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# Climate Change Mitigation – Unleashing the Potential of Agriculture The contribution of LCA



### Content



- Food security and climate change mitigation: a dual challenge
- Main options and bottlenecks
- Potential support of LCA results for the dairy sector
- Conclusions and next steps

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## A dual challenge



- Agriculture: a growing sector, especially livestock in developing countries
  - driven by income, demography and changing preferences: food output expect to grow by 70 percent by 2050, 100 percent for livestock
  - 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)

 $\checkmark$  Dual challenge of food security and climate change mitigation

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# **Consumption is growing rapidly in developing countries ...**



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# Mitigation success depends on agriculture and can yield significant co-benefits



- Agriculture is a major source of GHG emissions (14%), and 30% if considering of land use change such as deforestation (IPCC).
- Vast mitigation potential in agriculture, including soil carbon (IPCC).
- 70% of technical mitigation potential from agriculture is in developing countries (IPCC).
- Agricultural mitigation practices can generate co-benefits (productivity, resilience, ecosystem services).
- Synergies and tradeoffs with other sectors and environmental/social issues.

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# **GHG Assessment for Agriculture Sector**

- Still considerable data and knowledge gaps regarding MRV of GHG emissions from the agricultural sector.
  - constraint to policy making
  - missed incentive to mitigation
- FAO has therefore initiated a programme to build the capacity in the area of statistics and analysis.
- The objective is to develop a global assessment (possibly every 4 years) which will include LCA components on individual products.
- Preliminary activities:
  - LCA of animal food chains
  - MICCA

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#### Mitigation of Climate Change in Agriculture (MICCA) Project Focal point: Marja-Liisa Tapio-Biström (NRC)





#### Background and goals

- 5 year multi-donor trust fund, 2010-2014, 10 million US\$
- Supports efforts for climate change mitigation through agriculture  $\rightarrow$  move towards carbon friendly agricultural practices.

#### Output

- Development of emissions database and life cycle analysis (LCA) & mitigation potentials and costs.
- Global economic analysis of mitigation policy options.
- Development of 5 smallholder pilot projects.







# GHG emissions from dairy food chains

### Development of a quantification model using the Life Cycle Assessment approach

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### A food-chain perspective of GHG emissions





### **Objectives**



- General objective: inform decision making
  - policy makers: climate, agriculture and food security policies
  - private sector: benchmarking and identification of mitigation options
  - consumer: food choices
- Specific objective: Produce estimates of GHG emissions for
  - major dairy products and related services: milk, cheese, butter, cream, milk powder, manure, and traction;
  - predominant dairy production systems (e.g. grass-based, mixed croplivestock);
  - main world regions and agro-ecological zone; and
  - major activity steps along the dairy chains.

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## Approach



#### • Requirements:

- design an "universal" approach, that allows cross-systems and crossregional comparisons.
- design an approach that can be implemented using currently available datasets.

#### • Main features:

- draw from national inventories and a growing body of literature.
- methodological issues and preliminary results discussed with a group of experts (WUR, INRA, SIK, ILRI, Danone, ITE, Agroscope, JRC).
- coupled with economic modeling cost effectiveness analysis, poverty and food security implications.
- Attributional assessment.

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### **System boundaries**





System boundary

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#### GHG emissions sources included From cradle to farm gate Processes for producing grass feed grons gron residues byof fertilizer ement of The assessment does not include GHG emissions n carbon gen losses. related to: land use under constant management practices; capital goods such as farm equipment and g, cooling, infrastructure: • on-farm milking and cooling; production of cleaning agents, antibiotics and Fre pharmaceuticals ises. ıilk, yound the cheese, butter, mink powder and bone mee meat. Packaging and waste handling. Refrigeration. Transport of processed products to retailer. Agriculture Department

# **GHG emissions calculations**



#### Allocation rules

- beef versus dairy: based on relative protein content.
- manure: emissions corresponding to chemical fertilizer of equivalent content attributed to crops, remainder to livestock; manure burnt exits the system after deposition.
- draught power: physical allocation based on extra longevity of animals.
- financial and insurance services: no emissions allocated.

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### **Input data example (i)**

#### Death rate of calves (%)



### Input data example (ii)

Estimated cattle distribution



### **Results – regional variations**

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



#### Relative contribution of world regions to milk production and GHG emissions associated to milk production, processing and transportation



# GHG emissions per kg of FPCM, by main farming systems and climatic zones



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### Relationship between total greenhouse gas emissions and output per cow





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### Discussion

- Uncertainties
  - statistics
  - emission factors (IPCC)
- Simplifications and assumptions
  - allocation
  - land use change

 $\succ$  sensitivity analysis, margin of error of ±26 percent.

- Validation
  - no comparison with direct measurements
  - herd model results with national statistics where available
  - results compared with literature where available
- Continuing process
  - data management and automatic scripts
  - country reporting?

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### Main messages



- Action on agriculture mitigation is necessary, possible and compatible with growth – uncertainties are not an excuse.
  O emission intensity (i.e. per unit of product)
- Agriculture mitigation requires improved Monitoring Reporting and Verification (MRV) as well as financing mechanisms that better meet farmer needs, LCA can contribute to this effort.
- 3. **Communication issues** related to a lack of standardization.
- 4. GHG emissions and C sequestration in soils: only one aspect of environmental sustainability.