

AGRICULTURE, LAND AND CLIMATE CHANGE

FAO side-event
Bonn, 5th June 2009

Climate change and agriculture,
with a specific focus on livestock

Henning Steinfeld
Animal Production and Health Division, FAO

Broad trends in agriculture

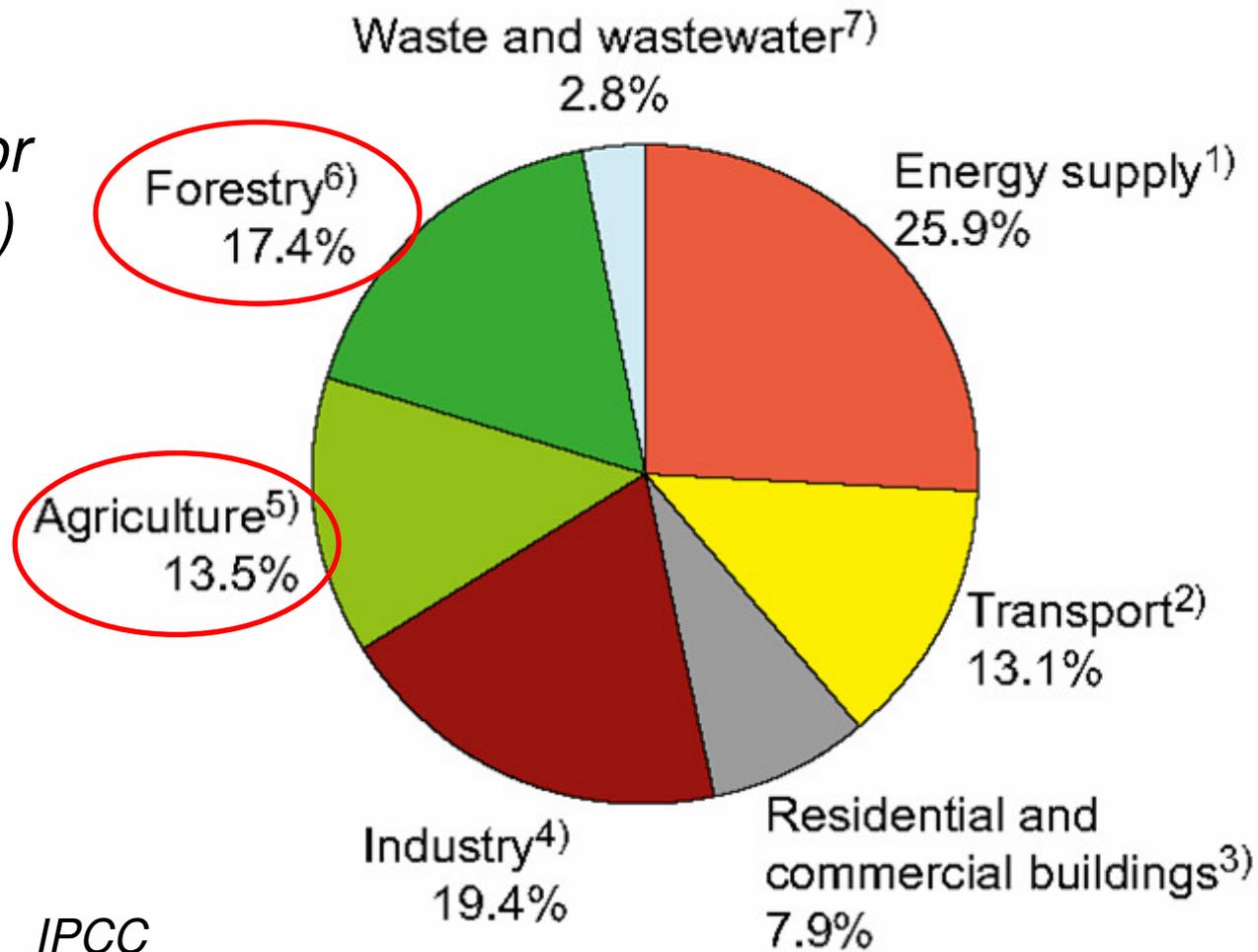
- Total population to exceed 9 billion by 2050
- Total agricultural production to expand by 70 percent (nearly 100 percent in developing countries) between 2005 and 2050
 - one billion ton cereals
 - 200 million tons meat
 - based on average energy consumption of 3130 kcal/pers/day
- World average of meat consumption expected to rise from 37 kg/pers/year to 52 kg/pers/year in 2050 (26 to 44 in developing countries), fueling animal demand for cereals
- Most growth in high value commodities (oils, livestock)

Broad trends in agriculture

- Production increase met by 20% from area expansion, and 80% percent from intensification, yield increase
- Arable land projected to expand by less than 5 percent (70 million hectares)
 - 120 million hectares expansion in developing countries (SSA, LAC)
 - 50 million hectares contraction in developed countries
- Crop yields continue to grow, but at decelerating pace
- Sufficient land and water resources available but some areas expected to face increasing stress: Near East/North Africa and South Asia

Emissions by GHG & sector

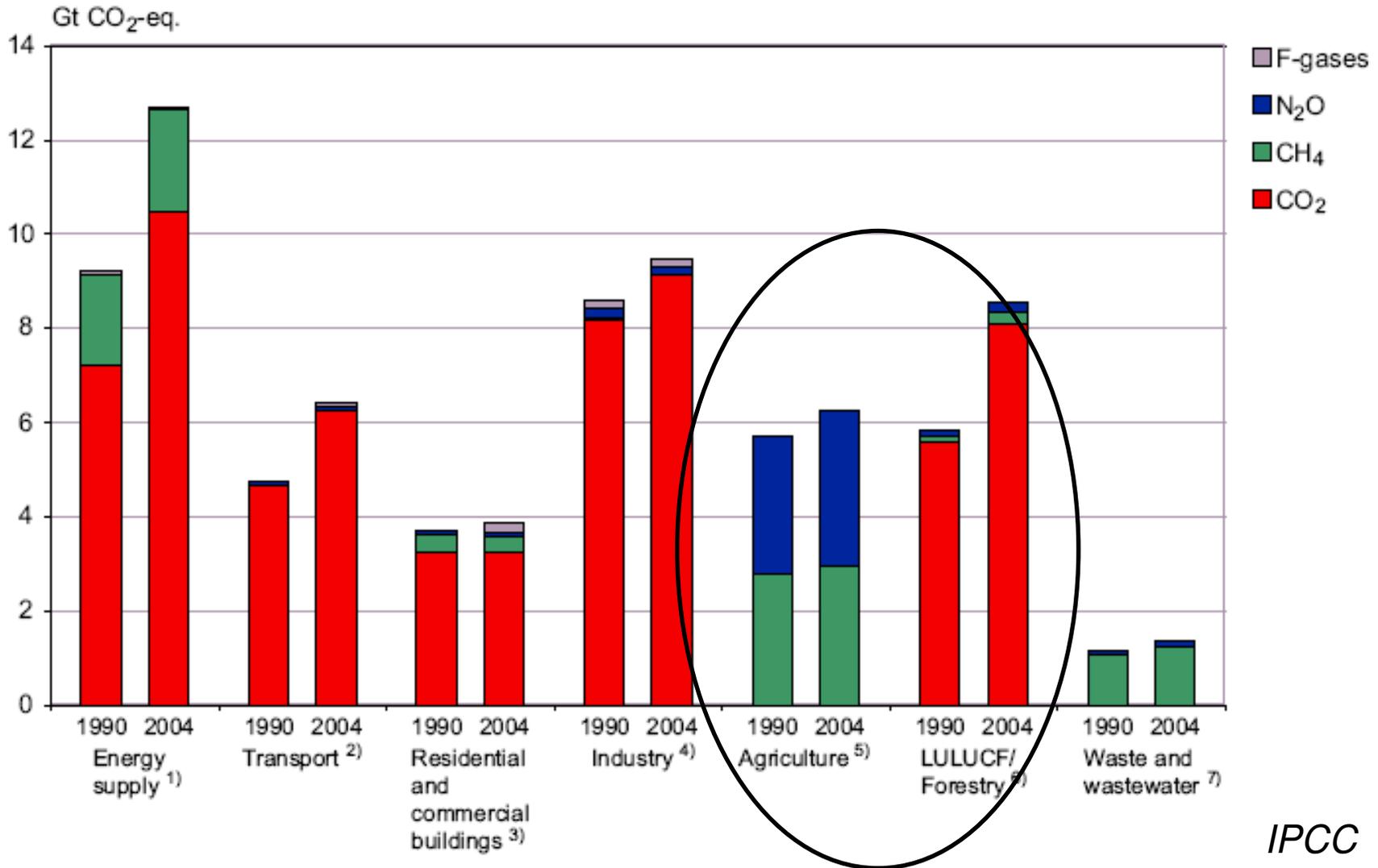
By sector
(CO₂ eq)
(2004)



IPCC



Emissions by Sector and GHG



CO₂ Emissions from Agriculture:

- Deforestation (17.4 % of GHG emission)
- In addition (reported elsewhere by IPCC):
 - Fossil fuel use in manufacturing fertilizer for crop production: ~200 M t CO₂ per year
 - Manufacturing of farm equipment and machinery
 - On-farm fossil fuel use: ~ 90 M t CO₂ per year
 - Transport of inputs and products
 - Processing of agricultural products
 - Buildings

CH₄ Emissions from Agriculture:

Agriculture accounts for 51 % of global anthropogenic emissions

- Methane from Enteric Fermentation in Ruminants: ~ 86 million t CH₄
- Methane from Anaerobic Livestock Waste Management 18 million t CH₄
- Methane from Paddy Rice Fields: 60 million t CH₄

N₂O Emissions from Agriculture

Agriculture accounts for 70 % of total anthropogenic emissions = ~ 5.1 million t

- use of mineral fertilizer ~ 0.7 million t
- aquatic sources following fertilizer use ~ 0.7 million t
- stored animal manure: ~ 0.7 million t
- applied or deposited animal manure: ~ 1.7 million t
- “indirect losses” (volatization and leaching) from applied manure: ~1.3 million t

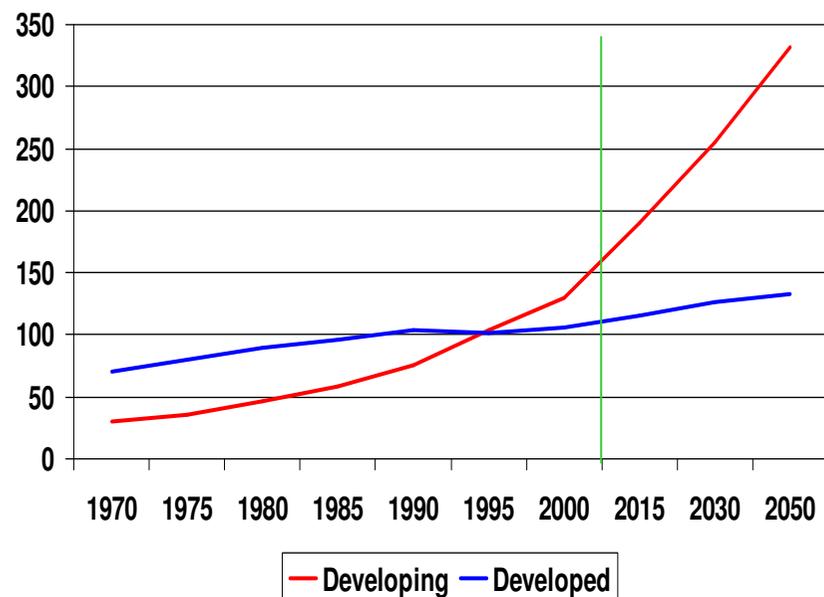
Total Emissions

- Total emissions from terrestrial and other agricultural sources more than 35 % of total anthropogenic sources
- Balance in ag expected to shift from C- to N-based emissions in the long term, reflecting higher intensities and productivity growth and reduced or no area expansion

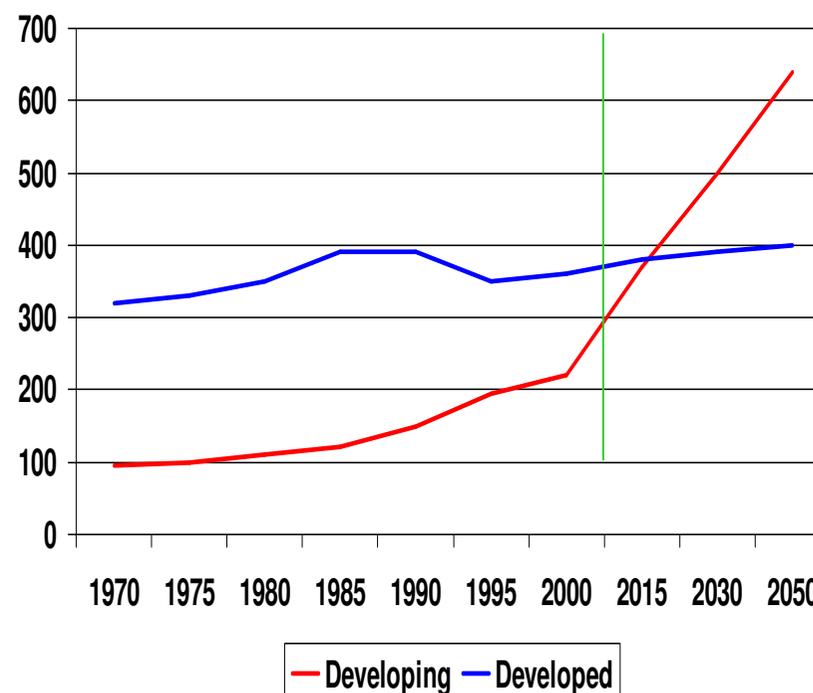
Livestock

Livestock sector's trends

Past and projected **meat** production (million tonnes)

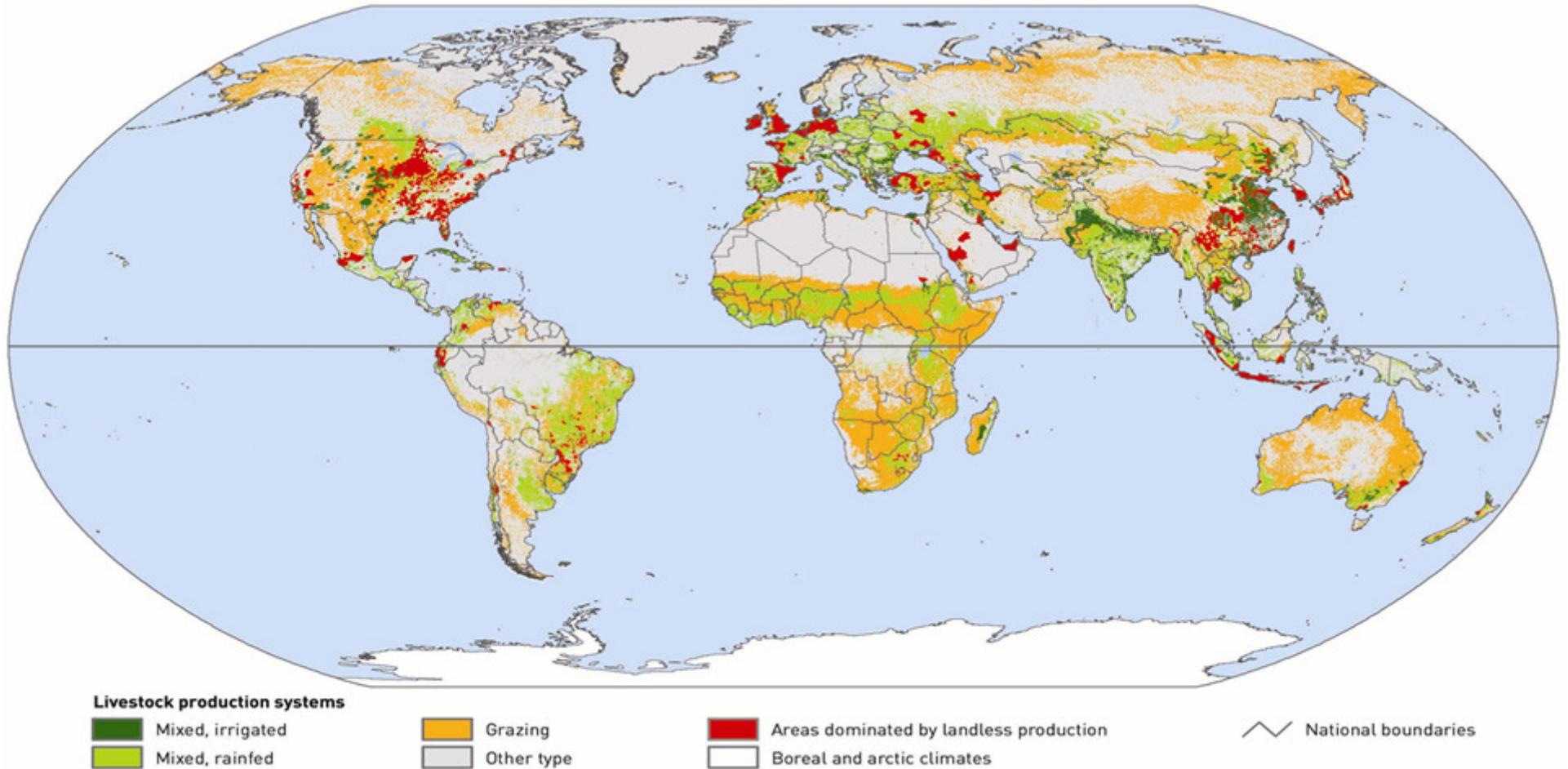


Past and projected **milk** production (million tonnes)



- Growing **intensities**
- Increasing **scales**
- Vertical **integration**/longer food chains
- Geographic shifts / **geographic concentration**

Estimated distribution of livestock production systems



Extend of land used by livestock

Pastures

- 3.4 billion hectares (about 26% of emerged lands)
- Wide range of production intensity
- Marginal land frontier exhausted

Feedcrops

- 470 million hectares (about 33% of arable land)
- Cereals:
 - production growth mainly based on intensification
 - maize, barley and wheat are the three main species
- Soybeans:
 - production growth based on expansion
 - eight countries provide 97% of global production

A food-chain perspective of GHG emissions

- Emissions from **feed** production

- chemical fertilizer fabrication
- chemical fertilizer application
- on-farm fossil fuel use
- livestock-related deforestation
- C release from ag. soils

- Emissions from **livestock rearing**

- Methane from enteric fermentation
- Methane and Nitrous Oxide from manure

- **Post harvest** emissions

- slaughtering and processing
- international transportation

reported under:

- industry and energy

- agriculture

- energy

- forestry

- agriculture

- agriculture/livestock

- agriculture/livestock

- industry and energy

- transport and energy

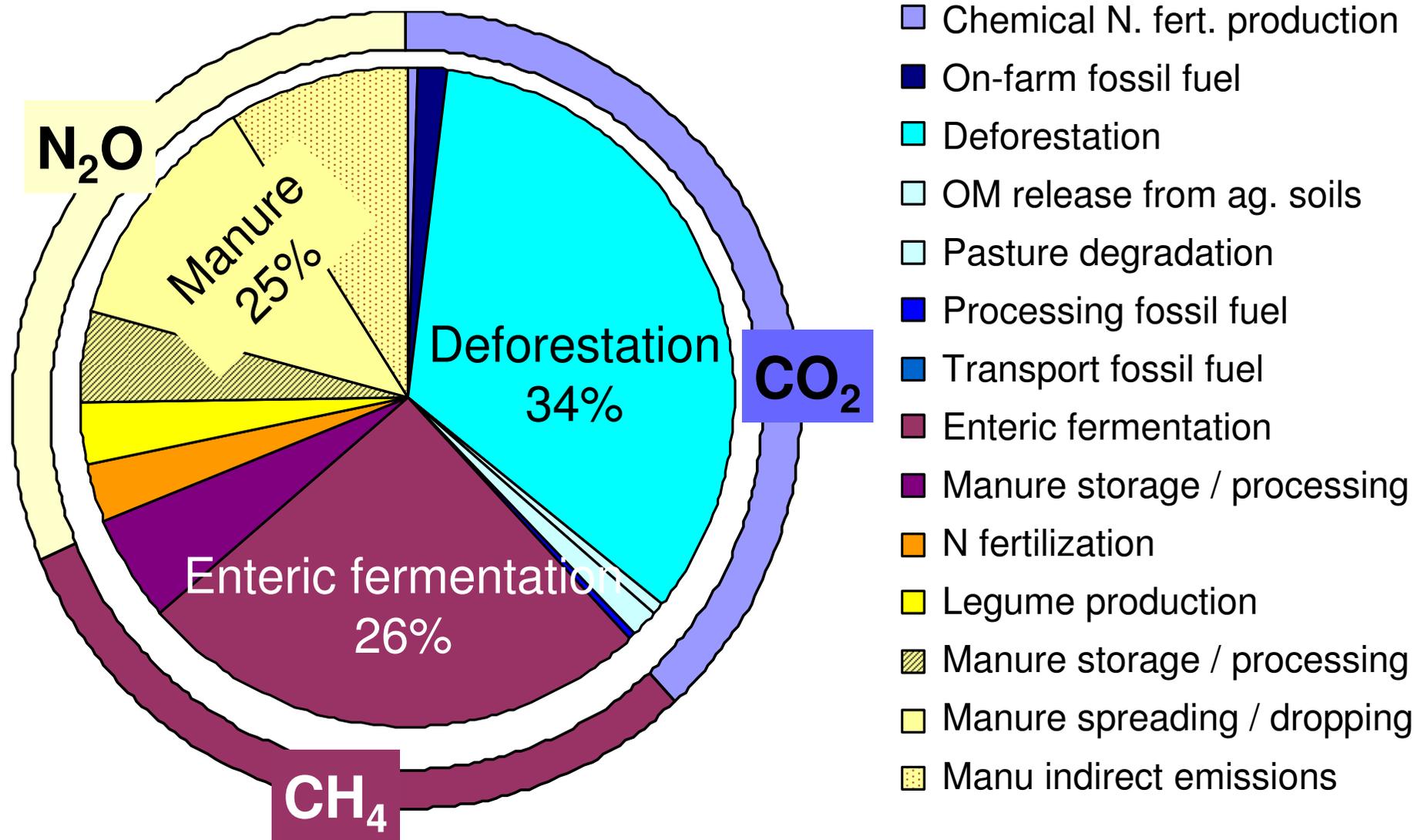
Livestock: relative contribution of GHG along the food chain

About 7.1 billion tonnes CO₂ equivalent
or

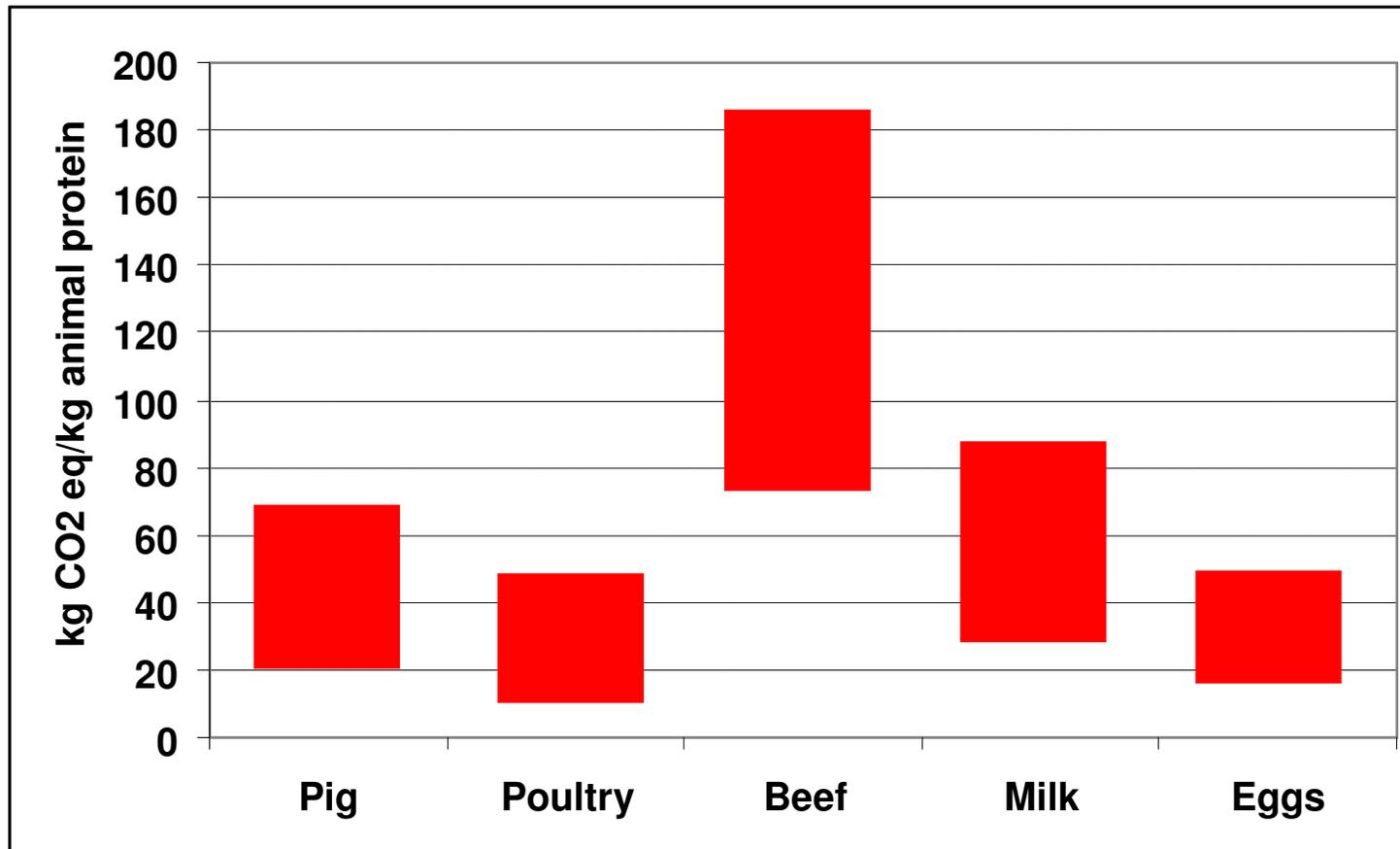
18% of total anthropogenic GHG emissions
(2/3 from extensive systems and 1/3 from intensive systems)

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

Relative contributions by GHG



Range of GHG for commodities in OECD-countries



Source: DeVries & DeBoer (2009)

Mitigation Options (1)

Productivity increase

Reduce emissions per unit of animal product:

- improved genetics
- animal health
- livestock fertility
- feeding

Shift in species: from ruminants to monogastrics

Mitigation Options (2)

Manure management

- (i) reduce emissions during storage and application
- (ii) recover energy from organic matter
 - balanced feeding
 - anaerobic digestion (methane production)
 - waste application (dosing and injection)



Mitigation Options (3)

Controlling enteric fermentation

Reduce methane emissions 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 and fertilization
 - minimum tillage practices (feed crop)

Mitigation Options (5)

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

Conclusions

- terrestrial and other GHG emissions from agriculture more than 1/3 of total
- agriculture: most affected sector by climate change
- agriculture: abundant low cost mitigation options available
- agric. efficiency is key to reducing emissions (intensification)
- closing yield gaps (crops) and performance gaps (livestock) can substantially reduce GHG emissions
- we can't compromise on food security and poverty reduction