Sustainable livestock systems: the methane debate

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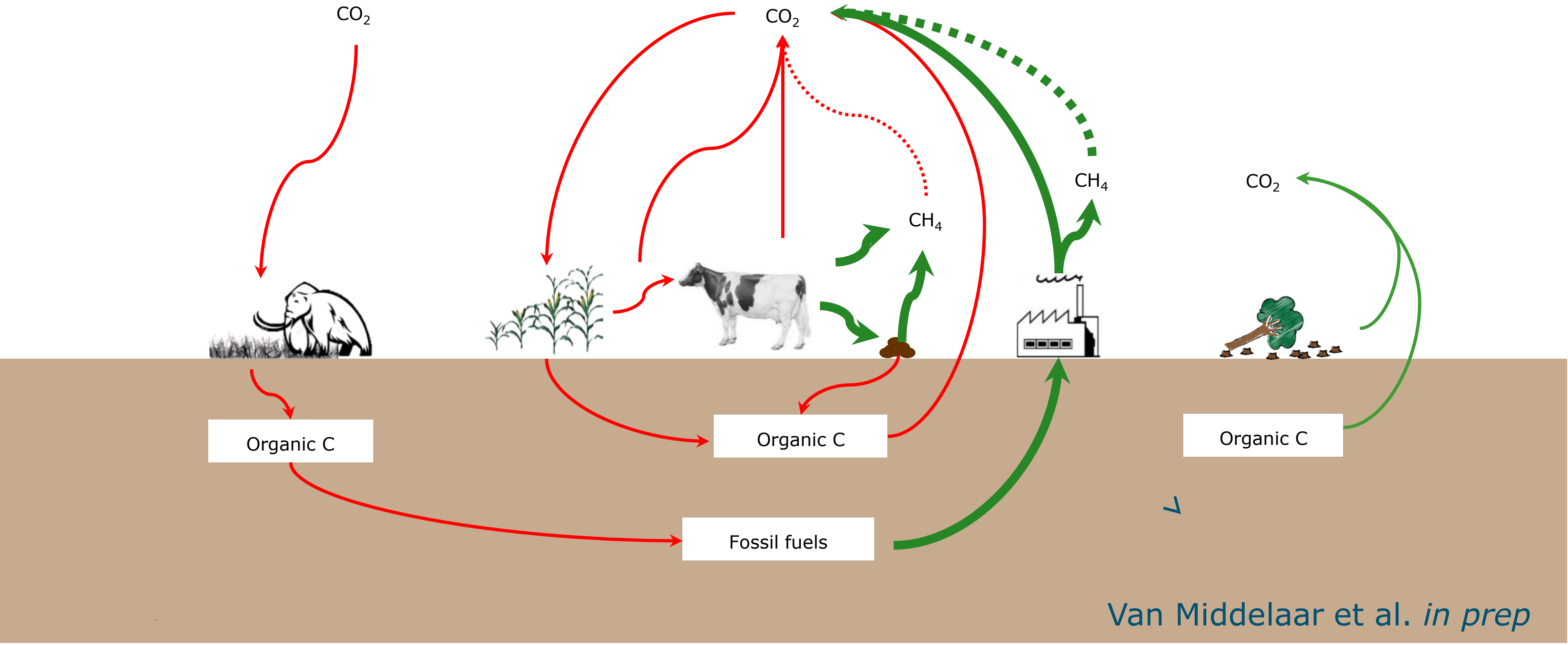
Outline

- Some background on methane and metrics
  - Understanding the carbon cycle
  - Climate impact of GHGs
- The methane pledge at COP26
- Cattle as main contributor – where does it happen?
  - Reducing methane in developed world?
  - Reducing methane in developing world?
- The bigger picture
  - Towards sustainable livestock systems
  - Methane and sustainability

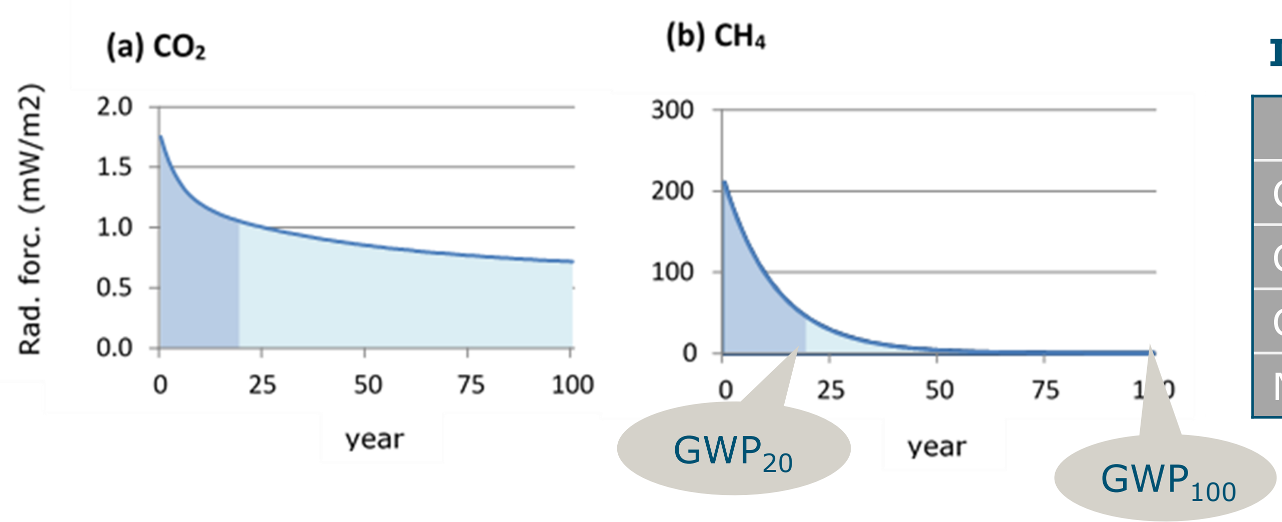
Understanding the carbon cycle



Van Middelaar et al. *in prep*

Climate impact of GHGs

Radiative forcing from a *pulse* emission of one million tons of CO_2 and CH_4



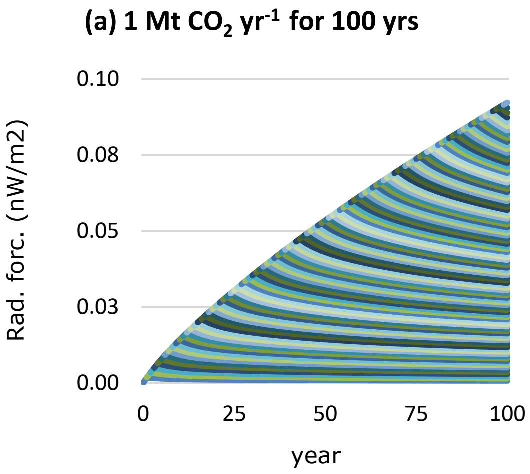
IPCC AR6

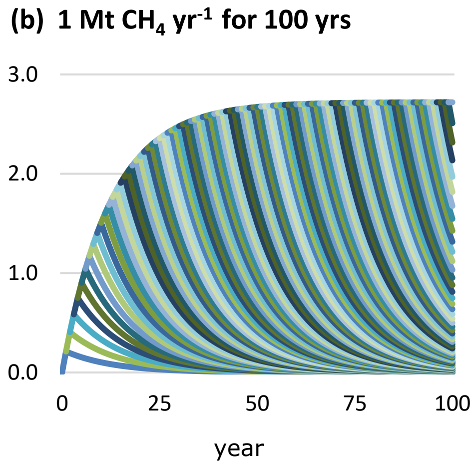
	GWP_{100}
CO_2	1
$CH_{4\ \text{biogenic origin}}$	27.2
$CH_{4\ \text{fossil origin}}$	29.8
N_2O	273

Persson et al. 2015 (based on AR5, IPCC 2013)

Climate impact of GHGs

Radiative forcing from a *continues flow* of CO_2 and CH_4 (1 Mt yr^{-1})





- Stable flux of methane → no *increased* warming
- Reducing methane is important to reduce overall climate impact ....
- .... but should not be at the expense of reducing CO_2

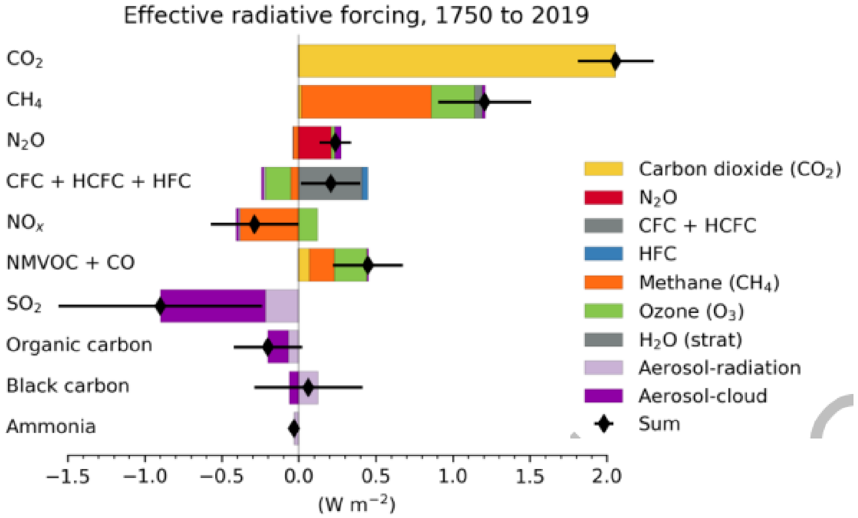
Using the model of Persson et al. 2015 (based on AR5, IPCC 2013)

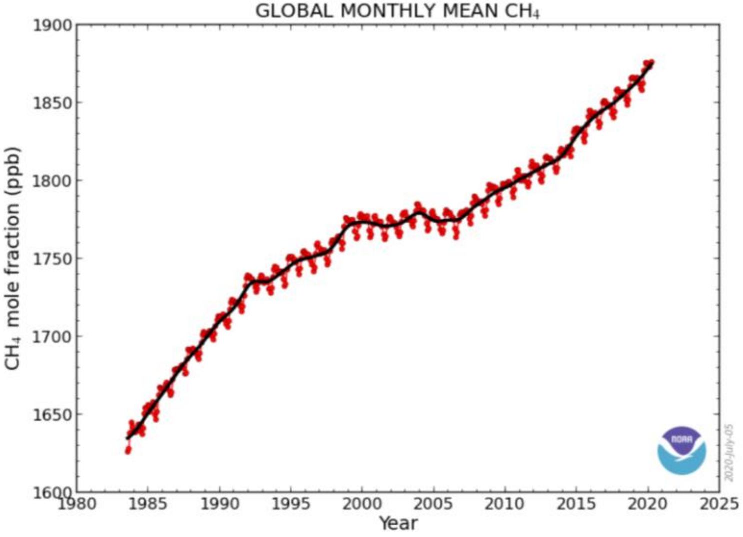
Climate impact of methane

IPCC AR6

Contribution to effective radiative forcing from component emissions

between 1750 to 2019





https://www.ccacoalition.org/en/news/2020-global-methane-budget-shows-methane-emissions-heading-wrong-direction-fossil-fuel-and

The methane pledge at COP26

Reduce methane emissions by 30 % in 2030 (reference 2020)

- >100 countries, not China, India, Australia and Russia
- 30% of anthropogenic emissions corresponds to 18.2 % of all emissions
- Reduces atmospheric methane concentration from 1900 ppb to 1550 ppb (=level 1980!)
- Various sectors should act! (of anthropogenic: enteric fermentation 30%, manure 4%, fossil fuel 29%, waste & landfills 20%)

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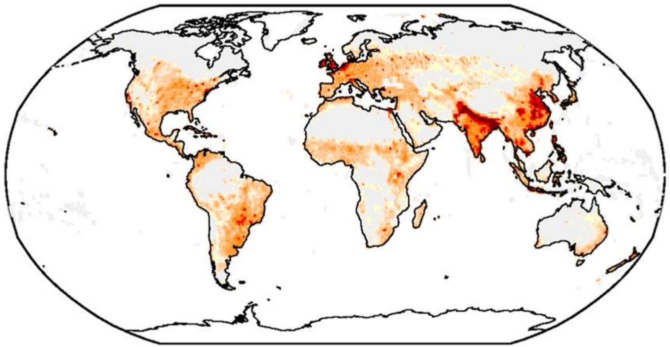
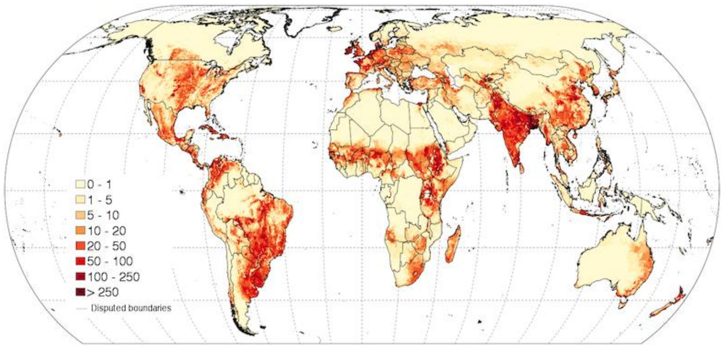
Cattle as main contributor

Methane emissions from agriculture and waste



Saunois et al. (2020)

Number of cattle per square kilometer



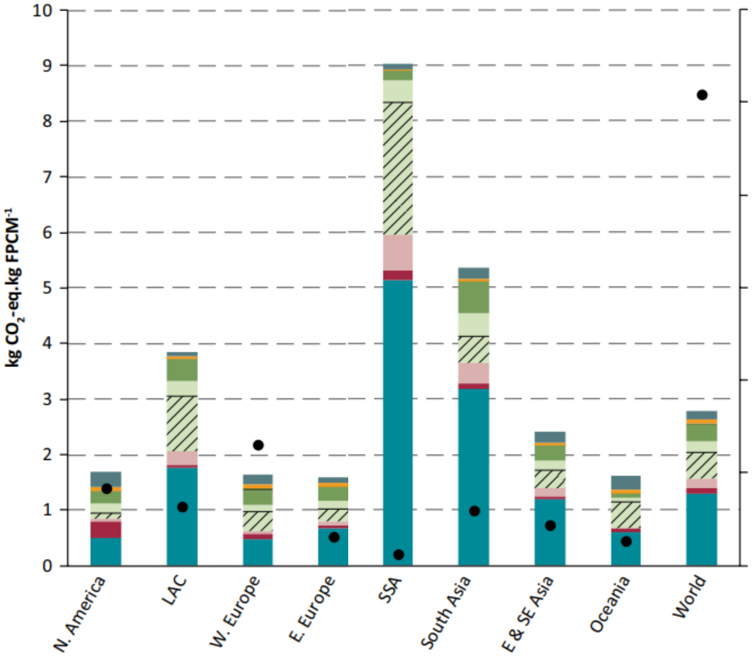
Gilbert et al. (2018) using livestock distribution data for 2010.

Reducing methane from cattle?

Livestock systems intrinsically differ between developed and developing world

Reducing methane in developed regions?

GHG emission intensities of milk



Gerber et al. (2013)

Generally intensive cattle systems

- high animal productivity
- high quality diets
- low emission intensity

Reducing methane?

Feeding

- feed additives
- feed quality
- dietary manipulation
- precision feeding

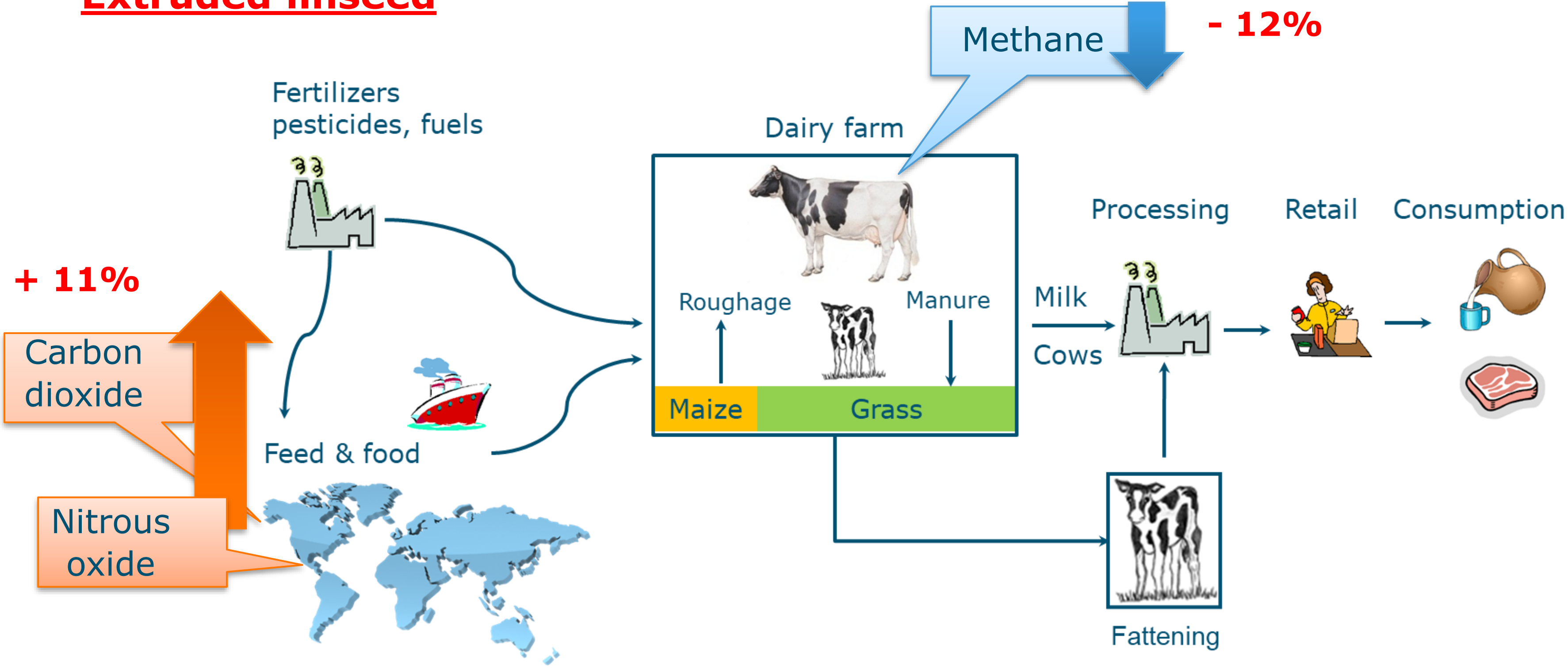
Animal management & breeding

- increasing productivity
- improving health
- reducing animal mortality

Consider consequences.....

Van Middelaar et al. (2014)

Extruded linseed



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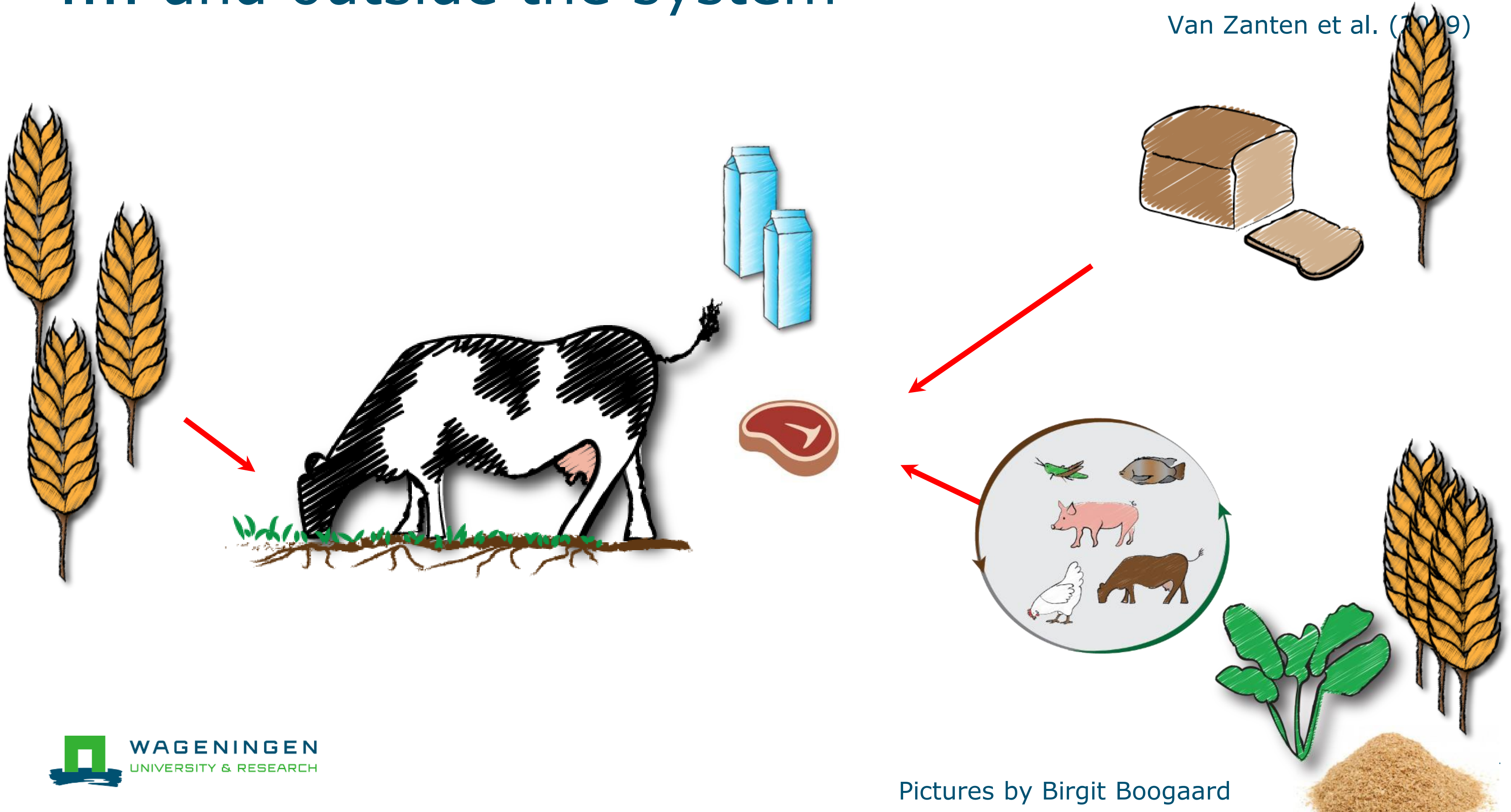
..... inside the system ....

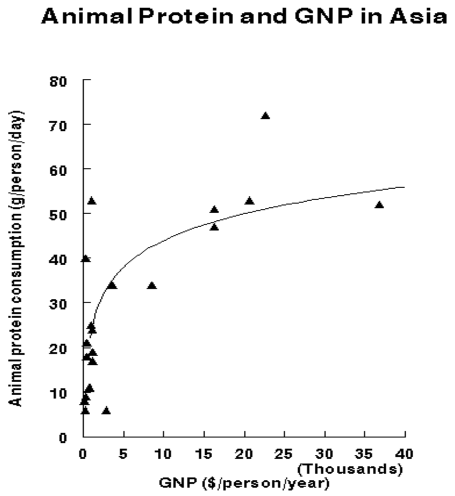
.... and outside the system

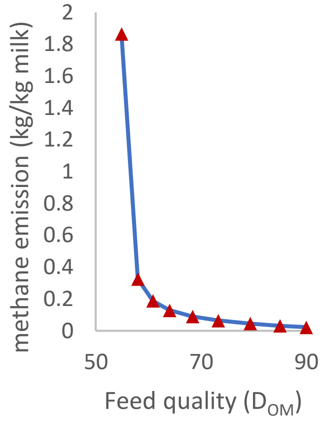
Van Zanten et al. (2019)

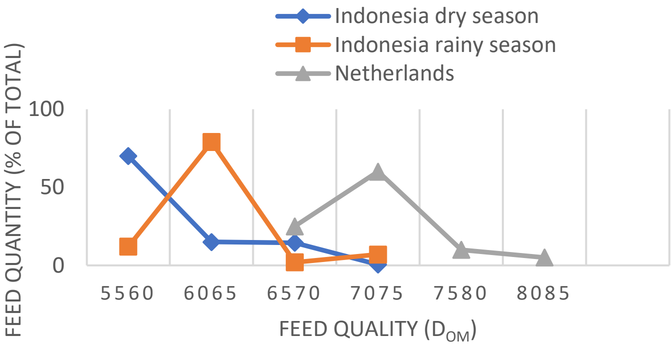


Pictures by Birgit Boogaard

Reducing methane in developing regions?



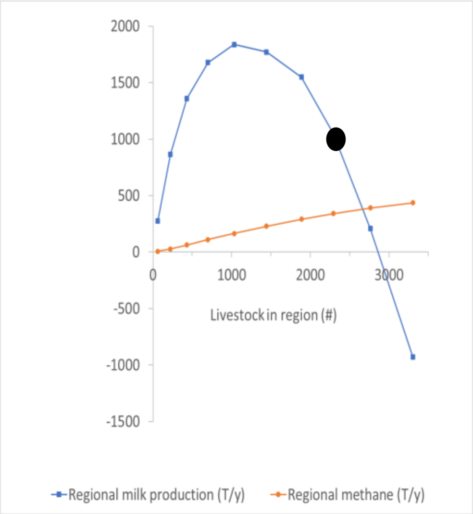




Reducing methane in developing regions?

Large ruminants ($*10^6$)

	1980	2019	Δ (%)
World	1335	1709	28
Europe	249	117	-53
Americas	414	527	27
Oceania	35	35	0
Africa	173	361	109
Asia	465	668	44



Livestock in mixed crop-livestock systems

Manure (fertilizer, fuel)

Draught power

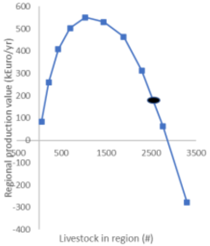
Banking and insurance function

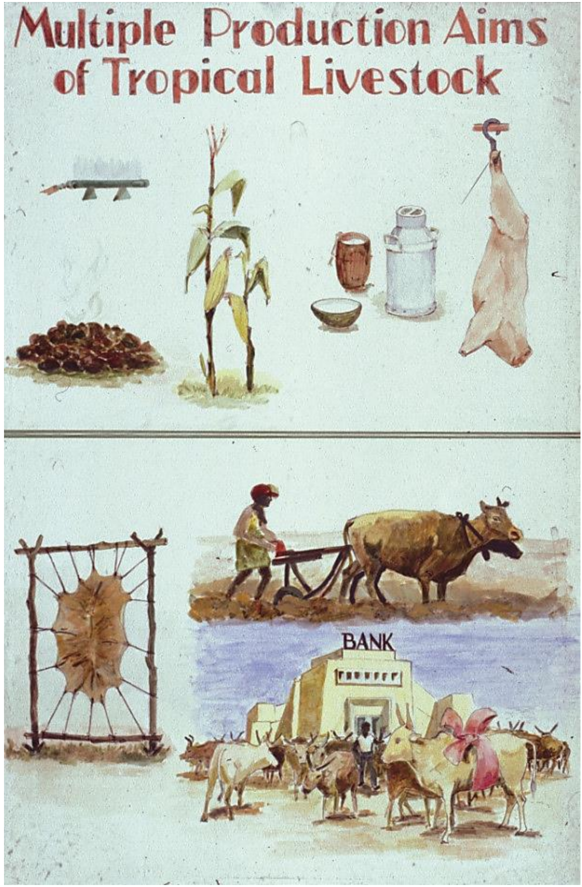
} Increase with increasing herd size (livelihood/support of crop production!)

Meat

Milk

} Optimal herd size





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Towards sustainable livestock systems

- Positive: food security and livelihood
- Negative: environmental impacts and biodiversity loss

- Mainly through
  - Land use for feed (global warming & biodiversity loss)
  - Manure (global warming & biodiversity loss)
  - Enteric fermentation (global warming)

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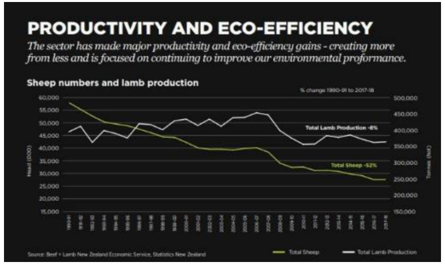
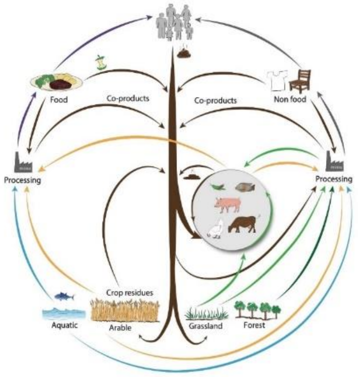
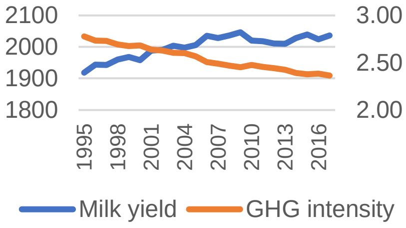
Case studies



- New Zealand: beef and sheep efficiency
- Netherlands: manure management,

  alternative farm strategies, circular food system
- Colombia: silvopastoral beef production
- Kenya: tier 2 inventory for dairy production





Towards sustainable livestock systems

Principles

- Principle 1. Contribute to a sustainable food future.
- Principle 2. Enhance carbon stocks.
- Principle 3. Improve efficiency at animal and herd level.
- Principle 4. Source feed sustainably.
- Principle 5. Couple livestock to land.
- Principle 6. Minimize fossil fuel use.
- Principle 7. Foster an enabling environment.

https://www.sustainablelivestockguide.org

Towards sustainable livestock systems

- Mixture of technological/managerial innovations and systemic transitions
- Context: need and direction/pick of principles
- Adoption and implementation:
  - Regulation
  - Collaboration/co-creation/inclusion of farmers and other actors
- Small and large wins!

Methane and sustainability

Reduce animal numbers

- Consume less (developed regions)
- Appropriate solutions to multi-functionality (developing regions)

Produce sustainably

- Produce in regions with least impact?
- Respect local eco-systems
- Prevent emission swapping
- Optimize food system rather than individual production chains or sectors
- Good science!

Thank you!

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