Meeting the dual demand for animal products and climate change mitigation by narrowing yield gaps

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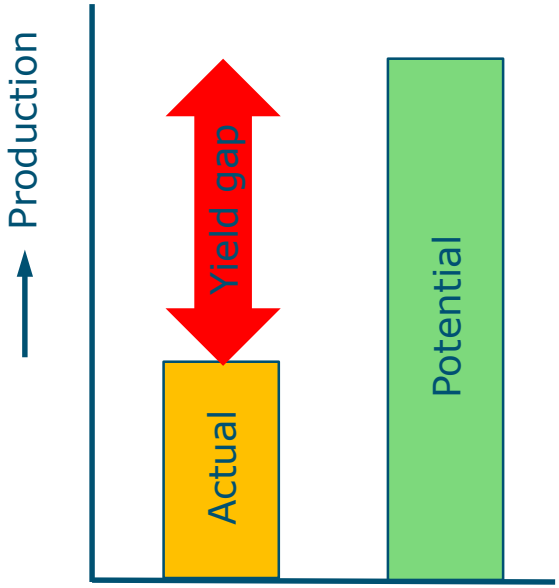
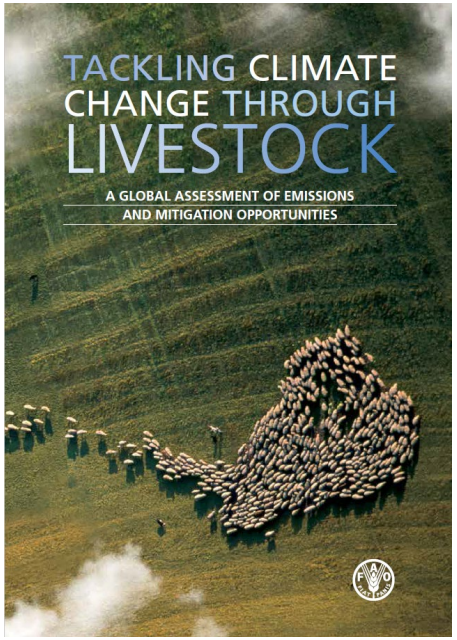
Introduction



‘Dual demand’



How to meet the dual demand?

Gerber *et al*. (2013), van der Linden *et al.* (2015)

Introduction

- Project: Investing in Sustainable Livestock

- Support governments and NGOs in meeting the dual demand

Aim: assess relations between yield gap mitigation and emission intensity for beef cattle in Uruguay, and for dairy cattle in Ethiopia and Bangladesh

Materials and methods

Beef production systems Uruguay

- Grass-based cow-calf systems
- Finishing on natural pasture, improved pasture, and in feedlots

Dairy production systems Bangladesh

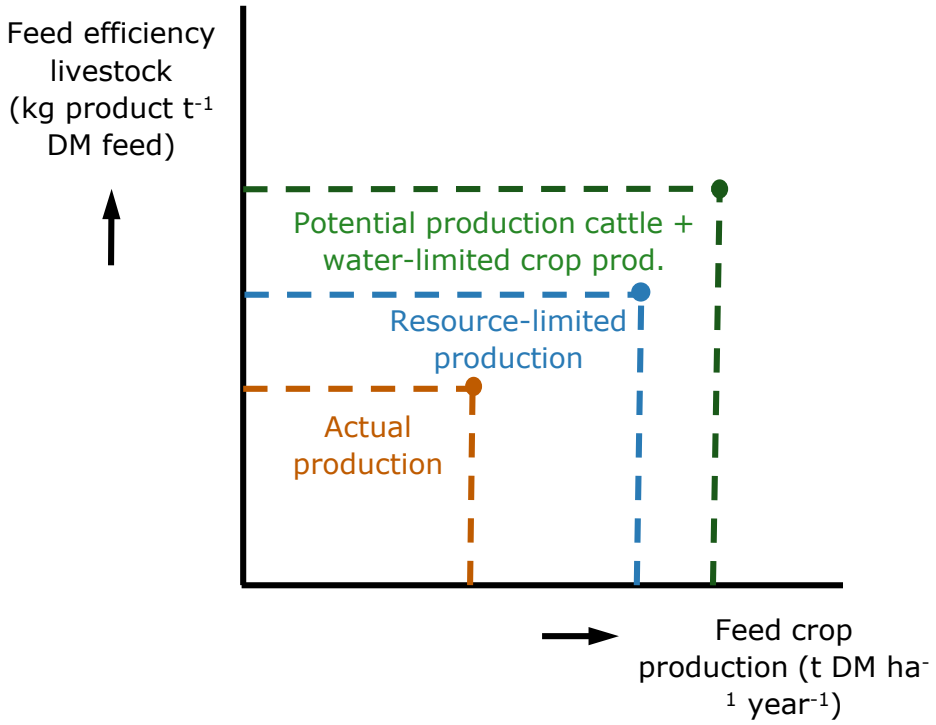
- Crop residues and by-products in diet
- Subsistence and commercial systems

FAO and NZAGGRC (2017a,b), Modernel *et al.* (2013)

Materials and methods

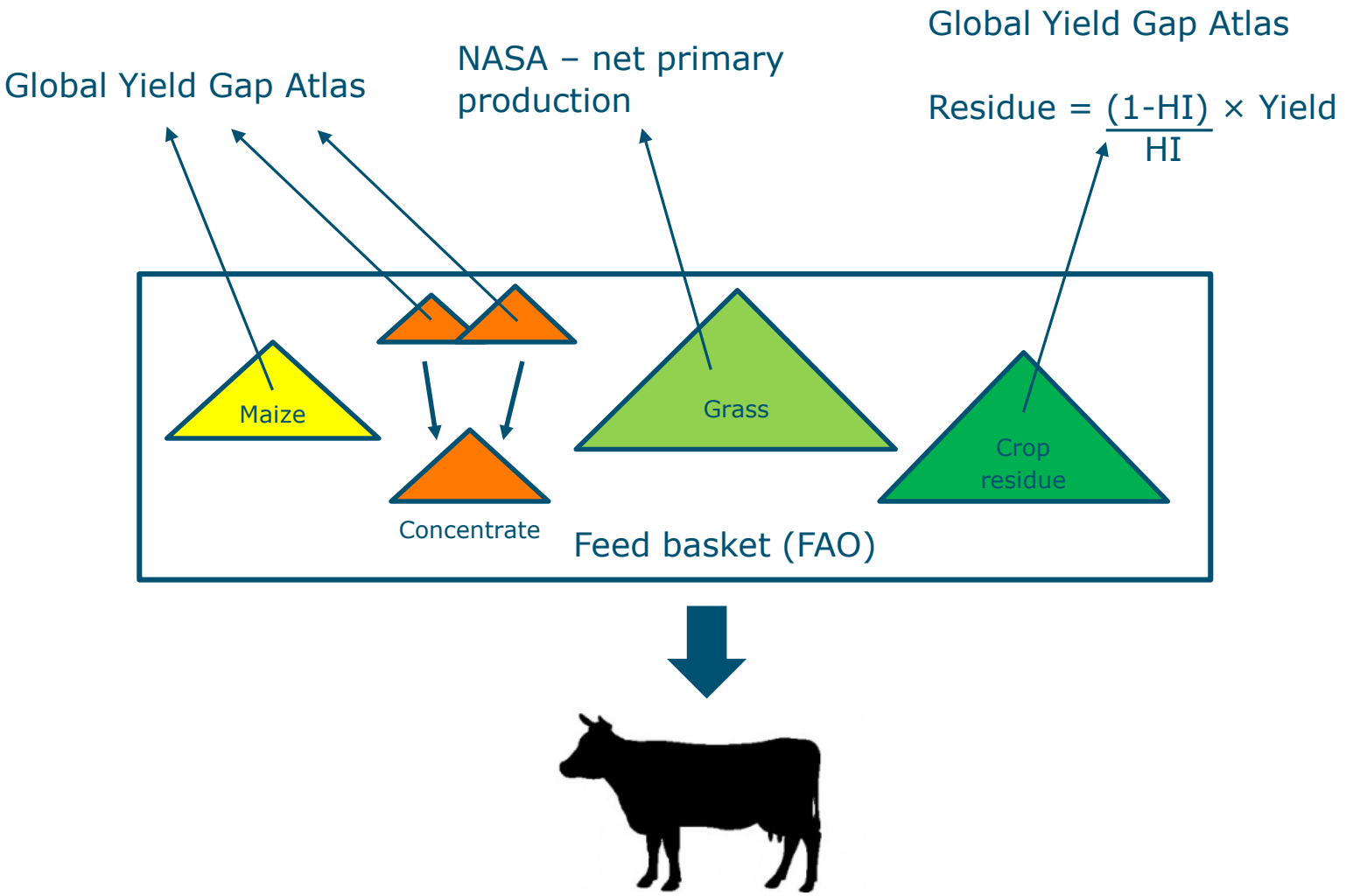
Dual demand: production (kg product ha^{-1} year^{-1})

- Actual production
  - Ideal management
  - Crops:
    - nutrient limitation
    - pest, diseases, weeds
  - Cattle:
    - diseases and stress
- Resource-limited production
  - feed-limitation, high-quality diet
- Potential cattle production + water-limited crop production ("Potential production")

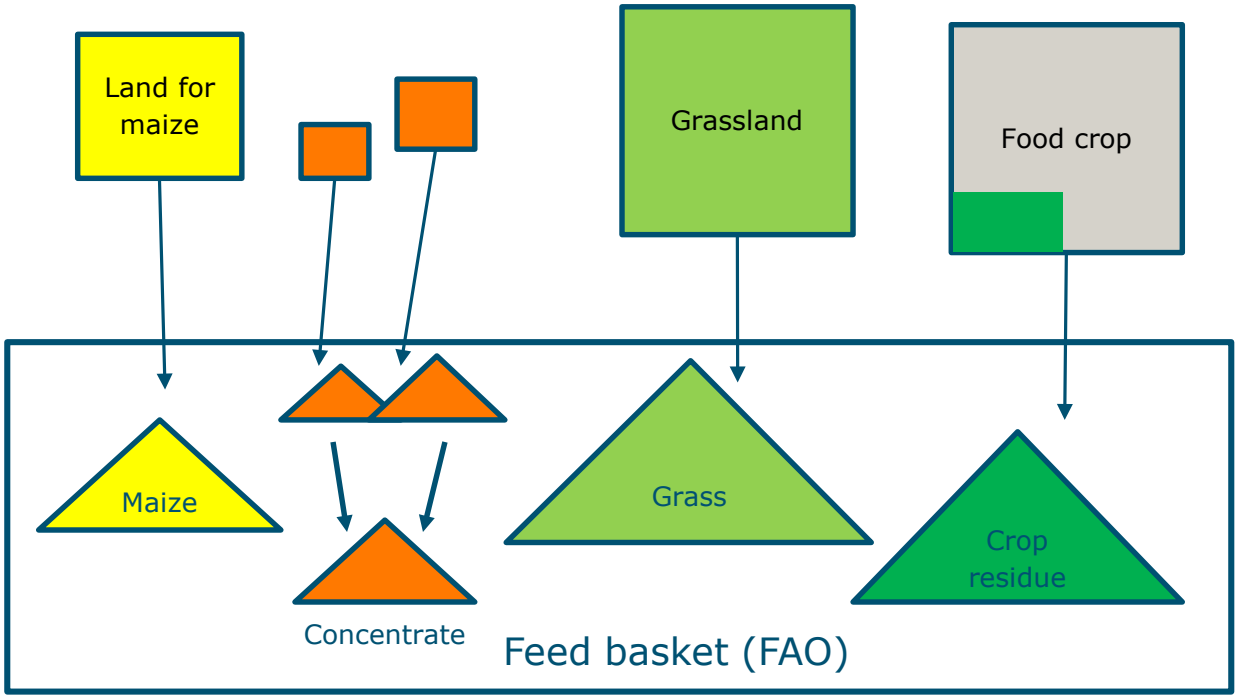


FAO and NZAGGRC (2017a,b,c), Van de Ven *et al.* (2003), Van der Linden *et al.* (2015)

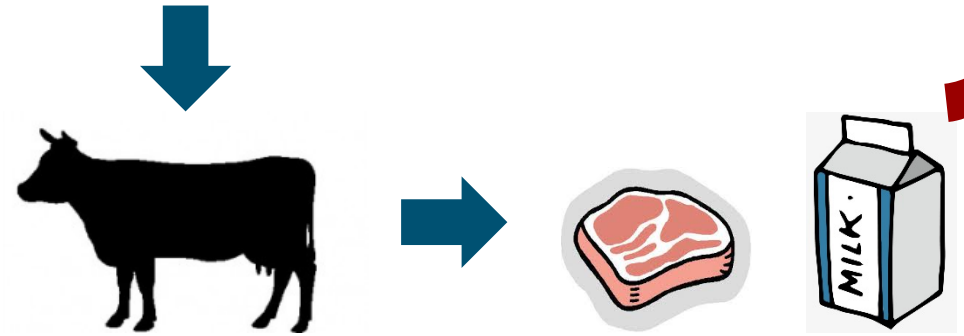
Materials and methods



Materials and methods

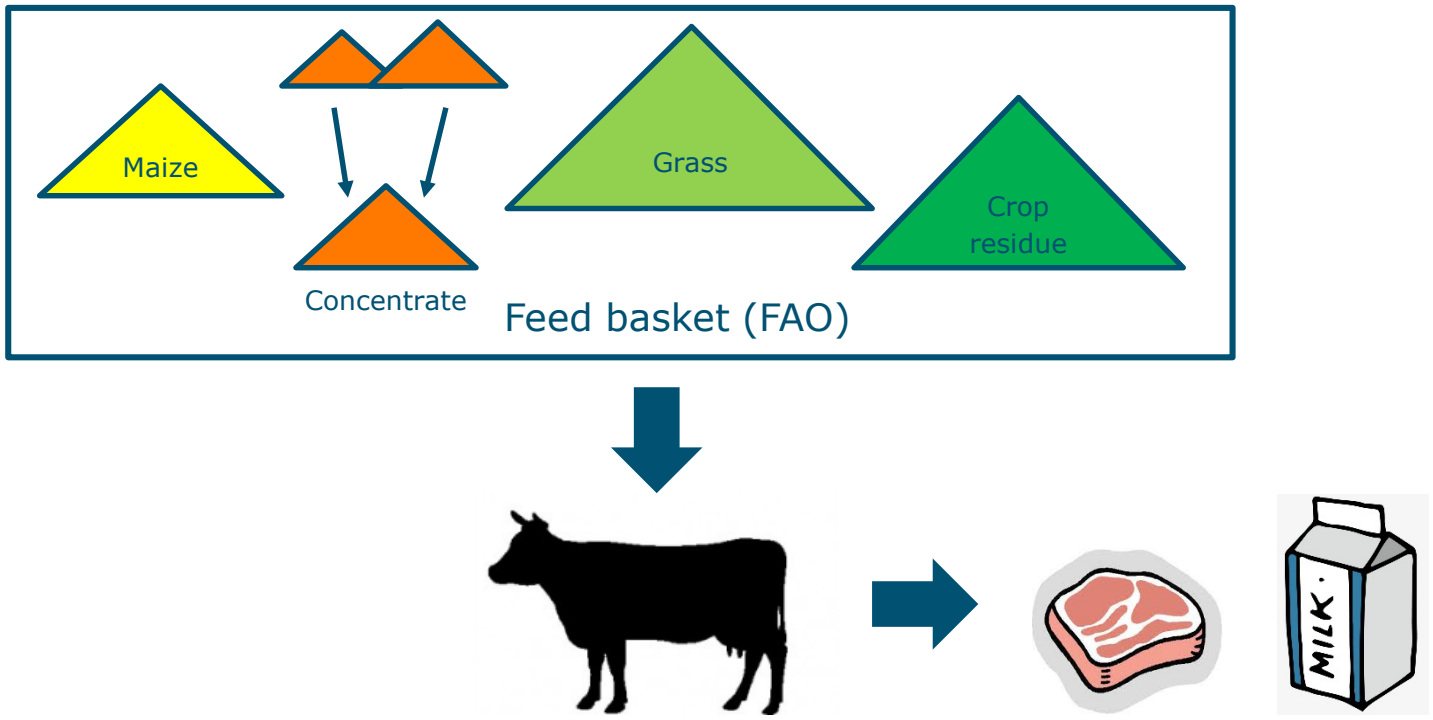


- Harvest, storage, and feeding losses
- Trampling, refusals



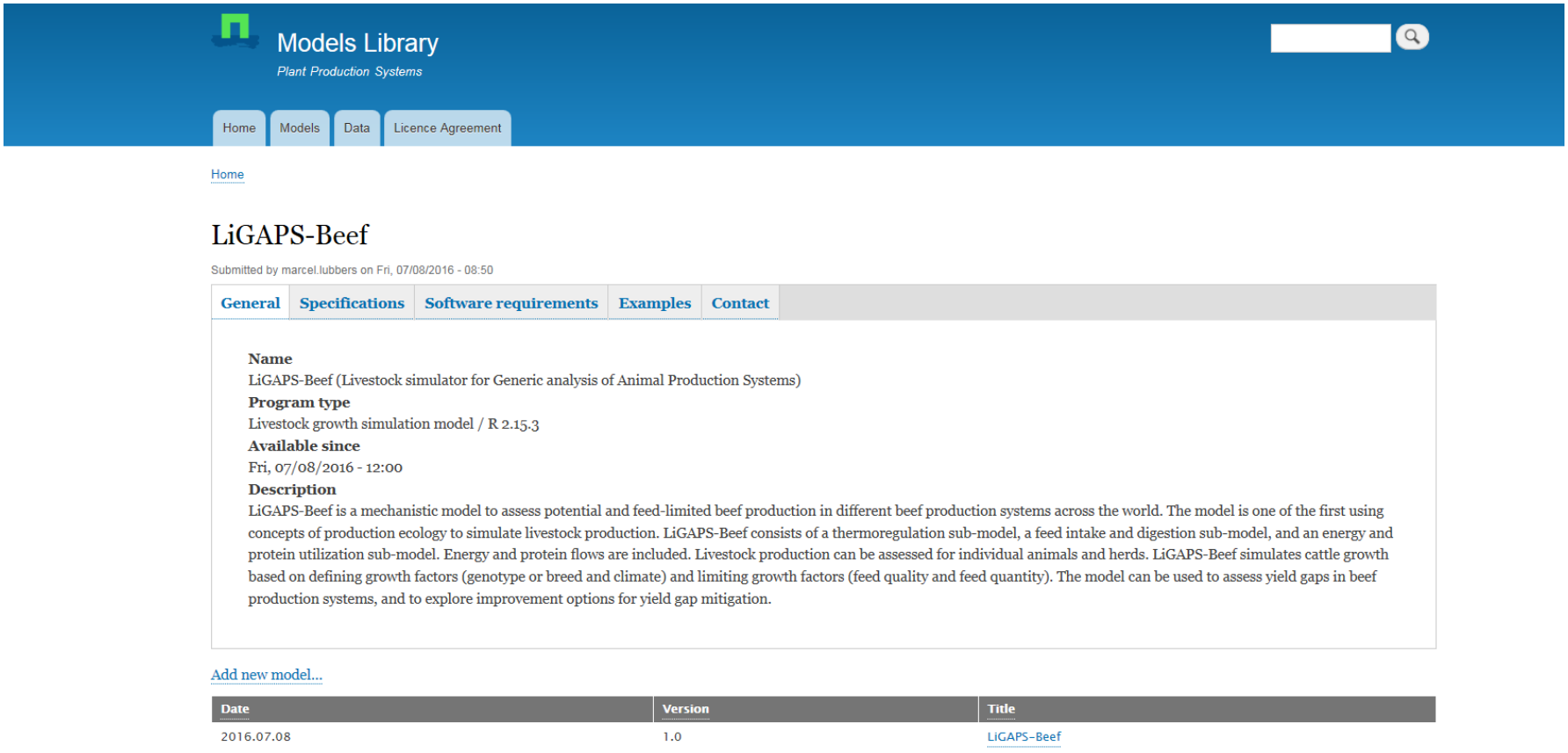
Materials and methods

- LiGAPS-Beef
- LiGAPS-Dairy



Van der Linden *et al.* (2018a,b,c)

Materials and methods



http://models.pps.wur.nl/ligaps-beef

Materials and methods

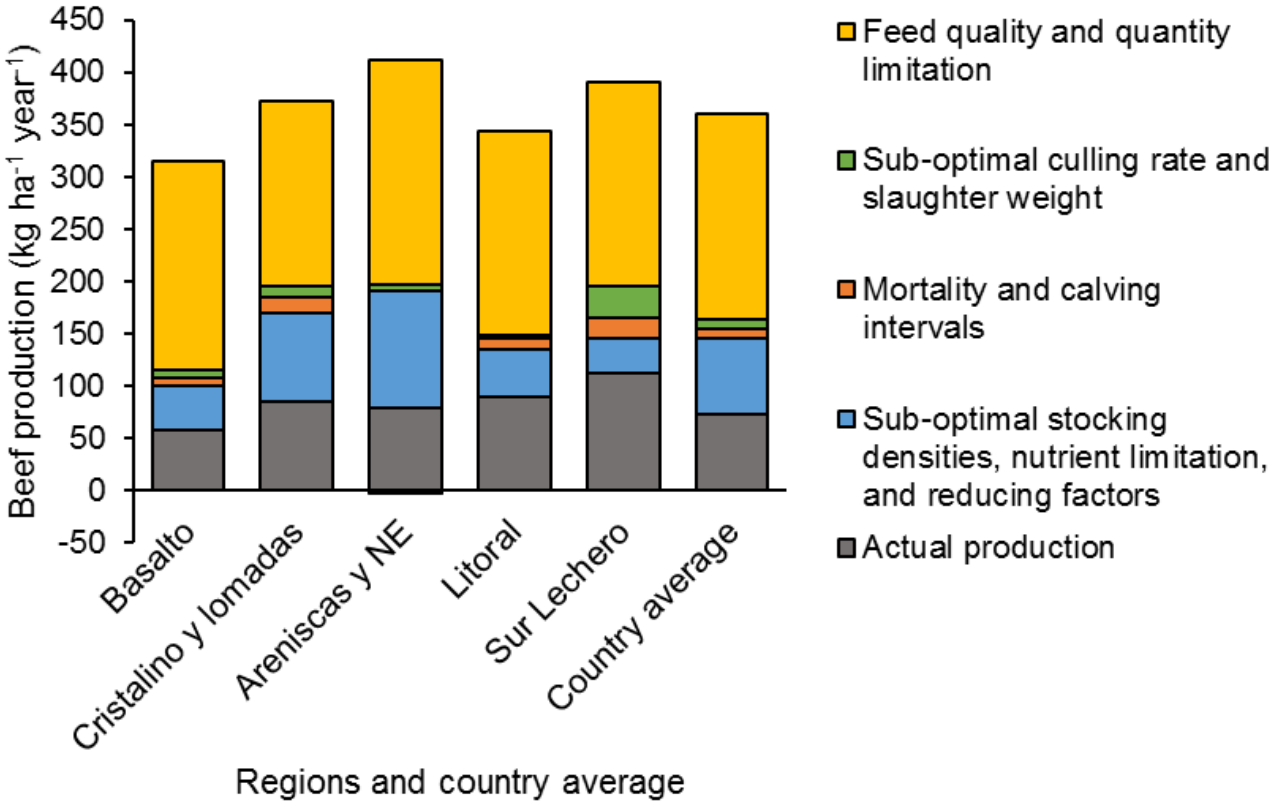
Dual demand: GHG emissions

- Production levels combined with IPCC equations (2006)
- GHG for feed → economic allocation

IPCC (2006)

Results and discussion Uruguay (I)

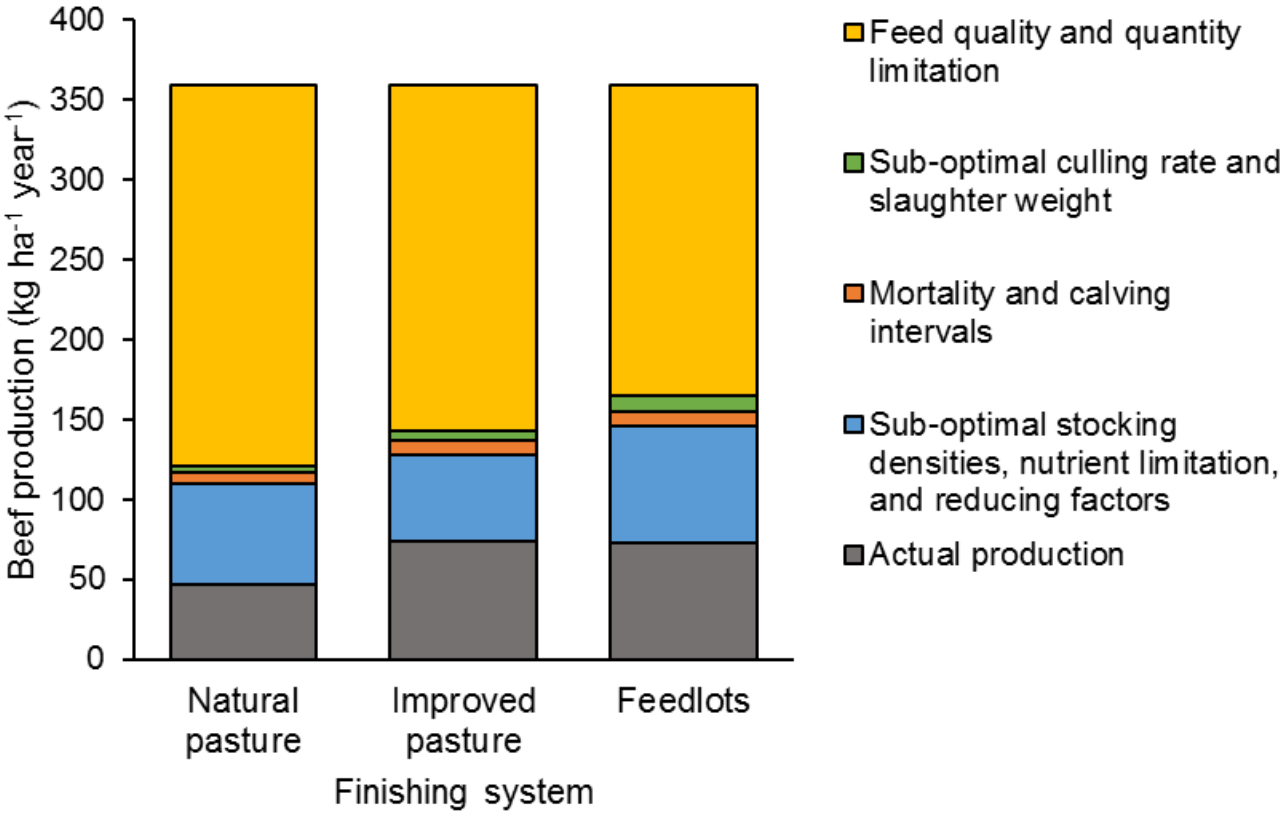
Cow-calf system + finishing calves in feedlots



RYG_P = 80%
RYG_{RL} = 56%

Results and discussion Uruguay (II)

Cow-calf system + three finishing systems



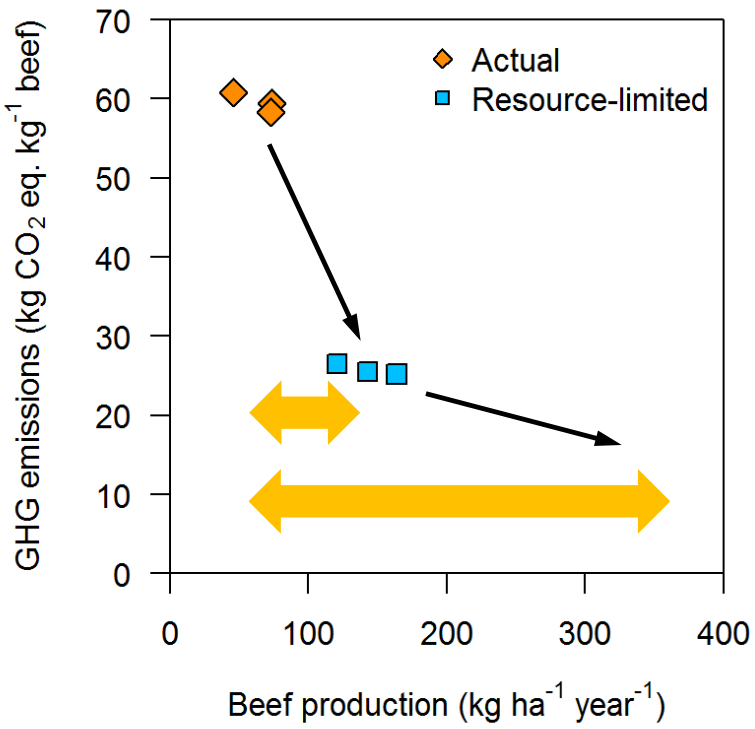
RYG_P = 80-87%
RYG_{RL} = 49-62%

Results and discussion Uruguay (III)

Beef cattle, Uruguay

Finishing calves:

- Natural pasture
- Improved pasture
- Feedlots



Synergy

GHG ←→ Prod.

Relative yield gap

Resource-limited: 49-62%

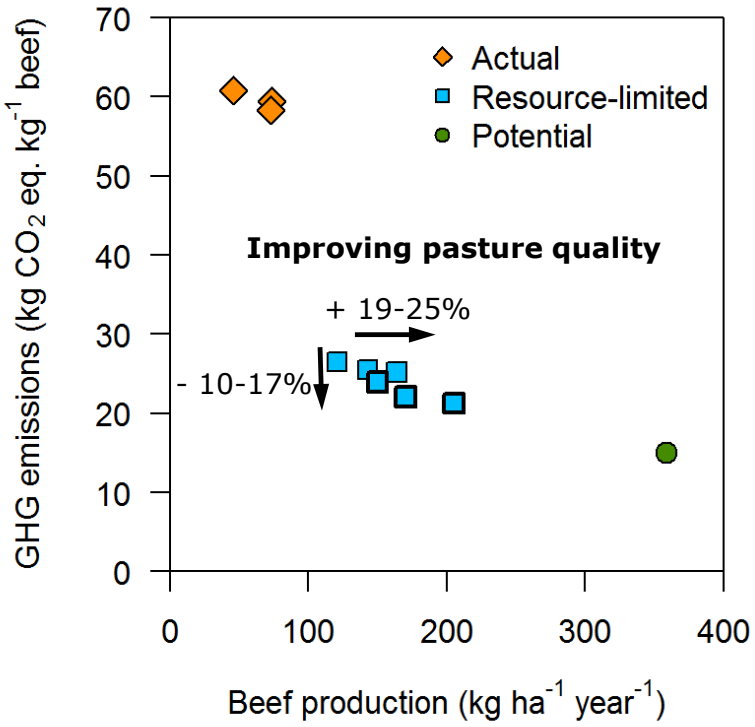
Potential: 80-87%

Results and discussion Uruguay (III)

Beef cattle, Uruguay

Finishing calves:

- Natural pasture
- Improved pasture
- Feedlots



Synergy

GHG ←→ Prod.

Relative yield gap

Resource-limited: 49-62%

Potential: 80-87%

Feasibility intervention options

Results and discussion Uruguay (IV)

Replacing breeds

Hereford

Hereford × Angus

Resource-limited Beef production: + 5-6% per unit area

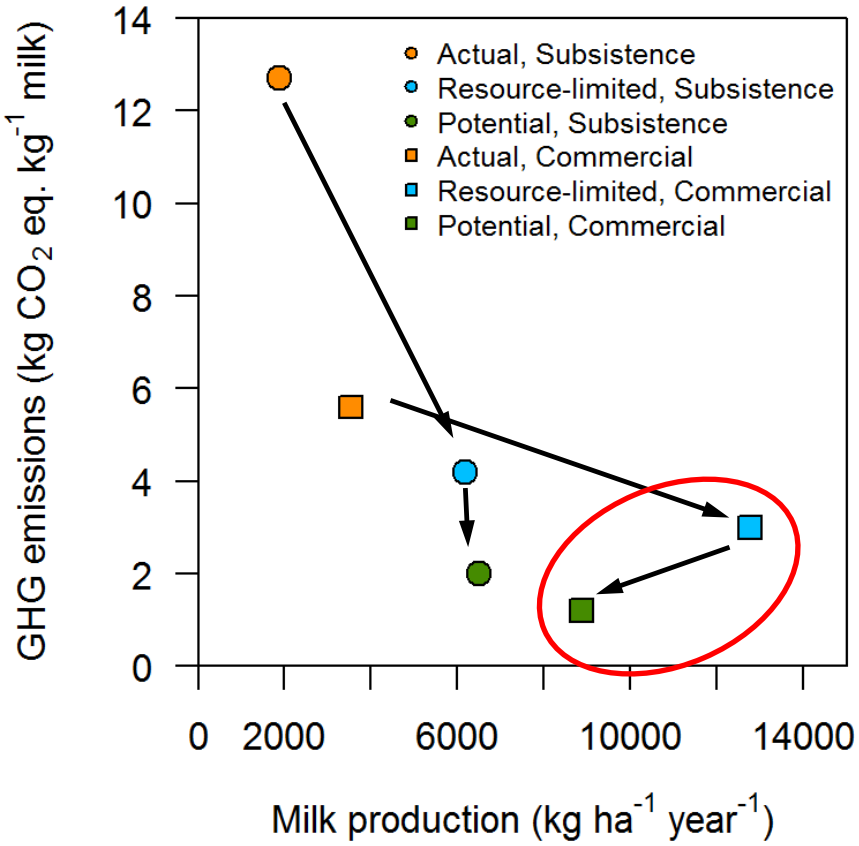
Emission intensity: - 7-9%

Results and discussion Bangladesh (I)

Dairy cattle, Bangladesh

Farm types:

- Subsistence
- Commercial

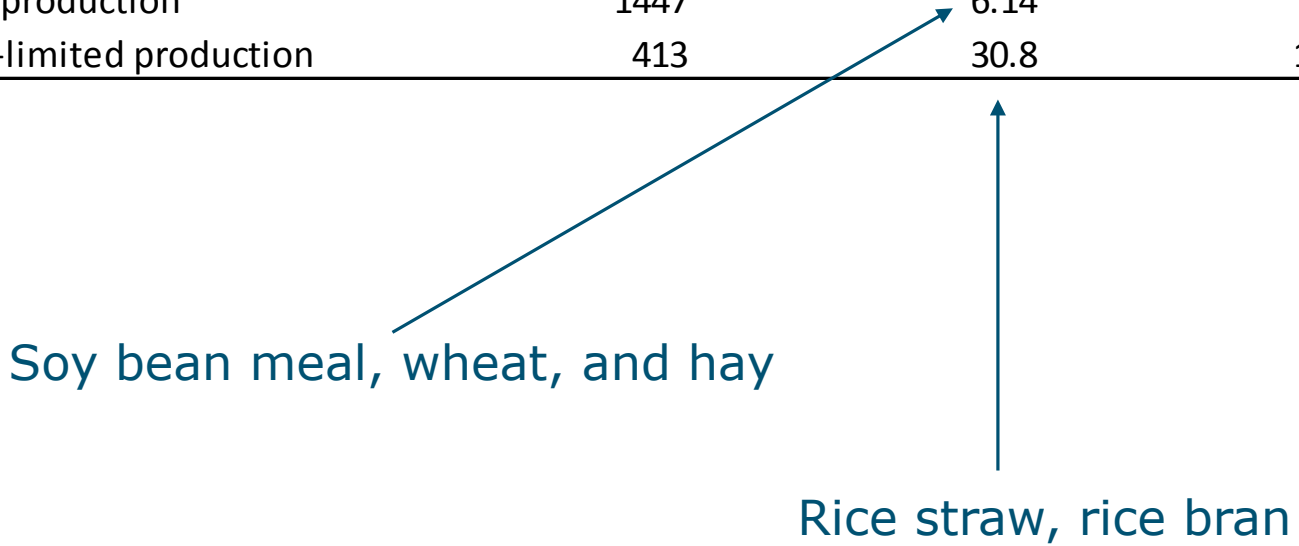


Synergies and trade-offs!

Results and discussion Bangladesh (II)

Trade-off milk production and GHG emissions (commercial farms)

	Feed efficiency (kg milk t^{-1} DM)	**Crop production** (t DM ha^{-1} $year^{-1}$)	**Milk production** (kg ha^{-1} $year^{-1}$)
Potential production	1447	6.14	8876
Resource-limited production	413	30.8	12756



Results and discussion Bangladesh (III)

- Treatment of rice straw with urea
  - Feed efficiency increases
  - Labour intensive

Results and discussion Bangladesh (III)

- Treatment of rice straw with urea
  - Feed efficiency increases
  - Labour intensive
- Fodder cultivation
  - Requires more land
  - Food-feed competition

Discussion

Limitations

- Animals used for multiple purposes: allocation
- Interaction between grass and animals
- Multiple animals using the same pasture
- C-sequestration

Further analysis

- Food-feed competition, amount of protein produced per hectare

Conclusions

- Considerable scope to increase beef and milk production.
- Synergies exist between narrowing of yield gaps and decreasing emission intensities.
- If crop residues are available, avoid food-feed competition.

Thank you for your attention

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