MITIGATION STRATEGIES AND ACTIONS IN LIVESTOCK

Technical information and recommendations

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The dual challenge

- Livestock: a growing sector, especially in developing countries
  - driven by income, demography and changing preferences,
  - among highest growth rate in agriculture commodity
  - over 80% of production growth in non OECD countries

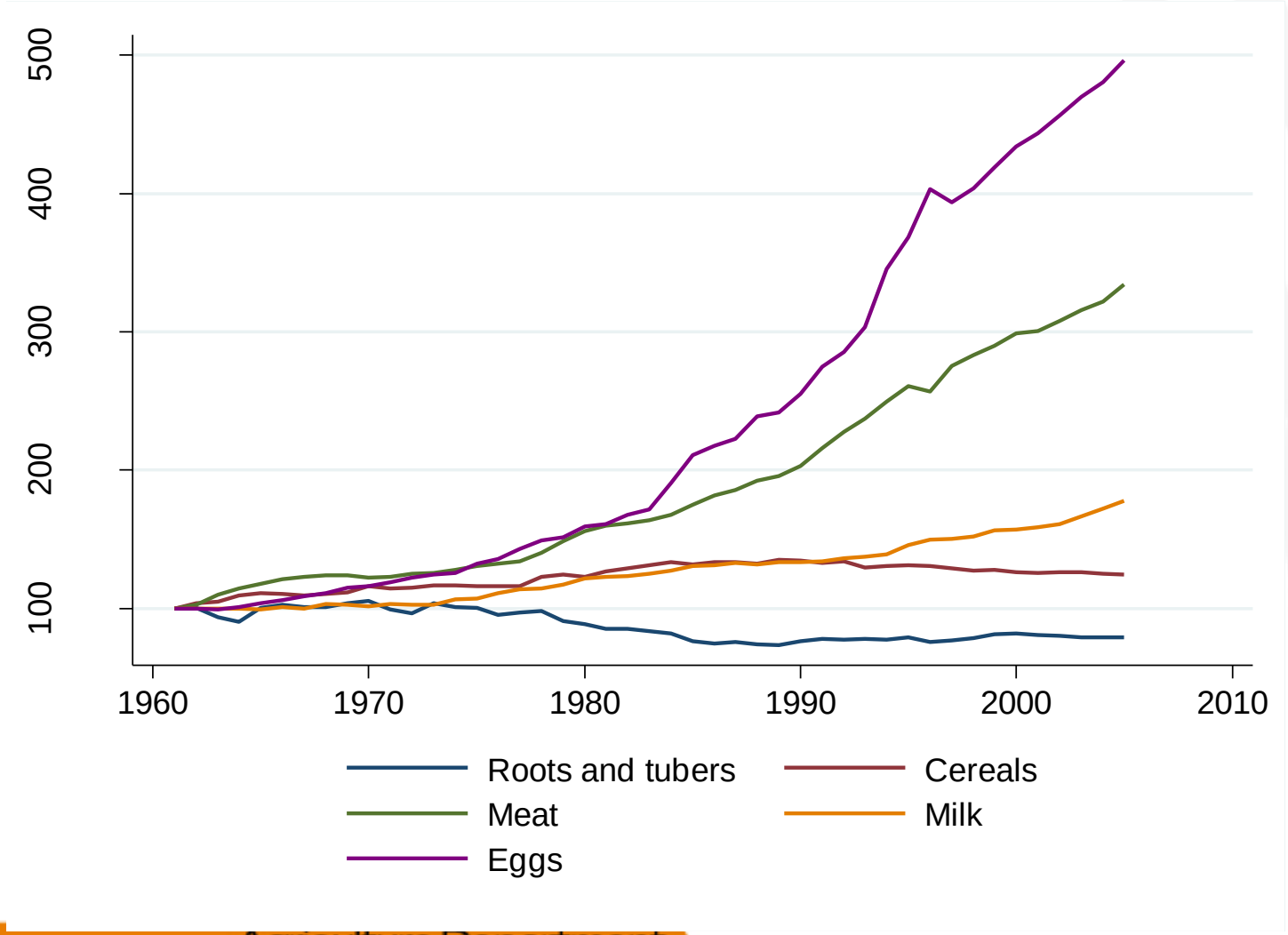
(OECD-FAO, 2009)

- Climate change
  - the worst-case ipcc scenario trajectories are being realized
  - societies are highly vulnerable, with strong differential effects on people within and between countries and regions.
  - risk of crossing tipping points
  - there is no excuse for inaction

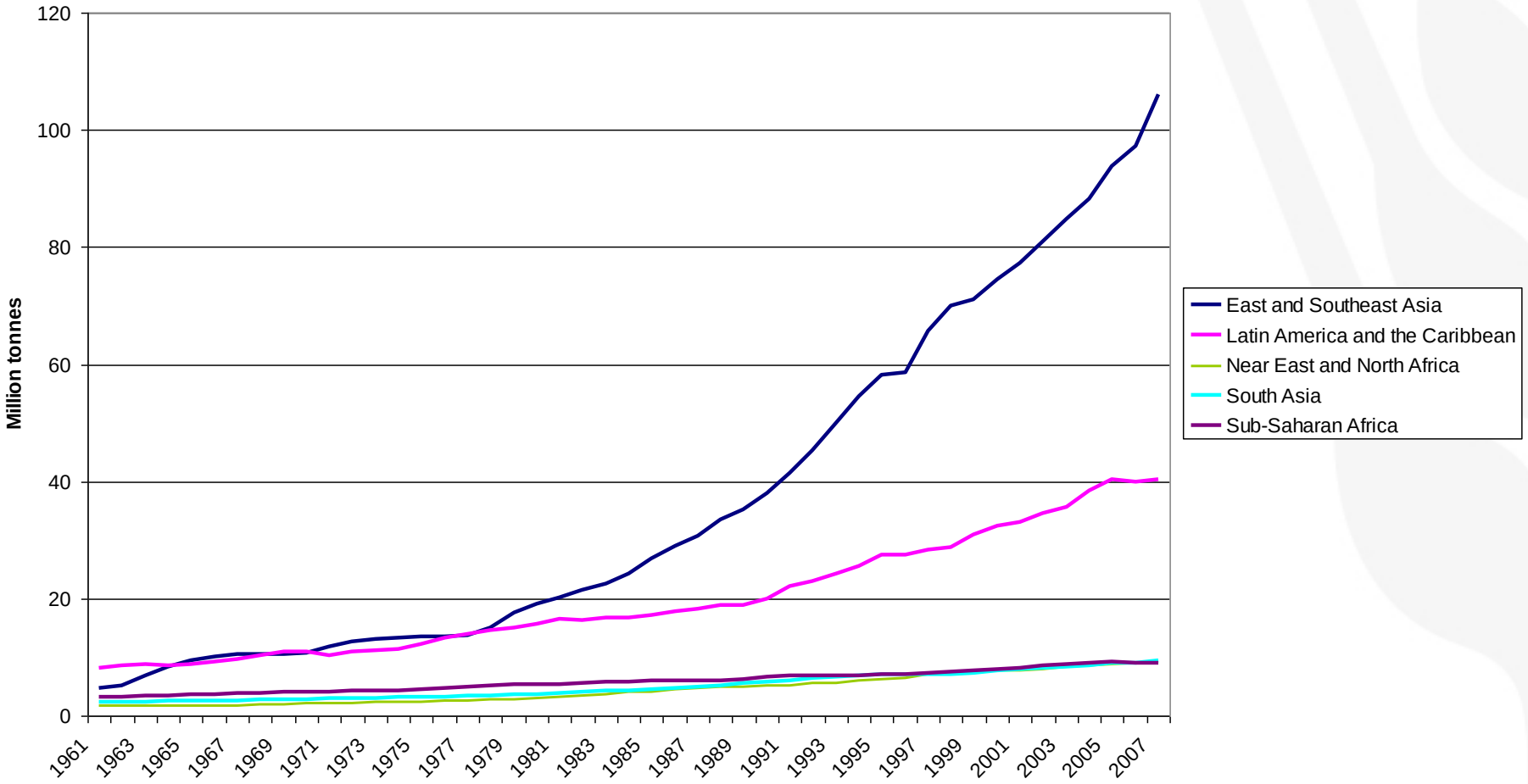
(Climate Change: Global Risks, Challenges & Decisions – 2009, Copenhagen)

↳ Dual challenge of food security and climate change mitigation

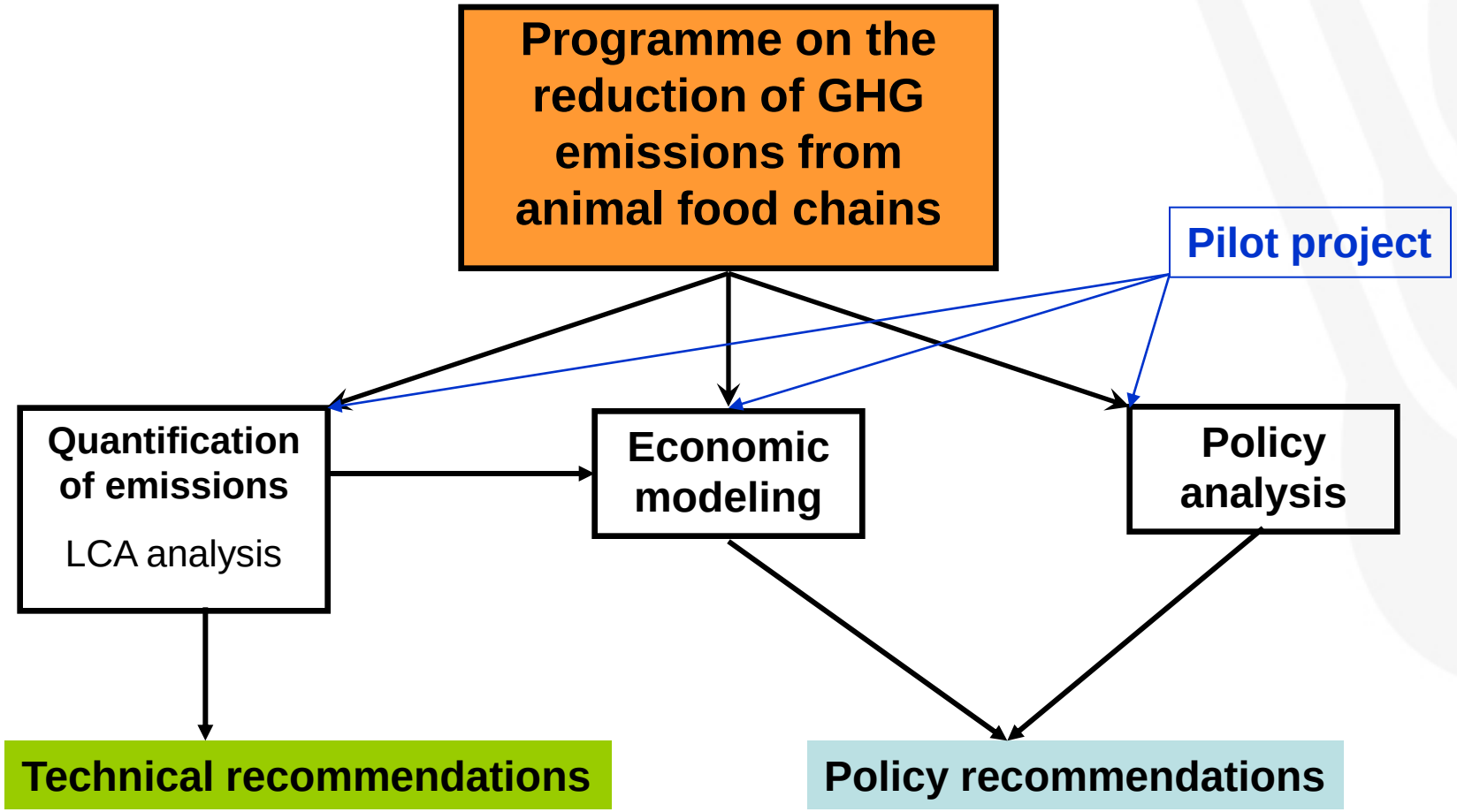
Consumption of major food items in developing countries – kg per caput per year (index numbers 1961=100)



Meat production - developing country regions



Overview of current activities



Green House Gas Emissions

A food-chain perspective of GHG emissions

IPCC attribution

- Emissions from **feed** production
  - chemical fertilizer fabrication ← Industry and energy
  - chemical fertilizer application ← Agriculture
  - on-farm fossil fuel use ← Energy
  - livestock-related deforestation ← Forestry
  - C release from ag. soils ← Agriculture
- Emissions from **livestock rearing**
  - Methane from enteric fermentation
  - Methane and Nitrous Oxide from manure

  ← Agriculture / livestock
- **Post harvest** emissions
  - slaughtering and processing ← Industry and energy
  - international transportation ← Transport and energy

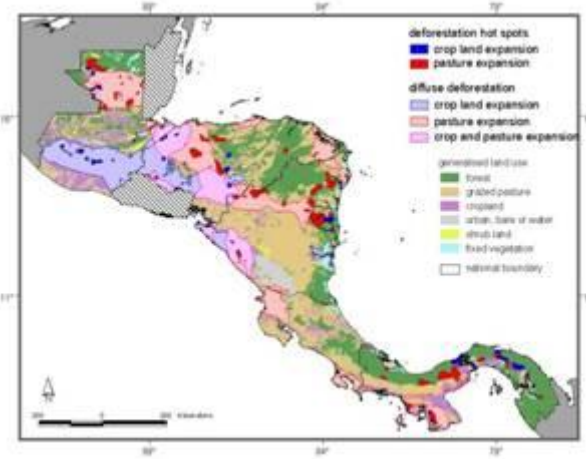
Relative contributions along the food chain

About 7.1 billion tonnes CO2 equivalent
or
18% of total anthropogenic GHG emissions
(2/3 from extensive systems and 1/3 from intensive systems)

…but variable across the world (eg. 60% of Brazil's emissions)

- Land use and Land Use Change : **36%**
- Feed Production: **7%**
- Animals: **25%**
- Manure Management: **31%**
- Processing and Transport: **1%**

Livestock Related Land Use Change: Deforestation in the Neotropics

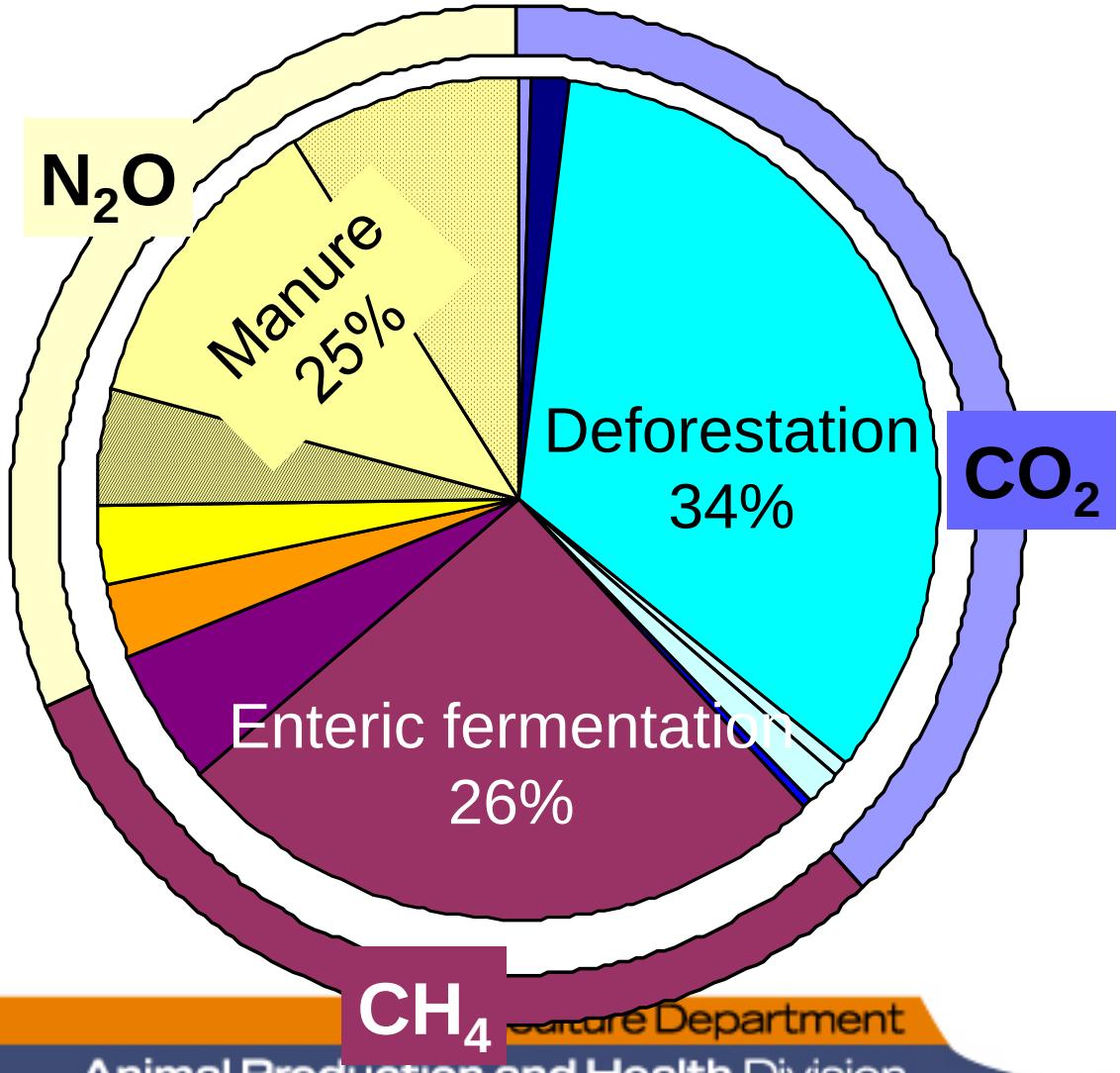


~2.4 million ha/year
Forest → Pasture

~0.5 million ha/year
Forest → Feed crops

~2.4 billion tons CO_2

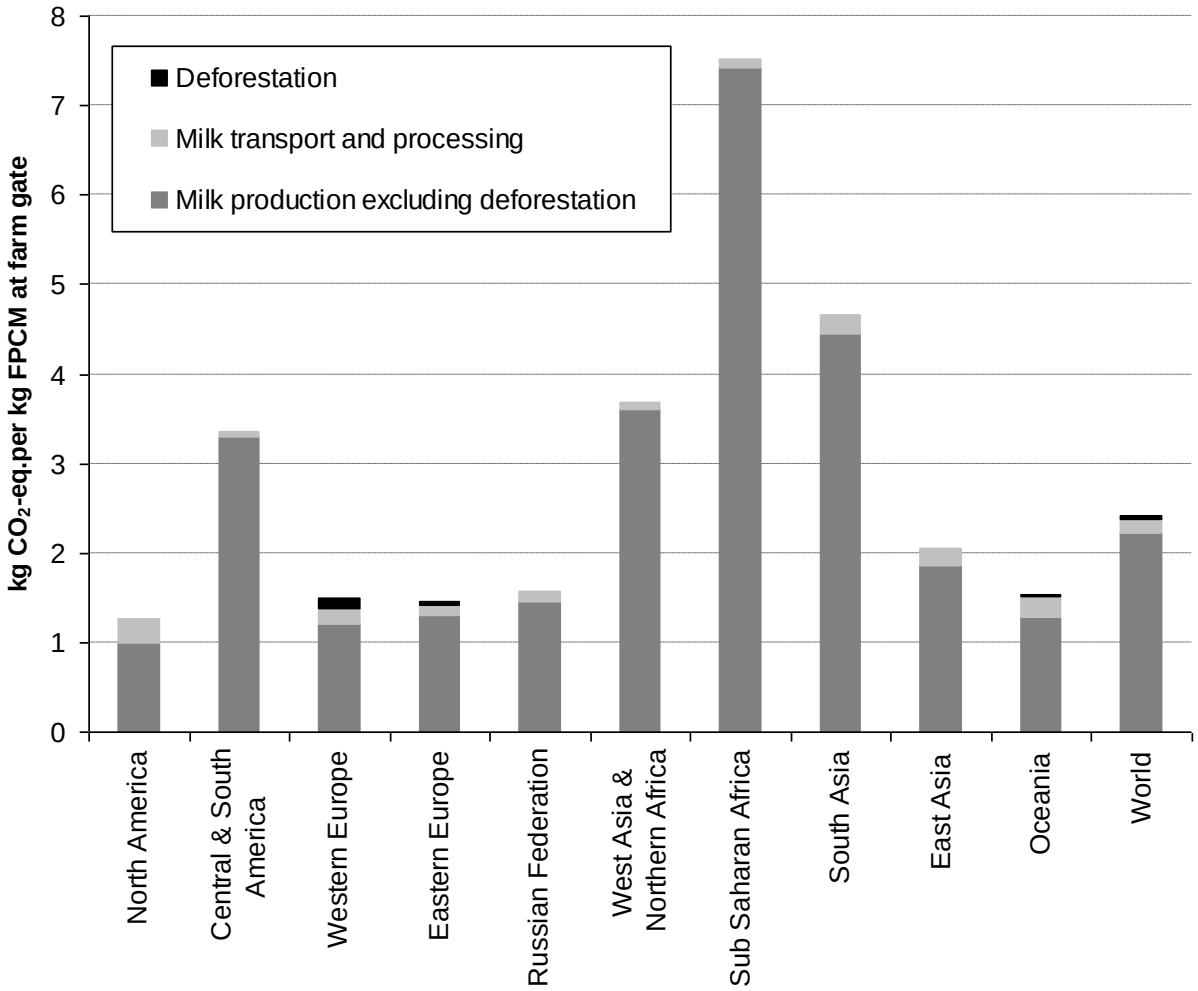
Relative contributions by GHG



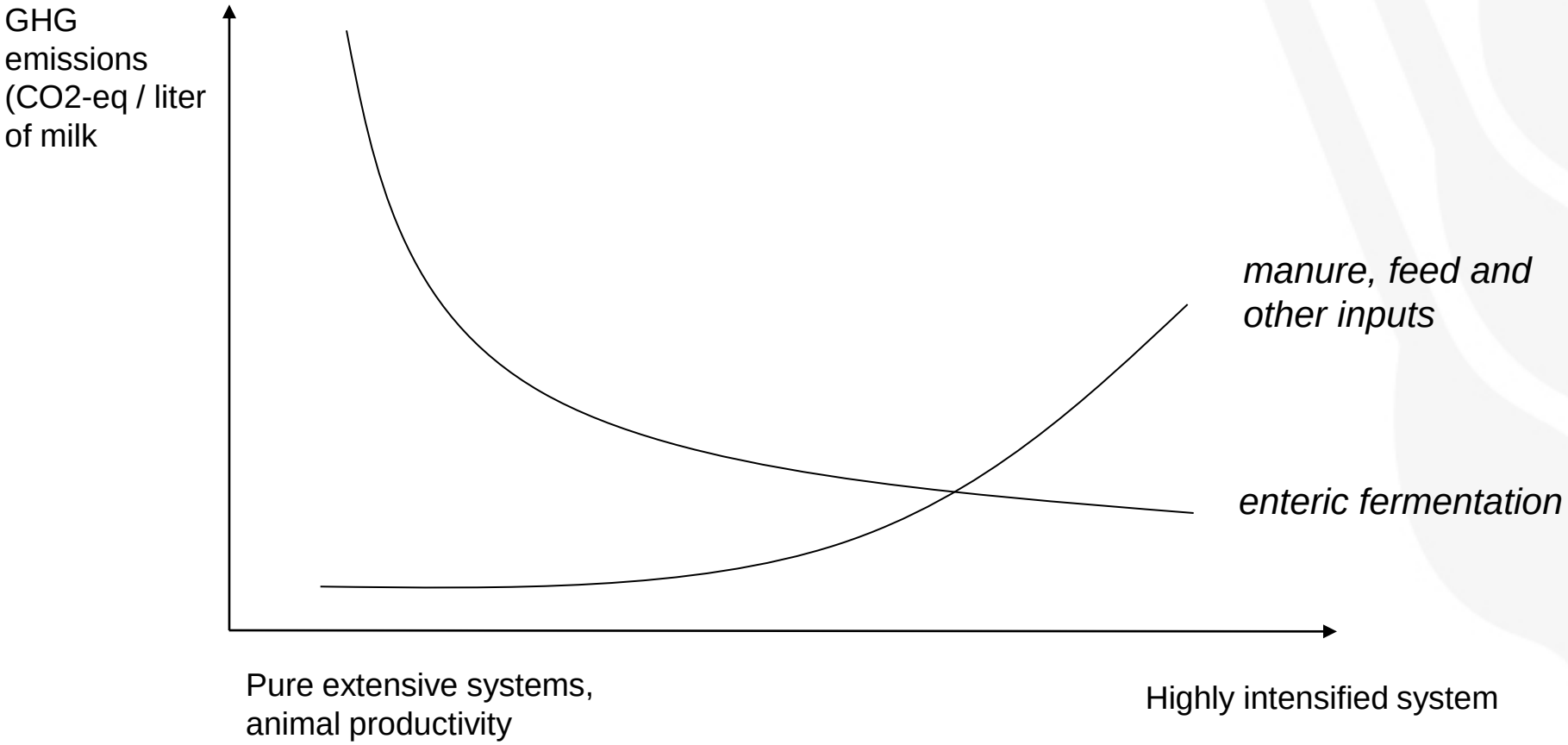
- Chemical N. fert. production
- On-farm fossil fuel
- Deforestation
- OM release from ag. soils
- Pasture degradation
- Processing fossil fuel
- Transport fossil fuel
- Enteric fermentation
- Manure storage / processing
- N fertilization
- Legume production
- Manure storage / processing
- Manure spreading / dropping
- Manu indirect emissions

LCA – dairy sector

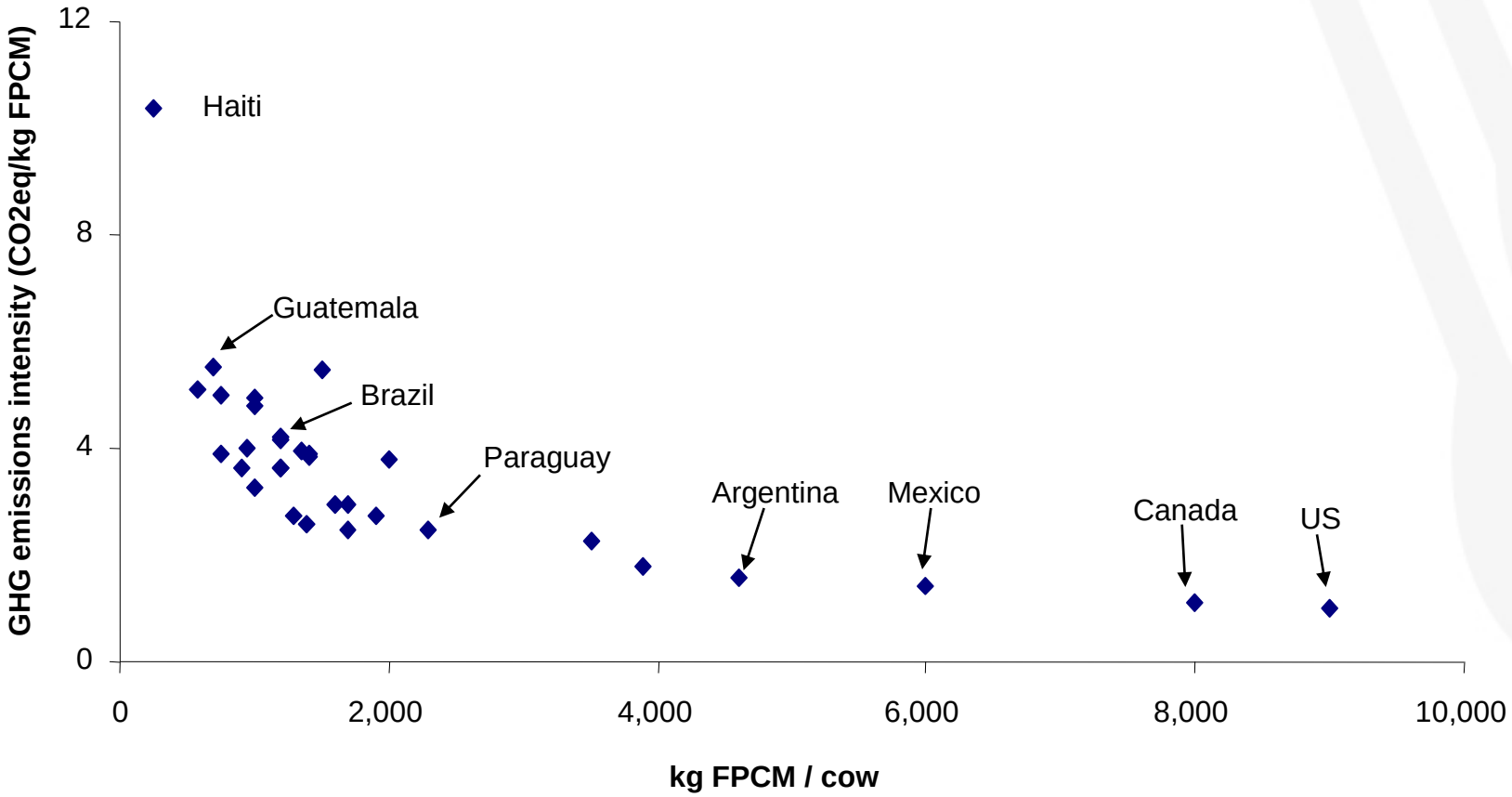
GHG emissions per kg of FPCM, averaged by main regions and for the world.



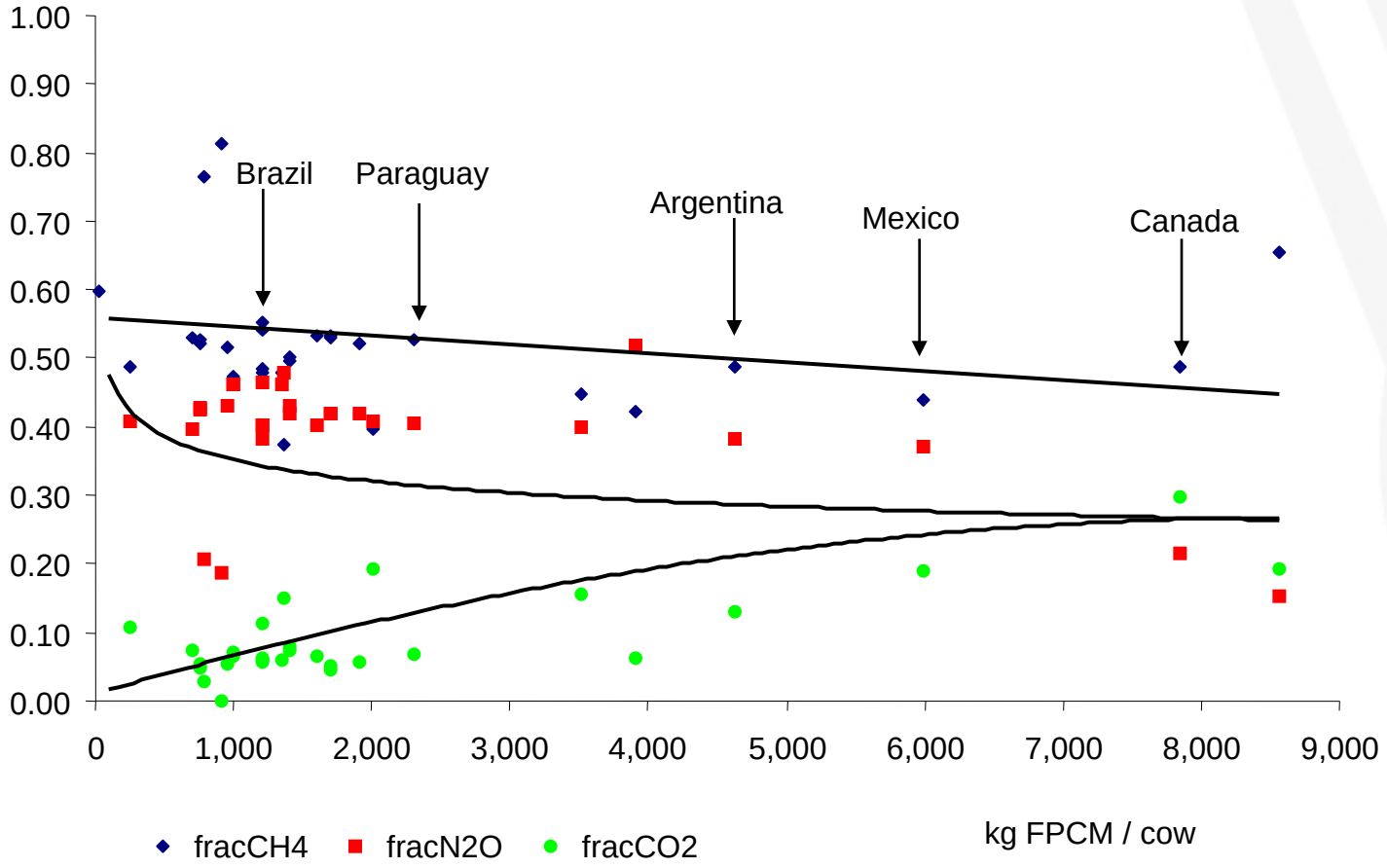
Working hypothesis – dairy sector



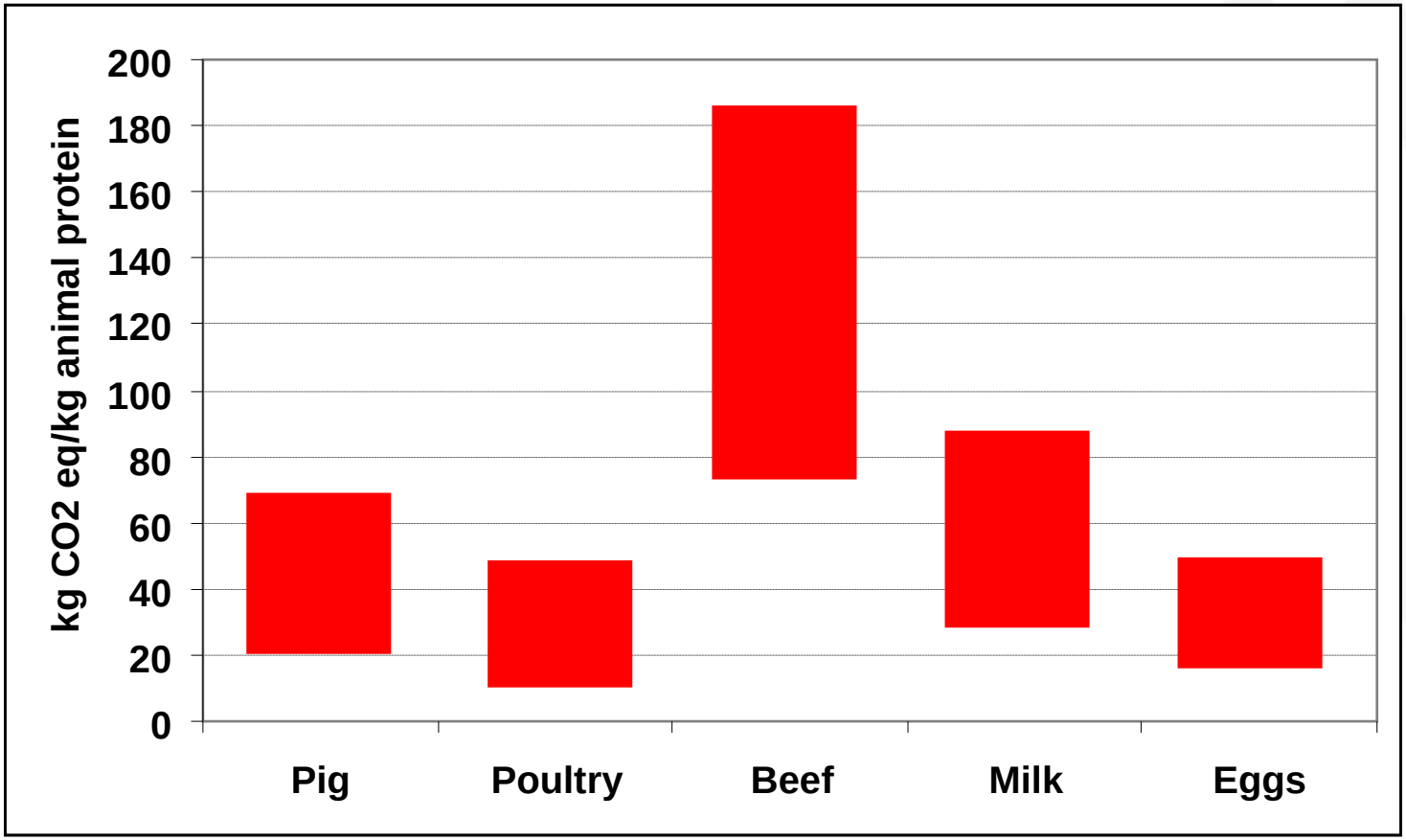
Animal productivity and the on-farm emissions intensities of milk in the Americas



Share of different gases in total emissions



Range of GHG for commodities in OECD-countries



Source: DeVries & DeBoer (2009)

Must also consider adaptation to climate change impacts

	Grazing systems	Non-grazing systems
Direct impacts	– extreme weather events – drought and floods –productivity losses (physiological stress) due to temperature increase – water availability	– disease epidemics – water availability –extreme weather events
Indirect impacts	Agro-ecological changes: – fodder quality and quality – host-pathogen interactions – disease epidemics	Resource price: – feed (production ; biofuels) – energy

Mitigation options

Mitigation Options (1)

Efficiency gains

Objective: reduce emissions per unit of animal product by cutting on "unproductive" emissions, e.g. those related to animal maintenance, stock replacement, ill animals, wastes, etc.

- livestock breeding (FCR, fertility)
- animal health
- feeding
- energy use efficiency (buildings, cooling)

shift in species: from ruminants to monogastrisc

Mitigation Options (2)

Manure management

Objectives: (i) reduce emissions during storage and application (ii) recover energy from organic matter

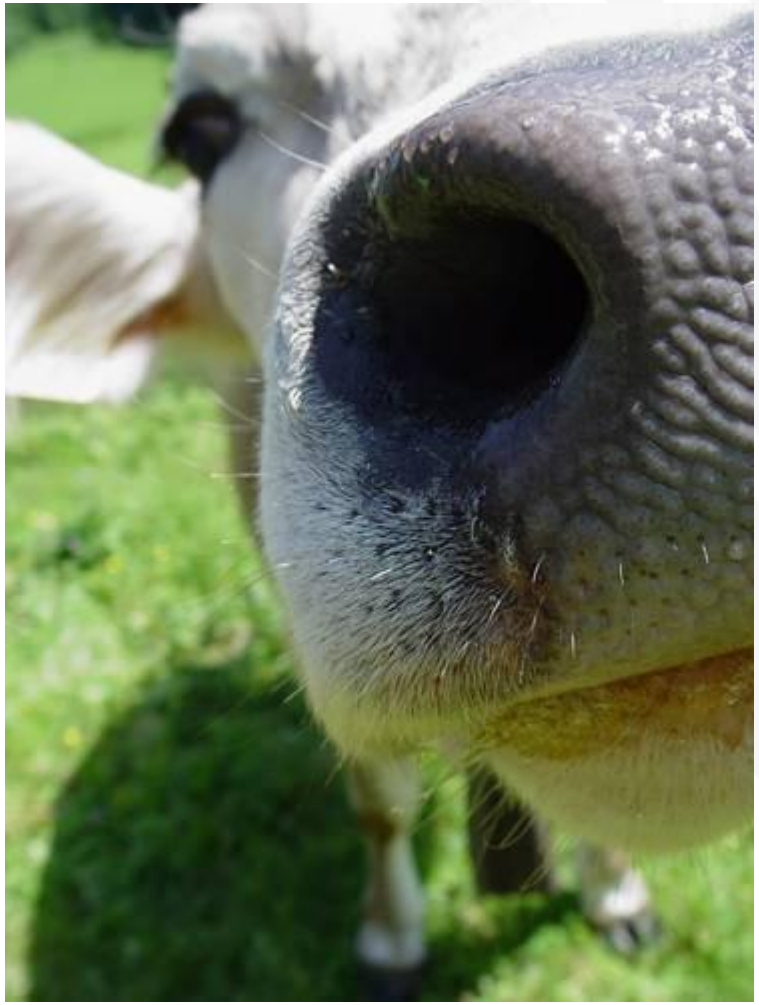
- balanced feeding
- storage facilities
- anaerobic digestion (methane production)
- waste application (dosing and injection)

Mitigation Options (3)

Control of enteric fermentation

Objectives: reduce methane emission from the rumen

- lower fiber content
- feed additives, e.g. medium-chain fatty acids (linolenic acid), plant extracts,
- rumen manipulation



Mitigation Options (4)
Land management

Objectives: (i) limit emissions related to land conversions (deforestation and grassland plowing) and (ii) sequester carbon in grassland's soil and vegetation

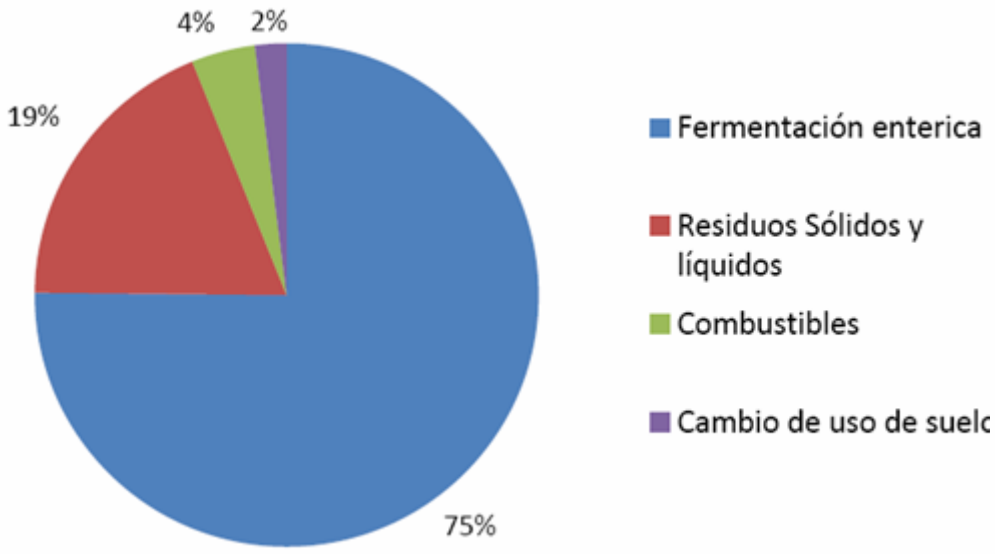
- Control **Land Use change**
  - intensification of animal production (genetics, animal husbandry) and of feed crop and pasture management (rotation, fertilization, improved pastures species, fodder and protein banks)
  - combined with other measure avoiding deforestation (land use, subsidies, etc.)
- Conserve/restore **C and N in pasture and cultivated soils**
  - increase tree cover and live fences
  - reduced grazing pressure and pasture rotation
  - improved pasture species, irrigation and fertilization
  - minimum tillage practices (feed crop)

➢ silvo-pastoral systems, conservation agriculture

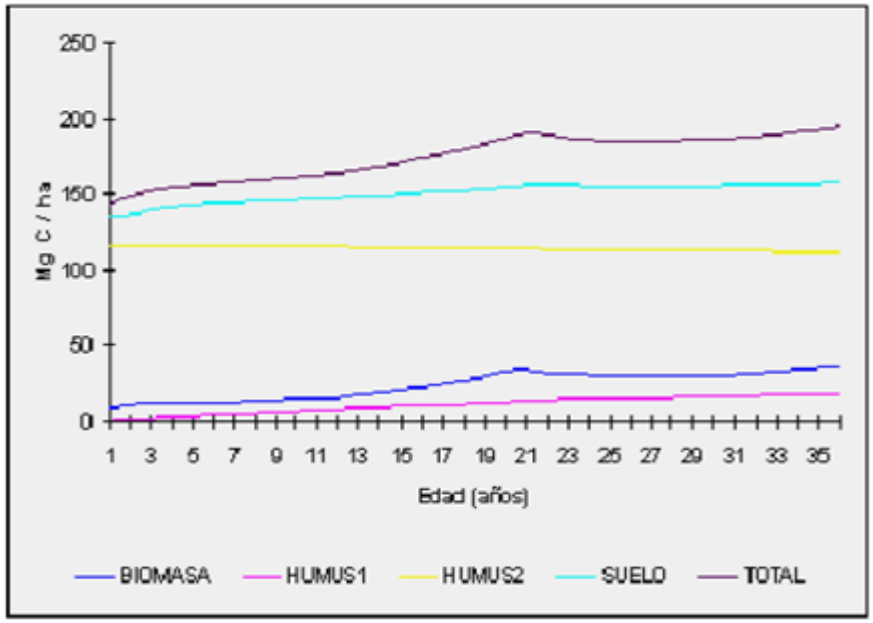
Mitigation Options (4)
Land management - continued

- Rangelands have a large technical potential for C sequestration.
- Sequestration can potentially offset emissions from animals and other sectors, i.e. generate C credits
- Synergies
  - carbon sequestration and fodder quality (thus methane emissions)
  - carbon sequestration and system productivity
  - carbon sequestration and climate change adaptation
- Limitations
  - information on technical potential does not reflect real economic potential (much lower)
  - only finite amounts of C can be sequestered
  - C will be sequestered only as long as improved management practices are continued (permanence)

LCA of milk production and beef production in Costa Rica - Esparza



Total emissions and distribution along the production activities



Carbon storage potential at landscape level

Source: Guerra, 2008

Mitigation potential - overview

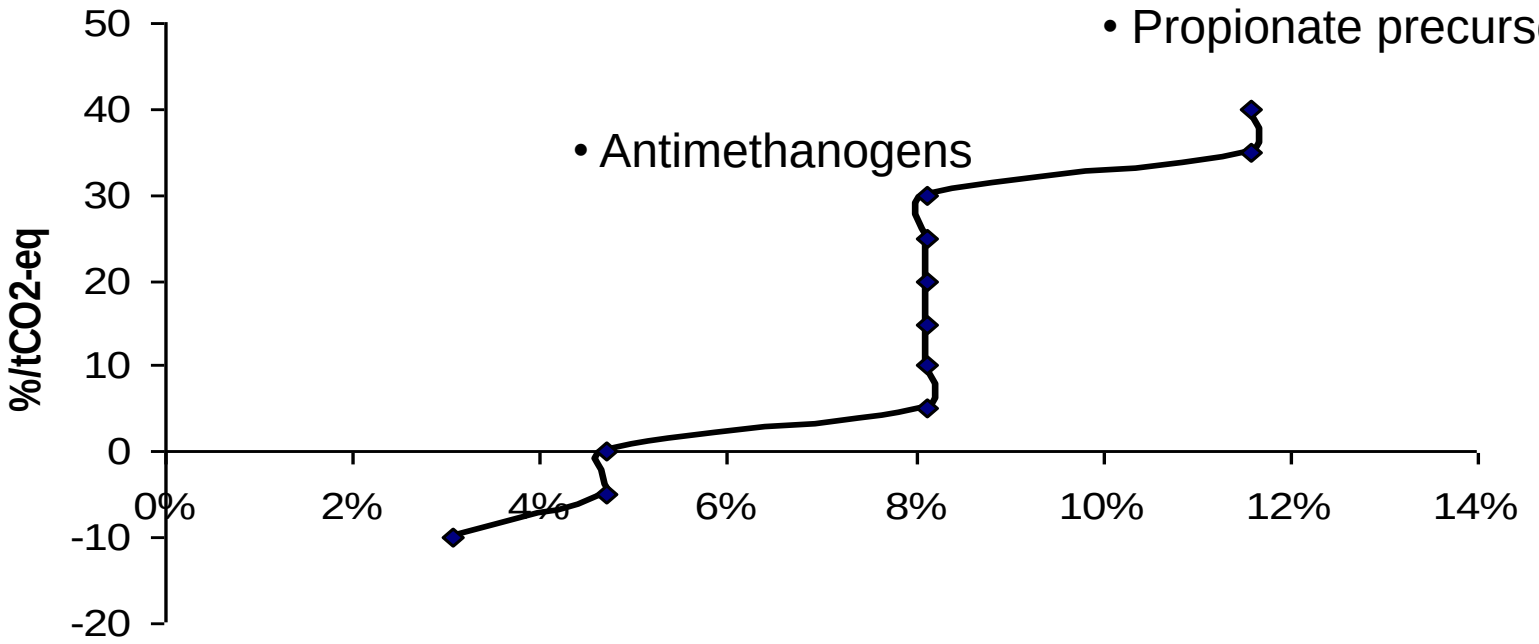
Relative emission intensity reduction potential (available technologies)

	Efficiency gains (yield, FCR, energy)	Enteric fermentation	Manure management	Land use management
Ruminant – high yields, limited or no grazing	++ (energy)	+	++	+
Ruminant – mixed systems	+++ (yield)	+++ (digestibility)	+	++ (feed and range)
Ruminant – extensive grazing	++	+		+++
Monogastrics	+		++	++ (feed crop)

Systems changes achieving reduced emissions per kg of protein

- from pure beef to dairy related beef
- from ruminant to monogastics

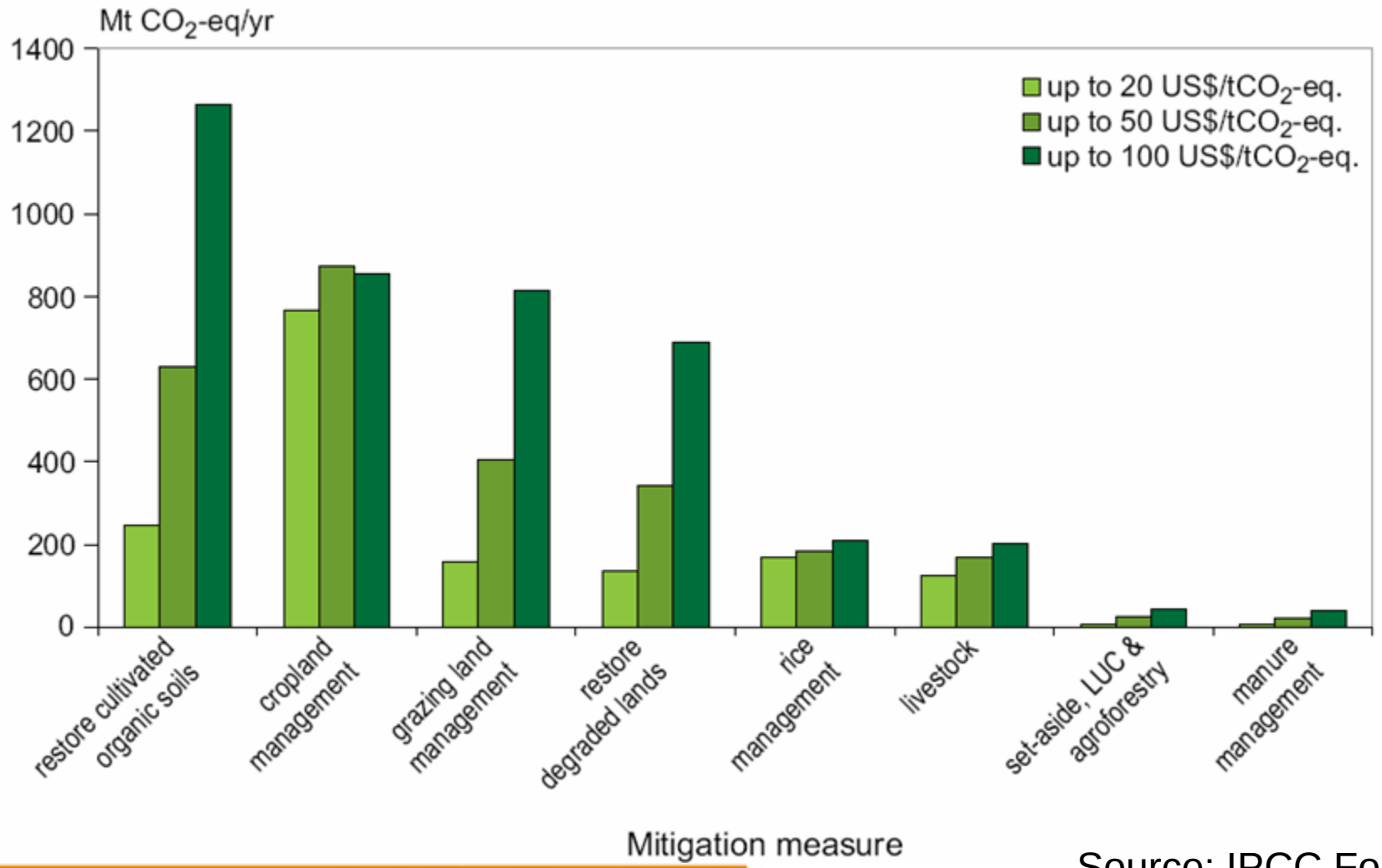
USEPA MAC curve
Brazil - Ruminant



- Improved feed conversion
- Propionate precursors
- Antimethanogens
- Intensive grazing
- Antibiotics

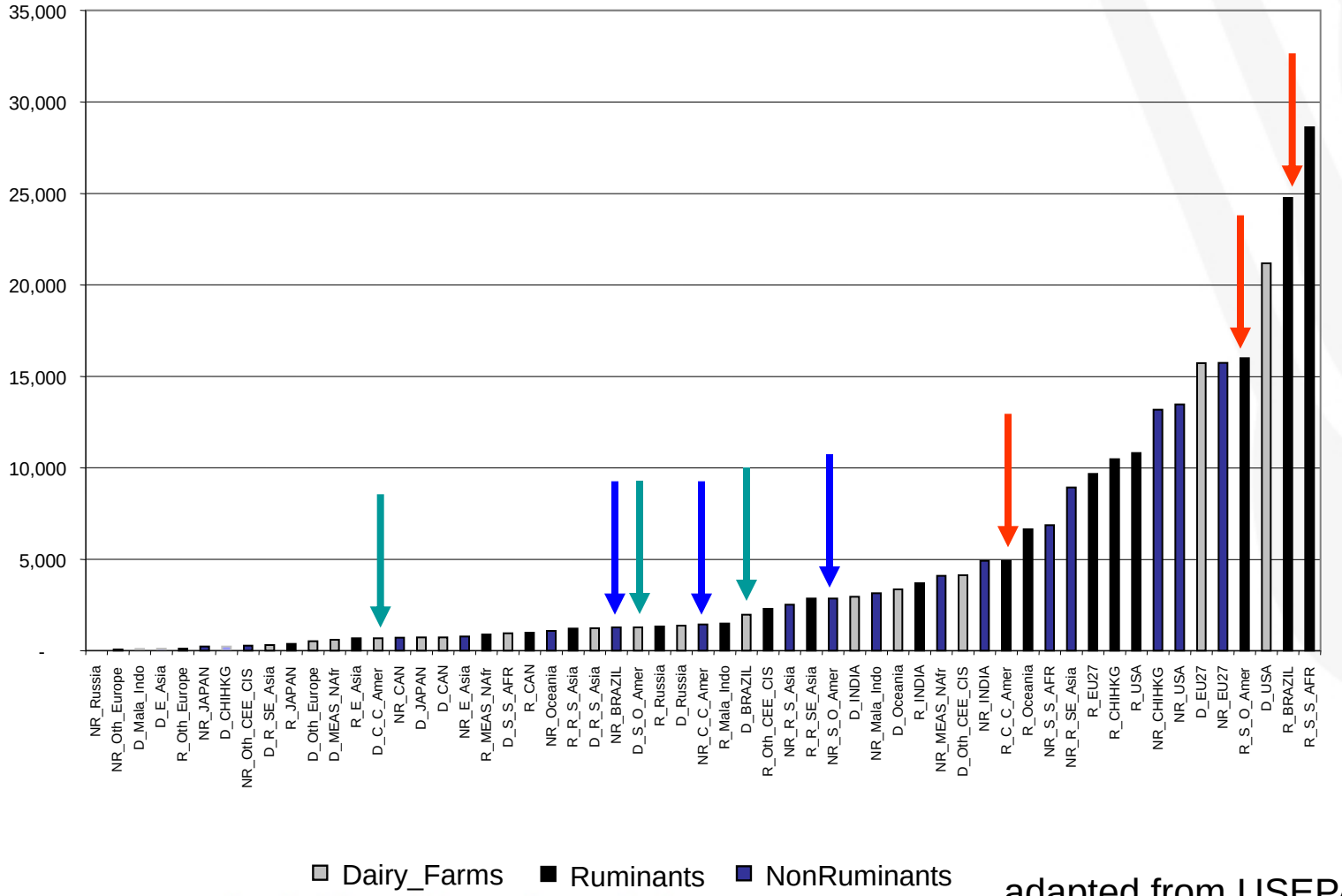
adapted from USEPA, 2010

Potential for C sequestration in rangelands is large and variable.



Source: IPCC Fourth AR

PE livestock non-CO2 emission abatement (tonnes) at 27 $/tCO2-eq



adapted from USEPA, 2010

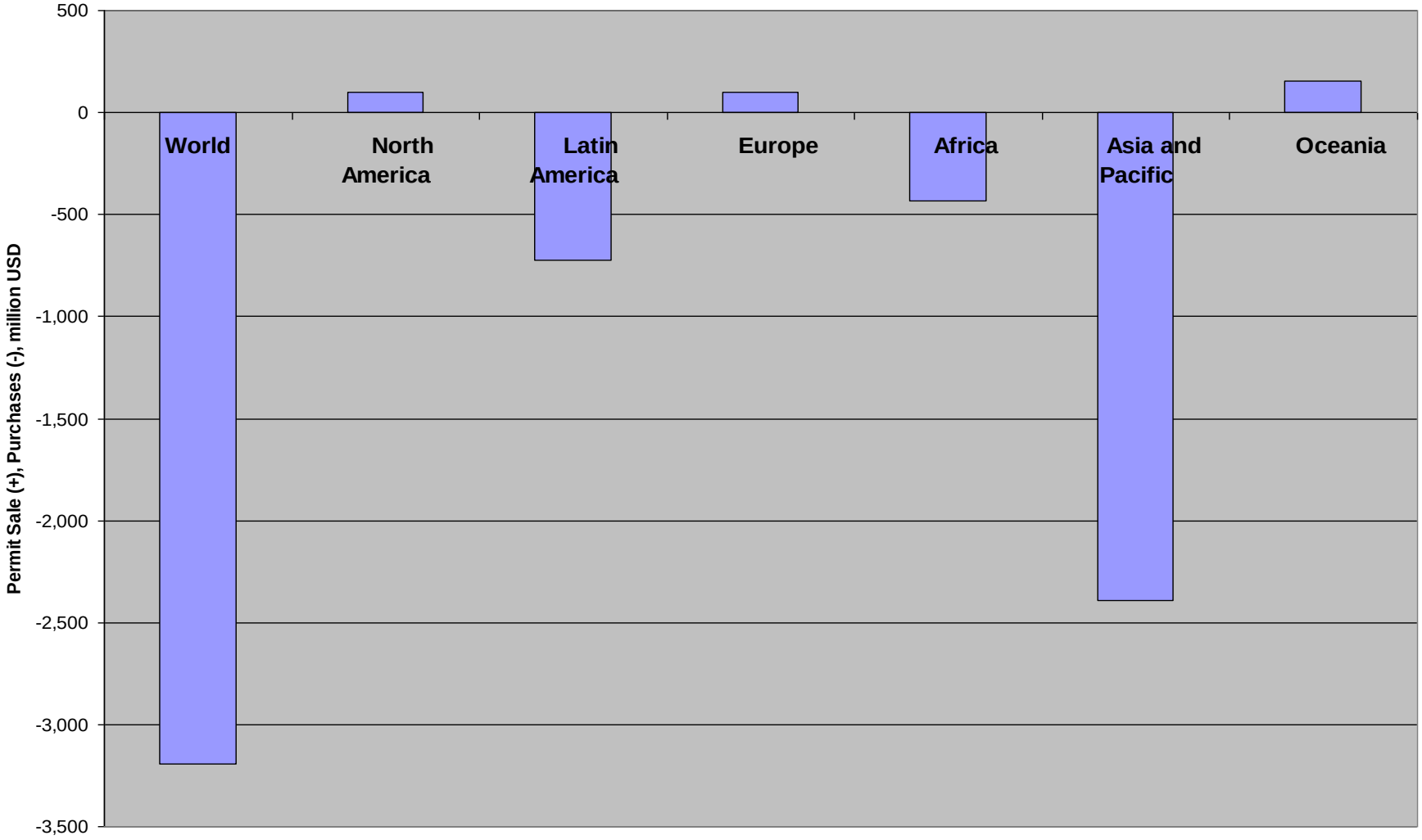
Policy instruments - mitigation

- **Taxation of emissions**
- **Payment for environmental services (public or private)** - Clean Development Mechanism
  - emissions from animal waste management
  - avoided deforestation?
  - carbon sequestration in rangelands??
- **Cap and trade policies**
- **Good practices**: voluntary (Coorporate Social Response), regulated or condition to access subsidy schemes
  - manure storage and land application
  - soil conservation
- **Absolute reduction** (kg CO2eq.) versus emissions **intensity reduction** (kg CO2eq. per kg product) reduction

Livestock sector purchases permits from other sectors

Emissions permit revenue (mil. USD), 2013

Cap = 100% of 2008 emissions

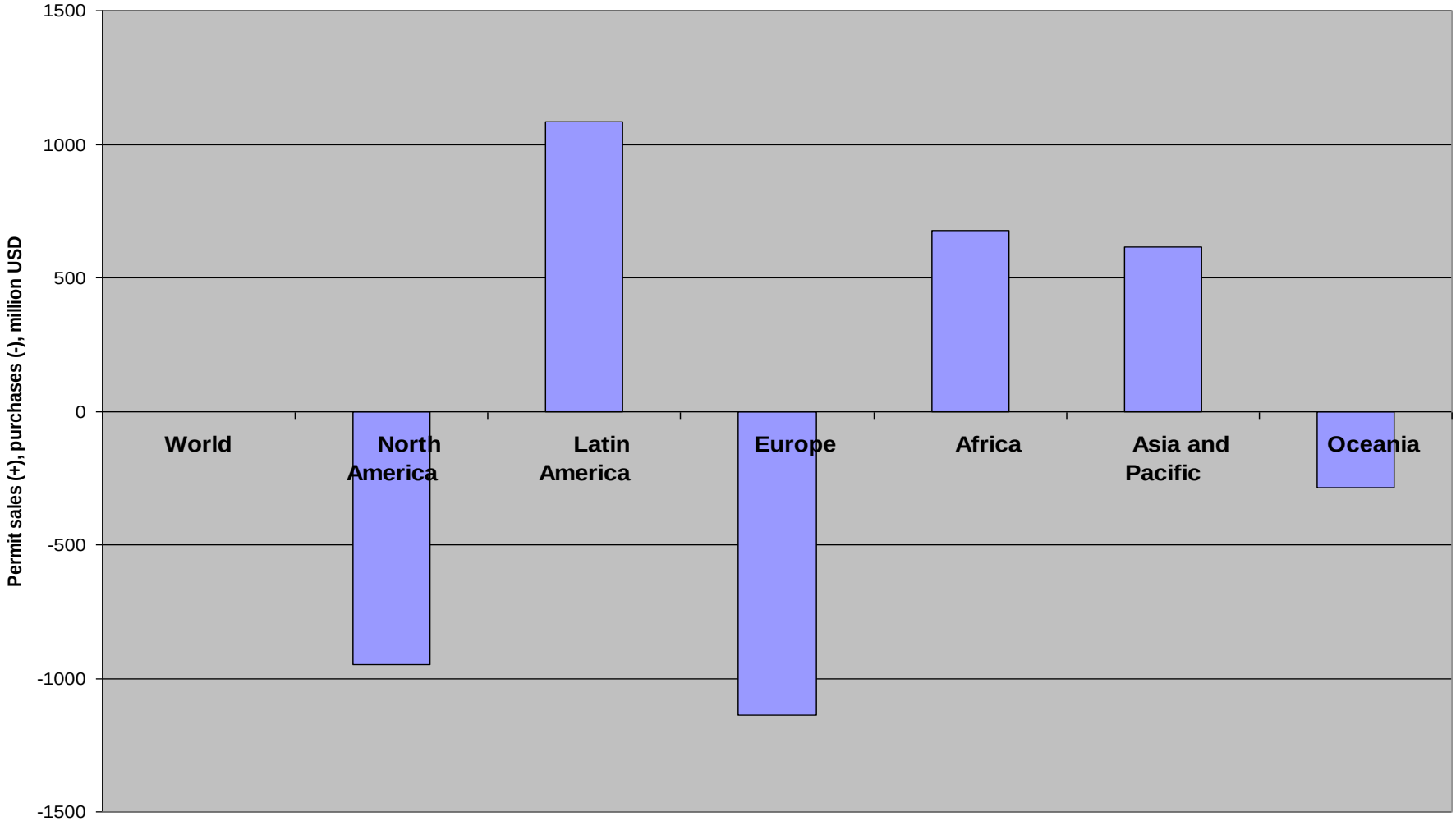


"High-cap" for non-Annex 1 countries

Emissions permit revenue (mil. USD), 2013

Cap = Annex 1: 84.5% of 2013 emissions

Non-Annex 1: 100% 2013 emissions



Limitations

- GHG emissions are only one component of the environmental sustainability of the sector. Other important environmental issues:
  - water resource preservation
  - soil erosion
  - biodiversity loss
  - air pollution
- Mitigation policies need to be understood within this broader environmental context, and with the context of other development objectives such as poverty reduction and food security.

Conclusions

Concluding remarks (i)

- Climate change is a relatively new scientific field, its interactions with agriculture/dairy is even more so...

...we however have enough information to assess the magnitude of the issue and start tackling it, and ...

... a lot can be achieved by applying available technology.

- Effects of climate change on the livestock sector should also be considered.

Concluding remarks (ii)

Taping into the agriculture mitigation potential calls for:

- Technology transfer
  - animal production and health
  - land management
  - sector organization
- R&D and forward looking analyses
- Development of RMV methodologies
  - simple and robust C footprint
  - certification of GHG emission reduction and carbon sequestration in soils