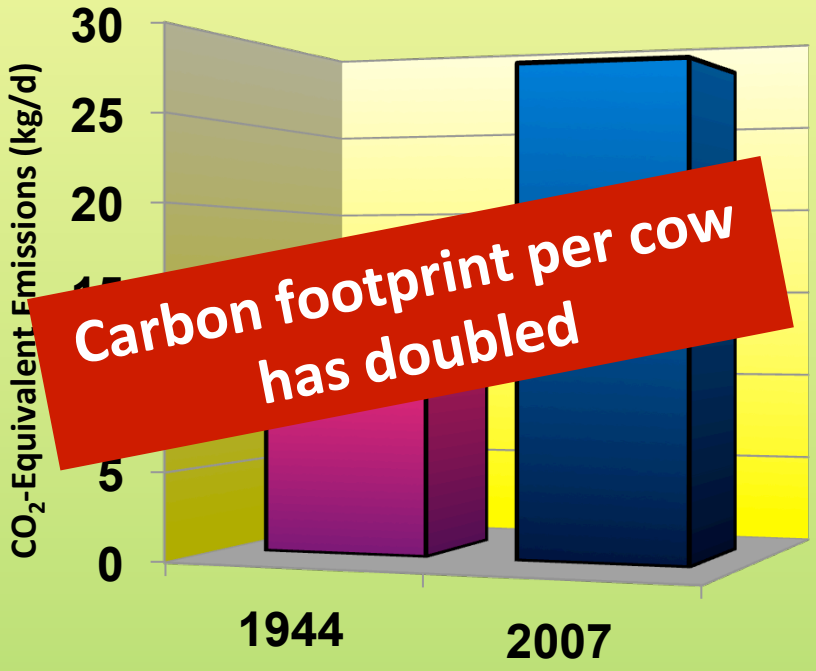
Sources: Created by Dr. Judith L. Capper, Washington State University, 2010

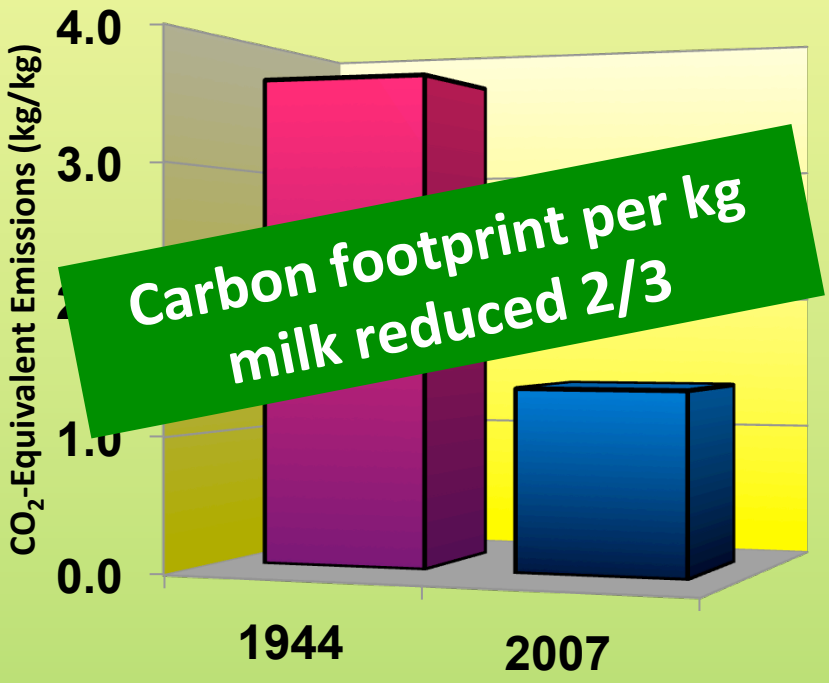
The Majority of Dairy Production's Environmental Impact Occurs On-Farm



Source: Graph created by Dr. Judith L. Capper, Washington State University, 2010; Innovation Center for U.S. Dairy (2010) U.S. Dairy Sustainability Commitment Progress Report. Available at:
http://www.usdairy.com/Public%20Communication%20Tools/USDairy_Sustainability_Report_12-2010%20%284%29.pdf

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

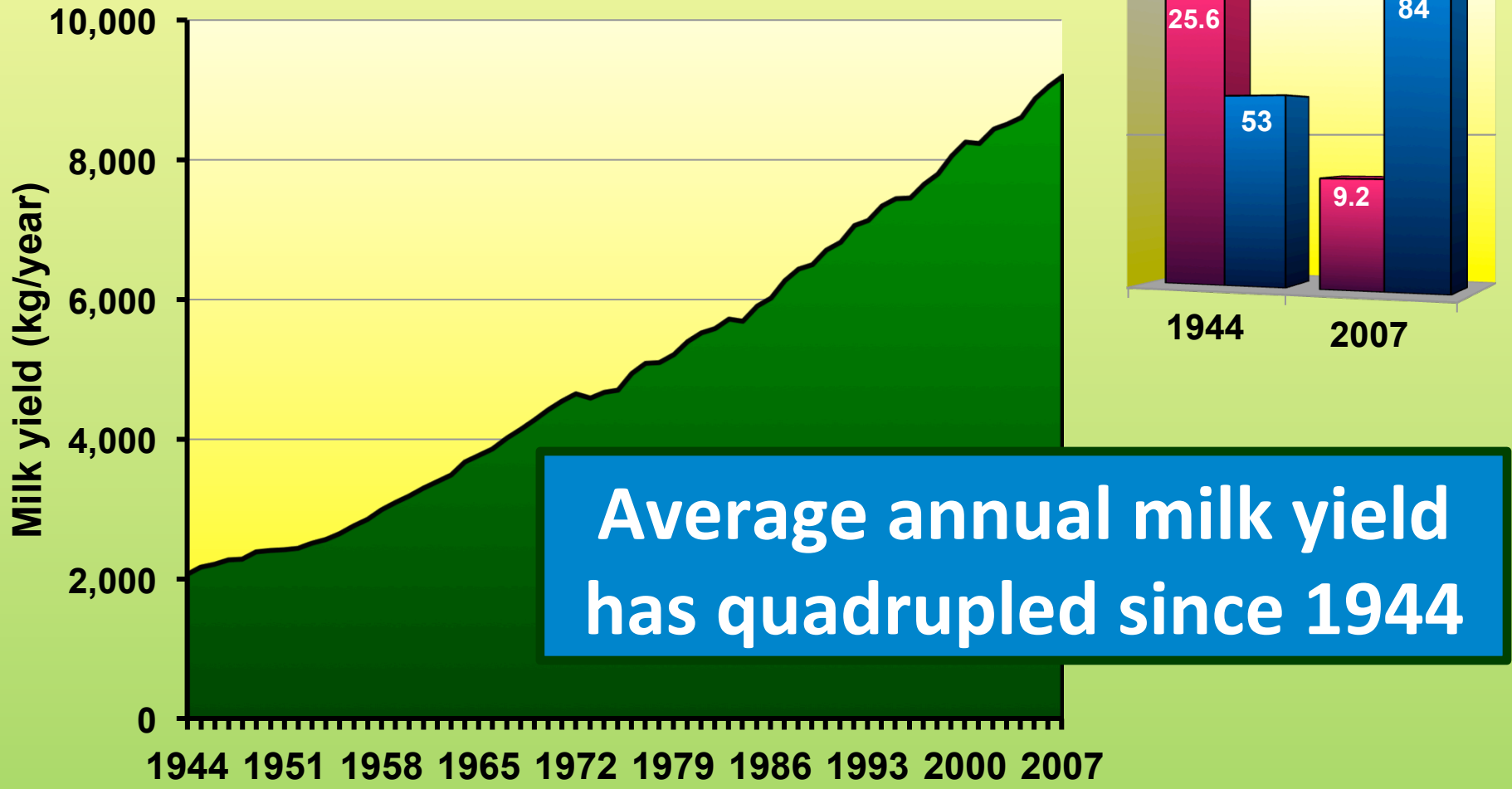




U.S. Dairy Farm Industry has Reduced its Total Carbon Footprint by 41% Since 1944

Source: Capper et al. (2009) "The environmental impact of dairy production: 1944 compared with 2007" *J. Anim. Sci.*

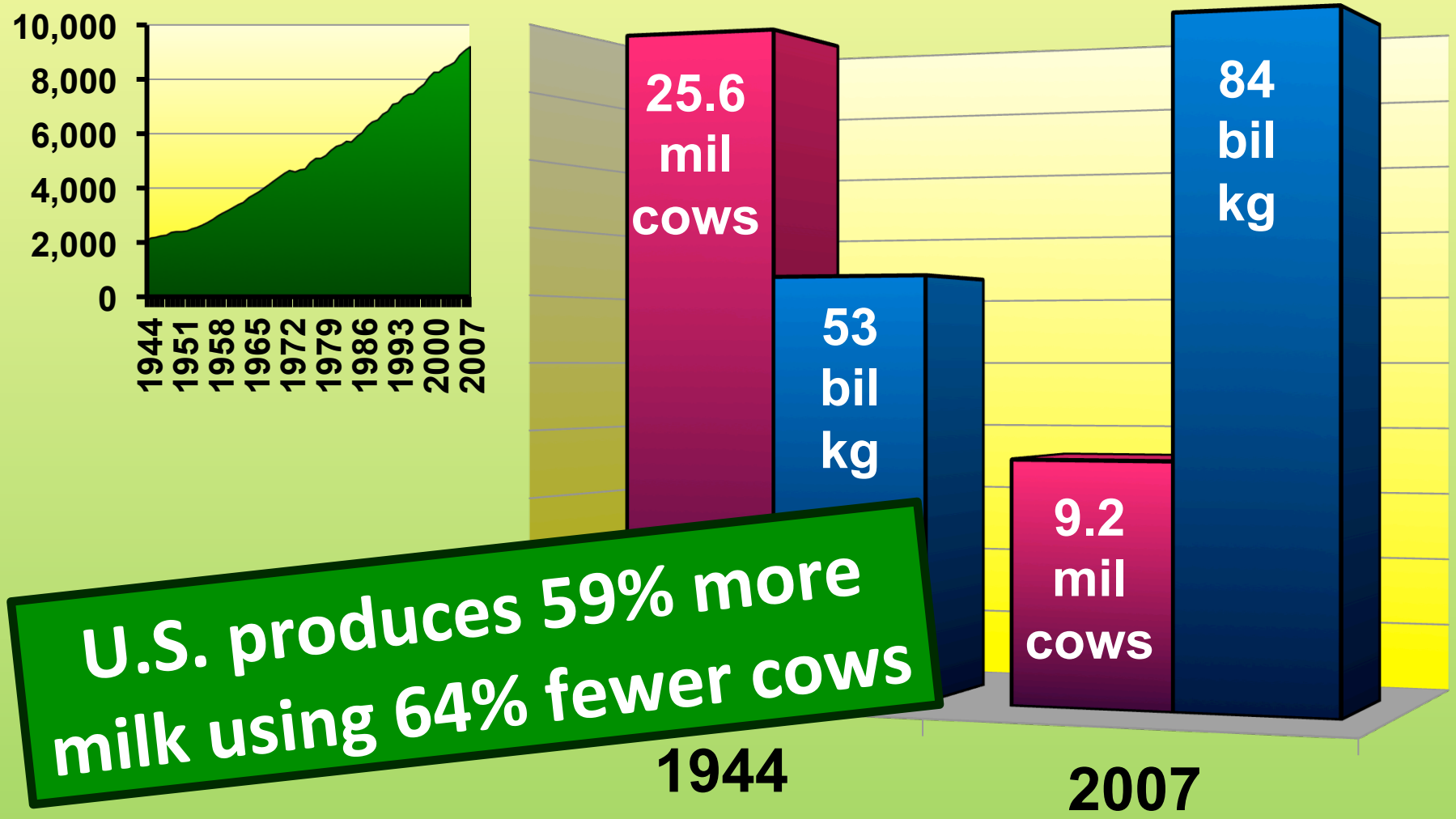
Environmental Impact Reduction due to Improved Productivity



Average annual milk yield has quadrupled since 1944

Source: Capper et al. (2009) "The environmental impact of dairy production: 1944 compared with 2007" *J. Anim. Sci.*

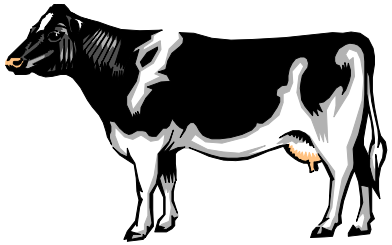
Environmental Impact Reduction due to Improved Productivity



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

Source: Capper et al. (2009) "The environmental impact of dairy production: 1944 compared with 2007" *J. Anim. Sci.*

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



Lactating & Dry Cows

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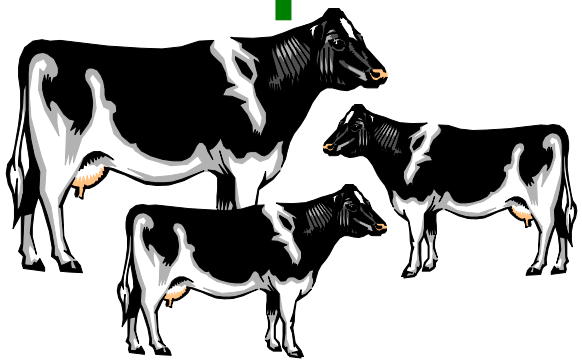

Heifers, Bulls, Young Bulls

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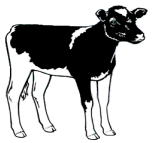


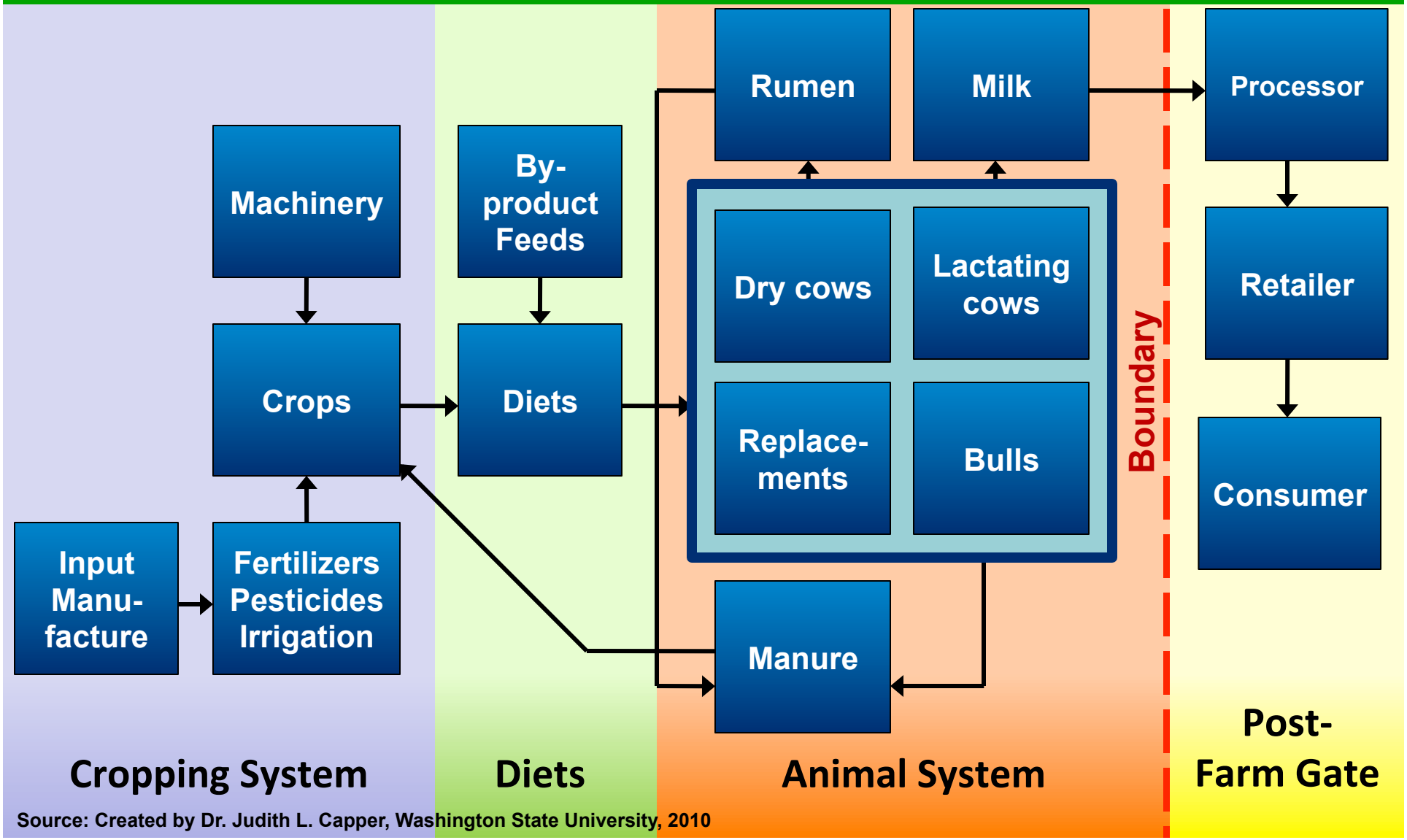
Calves

Increases

- **Feed**
- **Land**
- **Water**
  - Intake
  - Irrigation
- **Fertilizers**
- **Fossil Fuels**
- **Greenhouse Gases**
  - CO_2 - Carbon Dioxide
  - CH_4 - Methane
  - N_2O - Nitrous Oxide
- **Nutrient Excretion**
- **Manure**

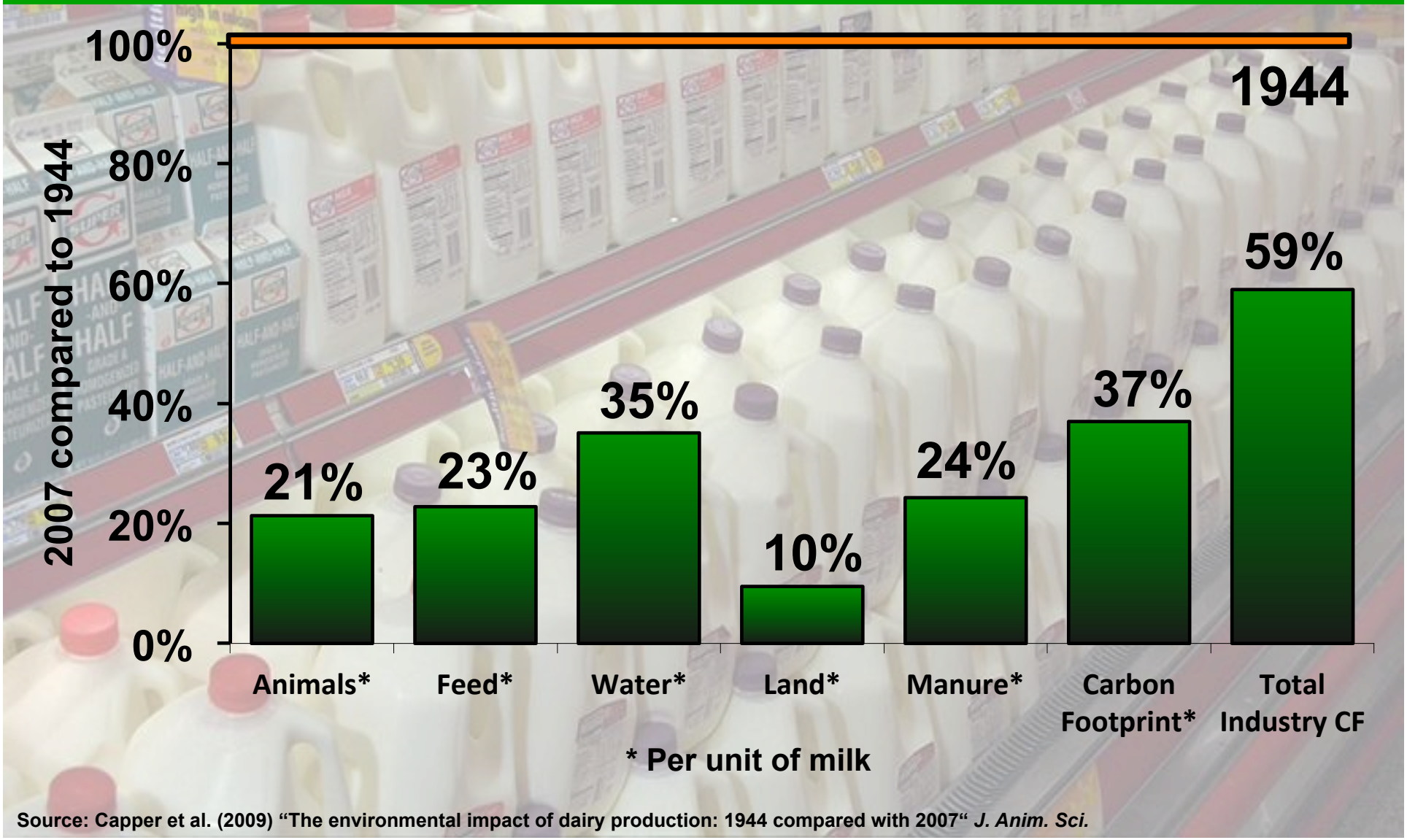
Sources: Created by Dr. Judith L. Capper, Washington State University, 2010

Summary of Model System



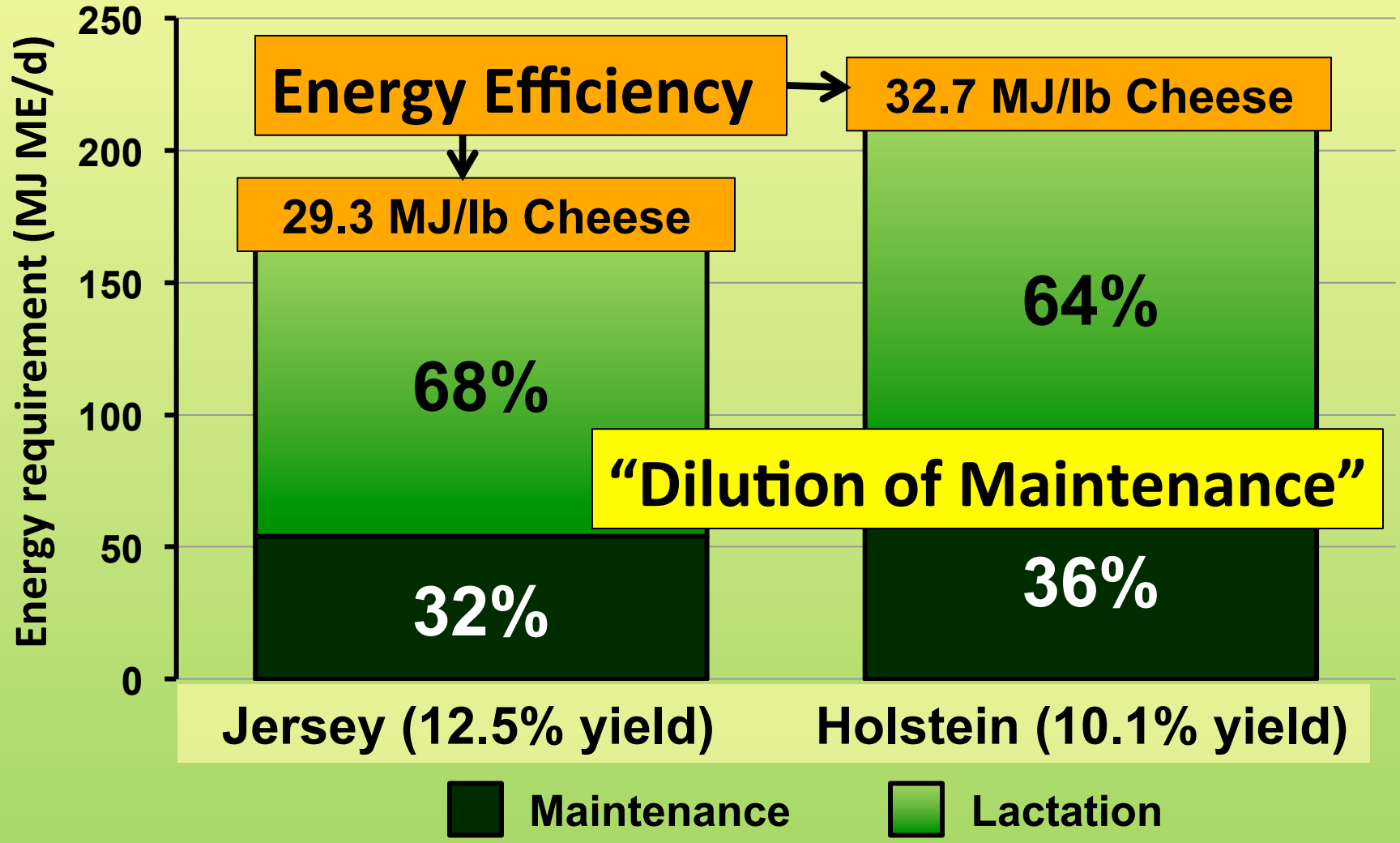
Source: Created by Dr. Judith L. Capper, Washington State University, 2010

Modern Production Practices Have Reduced Resource Use and Carbon Emissions



Source: Capper et al. (2009) "The environmental impact of dairy production: 1944 compared with 2007" *J. Anim. Sci.*

Reduction and Dilution of Maintenance Reduce Energy Use per Unit of Cheese



Source: Created as an example by Dr. Judith L. Capper, Washington State University, 2010; Based on nutrient requirements for a 454 kg Jersey cow (20.9 kg milk, 4.8% fat, 3.7% protein) and 681 kg Holstein dairy cow (29.1 kg milk, 3.8% fat, 3.1% protein)

Maximizing Productivity Reduces Total Maintenance Costs & Resource Use

Source: Created by Dr. Judith L. Capper; Capper , J. L. and R. A. Cady (2010). A Point-In-Time Comparison of the Environmental Impact of Jersey vs. Holstein Milk Production. Journal of Dairy Science – submitted.

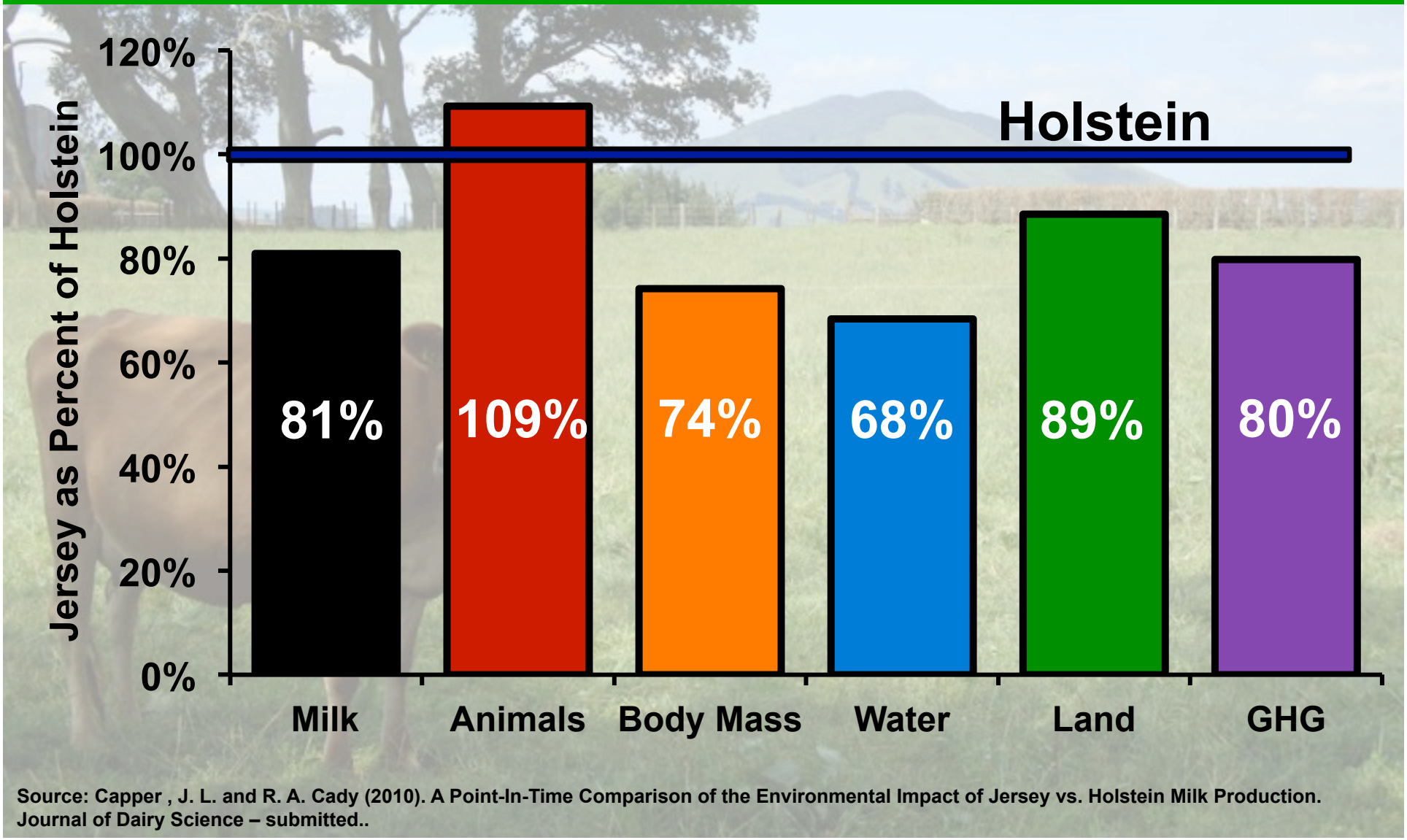
- **Jersey cattle produce 12.5 kg cheese per 100 kg milk**
- **Reduced body mass compared to Holsteins**
- **Cheese yield and body mass interaction may reduce population maintenance**

Breed Characteristics Summary

	Holstein	Jersey
Daily Milk Yield (kg)	29.1	20.9
Fat %	3.8	4.8
Protein %	3.1	3.7
*Cheese Yield (kg/kg)**	0.101	0.125
Calving Interval (mo)	14.1	13.7
Annual Turnover %	34.5	30.0
*Expected # Lactations**	2.54	3.00
Age @ First Calving (mo)	26.1	25.3
*Heifer:Cow Ratio**	0.86	0.83
Mature Cow Body Weight (kg)	680	454

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

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



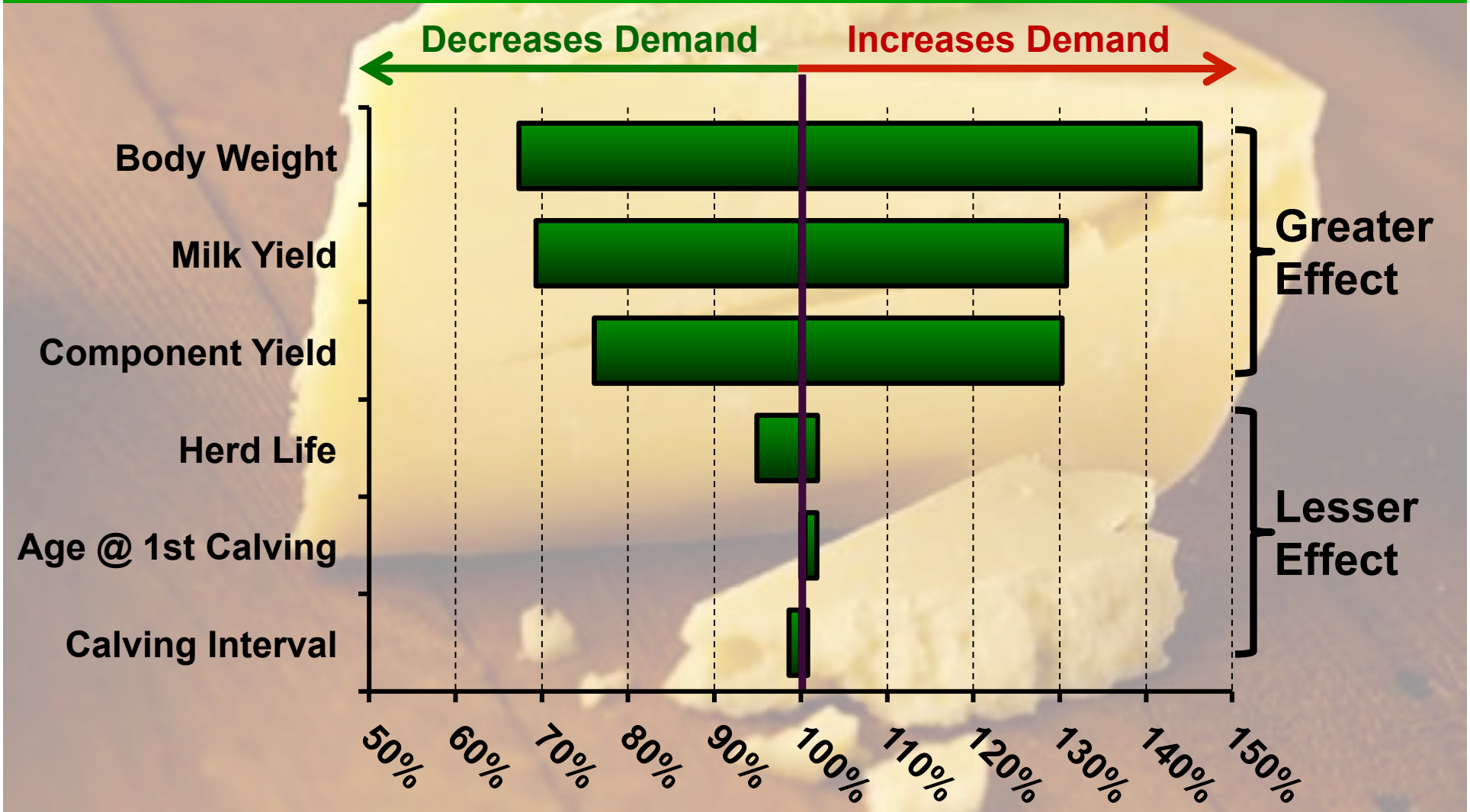
Source: Capper , J. L. and R. A. Cady (2010). A Point-In-Time Comparison of the Environmental Impact of Jersey vs. Holstein Milk Production. Journal of Dairy Science – submitted..

Environmental Savings in Producing 500,000 t Cheddar Cheese: Jersey Breed Advantage

- ✓**974 km^2 Land**
  - *Land area of Frankfurt (984 km^2)*
- ✓**251,972 million litres of Water**
  - *Would supply 3,081,846 Norwegians annually*
- ✓ **518 thousand million MJ of Energy**
  - *Equivalent to 15.7 million litres gasoline*
- ✓**1.71 million MT of CO_2**
  - *Equivalent to taking 336,888 cars off the road for a year*

Source: Amended from Capper , J. L. and R. A. Cady (2010). A Point-In-Time Comparison of the Environmental Impact of Jersey vs. Holstein Milk Production. Journal of Dairy Science – submitted.

Effect of Performance Characteristics on Water Use for Cheddar Cheese Production



Source: Capper , J. L. and R. A. Cady (2010). A Point-In-Time Comparison of the Environmental Impact of Jersey vs. Holstein Milk Production. Journal of Dairy Science – submitted..

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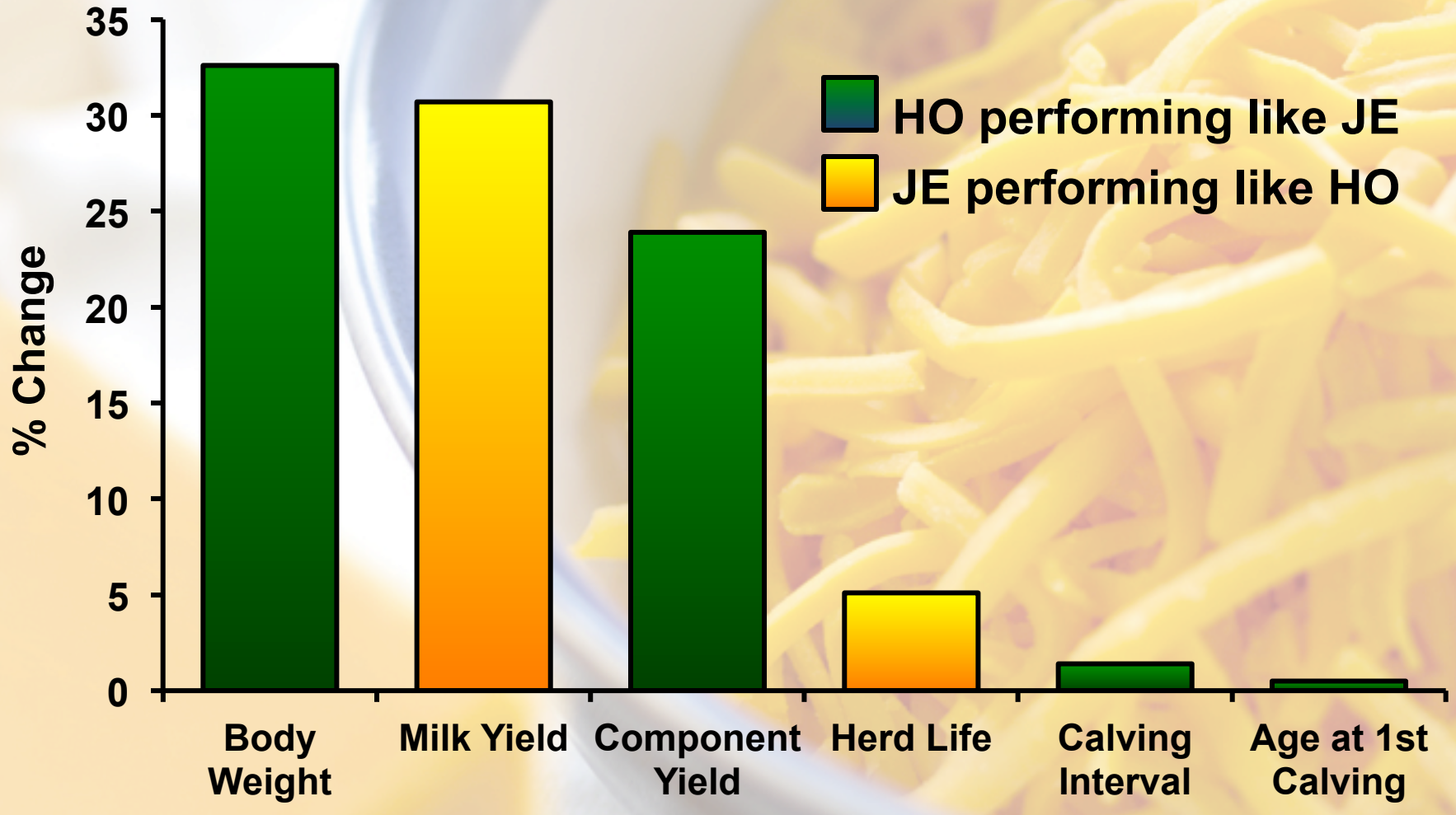
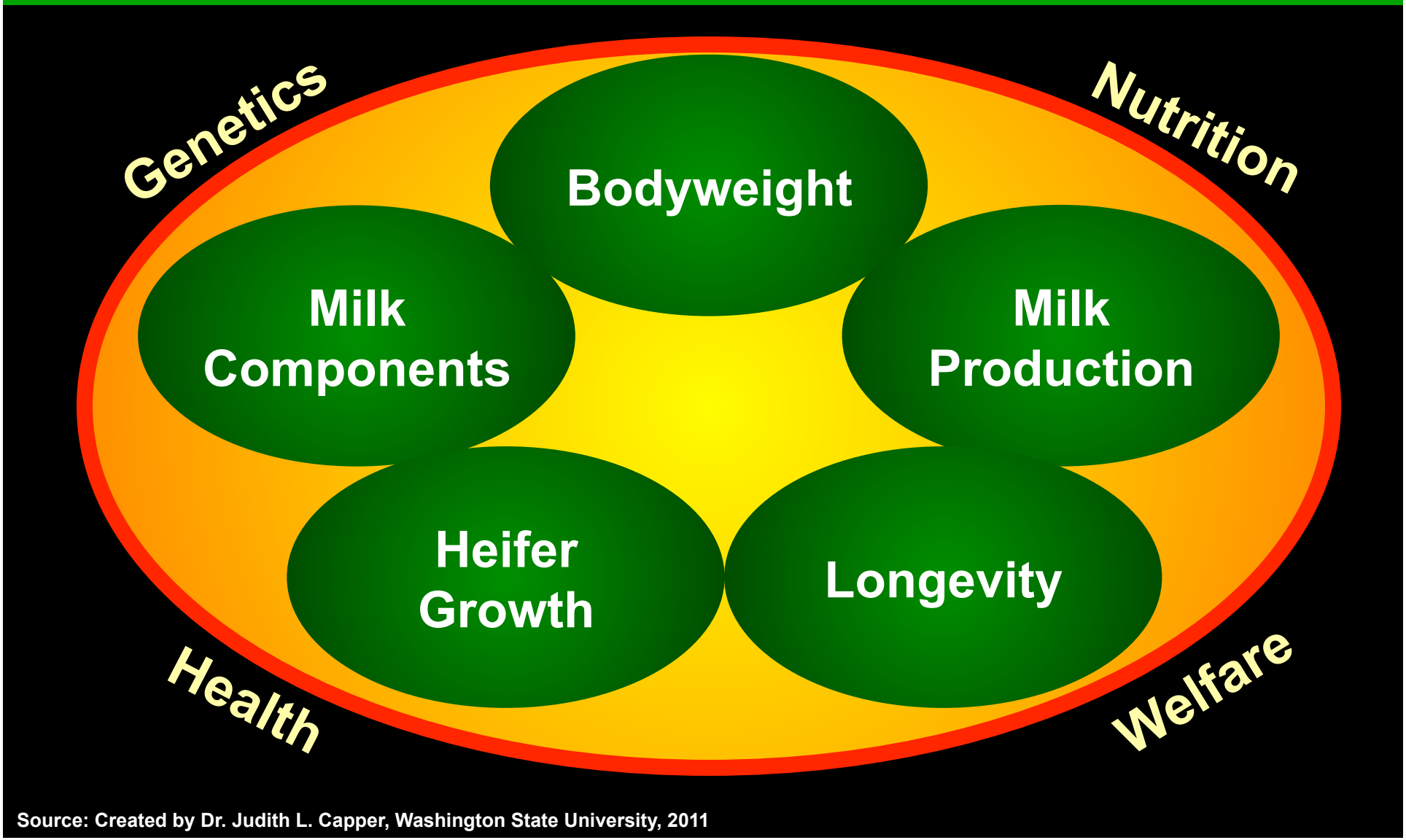


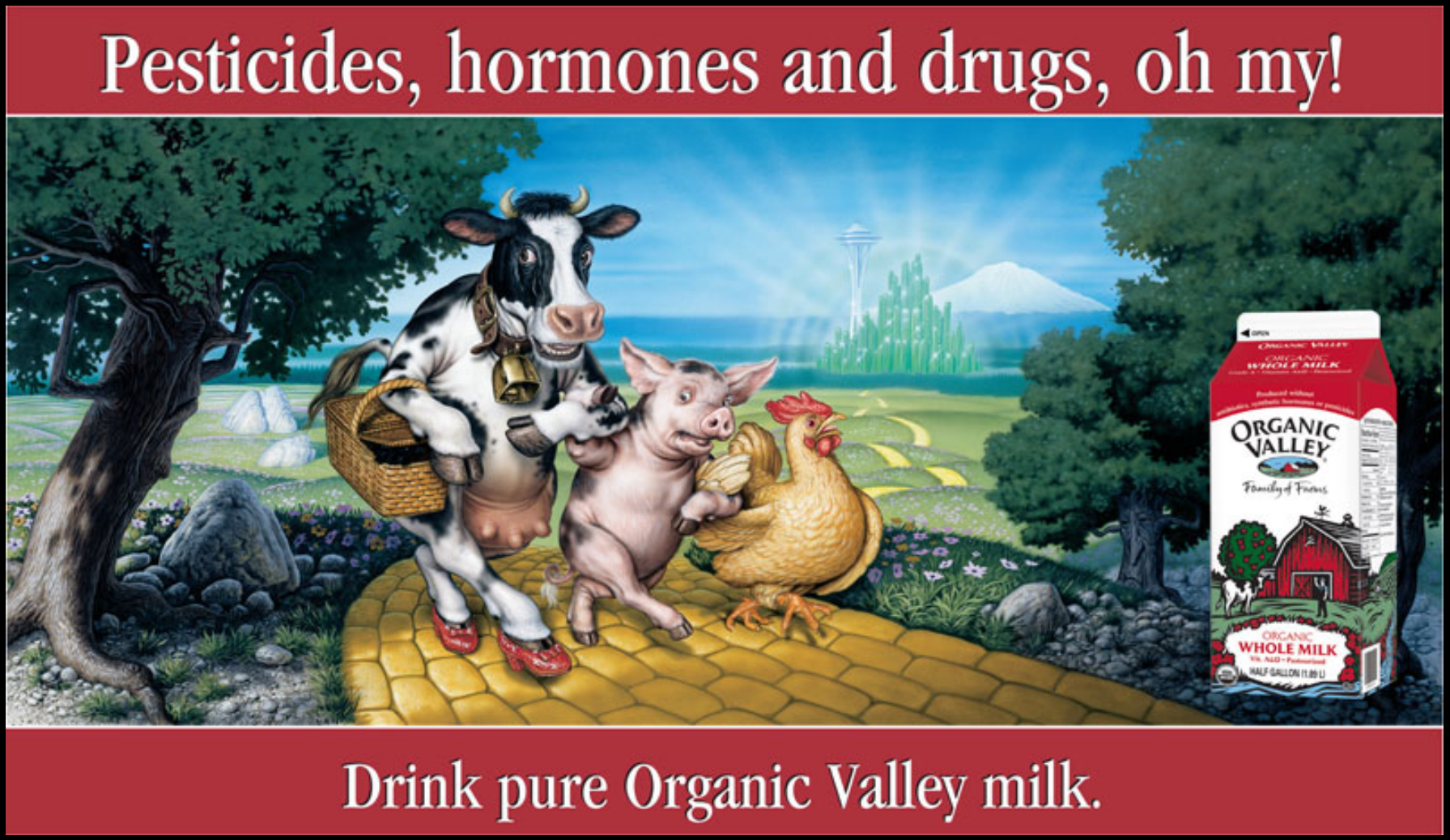
Source: Capper , J. L. and R. A. Cady (2010). A Point-In-Time Comparison of the Environmental Impact of Jersey vs. Holstein Milk Production. Journal of Dairy Science – submitted..

Selection Characteristics to Maintain and Improve Sustainability



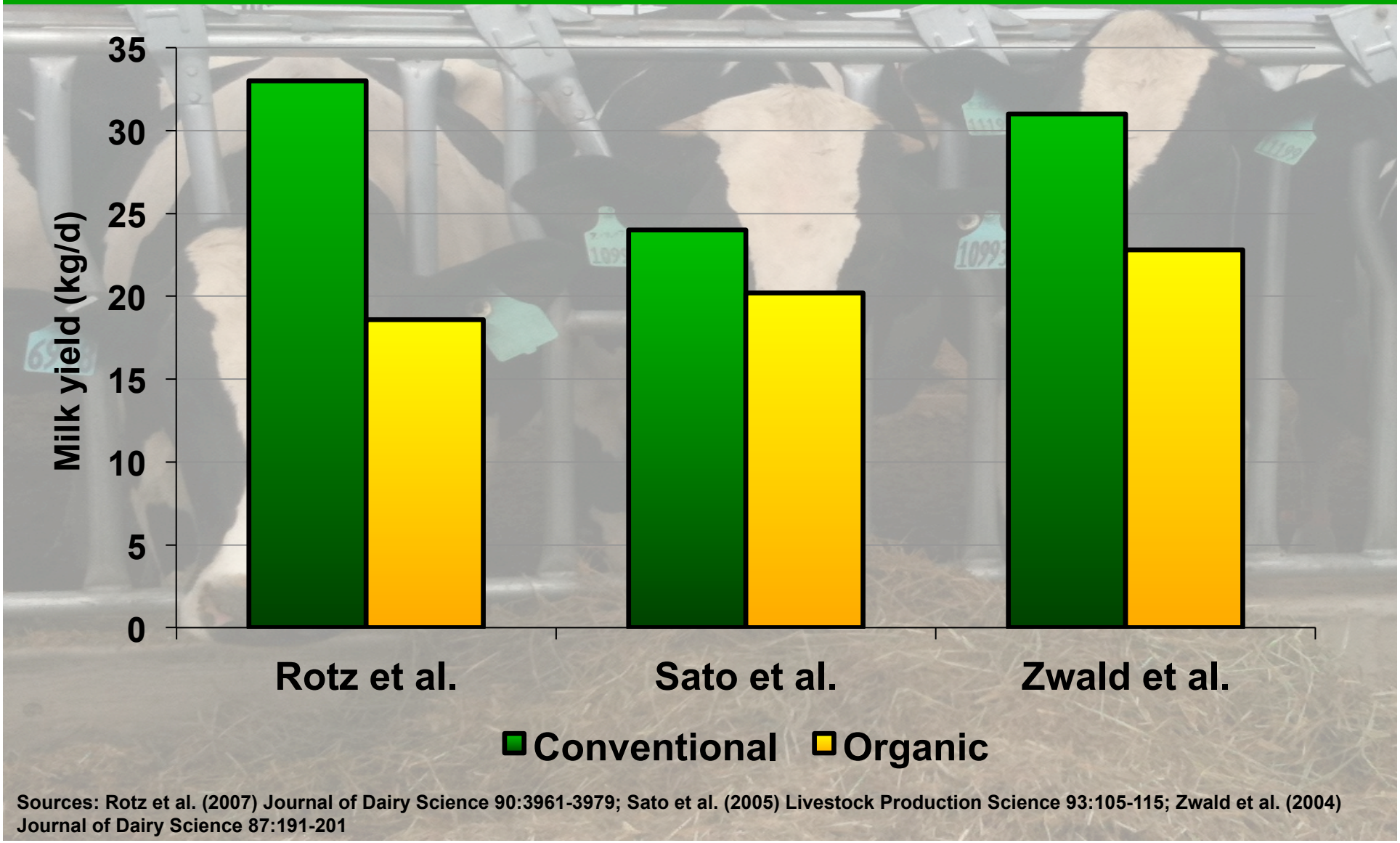
Source: Created by Dr. Judith L. Capper, Washington State University, 2011

Conventional Agriculture is Often Demonized



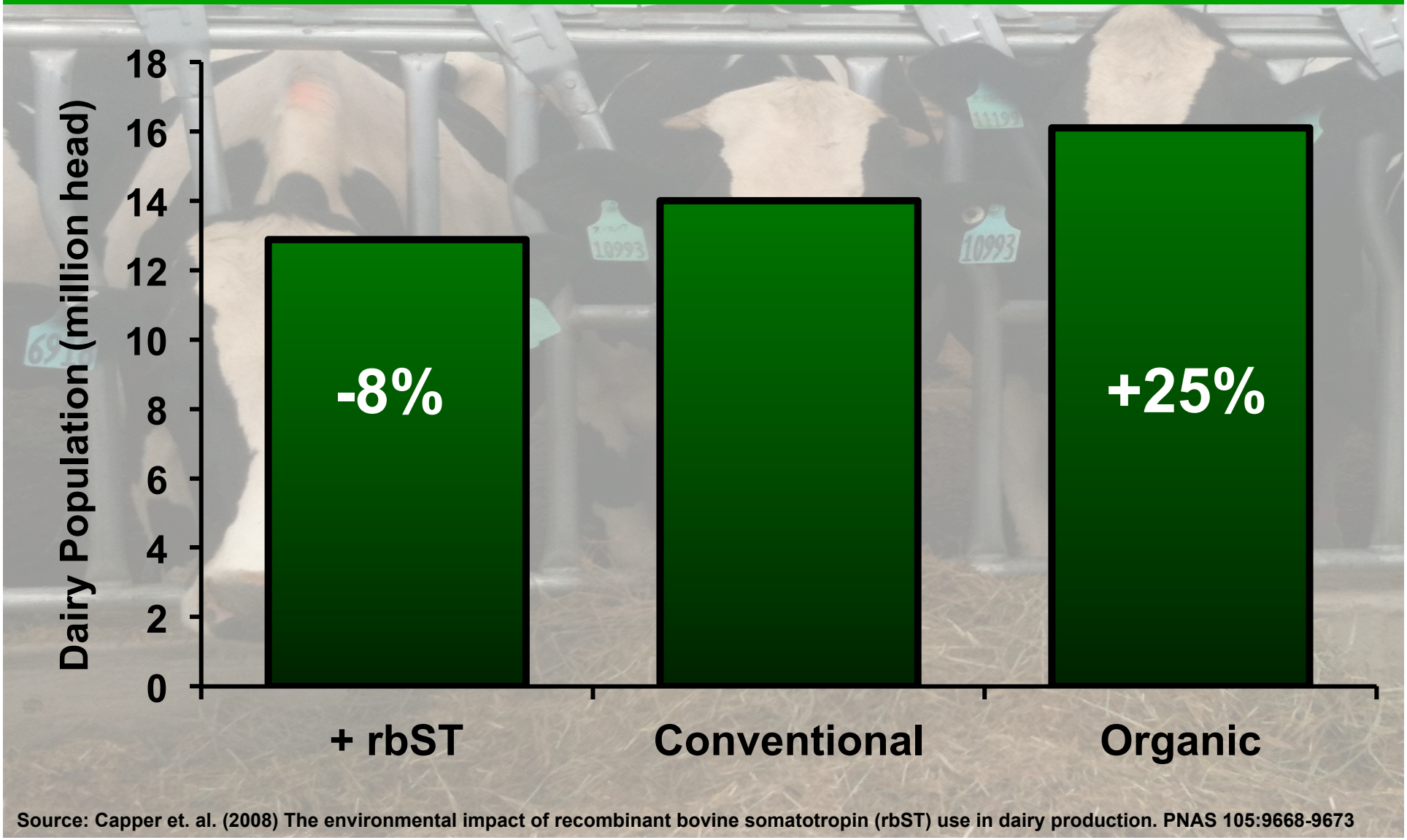
Source: Organic Valley (2010) http://www.organicvalley.coop/trade/retail/retail-resources/national-posters/pesticides-hormones-and-drugs-oh-my

Organic Dairy Production Systems Have Lower Yields Than Conventional Systems



Sources: Rotz et al. (2007) Journal of Dairy Science 90:3961-3979; Sato et al. (2005) Livestock Production Science 93:105-115; Zwald et al. (2004) Journal of Dairy Science 87:191-201

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



Source: Capper et. al. (2008) The environmental impact of recombinant bovine somatotropin (rbST) use in dairy production. PNAS 105:9668-9673

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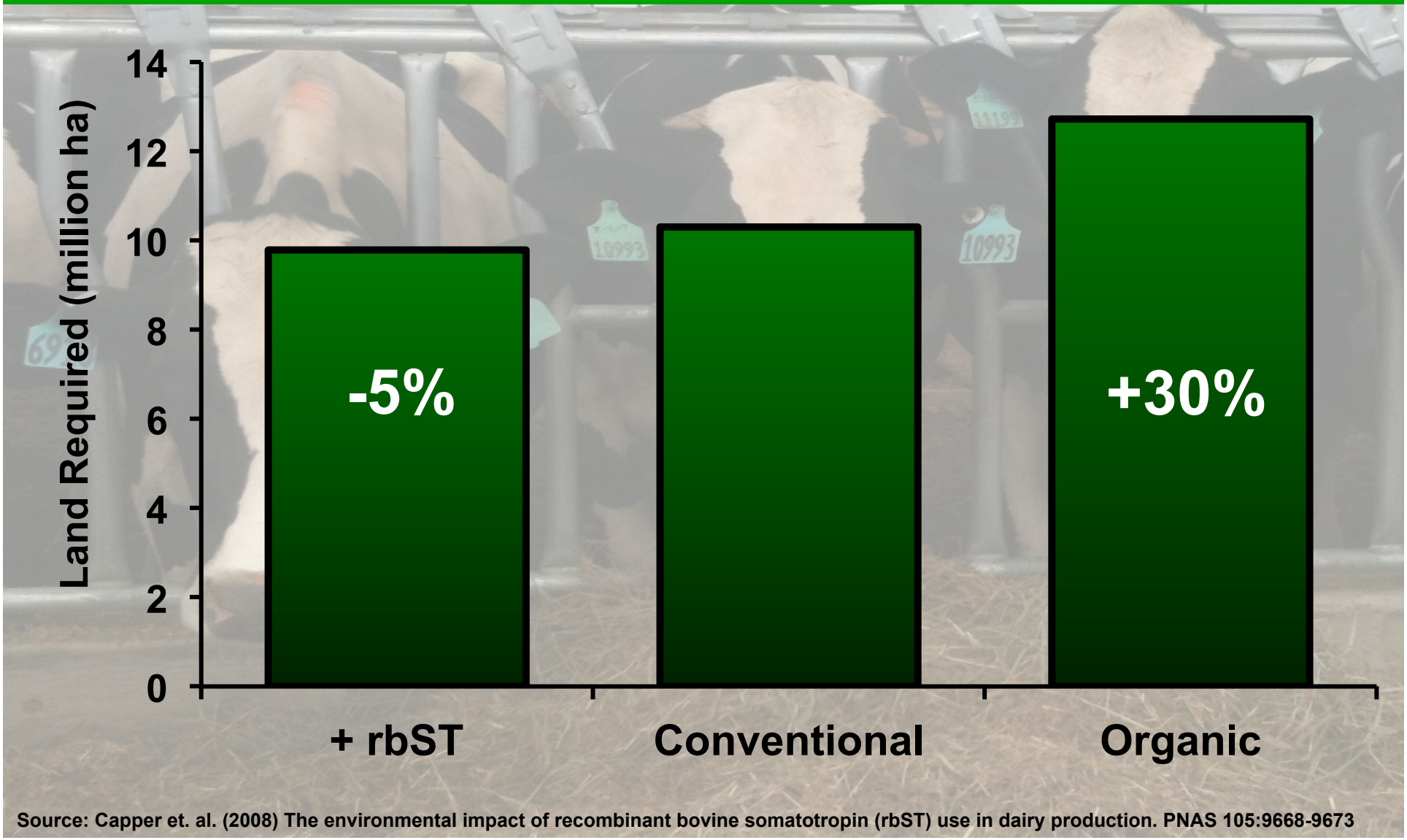

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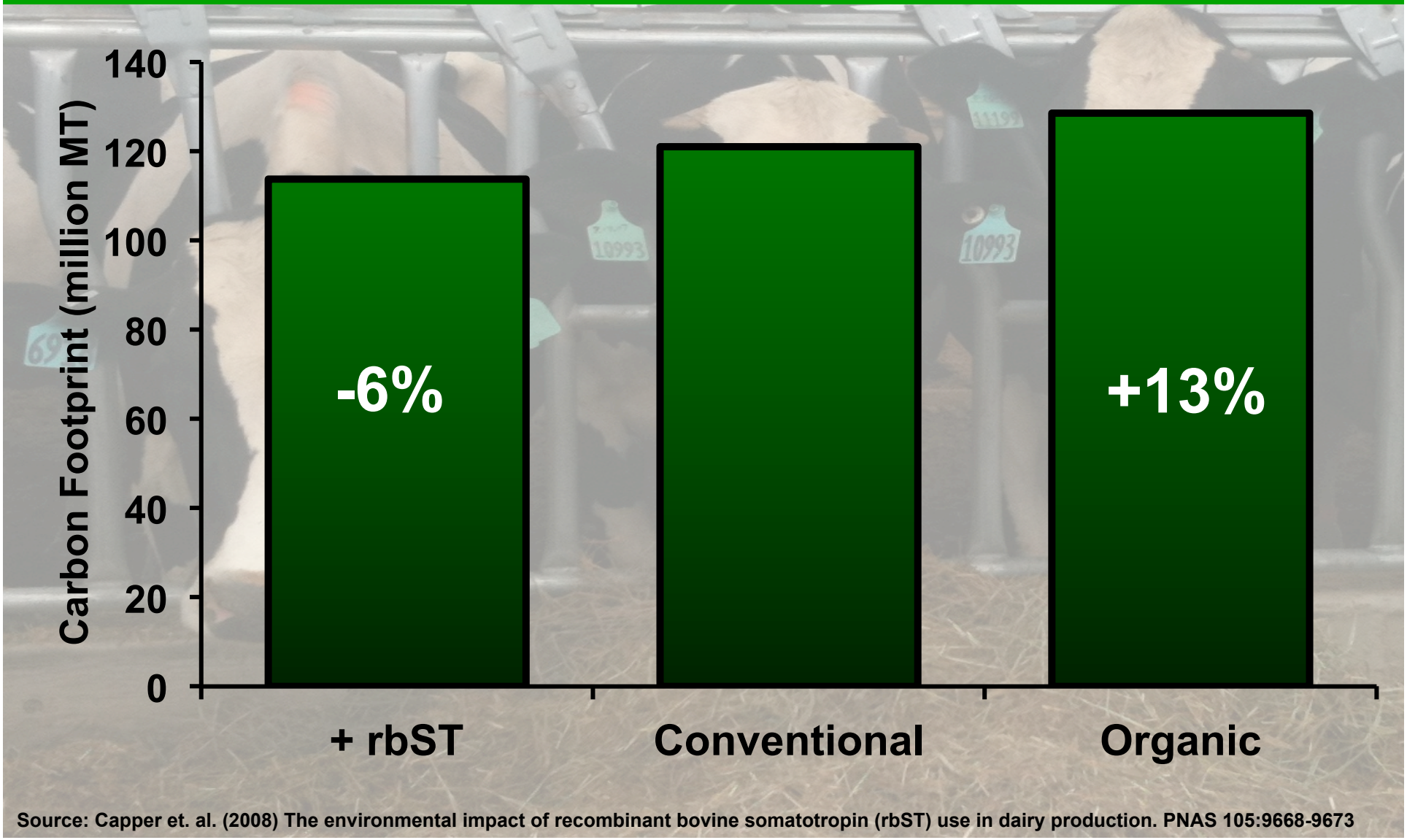
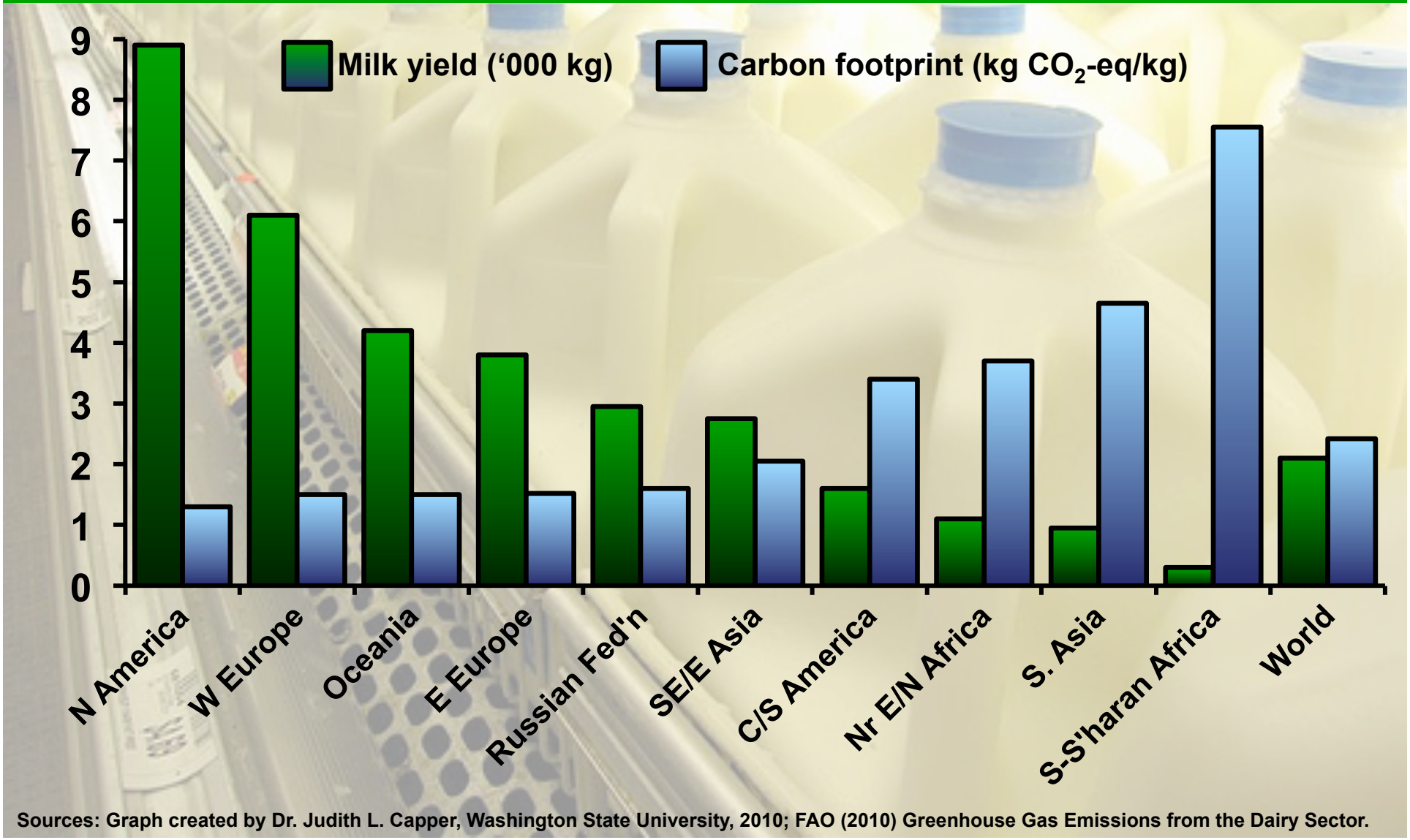
Future U.S. Demand for Dairy Products Best Met via Improved Productivity



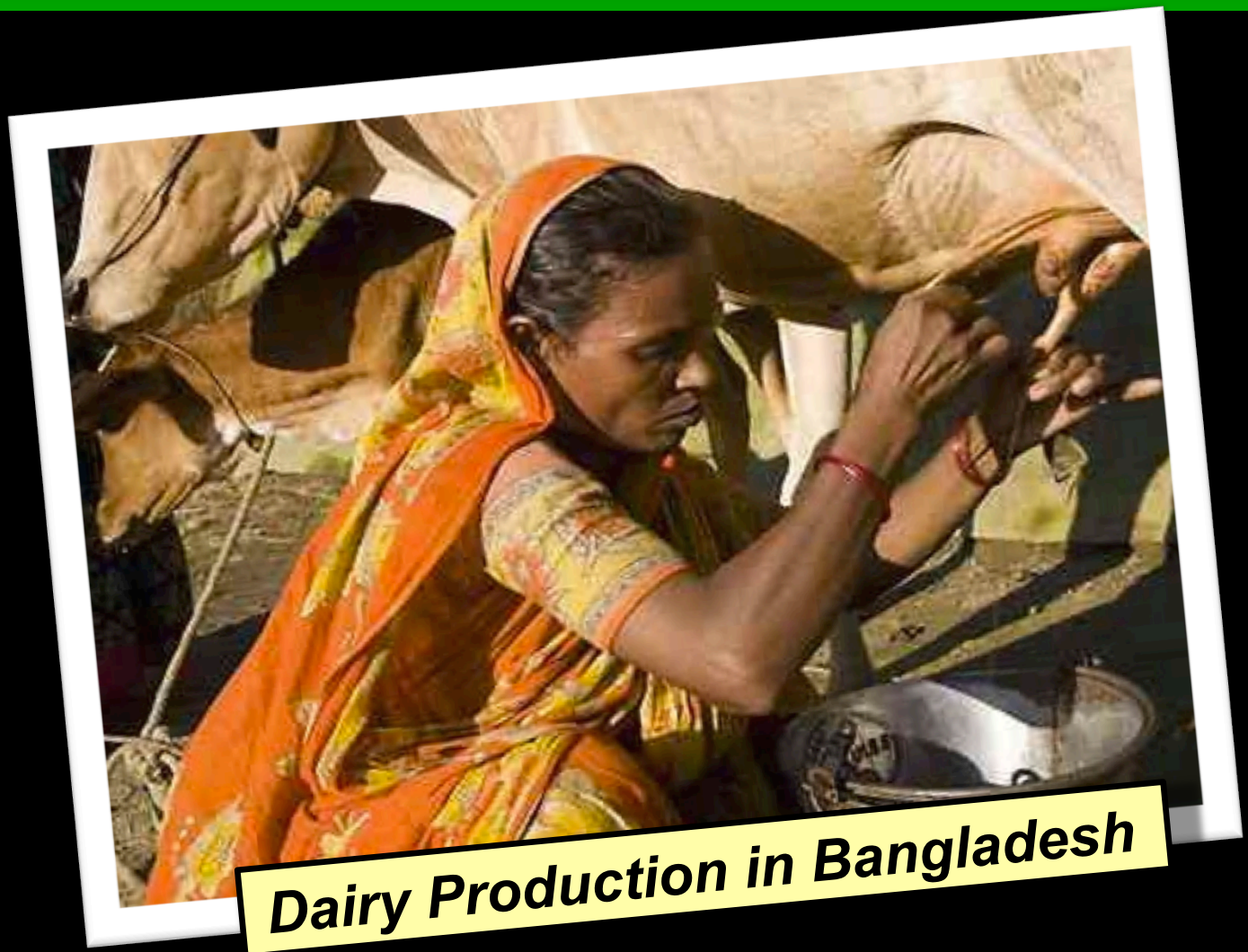
Source: Capper et. al. (2008) The environmental impact of recombinant bovine somatotropin (rbST) use in dairy production. PNAS 105:9668-9673

A Negative Correlation Exists Between Milk Yield and Carbon Footprint



Sources: Graph created by Dr. Judith L. Capper, Washington State University, 2010; FAO (2010) Greenhouse Gas Emissions from the Dairy Sector.

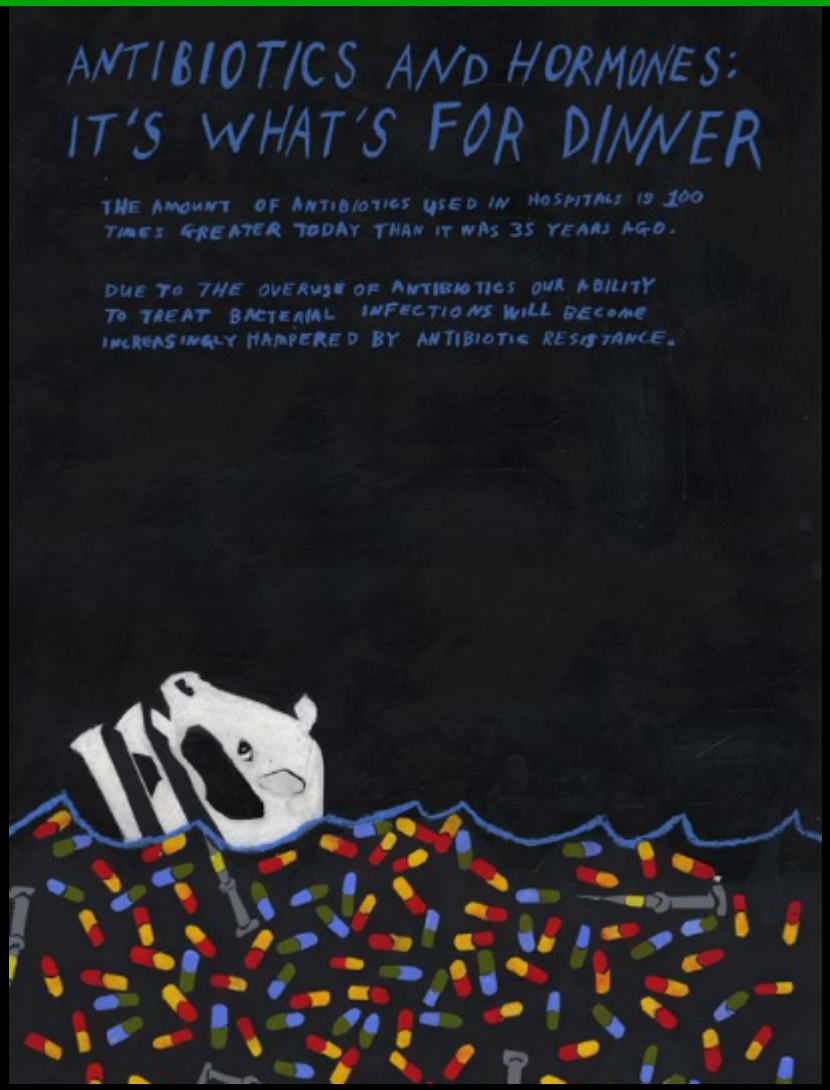
Sustainability has Three Pillars: Environmental, Economic and Social



Dairy Production in Bangladesh

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

Social Sustainability Remains a Huge Challenge



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

Conclusions

- ✓ **Productivity is a key factor in improving the environmental impact of the dairy cow**
- ✓ **Improved genetics, nutrition, and management have considerably reduced the environmental impact of modern livestock production**
- ✓ **Environmental impact must be assessed using sound science rather than ideological principles and sentimental thought processes**

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

Thank you!

capper@wsu.edu

@bovidiva

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