

Climate change, livestock production, and food security in Southeast Asia

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Presentation Outline

1. What are the impacts of climate change on livestock production systems?
2. How does livestock production affect climate change?
3. How do all these impact food security?



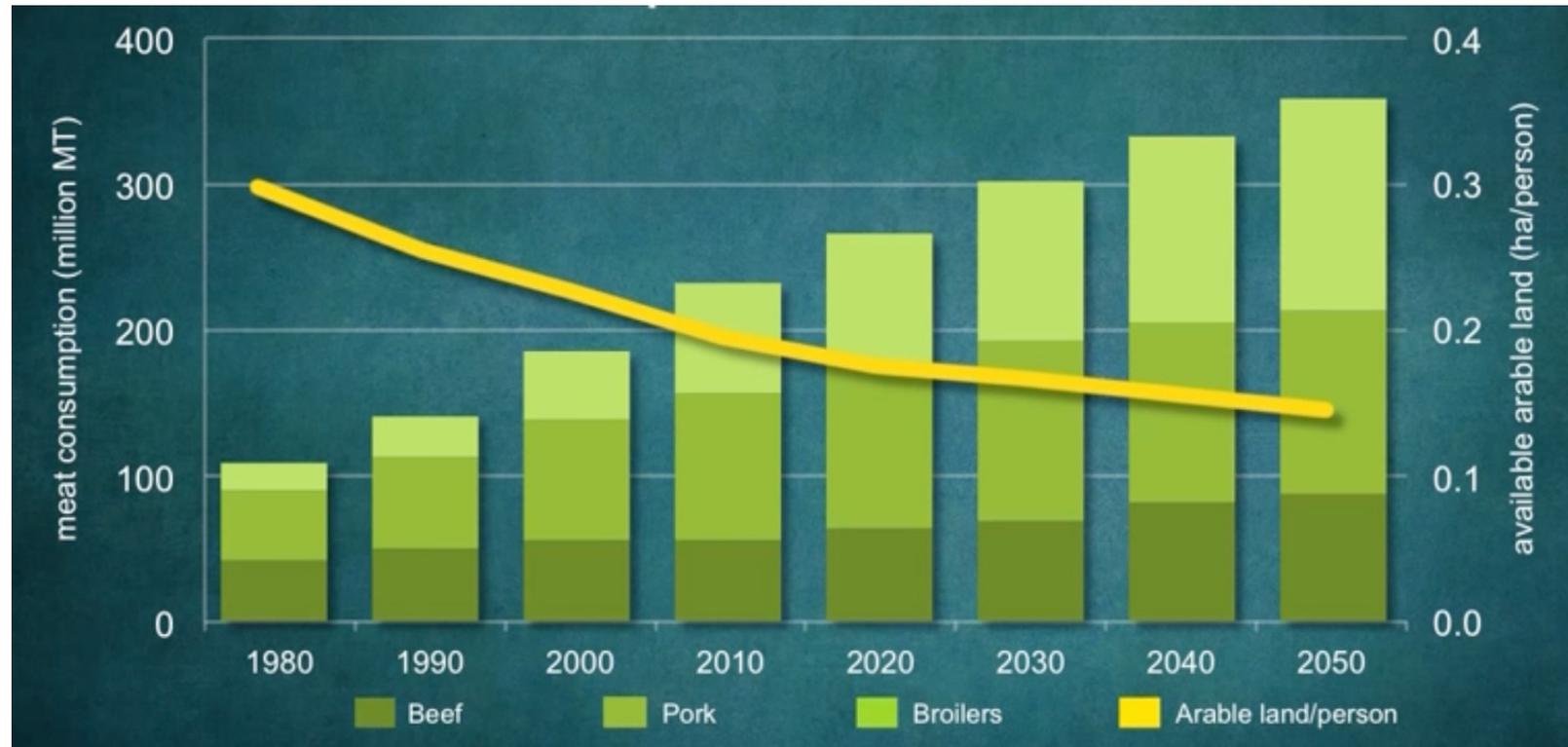
Importance of the livestock industry

- Livestock products are an important agricultural commodity for global food security¹
 - 17% of global kilocalories consumption
 - 33% of global protein consumption
- Employs 1.1 billion people and contributes livelihoods of 1 billion of the poorest population in the world²



¹Rosegrant et al. (2009); ²Hurst et al. (2005)

Global beef, pork and poultry consumption (1980-2050)



Bauman and Capper (2011)



The demand for livestock products to 2050

	Year	Annual per capita consumption		Total consumption	
		Meat (kg)	Milk (kg)	Meat (Mt)	Milk (Mt)
Developing	2002	28	44	137	222
	2050	44	78	326	585
Developed	2002	78	202	102	265
	2050	94	216	126	295

Rosegrant et al. (2009)



Livestock production in ASEAN countries

ASEAN countries	Buffalo	Goat	Cattle	Duck	Chicken	Pig
Brunei Darussalam	102	40	604	250	28,040	30
Cambodia	9,723	-	69,205	9,142	17,556	1,04,195
Indonesia	35,236	65,142	497,669	37,985	1,939,225	7,58,999
Lao PDR	19,750	1,923	30,131	4,550	25,234	68,443
Malaysia	3,477	1,670	27,462	157,279	14,15,515	2,17,558
Myanmar	46,914	66,356	232,804	129,005	1,389,207	834,000
Philippines	100,078	55,323	201,390	29,767	1,114,881	1,690,692
Singapore	0	12	46	5,000	90,000	18,542
Thailand	28,306	1,868	163,264	56,178	1,756,536	948,901
Viet Nam	94,420	8,085	292,501	102,646	633,334	3,330,590

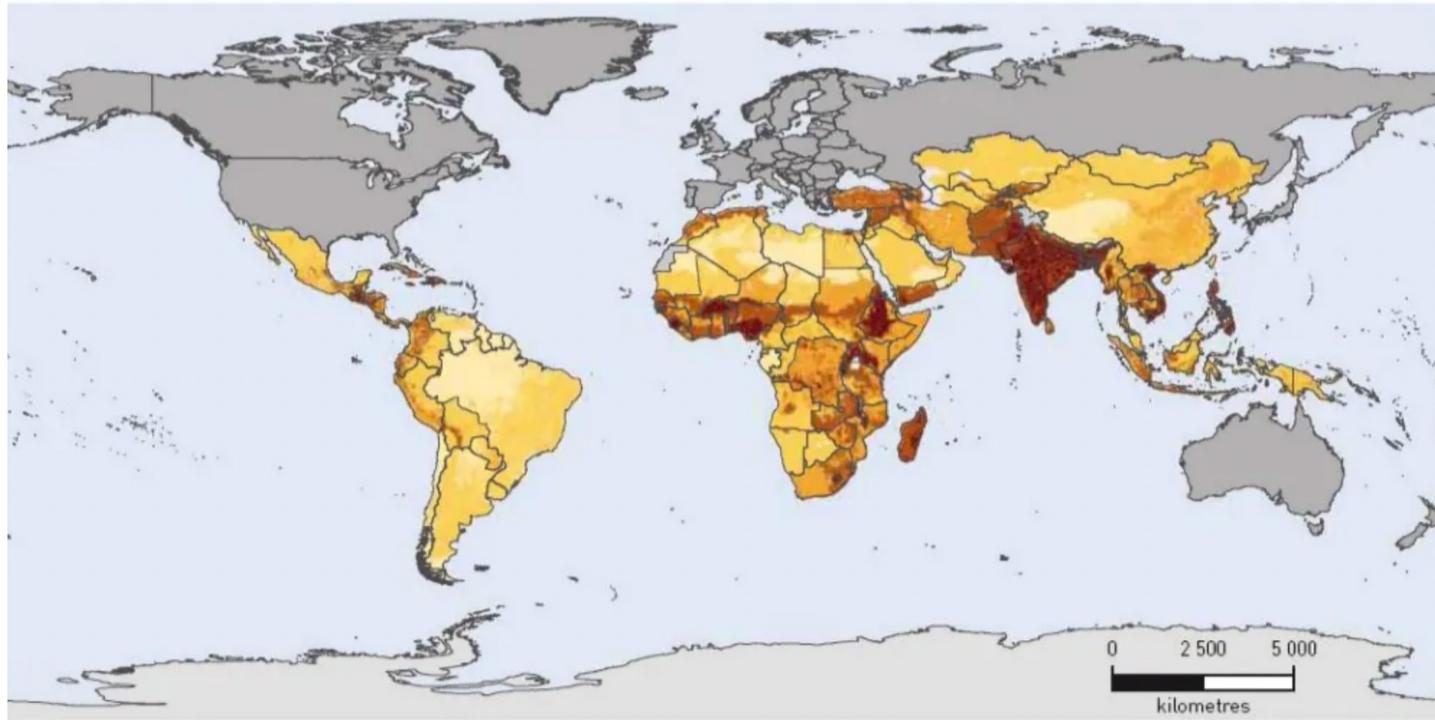
ASEAN = Association of Southeast Asian Nations, Lao PDR = Lao People's Democratic Republic.

Note: All livestock values are in tonnes.

Source: Food and Agriculture Organization Statistics (2014).



Density of "poor livestock keepers" using national poverty lines



Values per km²



>430 million PLKs globally.
Thornton in Robinson et al. (2011)



Climate change vulnerability



“Southeast Asia is one of the world’s most vulnerable regions to adverse impacts of climate change.”

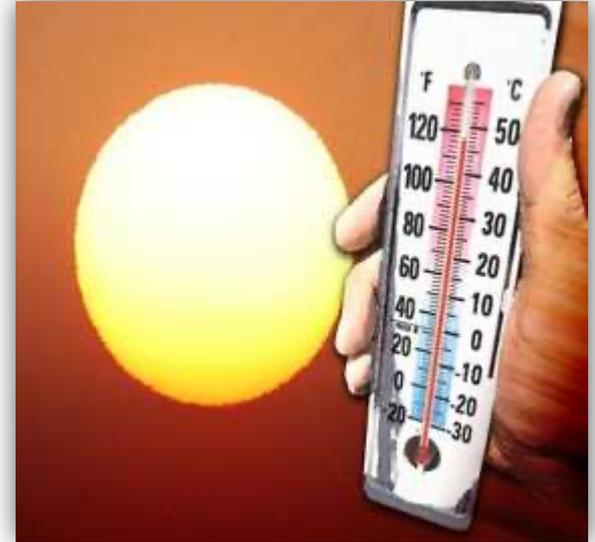
- IPCC



Projected Rise in Temperature

- ❑ Philippines Initial National Communication on Climate Change:

Cagayan Valley	< 2°C
Central Luzon	2-3°C
Southern Luzon	2-3°C
Central Visayas	2-3°C
Southern Mindanao	2-3°C
- ❑ Rainfall ratio: 1-2.0
- ❑ CRU-WWF estimate: 0.1°C to 0.3°C per decade



Impact of climate change on livestock

- 1) Quantity and quality of feeds (crop and forage)
- 2) Water availability
- 3) Animal growth and milk production
- 4) Diseases
- 5) Reproduction
- 6) Biodiversity



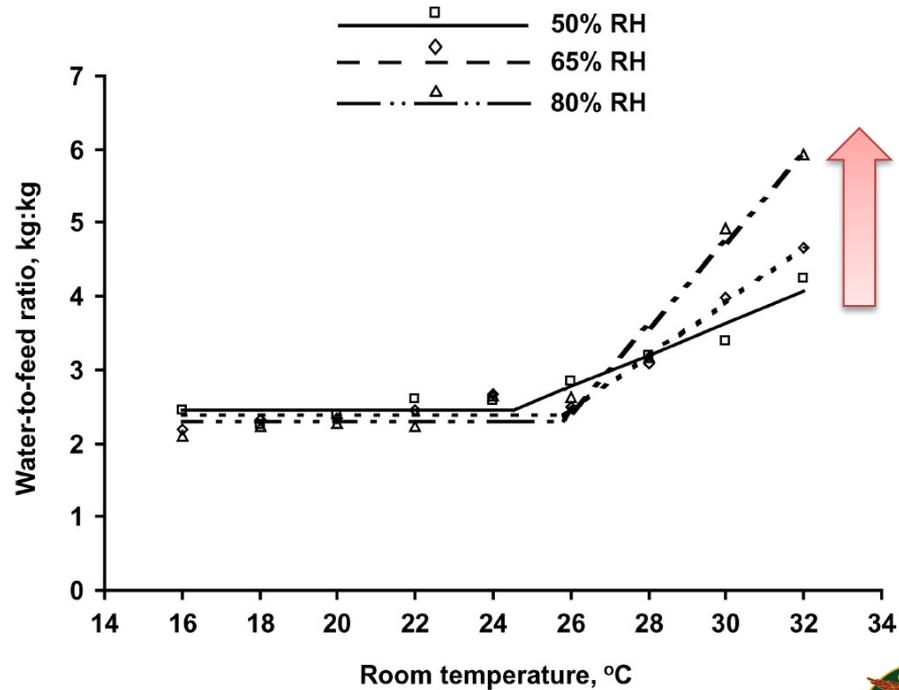
1) Quantity and quality of feeds (crop and forage)

- Mainly affected by \uparrow atmospheric CO_2 levels and temperature
 - depends on location, livestock system and species
- Changes in herbage growth (+ C3 species)
- Changes in nutrient concentration and availability
 - \uparrow lignin, cell wall components
- Affect pasture composition by altering species competition dynamics
- Extreme climate events may decrease total yields



2) Water availability

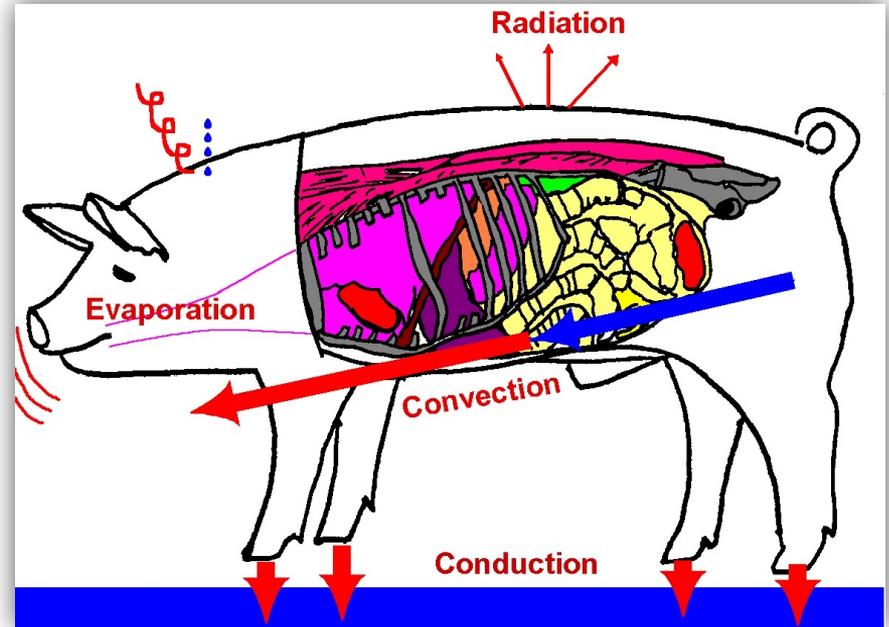
- Water for animal drinking, feed crops and product processes
 - 8% of global human water use
- ↑ temperature,
↑ animal water feed consumption by 2-3 times,
↑ water/feed ratio



Huynh et al. (2005)

3) Animal growth and milk production

- Heat stress effects
- ↑ metabolic heat production:
 - Reduced feed intake
 - Reduced growth
 - Reduced carcass wt
 - Higher mortality
 - Milk and egg production & quality



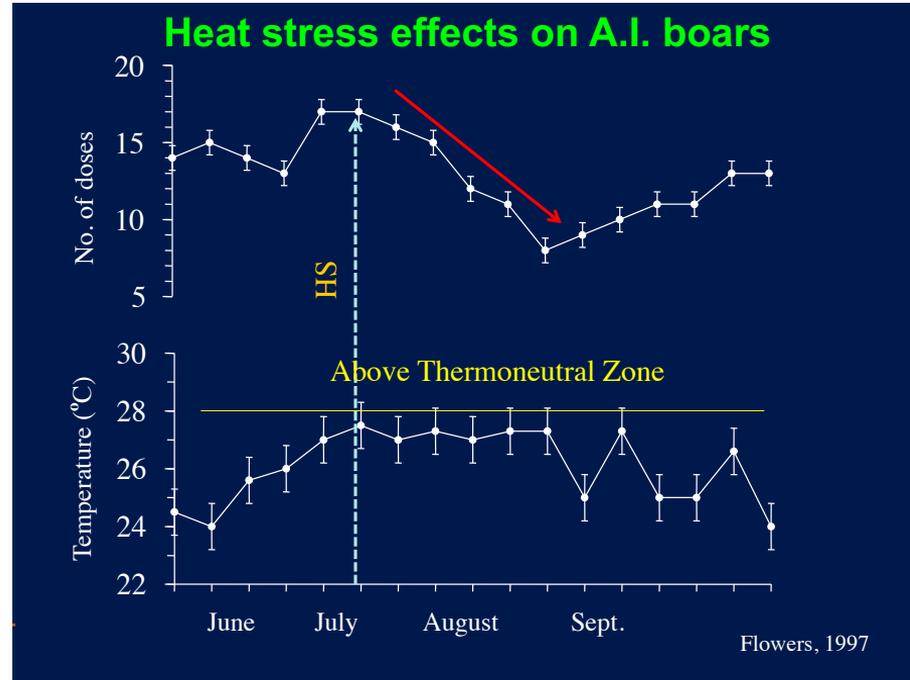
4) Diseases

- Depends on geographical region, land use type, disease characteristics and animal susceptibility
- Direct effects: ↑ morbidity and mortality
- Indirect effects: microbial communities (pathogens or parasites), spreading of vector-borne diseases, food borne diseases, host resistance
- Potential role on emergence of new diseases and zoonoses



5) Reproduction

- Heat stress effects on reproduction efficiency of both livestock sexes
 - Affects oocyte growth and quality
 - Impairment of embryo development
 - ↓ pregnancy rate
 - ↓ sperm concentration and quality



6) Biodiversity

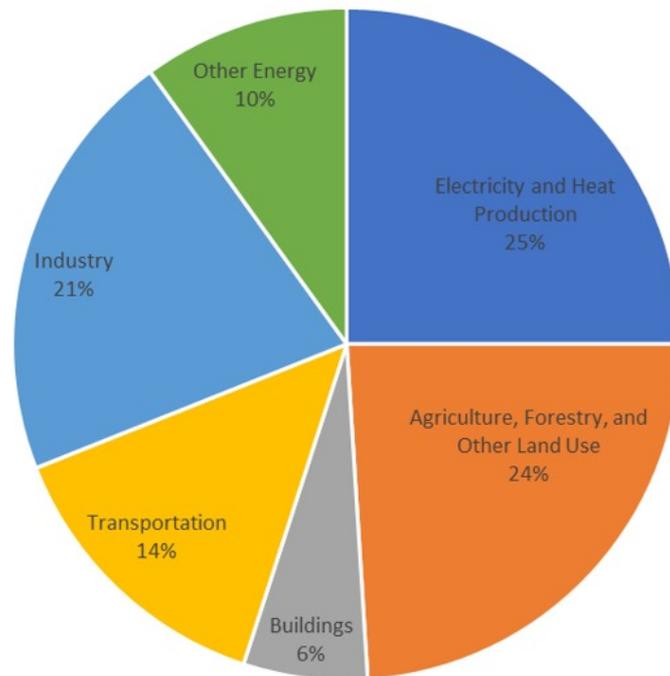
- Direct driver of biodiversity loss in both plants and animals
- Temperature increases have affected specie reproduction, migration, mortality and distribution
- By 2000, 16% of livestock breeds were lost
- Highest percentages of breed elimination
 - Chicken – 33%
 - Pigs – 18%
 - Cattle – 16%
- Breeds and species cannot be replaced naturally



Impact of livestock on climate change

- GHG emissions
 - Land use change
 - Feed production
 - Animal production
 - Manure
 - Processing and transport

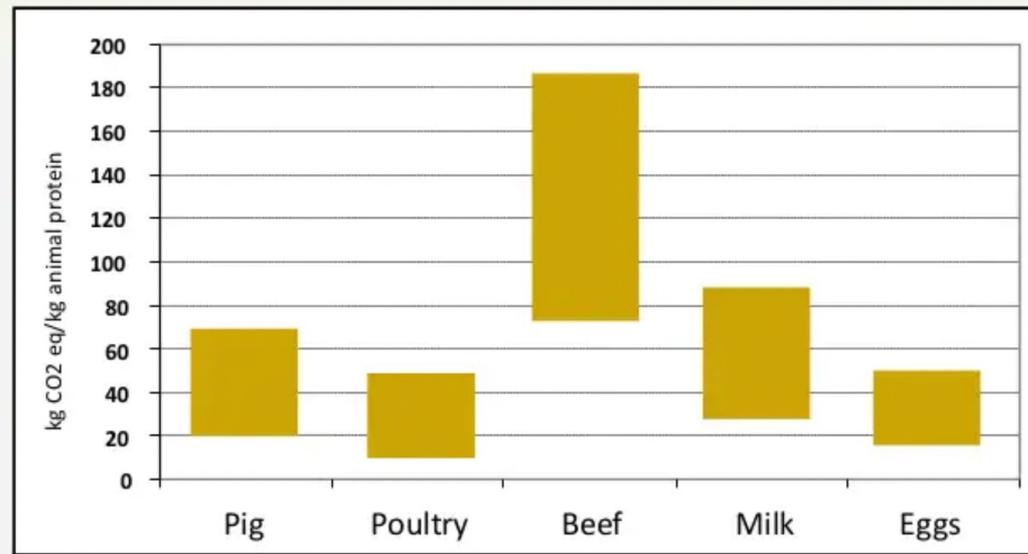
Global Manmade GHG emissions (IPCC)



Impact of livestock on climate change

- Livestock alone is responsible for 8-18% of all global anthropogenic GHG emissions
 - Range due to methodological differences
- Highest variation in beef
 - Require more fossil energy use, emit more CH₄ per animal

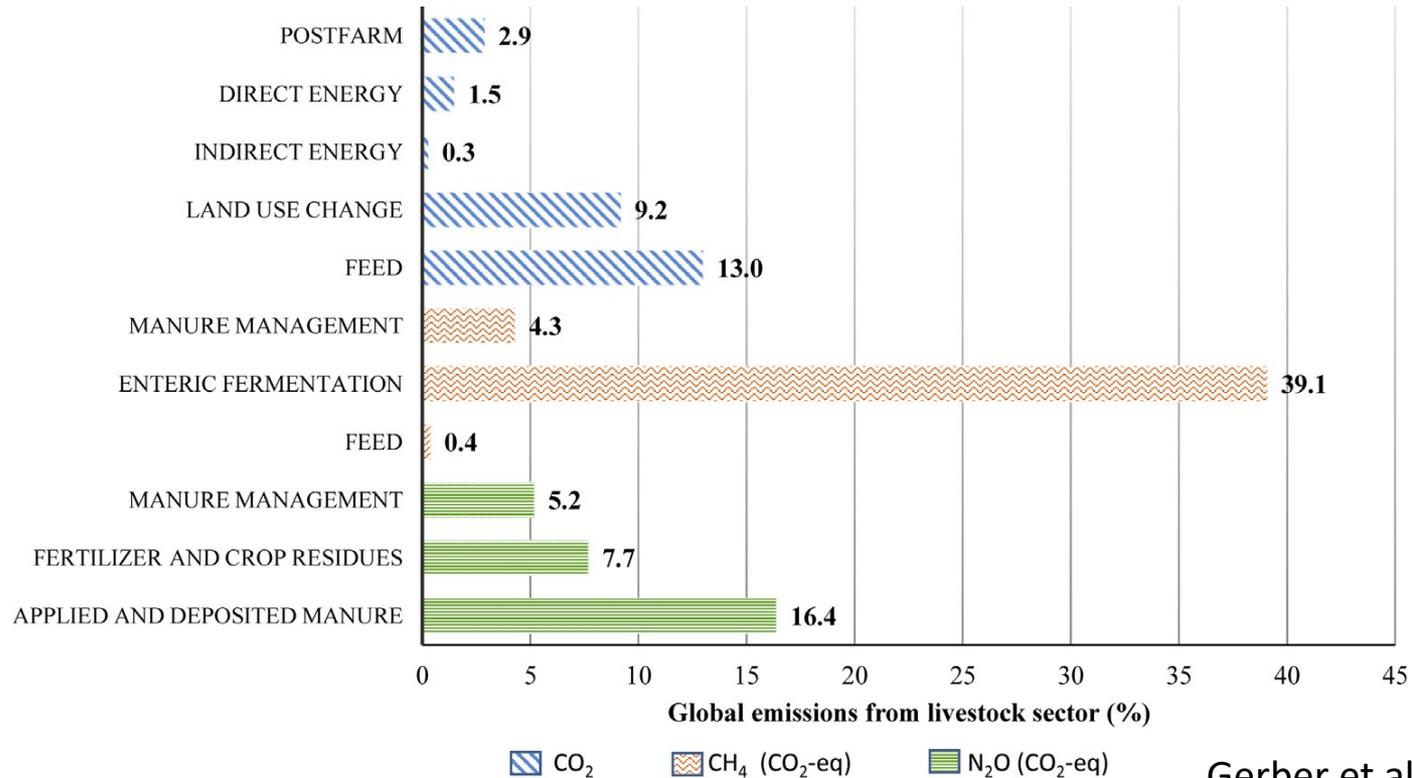
Range of GHG emissions



De Vries and de Boer (2009)



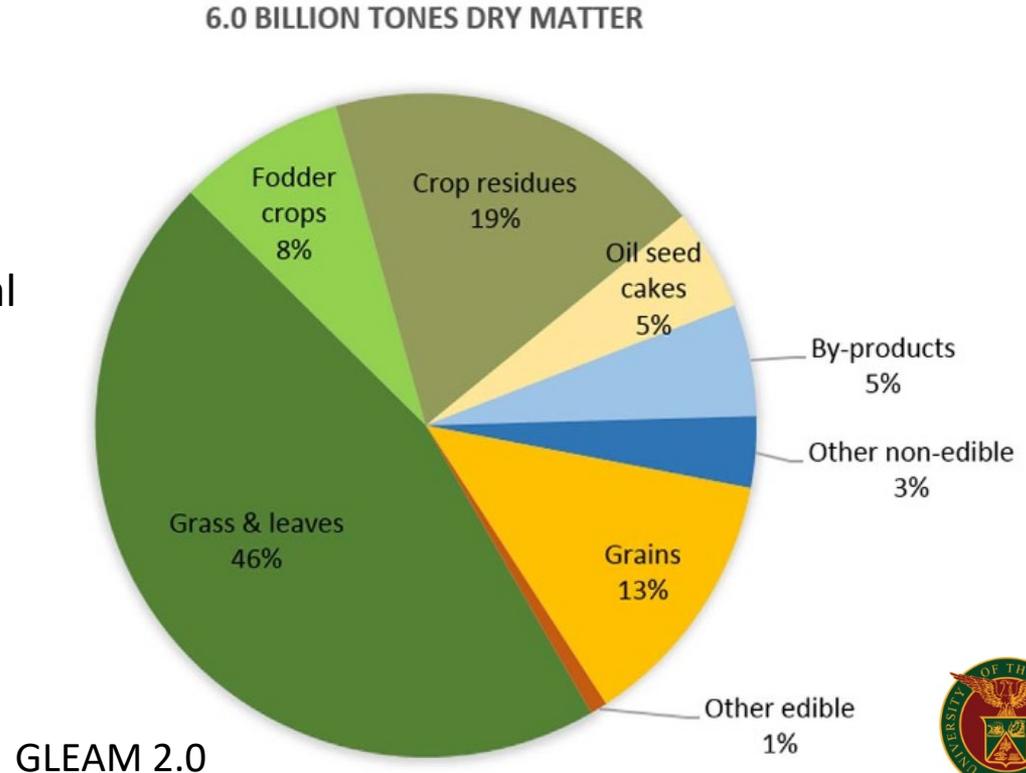
Global GHG emissions from the livestock



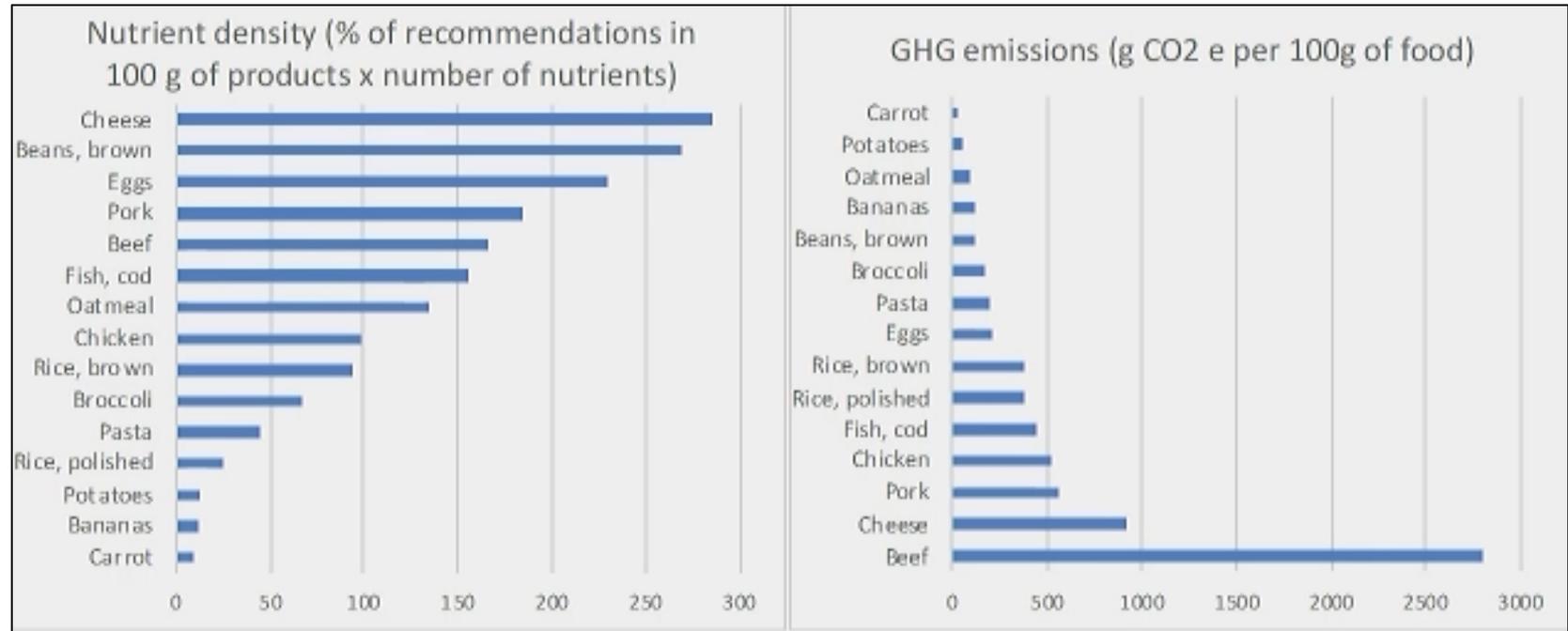
Gerber et al. (2013)

Global livestock feed composition

- Fodder crops: grain and legume silage, fodder beets
- Crop residues: straws and stover, sugar cane tops, banana stems
- By-products: brans, corn gluten meal and feed, molasses, beet pulps, breweries, distilleries, biofuel grains
- Other non-edible: second grade cereals, swill, fish meal, synthetic amino acids
- Other edible: cassava, beans and soybeans, rapeseed and soy oil



Classifications of food based on nutrient density and GHG emissions



Bruun Werner et al. (2014)

Land use change

- Conversion of forests and natural habitats to pasture and cropland
- Land degradation
- Cultivated soils

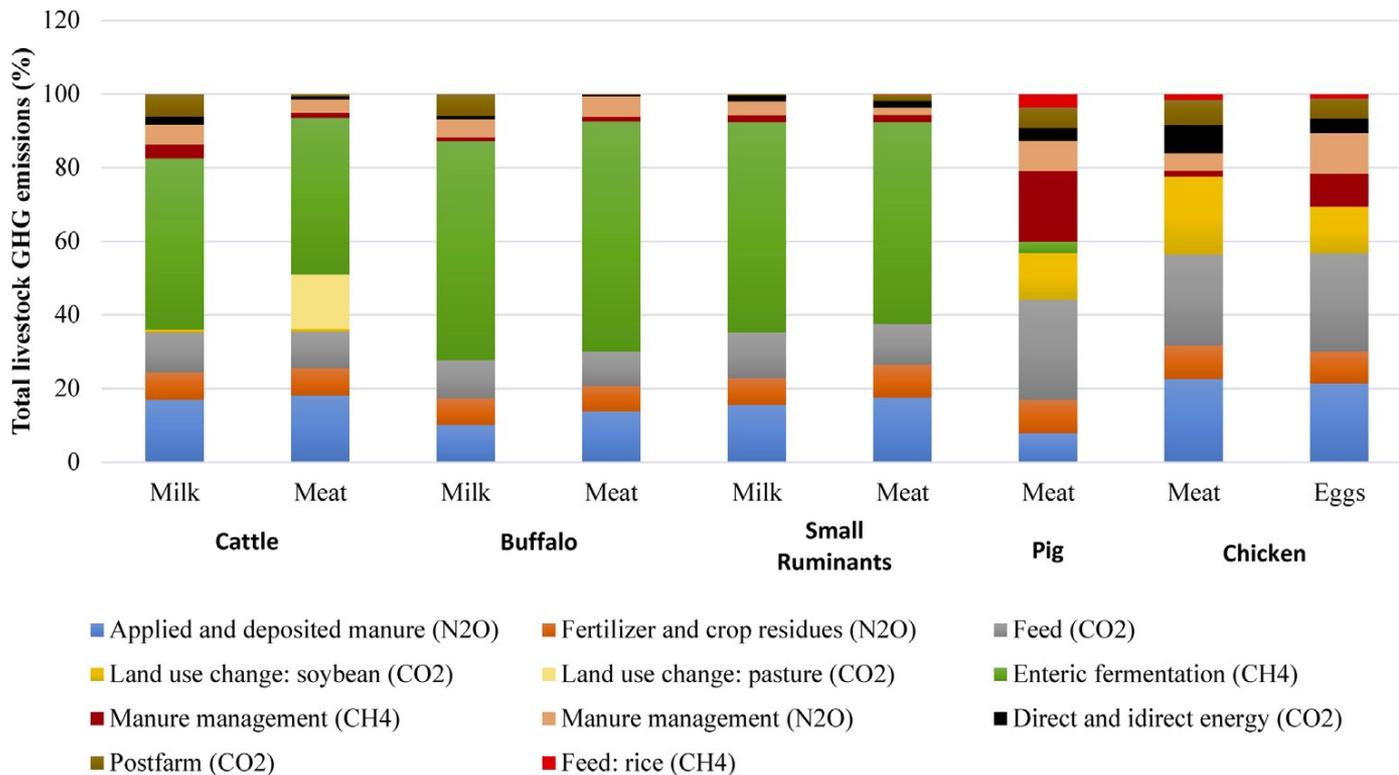


Feed production

- Manufacturing, packaging and transport of fertilizers
- Fertilizer application
- Crop residue management
- Leguminous feed crops
- Atmospheric N depositions
- Agricultural N fixation



Total global livestock GHG emission by specie and product

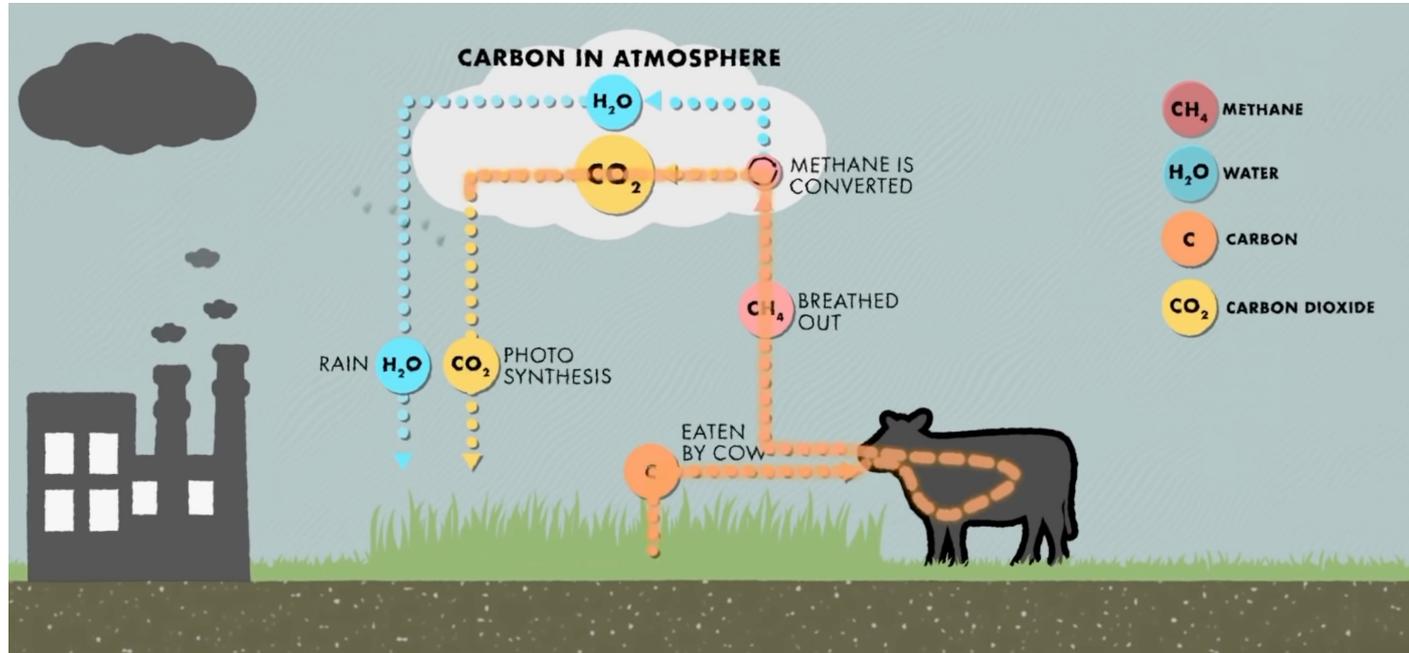


Gerber et al. (2013)



Animal production

- Enteric fermentation by ruminant livestock



Manure

- Manure management
 - Applied and deposited manure
 - Manure storage
 - Manure decomposition

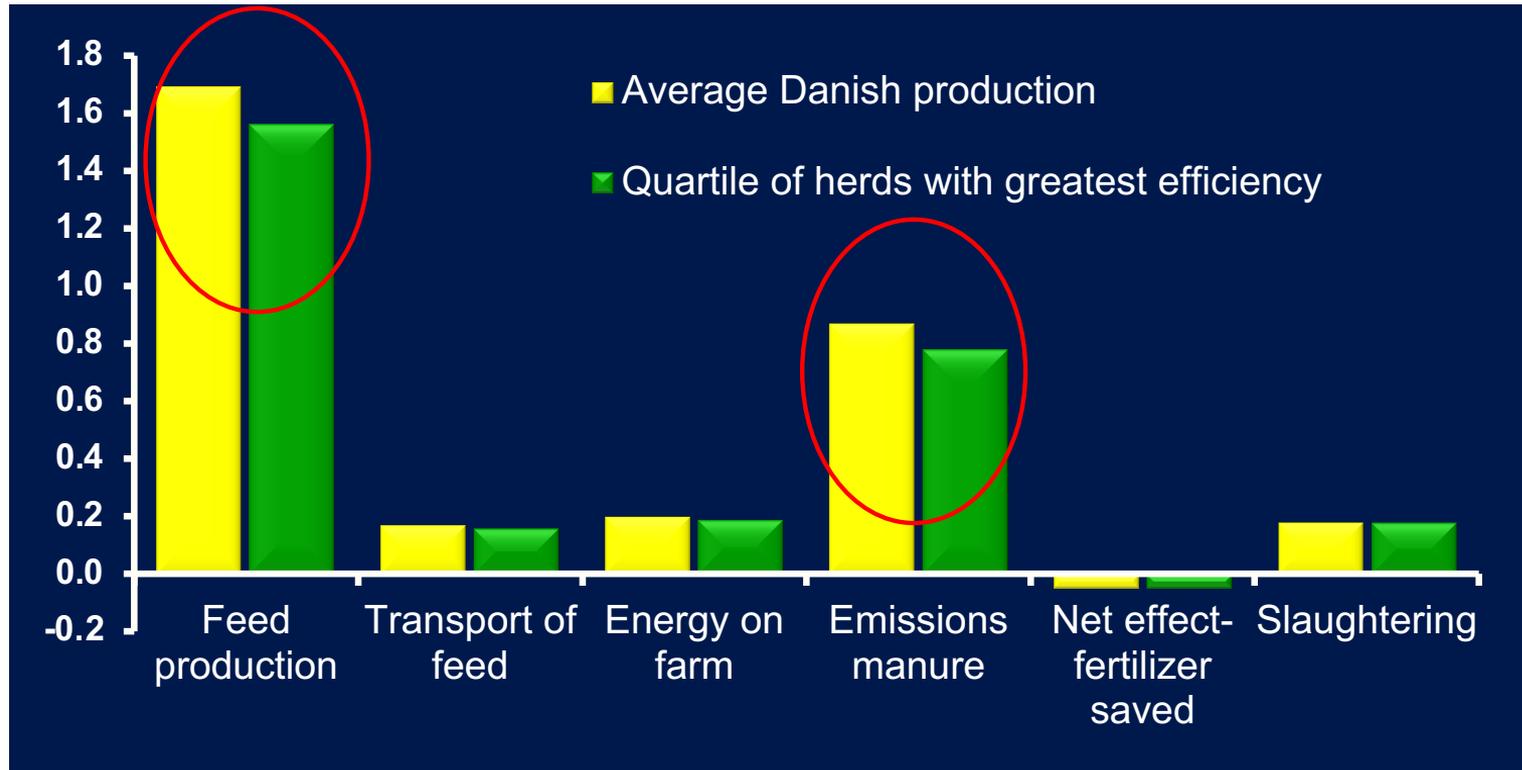


Processing and transport

- Transportation of live animals
- Animal product processing and transportation
- Direct and indirect on-farm energy use



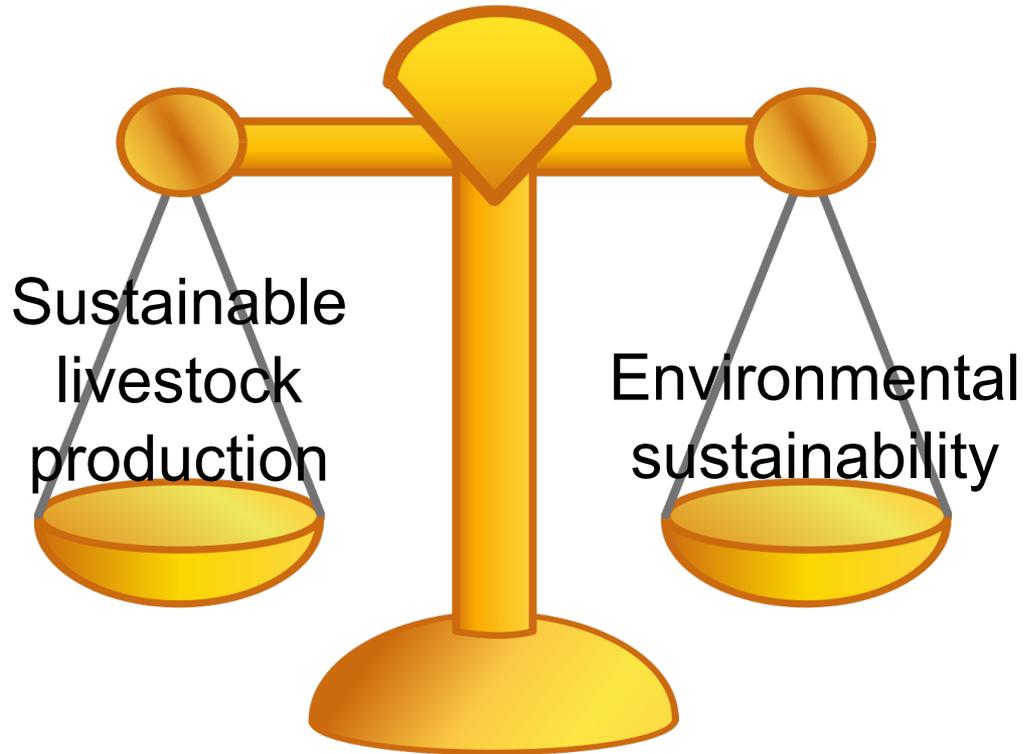
Contribution to the carbon footprint of pork from different processes



Nguyen et al. (2011)



Balancing the discourse between climate change and livestock



Livestock contribution to food security

- 1) Suppliers of global calories, proteins and essential micronutrients
- 2) Produced in areas that have difficulty in growing crops
- 3) Most of the feed for livestock is not appropriate for human consumption
- 4) Provide manure for crop production



Ensuring the future of the livestock industry

- Climate change adaptation, mitigation practices and policy frameworks are critical to protect livestock production
- New technologies will be needed to assure a balance between increased production efficiency and environmental sustainability



Thank You Very Much!



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