Whose Sustainability?

Grass Fed

Grain Fed

vs.

Outline

- Meat Consumption: *Past, Present and Future*

- Beef: *Challenges and Opportunities*

- Grass Fed vs. Grain Fed: *Environmental Impacts*
  a) Greenhouse Gas Emissions
  b) Nitrate Pollution
  c) Land Use
     1. US Land use Model
     2. Brazil Land use Model

The Grain Behind our Meat

- Rules of Thumb

	Feed:Live Weight	Feed:Edible Weight
Beef	8	20
Pork	4	7.3
Poultry	2	4

Historical Perspective

Hunter-Gatherers or Gatherer-Hunters?

– Today among the San people of southwest Africa, the women who collect nuts and roots provide almost 80% of the calories.

The Picture Today

Meat Consumption: Kg/capita/yr

United States	123
Germany	86
China	53
Brazil	80
Indonesia	11
Kenya	16
India	5
World	40

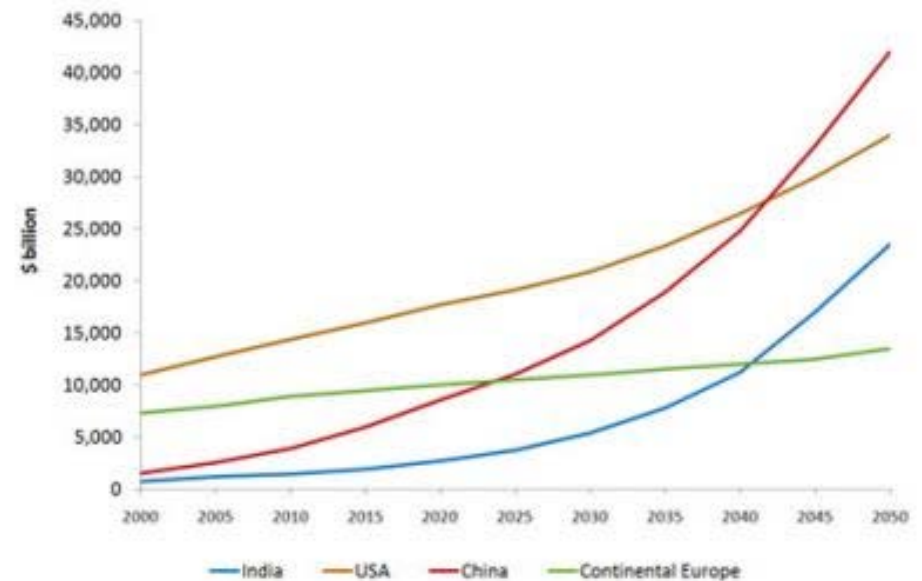# The Future

Consumption = f(population, GDP)

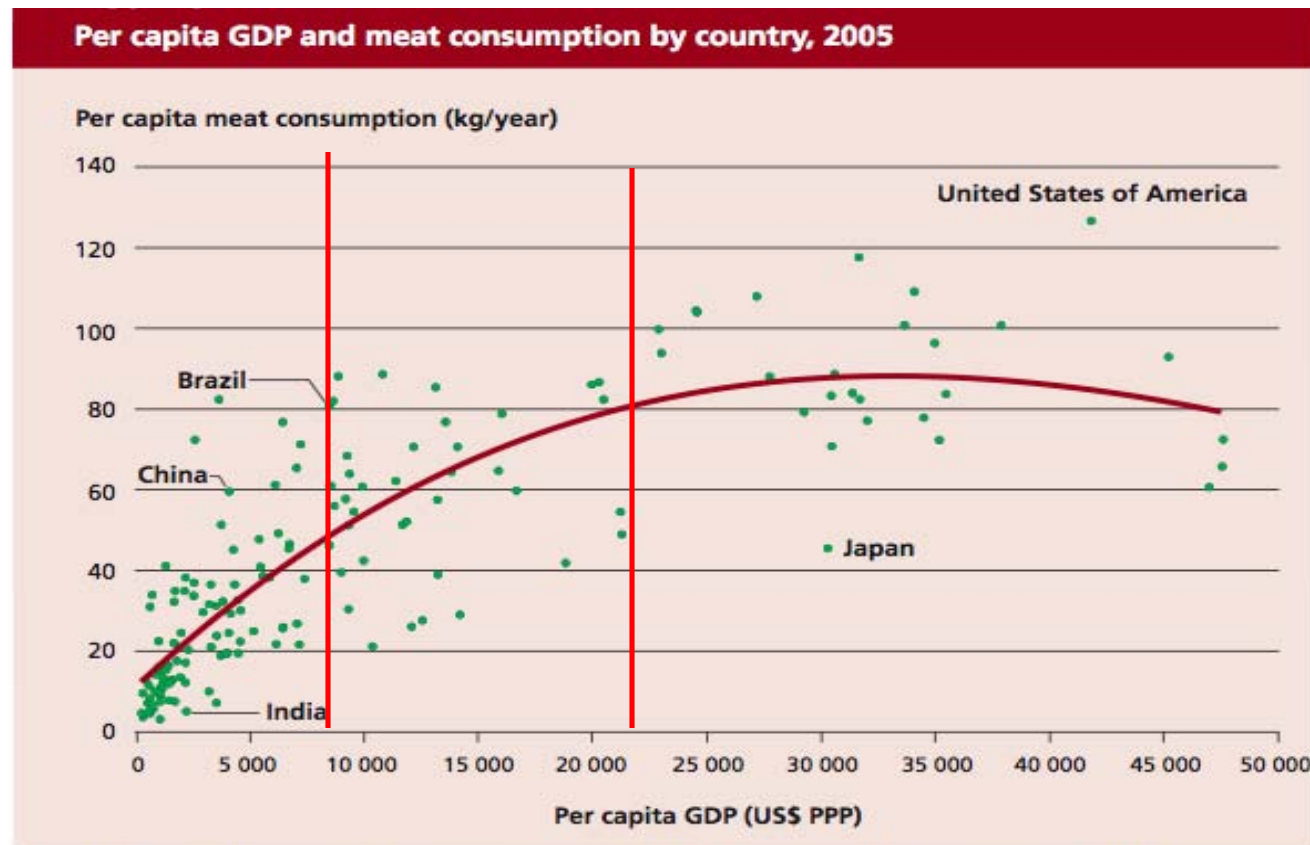~30% increase
in population   x

GDP projections for USA, Europe, India and China

Source: Barclays and Goldman Sachs
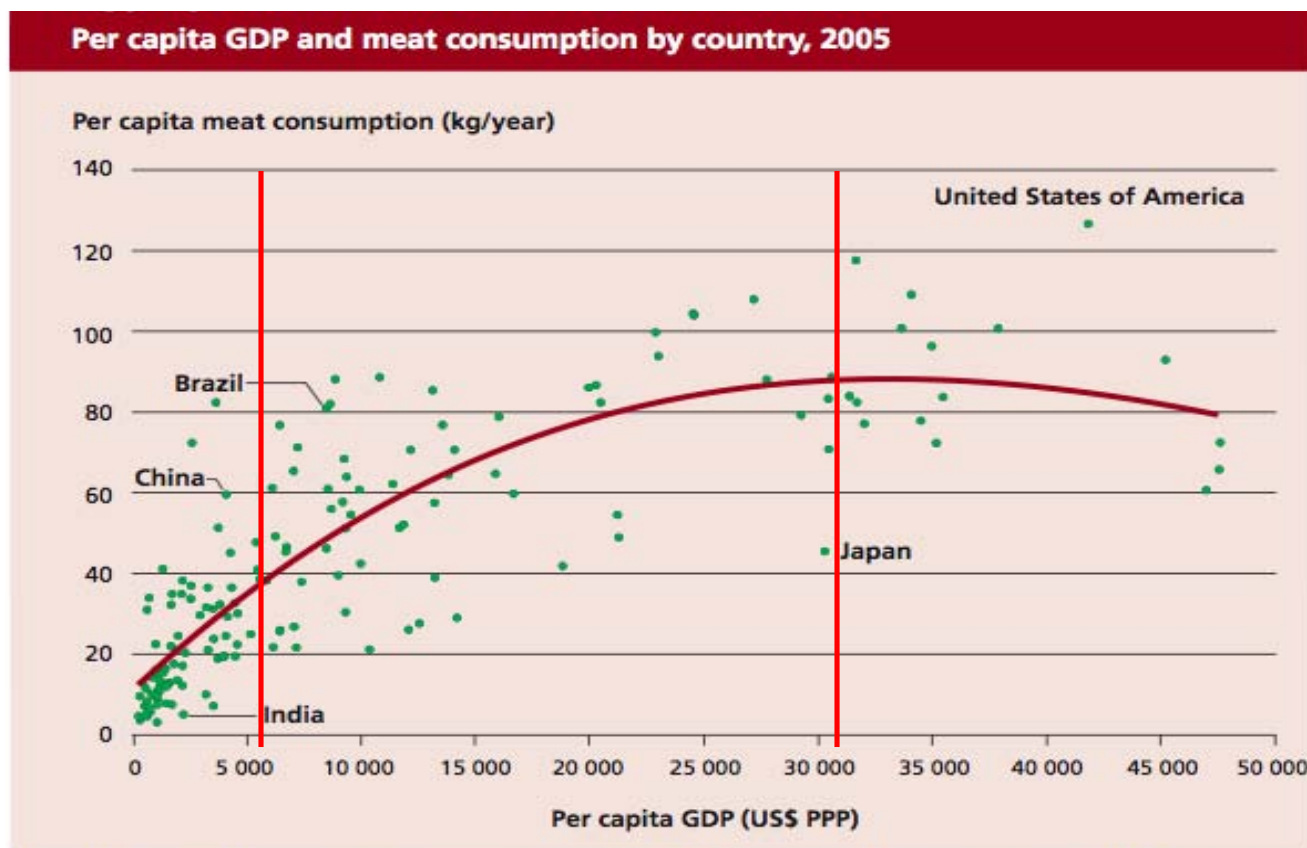
Income and Meat Consumption

Average GDP/capita, assuming 3% annual growth

Per capita GDP and meat consumption by country, 2005

Per capita meat consumption (kg/year)

United States of America

Brazil

China

Japan

India

Per capita GDP (US$ PPP)

Note: GDP per capita is measured at purchasing power parity (PPP) in constant 2005 international US dollars.
Source: Based on data from FAOSTAT (FAO, 2009b) for per capita meat consumption and the World Bank for per capita GDP.

Income and Meat Consumption

China Specific GDP/capita, 2050

Per capita GDP and meat consumption by country, 2005

Per capita meat consumption (kg/year)

United States of America

Brazil

China

Japan

India

Per capita GDP (US$ PPP)

Note: GDP per capita is measured at purchasing power parity (PPP) in constant 2005 international US dollars.
Source: Based on data from FAOSTAT (FAO, 2009b) for per capita meat consumption and the World Bank for per capita GDP.

Consumption by Type

World production of main categories of meat, 1961–2007
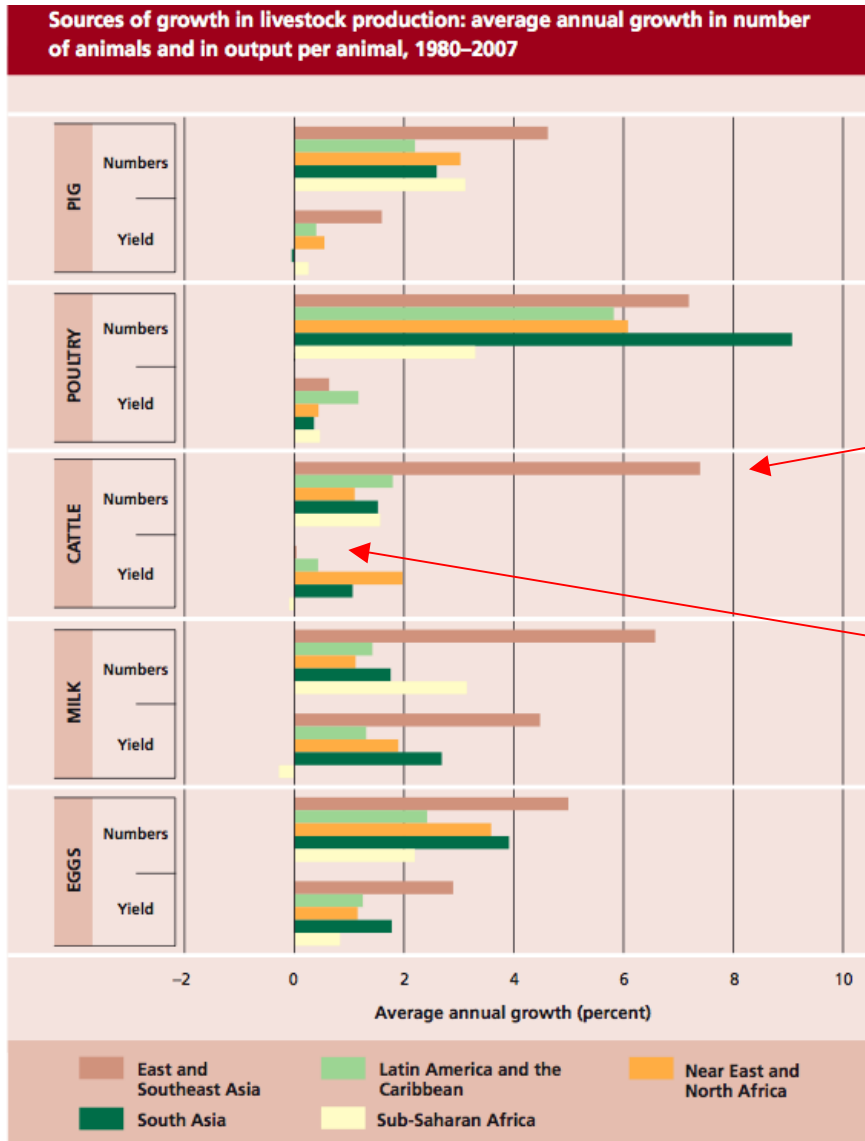
Index (1961 = 100)

Legend: Poultry, Cattle, Pig, Sheep and goat

Source: FAO, 2009b.

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Beef: The Challenge

Sources of growth in livestock production: average annual growth in number of animals and in output per animal, 1980–2007

High growth in Cattle Numbers

Little growth in Cow Yield

The Production Opportunity?

	LIVESTOCK PRODUCTION SYSTEM				
	Grazing	Rainfed mixed	Irrigated mixed	Landless/ industrial	Total
	(Million head)				
POPULATION					
Cattle and buffaloes	406	641	450	29	1 526
Sheep and goats	590	632	546	9	1 777
	(Million tonnes)				
PRODUCTION					
Beef	14.6	29.3	12.9	3.9	60.7
Mutton	3.8	4.0	4.0	0.1	11.9
Pork	0.8	12.5	29.1	52.8	95.2
Poultry meat	1.2	8.0	11.7	52.8	73.7
Milk	71.5	319.2	203.7	–	594.4
Eggs	0.5	5.6	17.1	35.7	58.9

~2% of the cows

~7% of meat

The Environmental Choice

1. GHG Emissions

2. Wastes / Water Pollution

3. Land
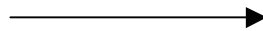
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1. Greenhouse Gas Emissions

- Livestock produce 37% of all methane
  - (~5% of total GHG)
    - Anaerobic Digestive Environments
- 65% of all Nitrous Oxide
  - (~10% of total GHG)
    - Feed input and Wastes

Methane

Grain Fed

~500 liters/day

~1300 lbs at 15 months

Grass Fed

~600-700 liters/day

~1200lbs at 24 months

Methane Efficiency

~220 liters methane/lb of Live weight

~400 liters methane/lb of Live weight

Nitrous Oxide

- Produced from Nitrogen in manure, as well as from the nitrogen in fertilizer applied to feed crop
- Conversion dependent on manure management regime, however, exact number remain extremely uncertain

~70 kg of N produced by a cow each year

N_2O-N Conversion Factors range: .001-.07 (IPCC)

By weight, N_2O has a radiative forcing potential ~ 200x CO_2

Grass Fed Emissions

Grass

16 grams CH_4/22.7 liters

400 liter /22.7 mols/liter * 16 grams CH_4/mol
= 155 grams CH_4 = .94 kg CO_2e/lb liveweight

~2.05 kg of CO_2e/kg liveweight from enteric f.

70 kg N/yr * .02 MCF * 200 N_2O-CO_2
conversion * 2 years = 350 kg CO_2e/cow

~1 kg of CO_2e/kg liveweight from manure N20

3.05 kg CO_2e/kg liveweight --> 6 kg CO_2e/kg meat

Lifecycle Grain Fed Emissions

Grain

16 grams CH_4/22.7 liters

220 liter /22.7 mols/liter * 16 grams CH_4/mol
= 155 grams CH_4 = .62 kg CO_2e/lb liveweight

~1.35 kg of CO_2e/kg liveweight from enteric f.

70 kg N/yr * .02 MCF * 200 N_2O-CO_2
conversion * 1.25 years = 350 kg CO_2e/cow

~.6 kg of CO_2e/kg liveweight from manure N_2O

[500lbs / 2.2 lbs/kg]*(8kg grain/kg
liveweight)*.25kg CO2equivalent/kg feed

= 450 kg of CO2e for ~ 600 kg of liveweight

~.75 kg of CO_2e/kg liveweight from feed

2.7 kg CO_2e/kg liveweight --> 5.5 kg CO_2e/kg meat

Would you have guessed…

- Grass-fed beef is MORE greenhouse gas intensive than grain-fed.

Grain: **5.5 kg CO_2e/kg meat**

Grass: **6 kg CO_2e/kg meat**

So for average American, this would amount to 62 kg CO_2e savings per year

To get same carbon savings:

Everyone drives 200 miles less every year

Or we decommission 32 averaged size coal power plants

Soil CO_2 Sequestration

Have found little evidence for long term enhanced storage on mature pastures. However, converting farmland to pasture would add .2-.5 tons C/acre*year for a period of about 10 years.

So, if a new grass fed pasture was created via conversion, might get about 1kg CO_2e back for every 1kg of live weight grown

~30% reduction in total emissions

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2. Feedlot Nitrate Pollution

- EPA: 170,000 river miles, and 3 million lake acres "impaired" from agricultural water pollution (20% attributed to feedlots)

- Directly nitrate leaching is more of a problem on abandoned feedlots that on active ones.

- Rates/threat is highly dependent on height of water table and soil type (sandy vs. clay)

Some Major Spill Events…

- "From 1995 to 1998, 1,000 spills or pollution incidents occurred at livestock feedlots in 10 states and 200 manure-related fish kills resulted in the death of 13 million fish.

- Huge open-air waste lagoons, often as big as several football fields, are prone to leaks and spills. In 1995 an eight-acre hog-waste lagoon in North Carolina burst, spilling 25 million gallons of manure into the New River. The spill killed about 10 million fish and closed 364,000 acres of coastal wetlands to shellfishing.

- Runoff of chicken and hog waste from factory farms in Maryland and North Carolina is believed to have contributed to outbreaks of Pfiesteria piscicida, killing millions of fish and causing skin irritation, short-term memory loss and other cognitive problems in local people."

  – NRDC

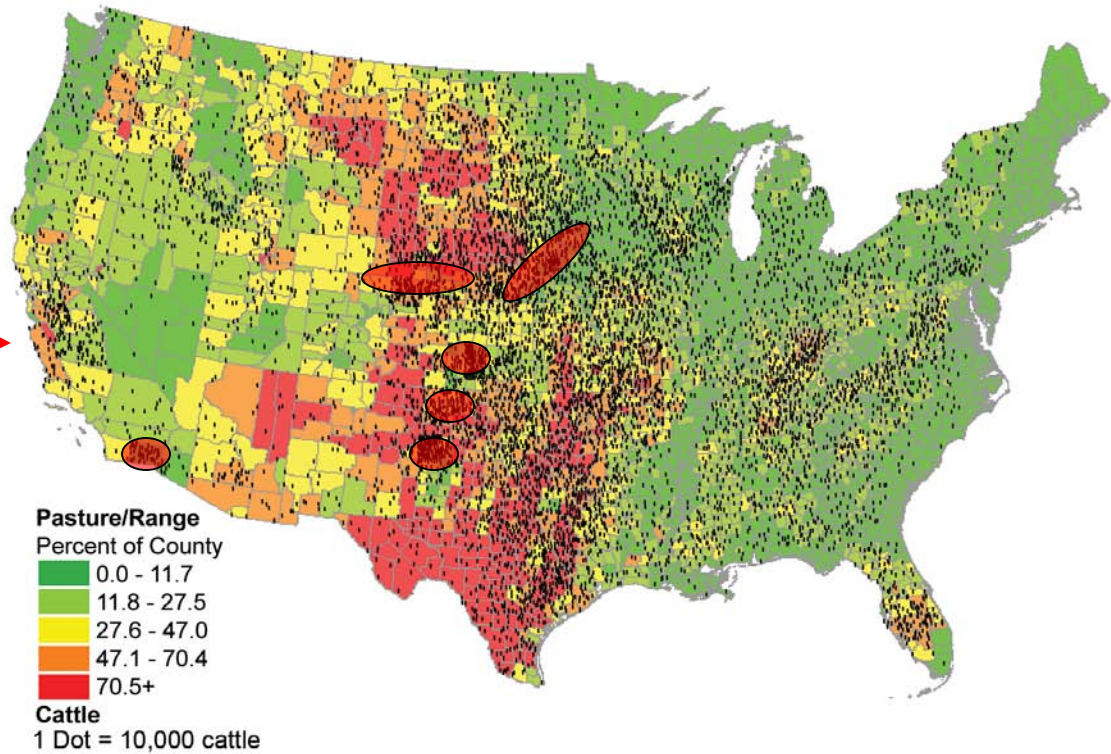# Compared to Grass Fed Nitrates

- Runoff from cattle on pasture ranges from .5 to 8.7 lbs N/acre*year
    - Comparable to that of a forest, and basically indistinguishable from background levels from normal rainfall.

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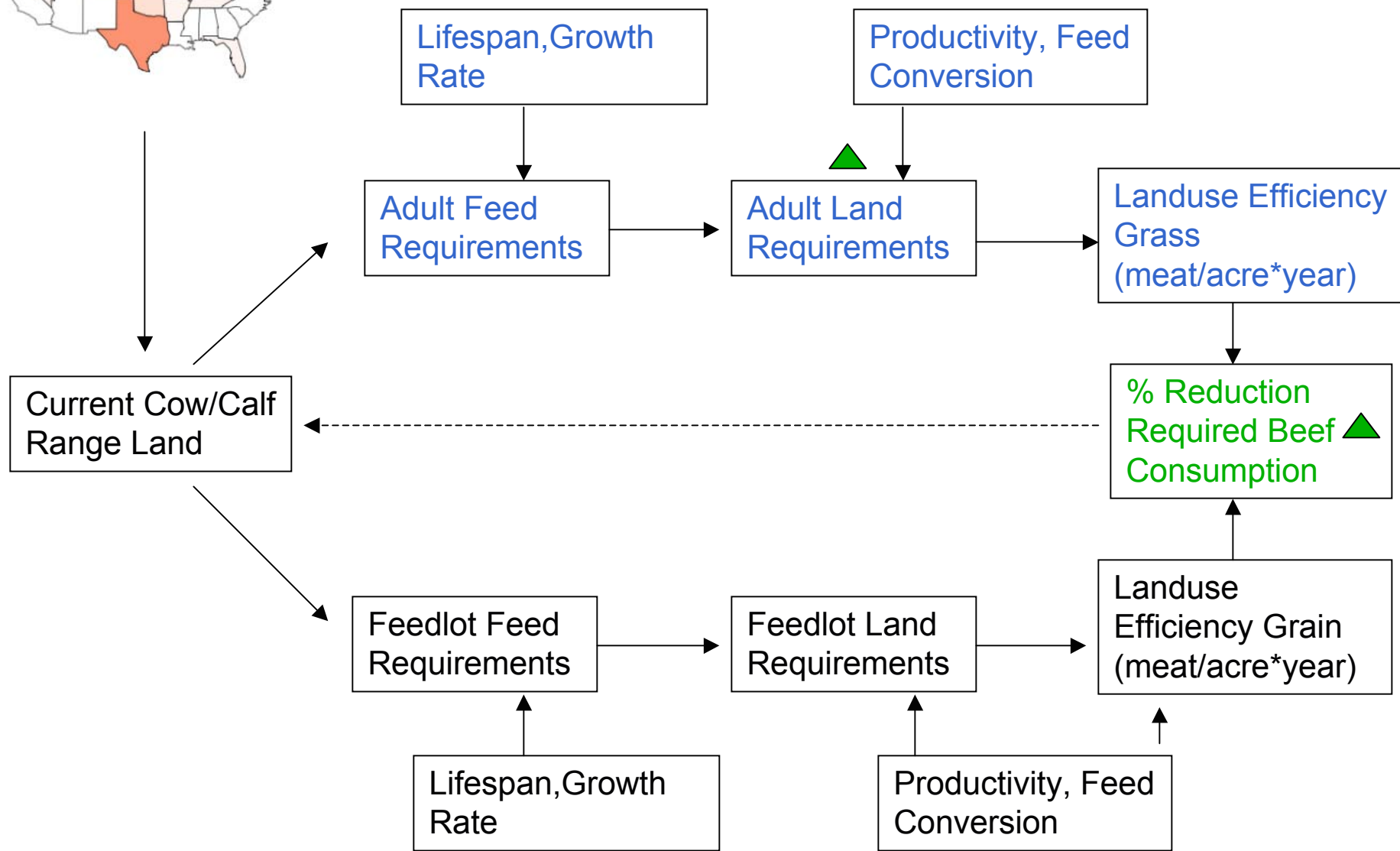   a) US Land use Model
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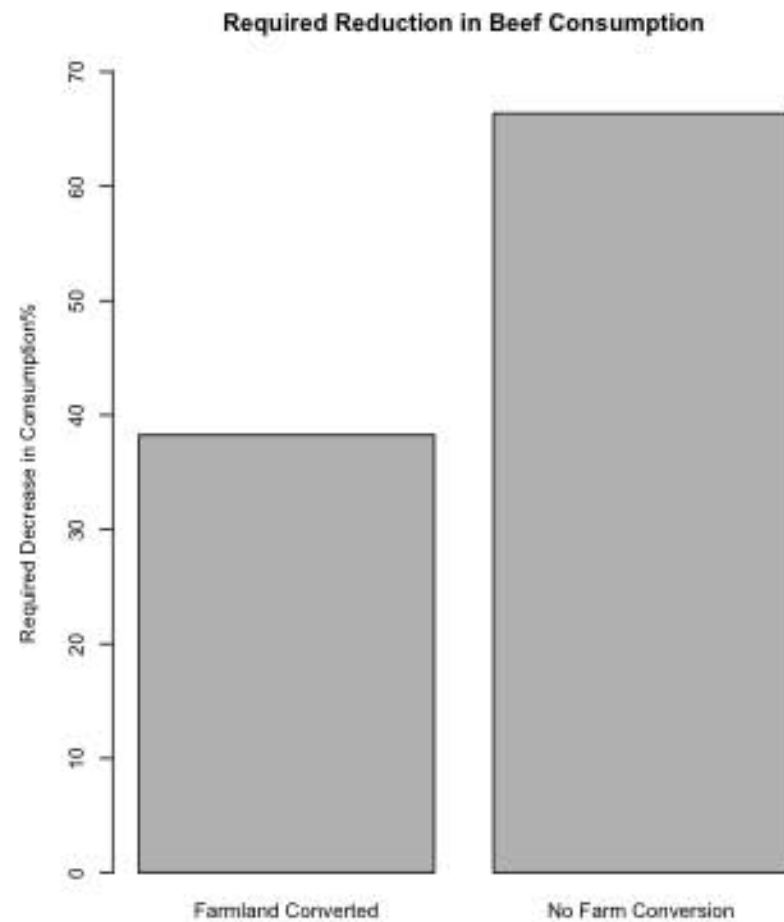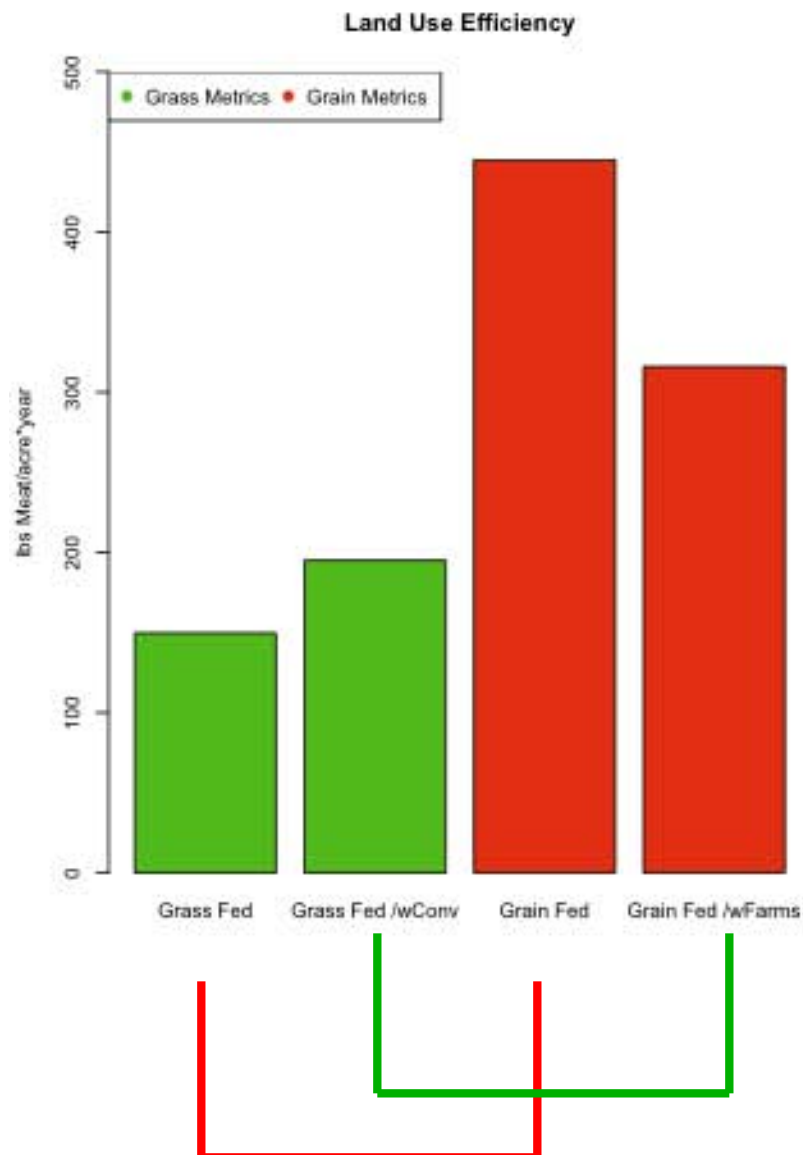
3. Land Requirements

Current Pasture /
Rangeland in US

Pasture/Range
Percent of County
- 0.0 - 11.7
- 11.8 - 27.5
- 27.6 - 47.0
- 47.1 - 70.4
- 70.5+

Cattle
1 Dot = 10,000 cattle

NASS[232]; NRCS[243]

Methodology

Cow/Calf Distribution (Current)

Lifespan,Growth Rate

Productivity, Feed Conversion

Adult Feed Requirements → Adult Land Requirements → Landuse Efficiency Grass (meat/acre*year)

Current Cow/Calf Range Land

% Reduction Required Beef Consumption ▲

Feedlot Feed Requirements → Feedlot Land Requirements → Landuse Efficiency Grain (meat/acre*year)

Lifespan,Growth Rate

Productivity, Feed Conversion

NA Land Model: Results

Caveat on Increased Land

In equal time periods grass will grow this much if it starts high on the growth curve, but much less if bitten way down.

BULK

TIME → EQUAL TIME

Daily Growth Rate(lb/acre)

125

75

12 18   36   54
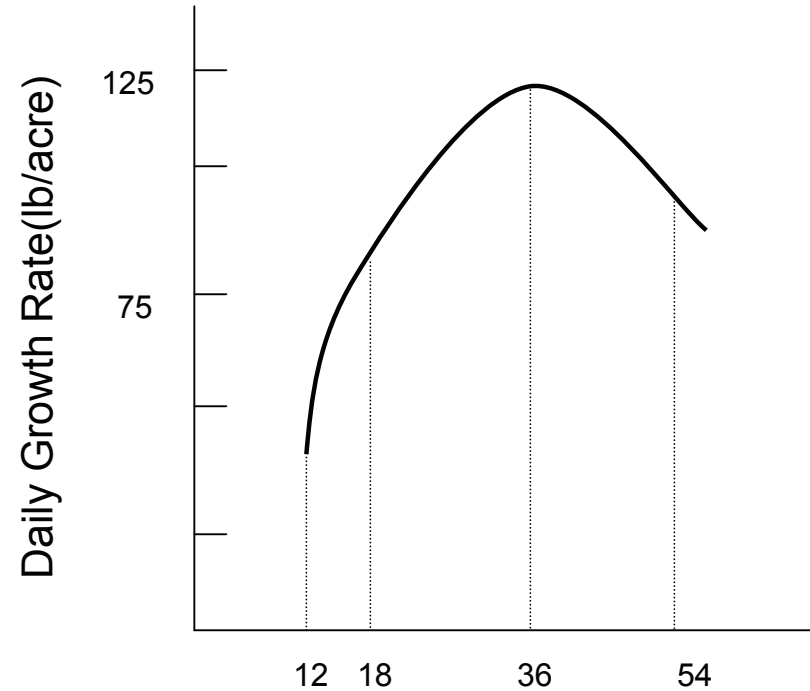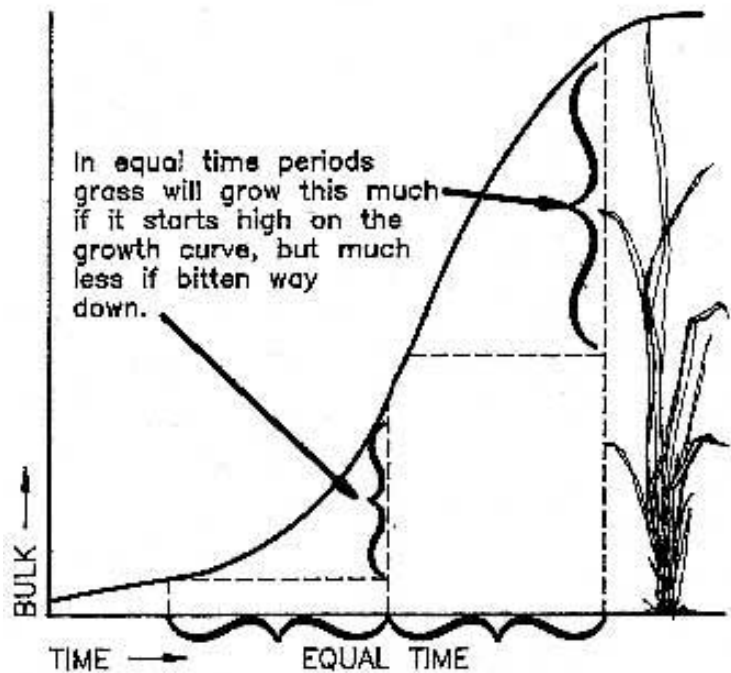
Day after grazing (August-September)

US Grass Fed Summary

- If demand does not change, grass-fed beef would require almost 100 million acre (40 million ha) increase in land dedicated exclusively to ranches.

Intelligent, herd management of cows shows potential, but would have to increase range productivity by over 120% for a grassfed transition to be land neutral.

Comparison: US v. Brazil

	USA	Brazil
Herd Size (millions of cattle)	95	198
Meat Production (million tons)	11.8	9.2
Time to Slaughter (Extensive, months)	24	30
Final Weight(Ext., kg)	570	Up to 300
Time to Slaughter (Intensive, months)	15	33
Final Weight (Int., kg)	620	Up to 500

Background: Brazilian Meat Production

- Total herd (2007): 198 million cattle
- Meat production (2009): 9.2 million tons
- On average, 0.93 hectare/head.
- Production focused in the central region, threatening biomes like the Cerrado and Amazon.
- Only 5% of cattle spend time in feedlots, and this number is growing.

Growing Land Use: Extensive System

- By 2020
  - 11.8 million tons of meat
  - 250 million cattle
- At a 10% intensity increase, this would require an additional 25 million hectares
- Release of 2.5 to 7.5 billion tons of carbon

An alternative: Feedlot Finishing

- Assumed an extra 3 months in feedlot with 150 kg weight gain
- Herd size would be cut to 195 million.
- Save 46 million hectares in direct LU.
- Indirect landuse (grain production) would require 25 million hectares.
- Versus extensive model: saves 20 million ha
- Net loss (from today) of only 2 million hectares

Brazil Summary

- Switching from pastured to grain-fed systems in Brazil has the potential to save 20 million hectares of land, and at leat 2.5 billion tons of carbon.

  – **This is over 13x Texas' greenhouse gas emissions in 2003.**

  Or the emissions of those same 32 coal plants operating for over 90 years!

Take Away Points

Beef demand will continue to rise

How much and how will have large impacts for our world…

Grass-fed beef MORE greenhouse gas intensive than grain-fed by 10%

Feedlots have a much larger impact through nitrogen pollution

In US, switching to grass could cost 40 million ha

In Brazil, switching to grain could save 20 million ha

Final Thoughts…

Everything depends on the metric:

- Sustainability may not always mean "natural"

- But sustainability also isn't the only thing that matters
    - Health,Ethics, Culture