Environmental performance along livestock food chains

DEVELOPING A GLOBAL AGENDA OF ACTION FOR RESPONSIBLE LIVESTOCK SECTOR DEVELOPMENT

BRASILIA, MAY 18, 2011

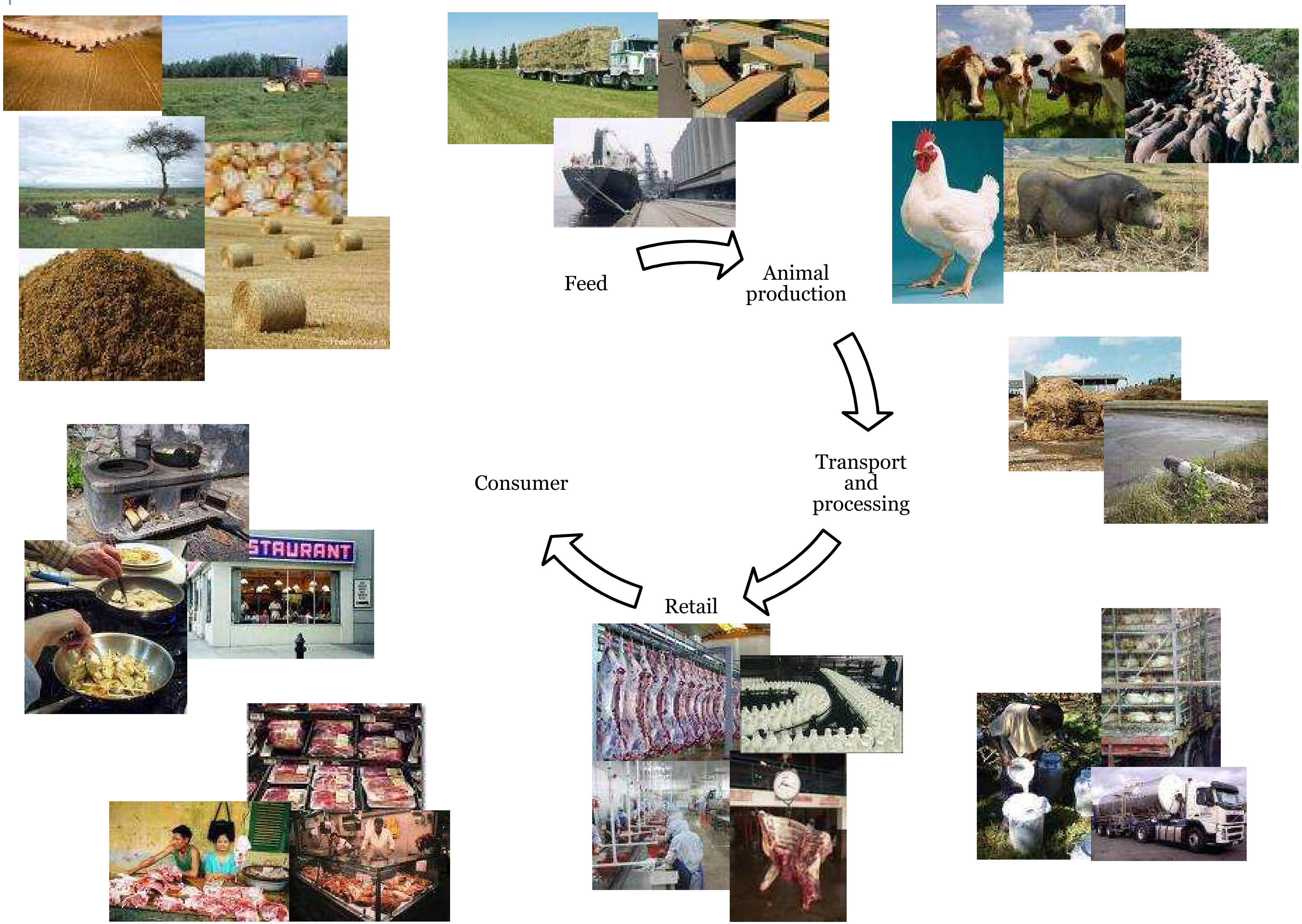
Content

- Biological processes along livestock food chains
- Main features in Monogastric an Ruminant food chains
- Environmental impacts and potential environmental efficiency gains along livestock food chains

Main references

- FAO
  - Livestock's long shadow (2006)
  - Livestock in changing landscape V 1 and 2 (2009)
  - State of food and agriculture (2009)
  - Global food losses and food waste (2011)
- Netherlands Environmental Assessment Agency - The protein Puzzle (2011)
- Rabobank, presentation at the IPC-FAO meeting (2011)
- European Nitrogen Assessment (2011)
- JRC-EC, European Greenhouse Gases Emissions from Livestock Production Systems (2008)

An overview of livestock food chains (LFC)



Feed production – biological processes

Photosynthesis: converts mineral nutrients and carbon dioxide into organic matter.

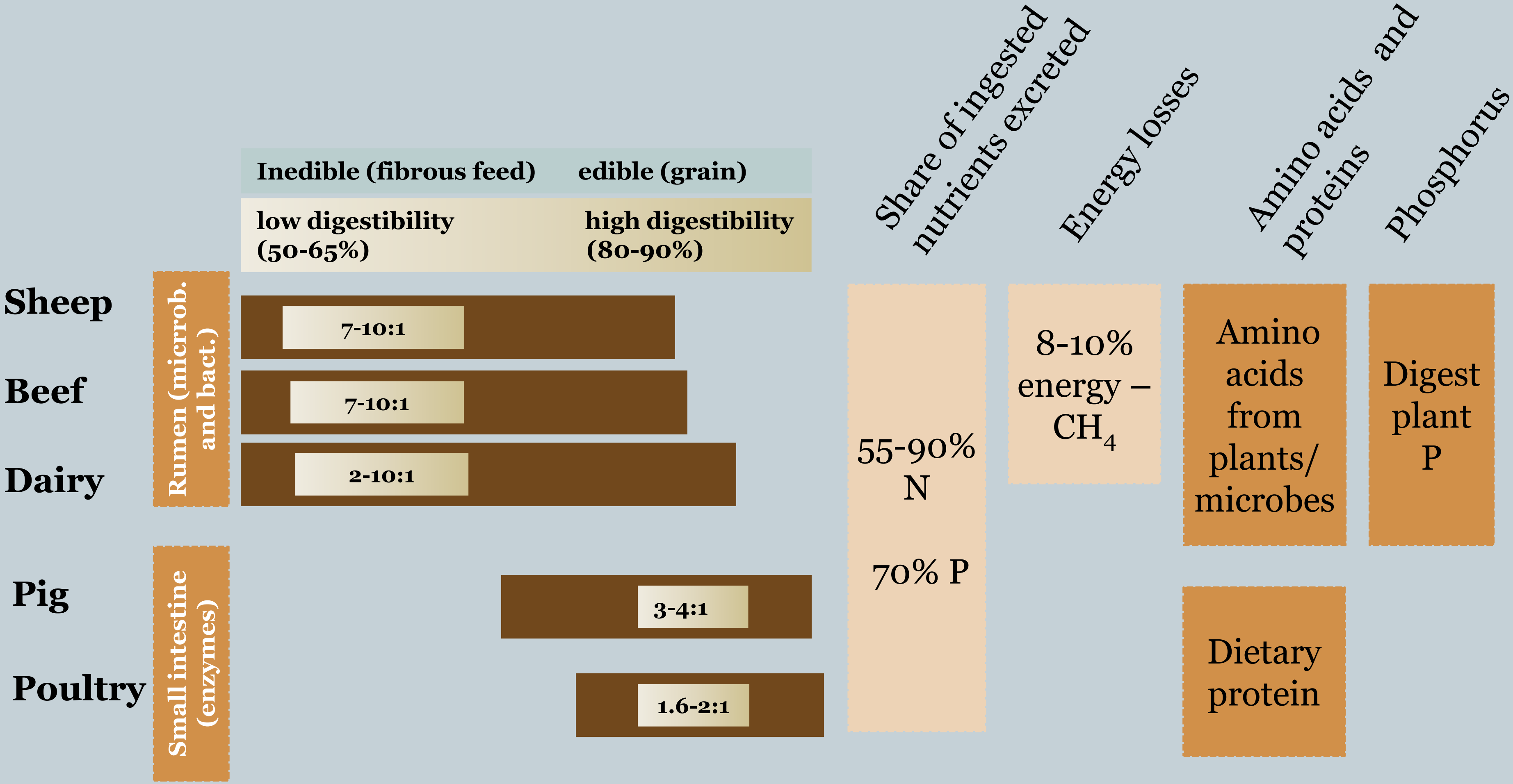
- Range of plant species and properties C3 (barley, wheat), C4 (maize), legumes (soy)
- Process requires large amounts of land (solar energy), nutrients and water
- Dependant on agro-ecological conditions
- Sequesters C from the atmosphere

Feed production – biological processes

- Production increase achieved through:
  - Intensification - increased use of inputs (irrigation, fertilizer (reactive N, pesticides). 48% of total crop output dependant on Haber-Bosh
  - Extension associated with land conversion: modification of vegetation cover and soil properties.

- Land conversion and degradation have follow-on effects on water resources, biodiversity and climate change

Animal production – biological processes



Animal production – biological processes

	Gestation	Offspring/female/year
Sheep	147 days	1-3
Beef	270 days	1
Dairy	270 days	1
Pig	114 days	7-14
Poultry	20-22 days	100-300

Post Harvest processing

- Biophysical processes largely controlled by human
- Independent from environment
- Waste rendering (temperature, centrifugation, chemical processes)

Livestock Food Chains - monogastric intensive

Feed and Pasture	Animal production	Post harvest processing	Retail
• Mostly relying on high nutrient value ingredients • Decreasing importance of crop residues • Strong regional imbalances • Largely traded • M&B meal ban in EU rediscussed	• Rapidly growing (poultry + 60% and pork + 43% by 2030) • Has often developed faster than institutional environment • Geographically concentrated, often away from feed-crop production	• Large proportion of production entering global trade (estimated 17% of poultry production by 2020)	• Large scale retail dominate

Livestock Food Chains - monogastric traditional

Feed and Pasture	Animal production	Post harvest processing	Retail
• Crop residues, household waste and “free range” source dominate	• Associated with rural population and mix production systems • Generally not targeted by environmental regulation	• Generally not processed	• Household consumption, wet markets

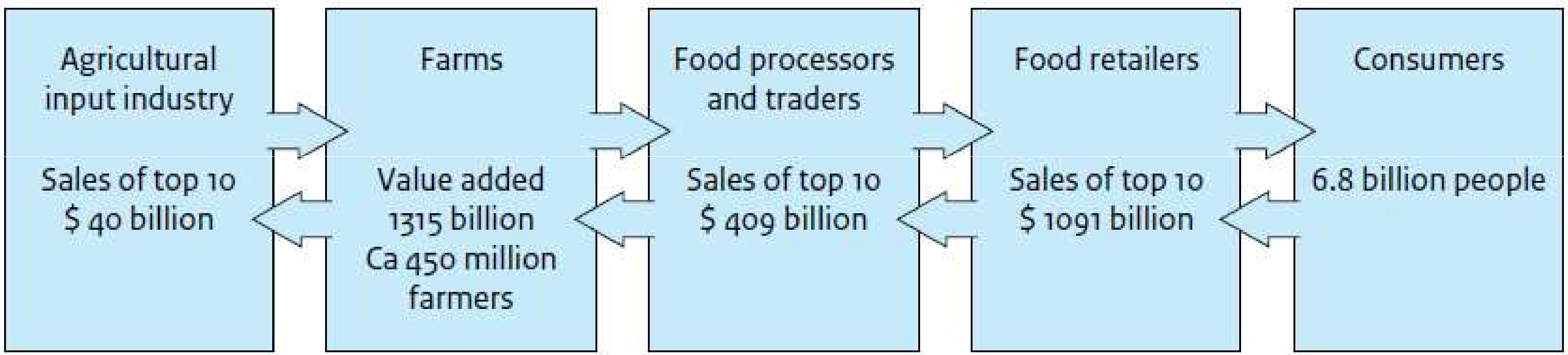
Livestock Food Chains - ruminants intensive

Feed and Pasture	Animal production	Post harvest processing	Retail
• Intensification of fodder production (hay, silage) • Grain dominant in feedlot systems • M&B meal ban in EU	• Growing (beef + 25% and sheep+ 35% by 2030) • Generally linked to land, with exception of some dairy systems and feedlots	• A relative small proportion enters trade • Limited processing, except for milk	• Large scale retail dominate

Livestock Food Chains – range based

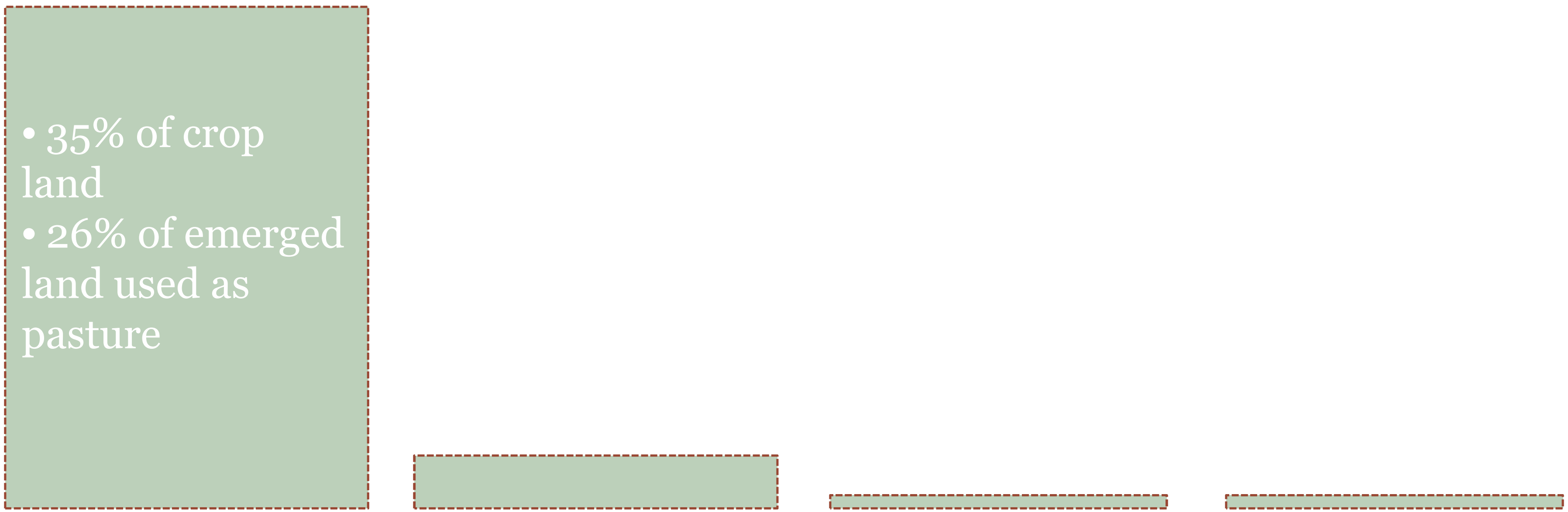
Feed and Pasture	Animal production	Post harvest processing	Retail
• Concentrate feed is marginal • Extensive range undisturbed, lightly managed, degraded	• Growing in LAC stable elsewhere • Dependant on ecosystem	•limited	• Limited to exported products

Stakeholders along global food chains



Land use

Feed and Pasture | Animal production | Post harvest processing | Retail



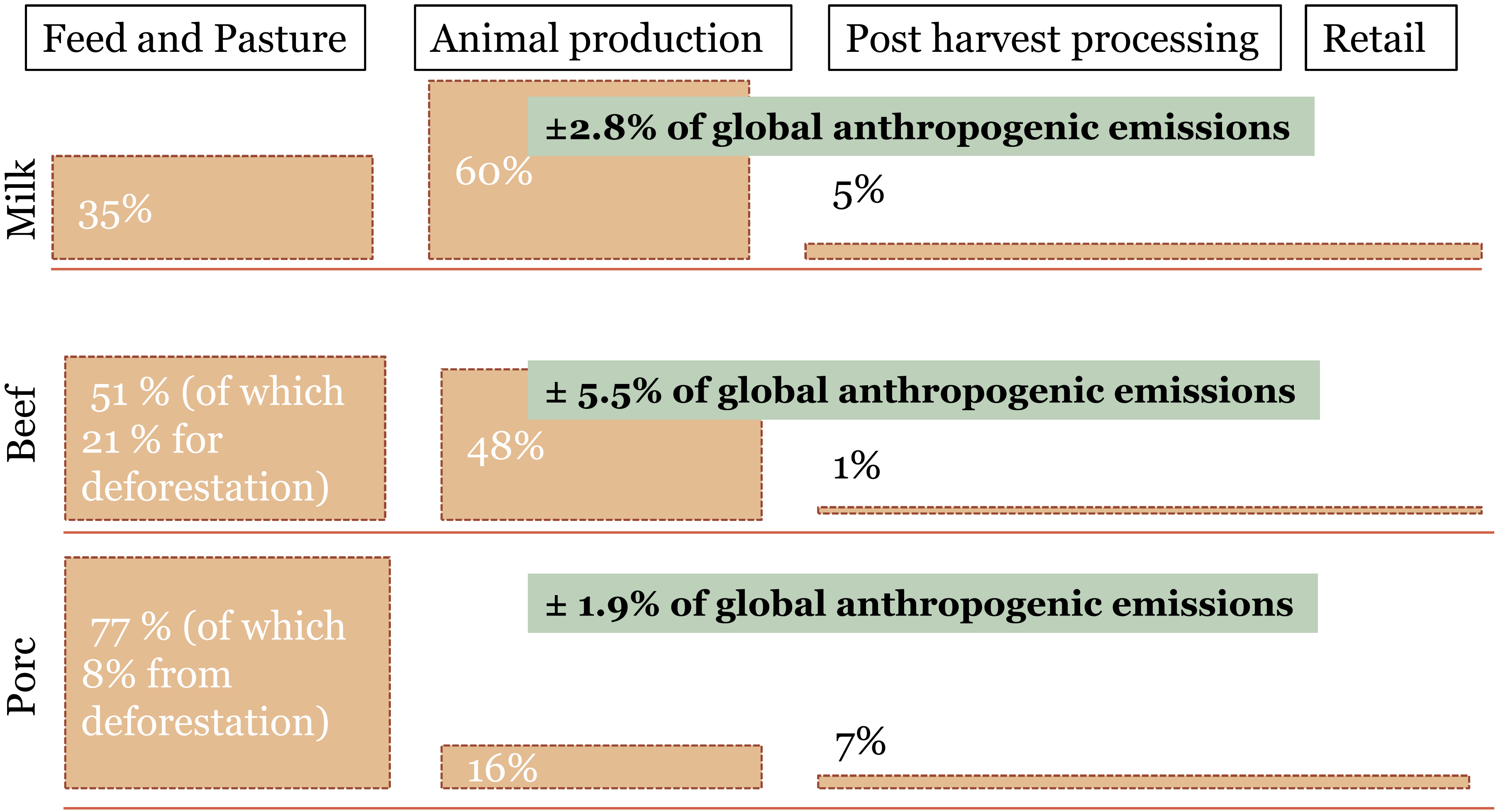
Impacts on Nutrient Cycles

Feed and Pasture	Animal production	Post harvest processing	Retail
•48% of fertilizers shipped used to grow animal feed •70% of applied N is lost to the environment •Nutrient accumulation – 8 Tg/year for P, 60 Tg/year for N	• 94 Tg N, 21Tg P, 67 Tg K in manure (1 to 3 times more than fertilizers) • Drug residues		

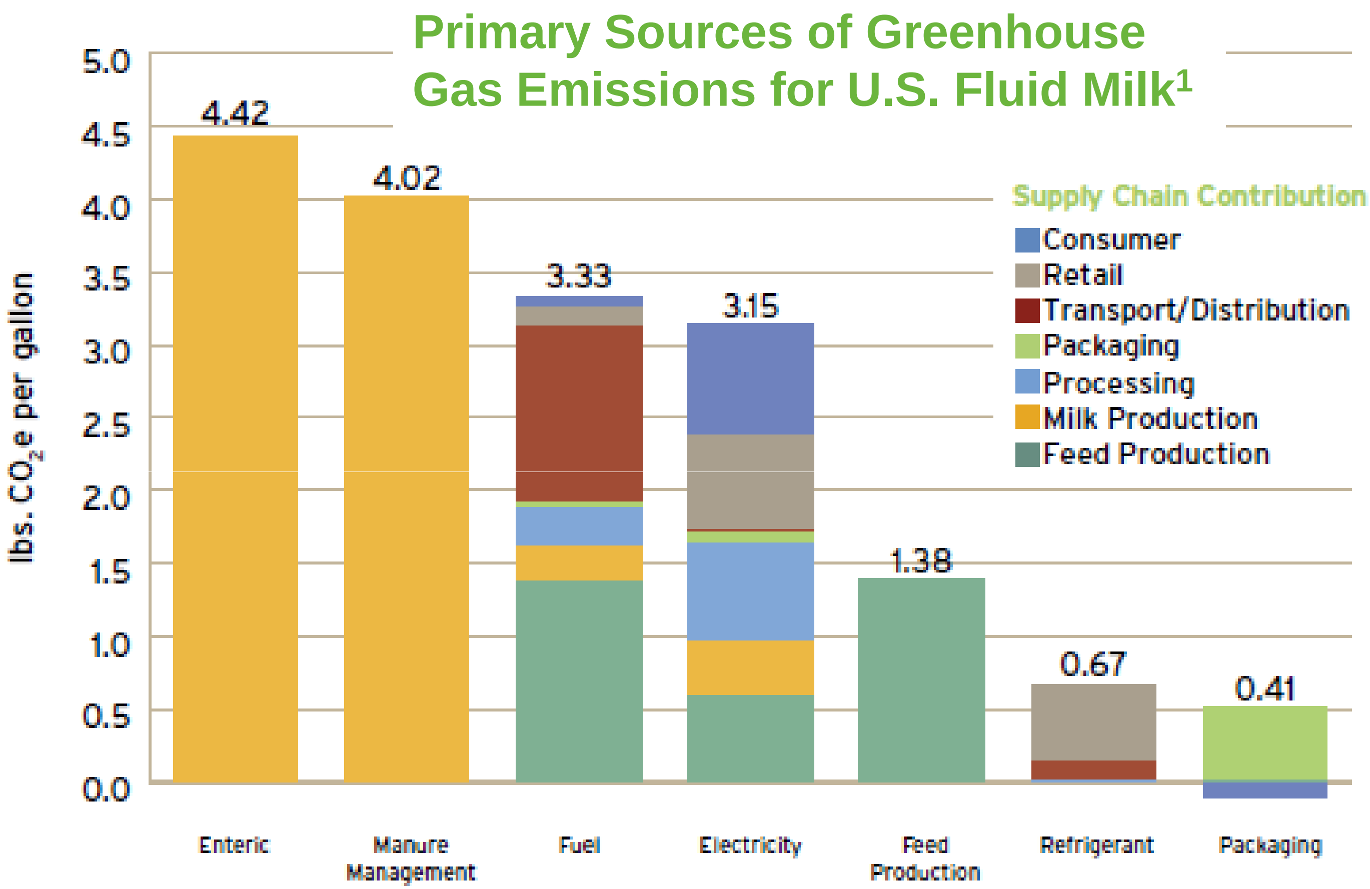
Impacts on water resources

Feed and Pasture	Animal production	Post harvest processing	Retail
• Withdrawals and pollution • 15 of water evaporated in irrigated areas • runoff and replenishment of ground water resources • virtual water transfers	• Pollution from manure (N and P) • Drug residues	• Pollution from waste (Organic Matter)	

Contribution to climate change



What we learned: opportunities for efficiency and innovation across the value chain



Carbon footprint = 17.6 lbs. CO2e per gallon of fluid milk consumed[2]

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[1] Does not include sources related to waste.
[2] "Greenhouse Gas Emissions of Fluid Milk in the U.S." University of Arkansas, 2010. Based on environmental and consumption data from 2007-2008. Natural variability in data ranges from 15.3 to 20.7 lbs. CO2e. The total fluid milk carbon footprint is approximately 35 million metric tons, with a 95% confidence range from 30 to 45 million metric tons.

Impacts on Biodiversity

Feed and Pasture	Animal production	Post harvest processing	Retail
• Land conversion and degradation •Eutrophication and release of pesticides • Co-evolution of wildlife and agricultural landscapes	• Disease transmission • Drug residues •Eutrophication	•BOD release	

Efficiency gains

Natural resource use efficiency: natural resource used and noxious emissions per unit of product (service)

Principles:

- Improve conversions (plant, animal)
- Reduce waste and recycle
  - A third of edible food wasted along the chains
  - Less animal products than crops
  - Animal proucts mostly wasted at end of food chain in affluent countries
- Provide offsets

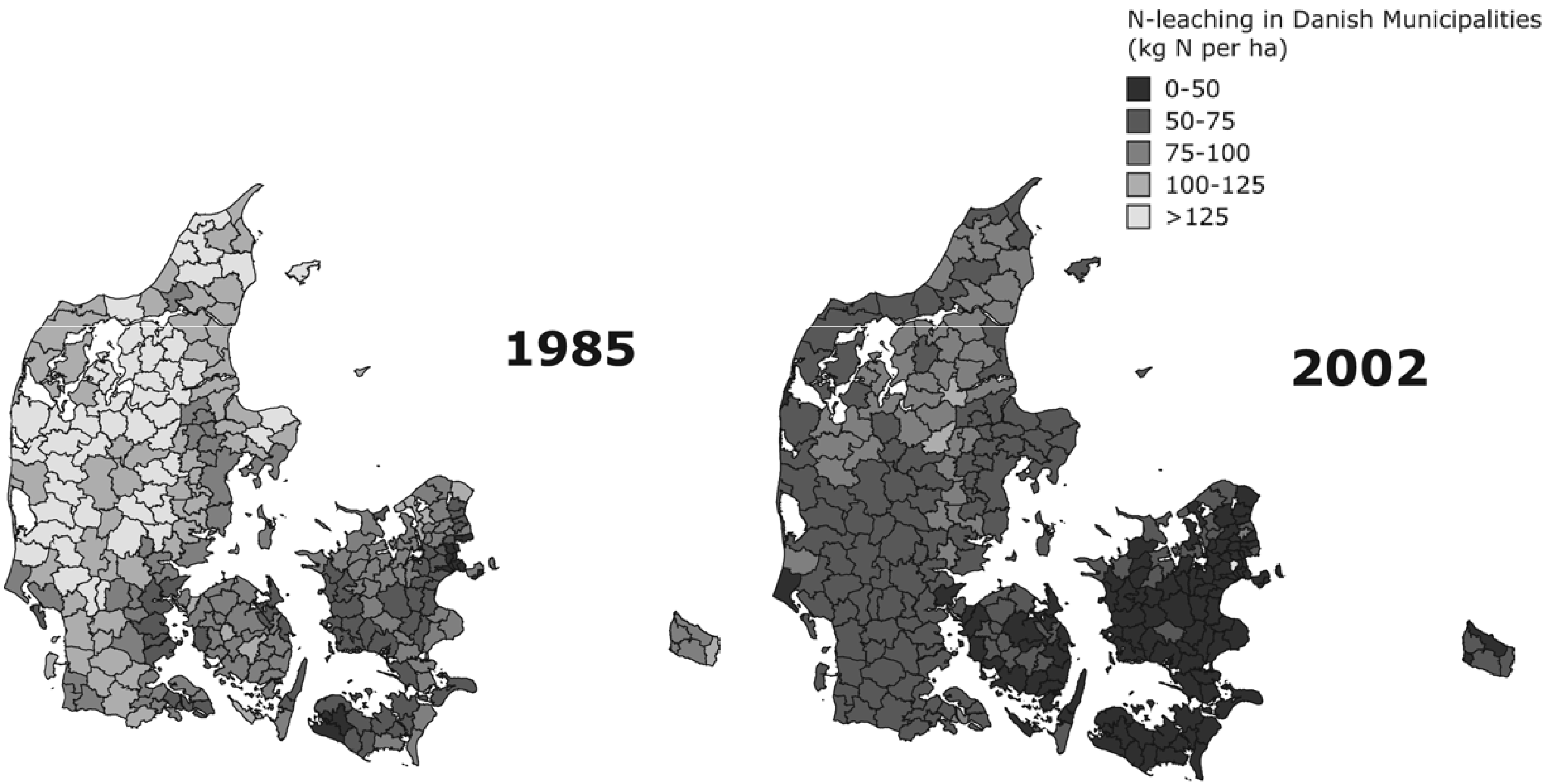
Efficiency gains – technical options

- Improve conversion
  - Precision agriculture (irrigation, fertilization and pesticide)
  - Develop feed-crops with higher yield (esp. legumes)
  - Improve feed conversion ratio (feed formulation, phased feeding, genetics, shift in species)
  - Improve animal health and pest control

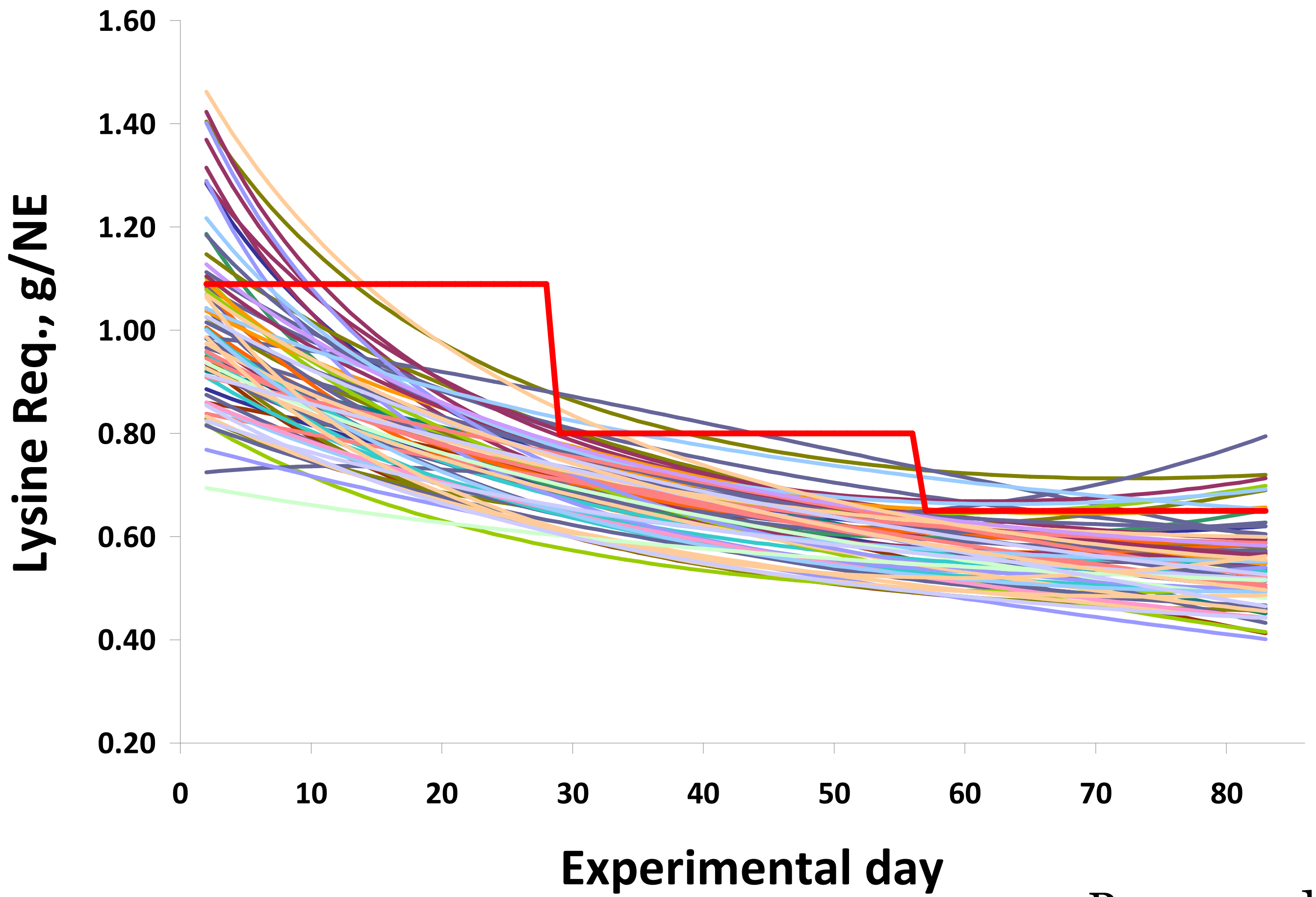
- Reduce waste
  - Develop crop livestock integration (avoid geographical concentration, improve manure application)
  - Improve energy use efficiency
  - Reduce post harvest, transport and storage losses
  - Reduce processing and retail losses
  - Assess risks related to meat and bone meal use as feed

- Provide offsets
  - C sequestration (reduced tillage, pasture management)

N-leaching in Danish municipalities

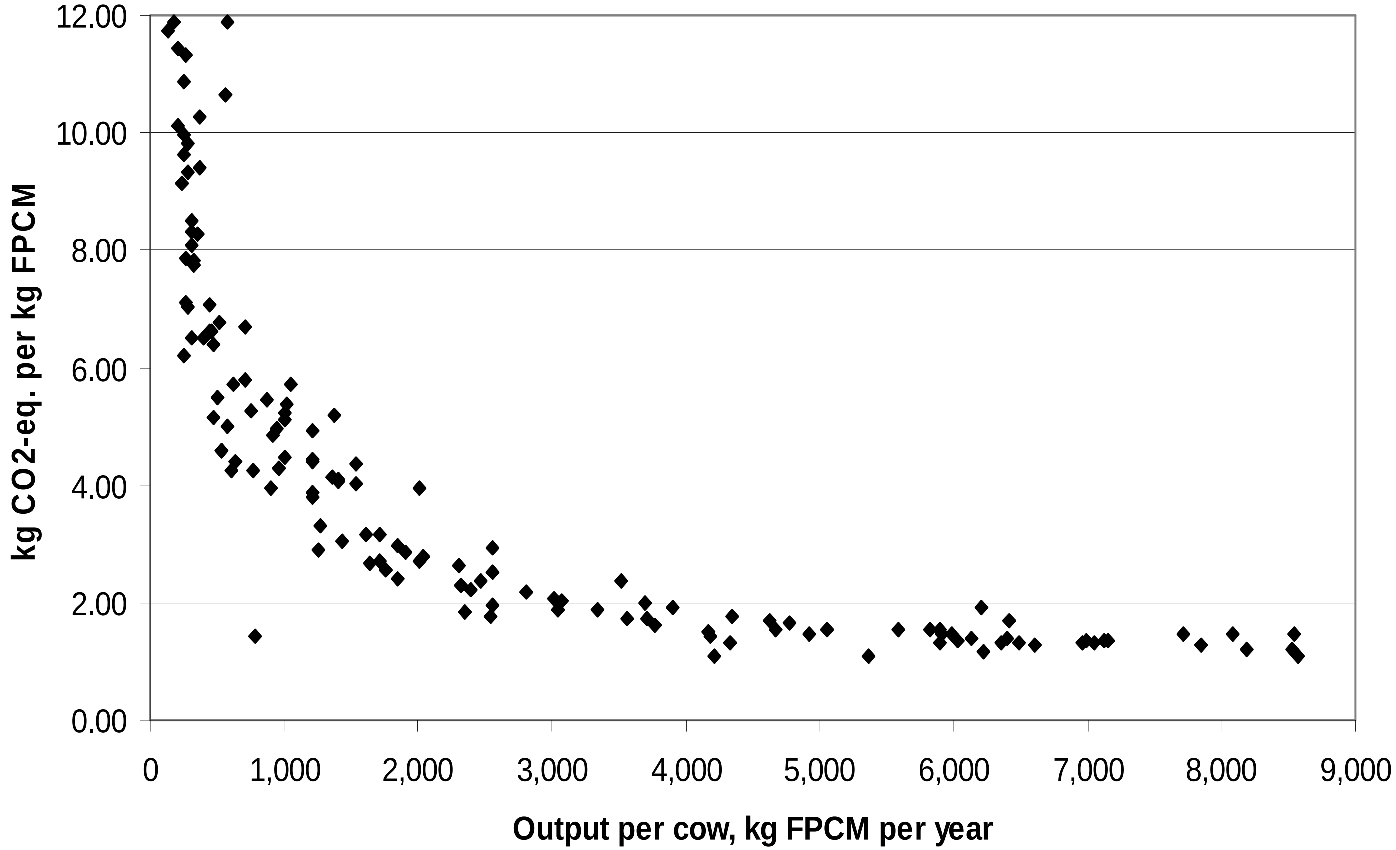


Precision feeding

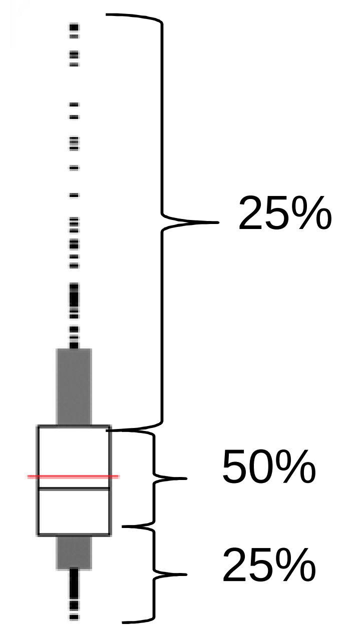


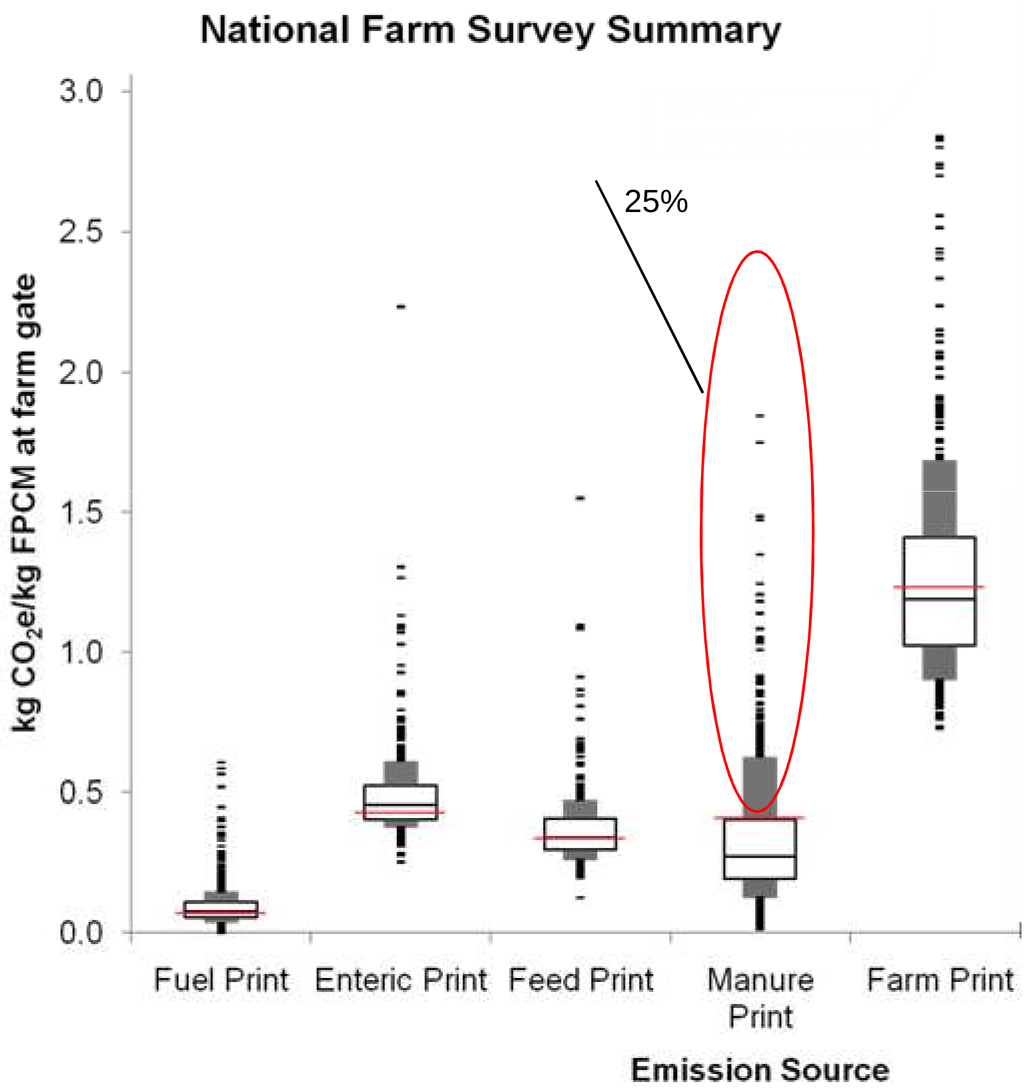
Pomar and Pomar, 2010

Relationship between total greenhouse gas emissions and output per cow



Variability means opportunities





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Efficiency gains – roles and istruments

The case of climate change

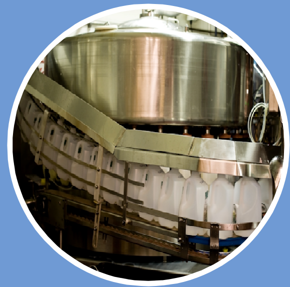
- Governments
  - Set national targets
  - Set broad legal and policy framework
- Producers/processors
  - Sector specific targets (in agreement with Govts)
  - Sector specific guidance (information, capacity building, GHG emissions quantification)
  - Practices and technologies
- Retail
  - Communicates with consumer <-> (Labeling, advertising, consumer surveys)
  - Set private standards

What we learned: management practices matter

Increasing feed efficiency

Reducing enteric methane

Improving manure management



Reducing electricity usage

Consolidating distribution network

Considering alternative packaging materials

Good truck maintenance

Better route design

Reducing long distance milk hauling

The basis for differences is best management practices – not size, region or age.

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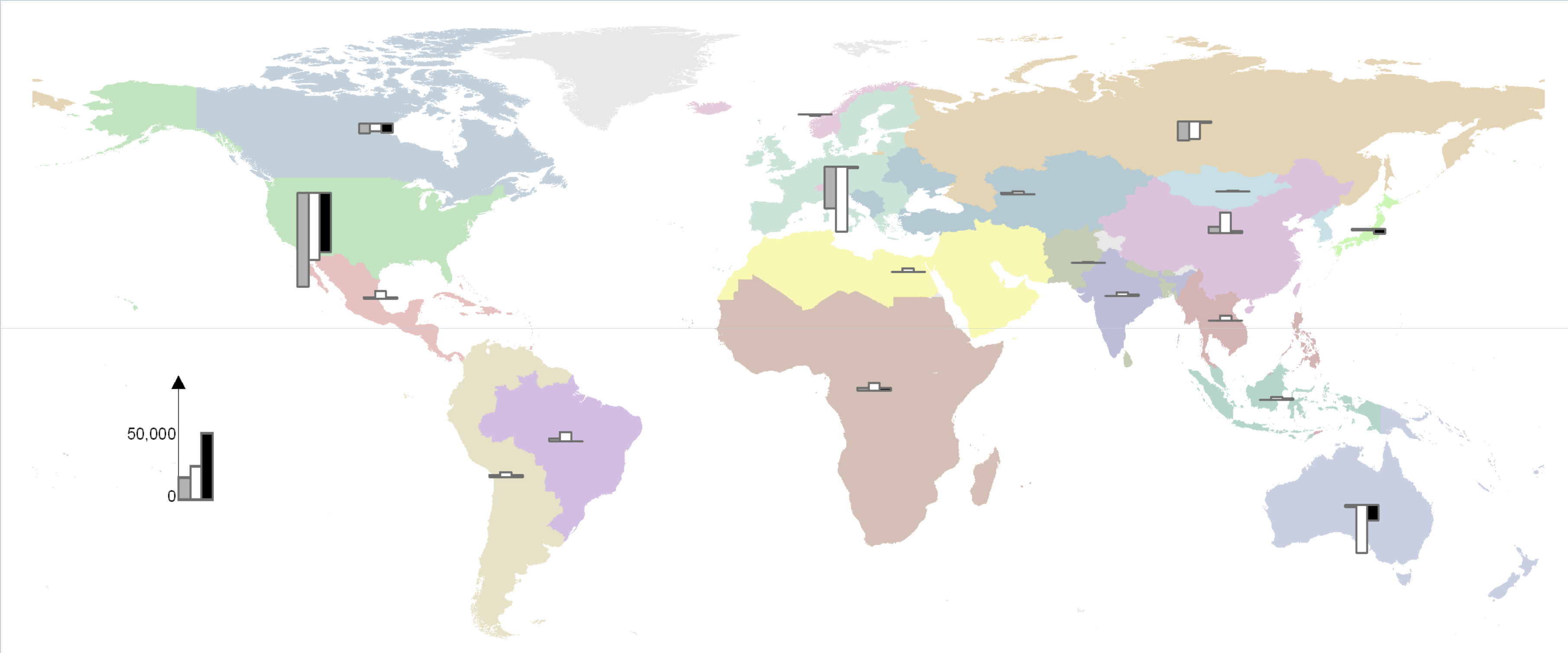
The need to look and act beyond single LFC

- Geographical coverage
- Cross-sector coverage

Policy scenarios

Scenario	Forest carbon sequestration subsidy		Carbon tax in emitting sectors, incl. agric.		Compensation for carbon tax payment	
	Annex I	Non-Annex I	Annex I	Non-Annex I	Annex I	Non-Annex I
A1 Tax+Fo	✓	-	✓	-	-	-
A1 Tax + G Fo	✓	✓	✓	-	-	-
G Tax+Fo + Comp	✓	✓	✓	✓	-	✓

A1 Tax+Fo

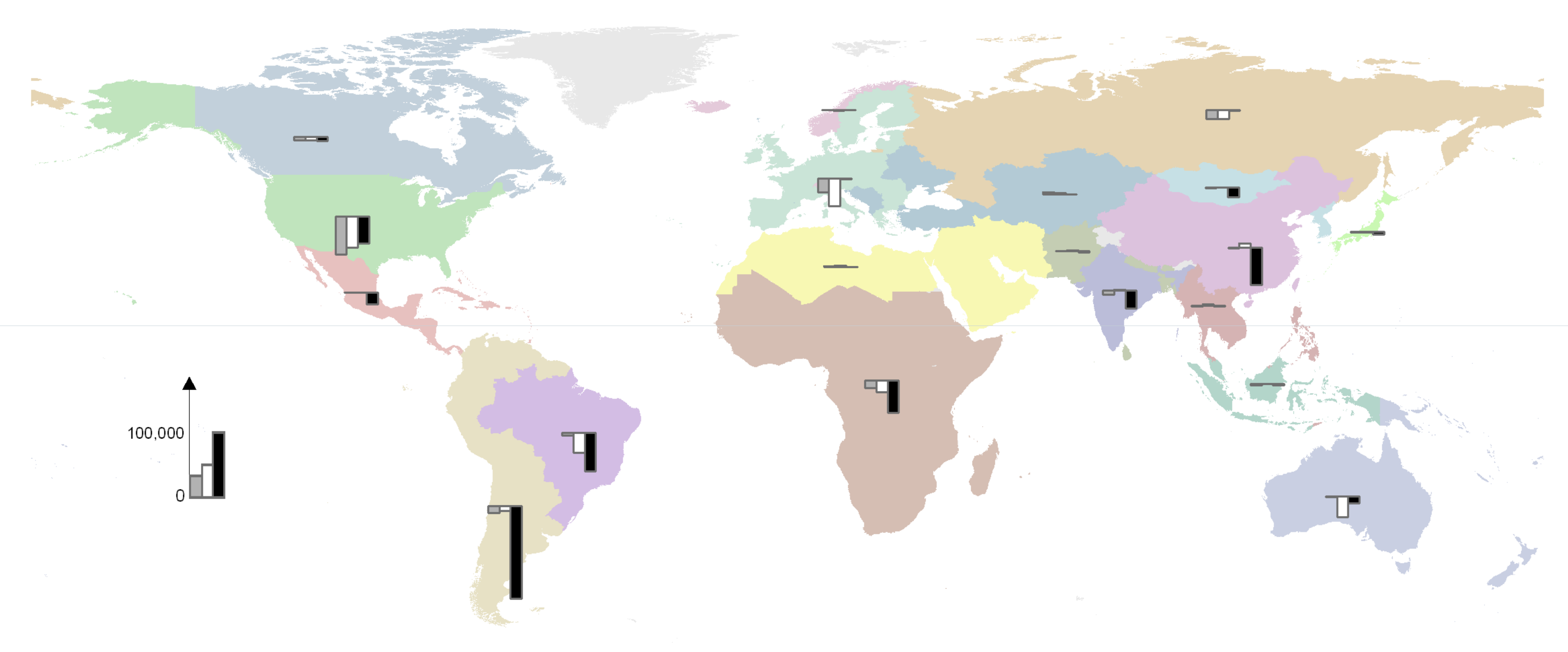


Emission changes

- Crops (HtCO2-eq)
- Livestock (HtCO2-eq)
- Forestry (KtCO2-eq)

Total land based	Forestry		Livestock		Crops	
	Annex I	Non-Annex I	Annex I	Non-Annex I	Annex I	Non-Annex I
-855	-722	91	-163	57	-298	74

Scenario A1 Tax + G Fo



Emission changes

- Crops (HtCO2-eq)
- Livestock (HtCO2-eq)
- Forestry (KtCO2-eq)

Total land based	Forestry		Livestock		Crops	
	Annex I	Non-Annex I	Annex I	Non-Annex I	Annex I	Non-Annex I
-5072	-694	-4042	-153	-39	-265	-71

Concluding remarks (i)

Food chain approach

- Supports the identification of most effective points of interventions
- Avoids pollution swapping along the chain
- Can be combined with other food chain analysis, e.g. stakeholder analysis, HCCP
- Complementary to system analysis (forces to identify main outputs)

Concluding remarks (ii)

Environmental performance

- Potential gains are substantial
- Main area include
  - Feed: precision agriculture, crop-livestock integration, use of by-products and wastes
  - Animal: manure management, FCR, feed formulation
  - Post Harvest: energy saving
- Most impacts take place upstream but market signals and standards issued downstream
- Need to control for geographical leakage and cross-sector interactions