CARBOSUR ®

Learn
Livestock Emissions & Abatement Research Network

WORKSHOP ON GHG EMISSIONS
IN LIVESTOCK GRAZING SYSTEMS
Montevideo, 21-24 July, 2008

Mitigation of Climate Change in Pastoral Systems: IPCC Fourth Assessment Report and Ideas for Implementationm

Daniel L. Martino
daniel.martino@carbosur.com.uy

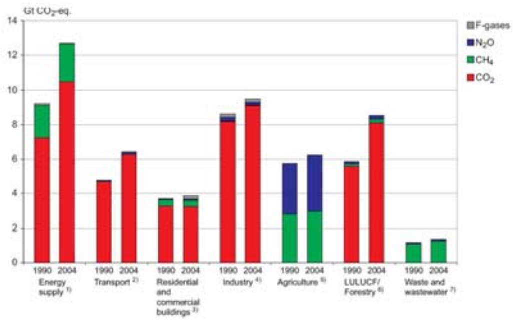
CARBOSUR ®

Outline

- GHG emissions in agriculture. Global and regional trends
- IPCC AR4: mitigation potentials. Focus on livestock emissions
- Mitigation options for grazing livestock systems
- Project activities
  - Pasture improvement with reduction in grazing area
  - Reduction in GHG intensity

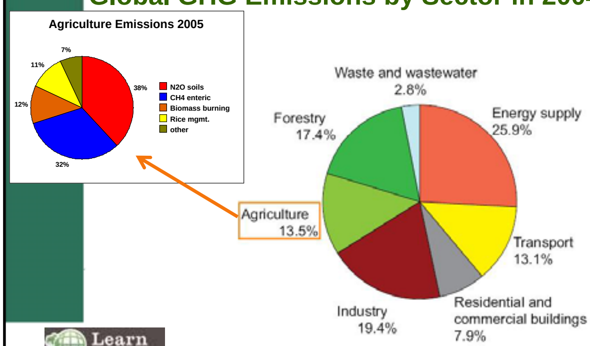
CARBOSUR ®

Global GHG Emissions by Sector



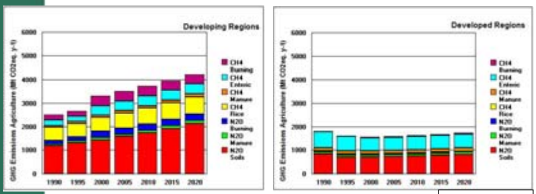
CARBOSUR ®

Global GHG Emissions by Sector in 2004



CARBOSUR ®

GHG emissions from agriculture



Source: US-EPA 2007

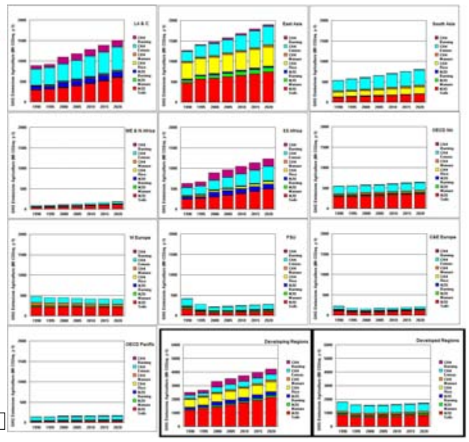
1990-2005:
Developed countries, EIT: -12%
Developing countries: +32%

Main drivers

- Increase in GHGs: population pressure, income increase, diet changes, technological changes
- Decrease in GHGs: increased land productivity, conservation tillage, non-climate policies (AI)

Learn

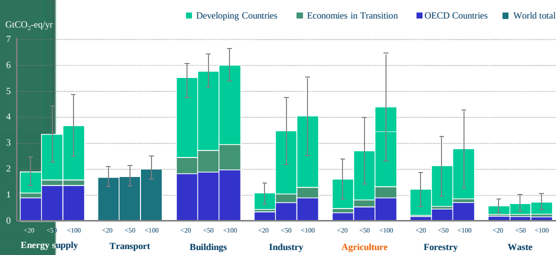
Workshop GHG in Grazing Livestock Systems - Montevideo, 21-24 July 2008



Source: US-EPA 2007

CARBOSUR ®

IPCC AR4: Mitigation Potentials by Sector

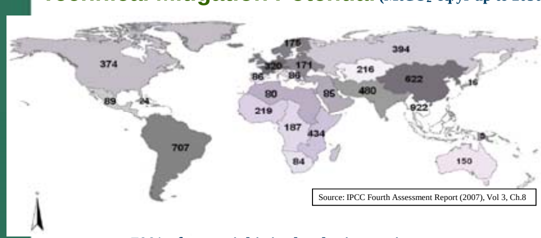


Relative contribution of Agriculture to total mitigation potential
US\$ 20/tCO_2 (equivalent to US\$ 10/oil barrel) – 12%
US\$ 50/tCO_2 (equivalent to US\$ 25/oil barrel) – 14%
US\$ 100/tCO_2 (equivalent to US\$ 50/oil barrel) – 18%

Source: IPCC Fourth Assessment Report (2007), Vol 3, TS

CARBOSUR ®

Agriculture: Regional Distribution of Technical Mitigation Potential ($MtCO_2$-eq/yr up to 2030)



Source: IPCC Fourth Assessment Report (2007), Vol 3, Ch.8

70% of potential is in developing regions

Potential largely missed by Kyoto mechanisms

Learn

Workshop GHG in Grazing Livestock Systems - Montevideo, 21-24 July 2008

CARBOSUR ®

Carbon price (US$/t$CO_2$-eq)	Economic Potential 2030 in Agriculture (GtCO_2-eq/yr)
20	**1.6** (0.3-2.4)
50	**2.7** (1.5-3.9)
100	**4.4** (2.3-6.4)
Baseline Emissions in 2030	8.2

Source: IPCC Fourth Assessment Report (2007), Vol 3, Ch.8

Mitigation practices in agriculture

Cropland management; Restoration of organic soils; Rice management; Grazing land management – 90% of potential is carbon sequestration

The mitigation potential in agriculture is very high, but reduction of ruminant CH_4 emissions has a very limited contribution to that potential (**0.2 GtCO_2-eq/yr** at US$ 100/tCO_2)

CARBOSUR ®

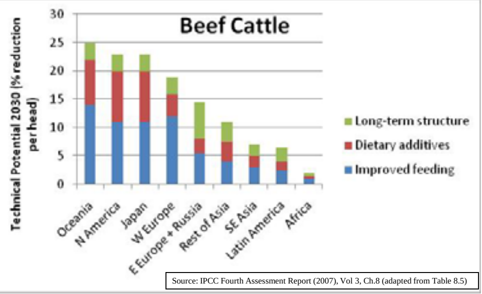
Mitigation under grazing conditions. Practices identified in IPCC AR4

- Improved feeding practices
  - Pasture improvement
  - Supplementation with concentrates
  - Adding oils or oilseeds to the diet
  - Optimizing protein intake to reduce N excretion (impact on N_2O emissions)
- Specific agents and dietary additives
  - Ionophores and antibiotics, halogenated compounds, condensed tannins, essential oils, probiotics, propionate precursors, vaccines, bST and hormonal growth implants

Source: IPCC Fourth Assessment Report (2007), Vol 3, Ch.8

CARBOSUR ®

Ruminant CH_4 Mitigation - technical potential



Source: IPCC Fourth Assessment Report (2007), Vol 3, Ch.8 (adapted from Table 8.5)

Per cent reductions are per head

Potential reductions per unit product would follow opposite trend

CARBOSUR ®

Drivers for reducing emissions

- Carbon price signals
  - Kyoto mechanisms
  - Other regulated market mechanisms (e.g., EU-ETS)
  - Voluntary (non-regulated) markets
  - Carbon taxes
- Non-climate policies
- Consumer demand for low carbon footprint of agricultural products
- Changes in lifestyle (e.g., reduced consumption of animal products)

Project-based mechanisms seem to offer the best opportunities in terms of cost and effectiveness

CARBOSUR ®

Implementation of Project Activities

- Possible standards for livestock emissions
  - Kyoto mechanisms: JI, CDM
  - Voluntary markets: VCS
- Baseline methodologies
  - Per head, per ha, or per unit product?
  - No methodologies have been approved for grazing livestock emissions
  - IPCC factors may be used (no need to actually measure emissions)
- Additionality (GHG reductions additional to baseline scenario)
  - Required for CDM and VCS, not necessarily for JI
- Project boundaries
  - Only GHG reductions within boundaries are accountable
- Leakage (emissions outside boundaries)
  - May be very significant and difficult to account if feed is imported from outside project boundaries
  - Displacement of livestock from project area may also cause leakage

Learn

Workshop GHG in Grazing Livestock Systems - Montevideo, 21-24 July 2008

CARBOSUR ®

Project Case #1: Pasture improvement combined with afforestation

- Applicable to extensive livestock systems based on low-quality pastures over large areas.
- Baseline estimated as emissions per unit of land area
- Project activity: pasture improvement on a fraction of land area, reduction of total grazing area to maintain the amount of baseline products, plantation of forests in the areas released from grazing.
- GHG benefits:
  - Reduced CH_4 and N_2O emissions (both absolute and per unit product).
  - Increased CO_2 removals (C sequestration in soils and forests)
- Associated benefits
  - Improved land productivity and resilience, soil conservation
  - Optimization of land use, risk management through diversification
  - Reduced emissions from deforestation (where it is driven by expansion of grazing areas or by procurement of timber) and reduced pressure on land.

Learn

Workshop GHG in Grazing Livestock Systems - Montevideo, 21-24 July 2008

CARBOSUR ®

Project Case #2: Pasture improvement with

- Applicable to same conditions as case #1 (extensive livestock systems based on low-quality pastures over large areas).
- Baseline estimated as emissions per unit of product
- Project activity: pasture improvement on a fraction of land area, maintaining the same grazing area as in the baseline, with or without supplementation
- GHG benefits:
  - Reduced CH_4 and N_2O emissions (per unit product only).
  - Increased CO_2 removals (C sequestration in soils)
- Associated benefits
  - Improved land productivity and resilience, soil conservation
  - Reduced emissions from deforestation (where it is driven by expansion of grazing areas) and reduced pressure on land.

Learn

Workshop GHG in Grazing Livestock Systems - Montevideo, 21-24 July 2008

CARBOSUR ®

Pasture Improvement: an example from Uruguay (CH_4)

	Range	Improved Pasture
Total Digestible Nutrients (%)	50	55
Crude Protein (%)	9	13
Fibre Detergent Acid (%)	50	41
Pasture productivity (kg d.m./ha/yr)	1,840	3,500
Intake (kg d.m./head/day)	6.3	7.1
Weight gain (kg/head/day)	0.16	0.47
Stocking rate (livestock units/ha)	1	1.37
Meat production (kg/ha/yr)	60	237
Emission factor (kg CH_4/head/yr)	45.8	51.0
Emissions per unit area (kg CH_4/ha/yr)	45.8	69.9
Emissions per unit product (kg CH_4/kg meat)	0.76	0.29

Source: Mieres and Martino, unpublished

Learn

Workshop GHG in Grazing Livestock Systems - Montevideo, 21-24 July 2008

CARBOSUR ®

Pasture Improvement: an example from Uruguay (N_2O)

	Range	Improved Pasture
Total Digestible Nutrients (%)	50	55
Crude Protein (%)	9	13
Fibre Detergent Acid (%)	50	41
Pasture productivity (kg d.m./ha/yr)	1,840	3,500
Intake (kg d.m./head/day)	6.3	7.1
Weight gain (kg/head/day)	0.16	0.47
Stocking rate (livestock units/ha)	1	1.37
Meat production (kg/ha/yr)	60	237
Emission factor (kg N_2O/head/yr)	1.5	2.1
Emissions per unit area (kg N_2O/ha/yr)	1.5	2.9
Emissions per unit product (kg N_2O/kg meat)	0.025	0.012

Source: Mieres and Martino, unpublished

Learn — Workshop GHG in Grazing Livestock Systems - Montevideo, 21-24 July 2008

CARBOSUR ®

Pasture Improvement: an example from Uruguay (CH_4 + N_2O)

	Range	Improved Pasture
CH_4 emissions per unit product (kg CH_4/kg meat)	0.76	0.29
N_2O emissions per unit product (kg N_2O/kg meat)	0.025	0.012
Total emissions per unit product (kg CO_2-e/kg meat)	27.1	12.0

Source: Mieres and Martino, unpublished

Learn — Workshop GHG in Grazing Livestock Systems - Montevideo, 21-24 July 2008

CARBOSUR ®

Summary (1)

- Agriculture emissions are increasing rapidly in developing regions and some developed countries, driven by population pressure, increase in income and other factors
- Livestock emissions (from enteric fermentation and manure management) comprise nearly ½ of agricultural emissions (~6-7% of global GHG emissions)
- Mitigation potential in the sector is high (14% of total potential at US$ 50/tCO_2-eq.), with 70% being in developing countries (with positive implications for SD), and 90% of it being through C sequestration.

Learn — Workshop GHG in Grazing Livestock Systems - Montevideo, 21-24 July 2008

CARBOSUR ®

Summary (2)

- For livestock emissions, IPCC AR4 assessed per-head emissions only, leading to higher potentials where production is more intensive. However, significant potential exists to reduce emissions per unit product in more extensive (e.g., grazing) systems
- Project-based activities seem to offer the most cost-effective opportunities for reducing livestock GHG emissions. Significant barriers (e.g., lack of approved methodologies, need for large-scale projects, non-eligibility of soil C sequestration in the CDM) exist for implementation of these projects.

Learn — Workshop GHG in Grazing Livestock Systems - Montevideo, 21-24 July 2008