



Comparison of different agricultural systems and diets in terms of climate change and food security.

## **Sustainable production of animal proteins**

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December 5, 2024

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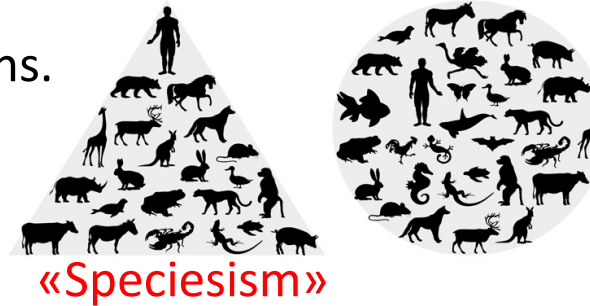
- Livestock farming and meat consumption is increasingly being questioned
- The role of livestock, globally and regionally
- Solutions
- Conclusions

# Livestock farming is increasingly being questioned

# (Unsustainable) livestock production versus maintaining the Earth system (planet) within safe boundaries

**Political challenges:** Paris Agreement (2015), reduction of livestock production and meat consumption part of the emission targets of many countries.

**Societal challenges:** Rising ethical concerns.



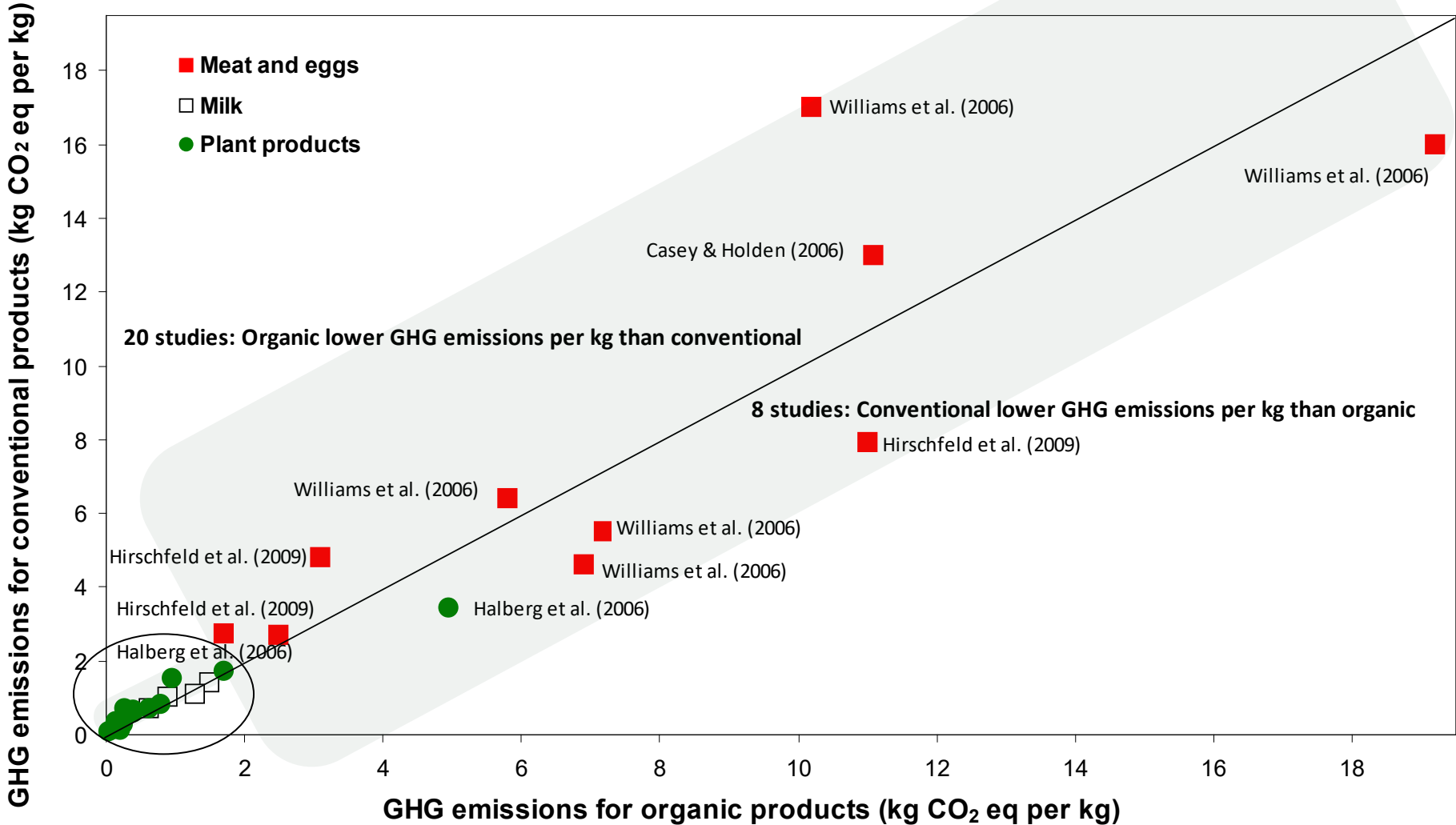
**But:**

**“The Gap: The Science of What Separates Us From Other Animals”**

**by Thomas Suddendorf,**

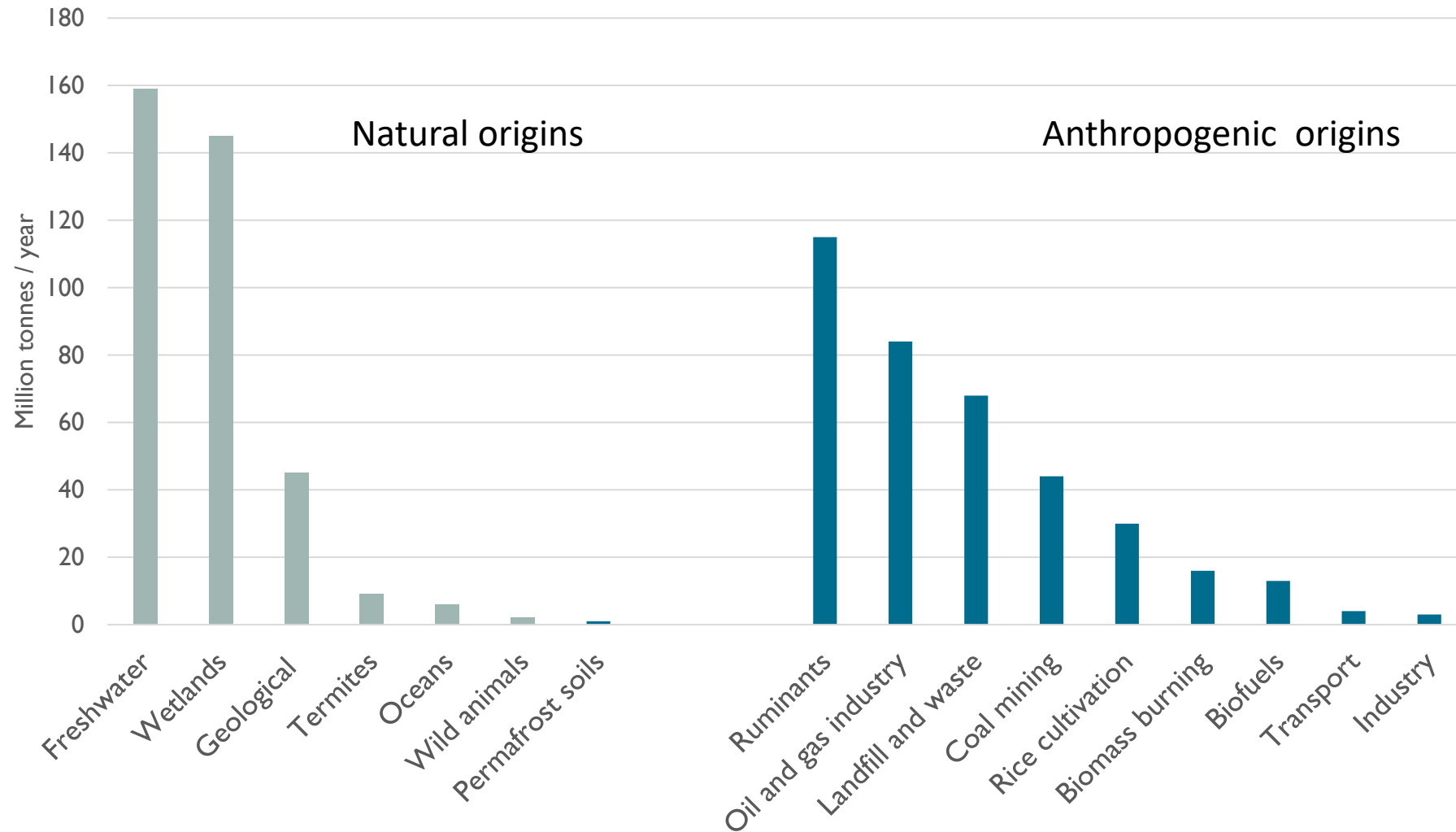
- Ability to use language conceptually, enabling communication of completely new information (enables rapid advances in science and technology).
- Ability to engage in mental time travel. Constantly pondering his future present and past in scenarios.

# Livestock products, esp. from ruminants: high GHG emissions



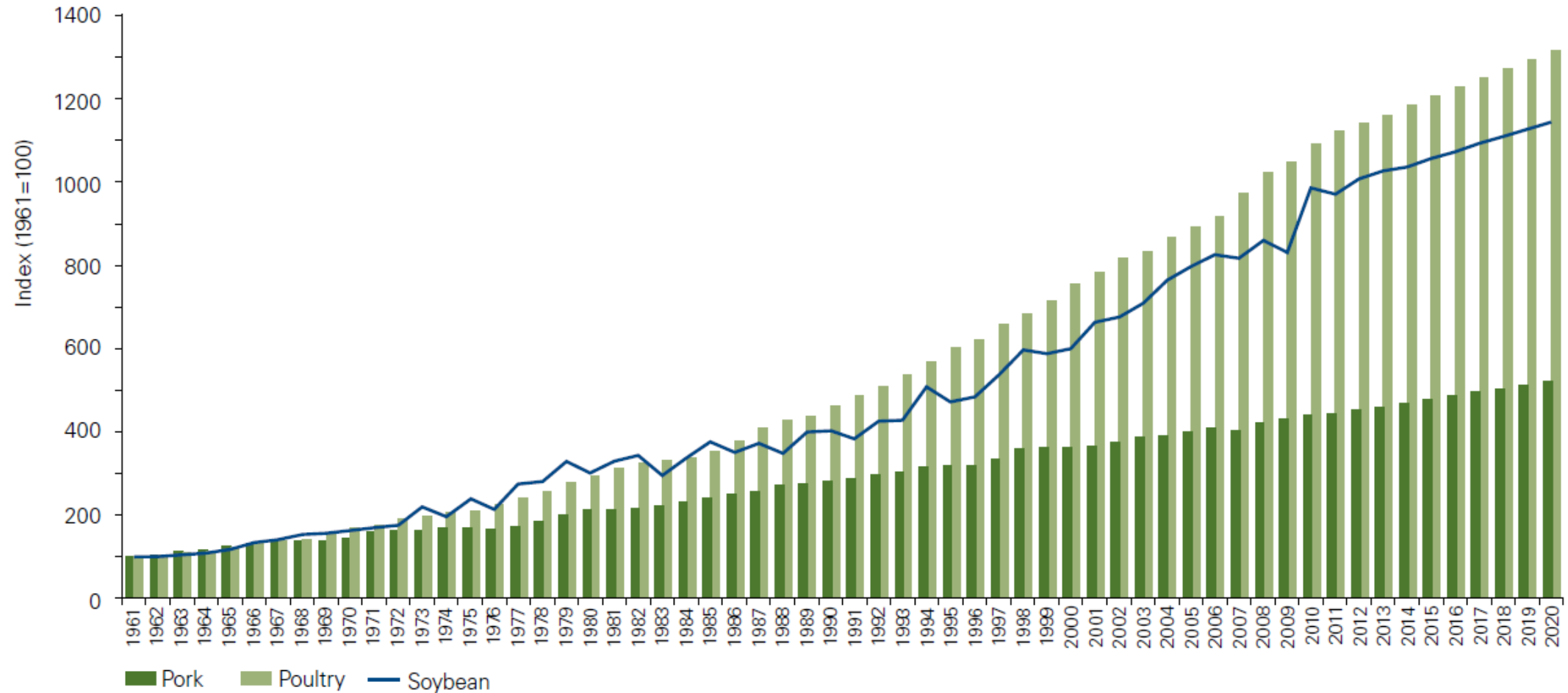


# Global methane emissions in 2021



Livestock systems: their role in the transformation of food systems in the context of climate change. Discussion paper by the Swiss National FAO Committee (CNS-FAO), 2024. [https://www.blw.admin.ch/dam/blw/de/dokumente/International/Institutionen/CNS%20FAO/cns-fao2024.pdf.download.pdf/Livestock%20systems\\_their%20role%20in%20the%20transformation%20of%20food%20systems%20in%20the%20context%20of%20climate%20change\\_CNS-FAO%202024.pdf](https://www.blw.admin.ch/dam/blw/de/dokumente/International/Institutionen/CNS%20FAO/cns-fao2024.pdf.download.pdf/Livestock%20systems_their%20role%20in%20the%20transformation%20of%20food%20systems%20in%20the%20context%20of%20climate%20change_CNS-FAO%202024.pdf)

## Development of global soybean production, pork and poultry 1961-2020: *No changes in eating patterns towards less meat*



Source: FAOSTAT/FAPRI

# Vegan diet or at least a reduction in meat consumption

- Austria: 62.6 kg of meat per person and year net (Lindenthal et al., 2021)
- Germany 57.3 kg (statista, 2022). **Trend minus 30%**
- Switzerland: 40.5 kg (Federal Office for Agriculture, 2022)

The per capita consumption of meat and sausage products recommended by the German Society for Nutritional Research is **12.5 kg** of meat per person per year.

Therefore, for health reasons, a reduction in meat consumption of **70 to 80** per cent would be necessary.

An **80** per cent reduction in meat consumption compared to today also corresponds to the recommendations of the Future Commission on Agriculture, which was set up by Chancellor Merkel (see <https://www.bmel.de/DE/themen/landwirtschaft/zukunftskommission-landwirtschaft.html>)



# The 3 sustainability narratives

- (Eco)efficiency
- **Consistency** e.g. consumer goods that can be completely recycled, which can be used as used materials in a closed system ('closed loops') as high-quality raw materials in the production cycle.
- **Sufficiency** Temperance, to avoid rebound effects.

**“The world has enough for everyone's need,  
but not enough for everyone's greed.”**

*Mahatma Gandhi*

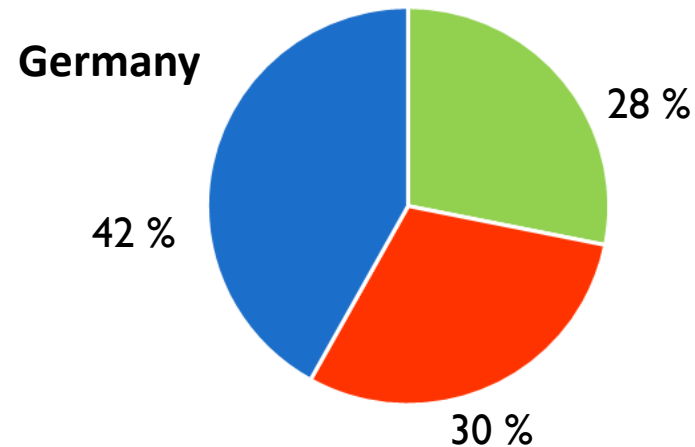
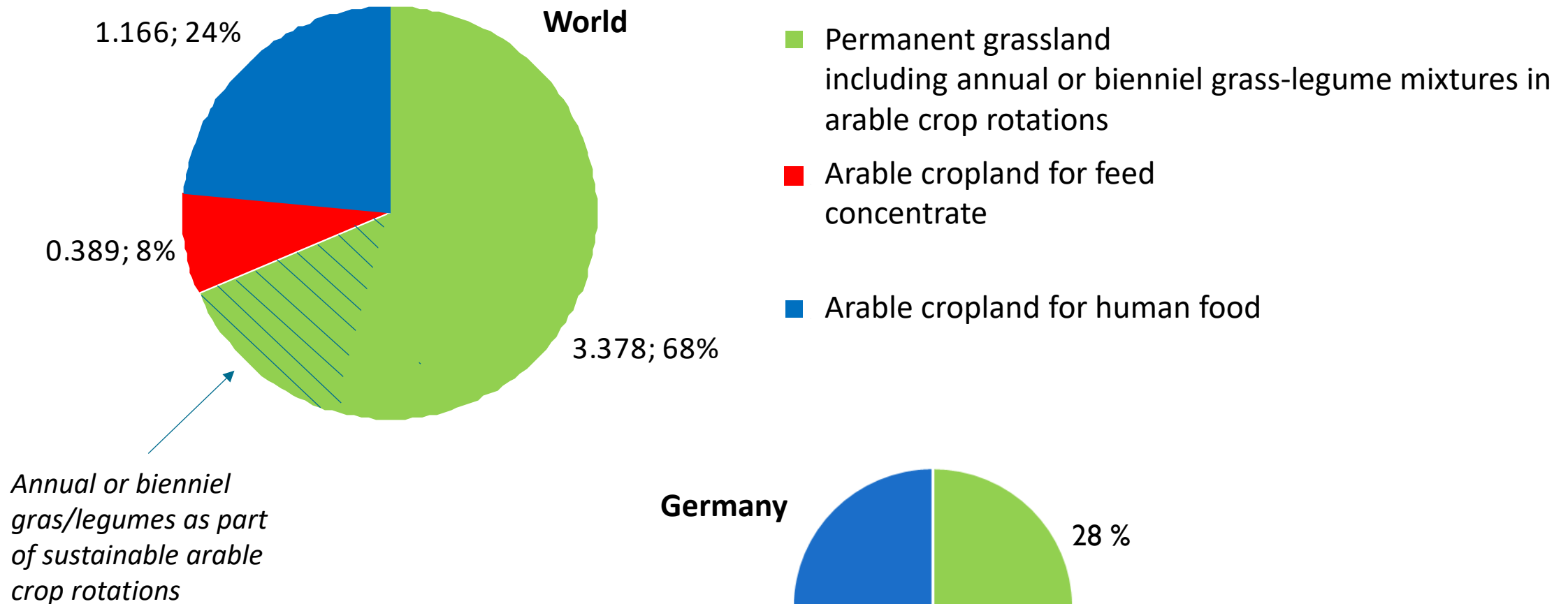
# The role of livestock for sustainable agriculture and nutrition

# More than 1 billion people depend on pastoralism



Some of them are threatened by climate change: overgrazing, soil depletion and erosion, hunger.

# Agricultural land use (in billion hectares)



# Changes in arable land by 2050

		Climate change impact on yields																	
		zero						medium						high					
		% organic						% organic						% organic					
		0	20	40	60	80	100	0	20	40	60	80	100	0	20	40	60	80	100
0	0	0	5	10	17	25	33	21	26	33	40	47	57	46	50	54	58	64	71
	50	-16	-12	-8	-4	2	8	2	7	10	16	22	27	25	26	29	32	35	40
	100	-26	-24	-20	-16	-12	-8	-9	-6	-3	1	5	9	12	13	14	15	17	20
25	0	-6	-1	5	10	18	26	14	20	25	32	40	48	39	42	45	50	56	61
	50	-22	-18	-13	-8	-4	-2	4	0	5	9	14	21	18	20	22	25	27	32
	100	-30	-27	-25	-21	-17	-13	-14	-11	-8	-5	-1	4	6	7	8	8	10	13
50	0	-11	-7	-1	5	11	20	8	13	18	25	32	40	30	34	38	42	47	53
	50	-25	-23	-19	-14	-9	-4	-9	-6	-2	3	8	14	10	12	15	17	21	25
	100	-35	-32	-29	-25	-22	-18	-19	-17	-13	-10	-7	-3	-1	0	1	3	4	7

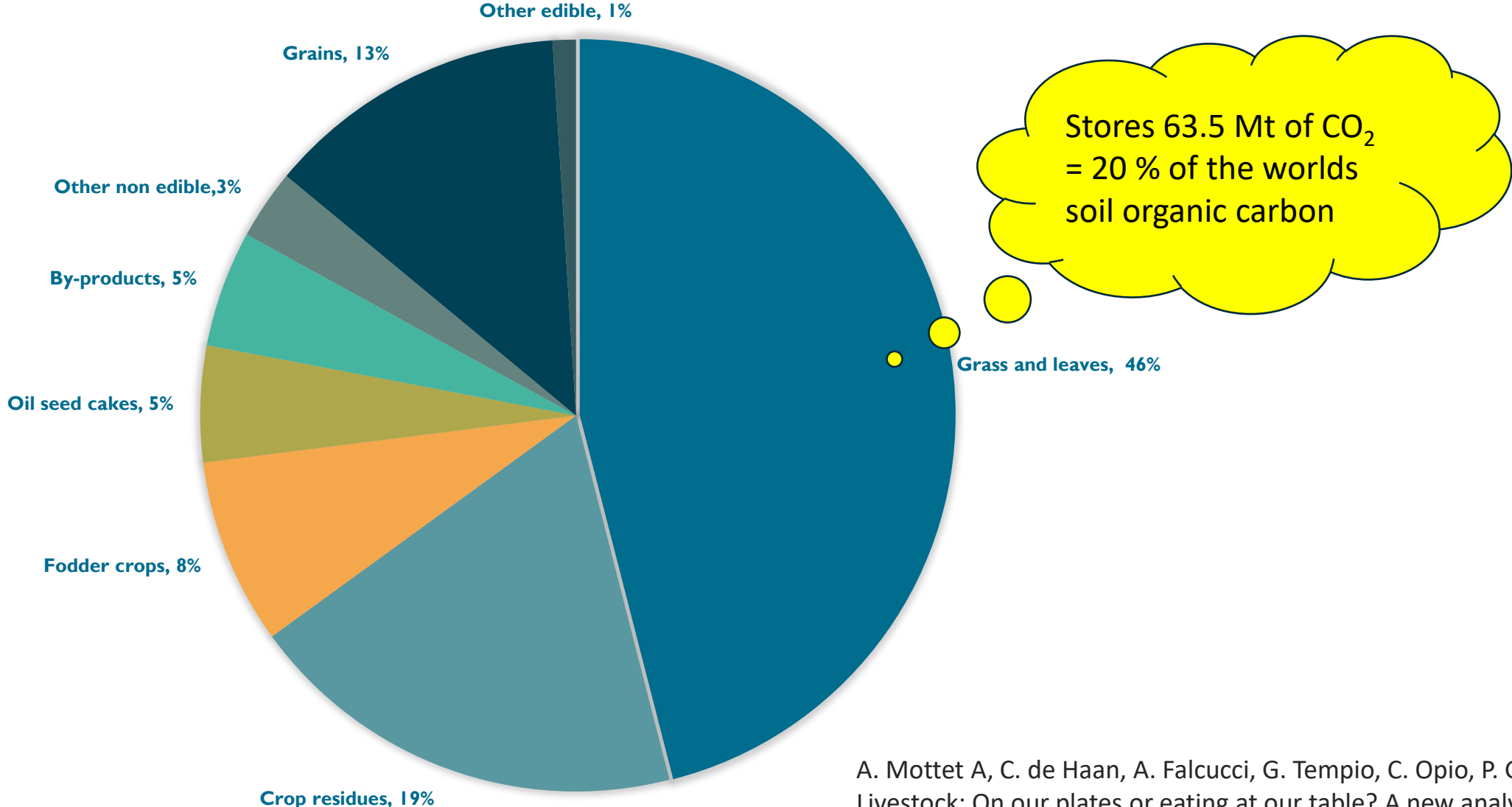
Increasing scarcity of arable land!

## Testing a combination of partial solutions:

- Organic 0 -100 % land area
- Food Wastage 0- 50 % reduction
- Cereal concentrates: 0-100 % reduction
- Global warming: zero, medium, high negative impact on yields

Muller, A., Schader, C., El-Hage Scialabba, N., Hecht, J., Isensee, A., Erb, K.-H., Smith, P., Klocke, K., Leiber, F., Stolze, M. and Niggli, U., 2017, Strategies for feeding the world more sustainably with organic agriculture, **Nature Communications** October/2017.

# Composition of the global livestock diet (6 billion tonnes dry matter)



A. Mottet A, C. de Haan, A. Falcucci, G. Tempio, C. Opio, P. Gerber (2017) Livestock: On our plates or eating at our table? A new analysis of the feed/food debate. *Global Food Sec.* **14**, 1–8.



# Utilization of by-products of grain growing and fruit and wine production, re-utilization of food waste for animal husbandry.



Apple pomace

Wine pomace



Rapeseed cake



Bran (wheat)

Husks (oats)



Sunflower cake



Food Waste to insect protein (Black Soldier Fly *Hermetia illuscens*) for feedstuff



# Restoration of degraded areas through sustainable grassland management: ecological and agronomic potential of the future





# Grassland: hotspots of biodiversity and habitat quality

	Forest	Meadows	Cropland	Settle-ments	Alpine pastures	High mountains
Biodiversity indicators	Vascular plants	21 +/- 1	35 +/- 1	15 +/- 1	19 +/- 1	42 +/- 1
	Mosses	15 +/- 1	6 +/- 1	1 +/- 0	5 +/- 1	19 +/- 1
	Snails	9 +/- 1	6 +/- 1	3 +/- 1	6 +/- 1	3 +/- 1

Biodiversity monitoring Switzerland

→ Agronomic solution: **Graduated intensity** of grassland management. Supported by the Swiss direct payment scheme

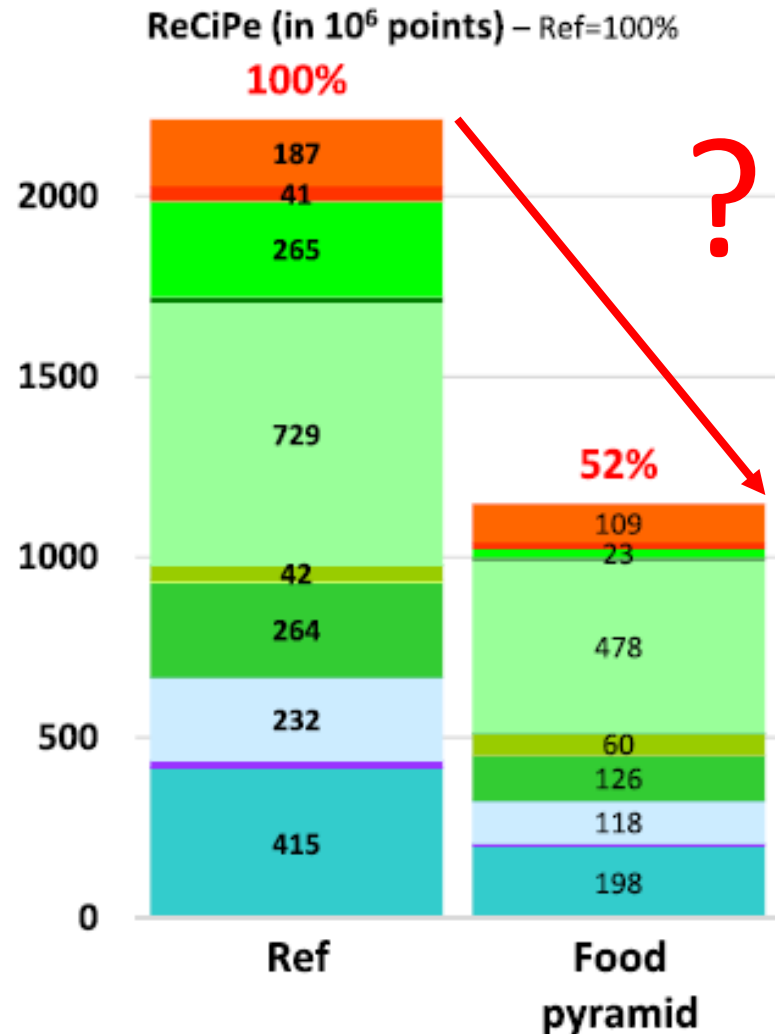


# Plant-based versus animal-based protein



- Per unit area legumes provide 2x more protein than dairy milk and 20x more than meat.
- Meat has very high protein quality (lysine, threonine, methionine, B vitamins (B12), vitamins A, D, K2, iron, zinc, selenium, long-chain omega-3 fatty acids, etc.).

# Comparison of the aggregated environmental impact (ReCiPe) between a reference scenario (=today's diet) and a food pyramid scenario (-69 % meat) **Scenario for Switzerland**



- Resources:**
- Fossil depletion
  - Metal depletion
- Ecosystems:**
- Natural land transformation
  - Urban land occupation
  - Agricultural land occupation
  - Marine ecotoxicity
  - Freshwater ecotoxicity
  - Terrestrial ecotoxicity
  - Freshwater eutrophication
  - Terrestrial acidification
  - Climate change Ecosystems
- Human Health:**
- Ionising radiation
  - Particulate matter formation
  - Photochemical oxidant formation
  - Human toxicity
  - Ozone depletion
  - Climate change Human Health
- Bold: Percentage of total indicator >1% (Ref)

# HOW?

- Information
- Education
- Recommendations
- Nudging
- Voluntary initiatives of the food chain
- Legal restrictions and prohibitions.



Source: (von Ow et al., 2020), ReCiPe: Aggregierter Indikator zur Umweltwirkung Agroscope, Bundesamt für Landwirtschaft

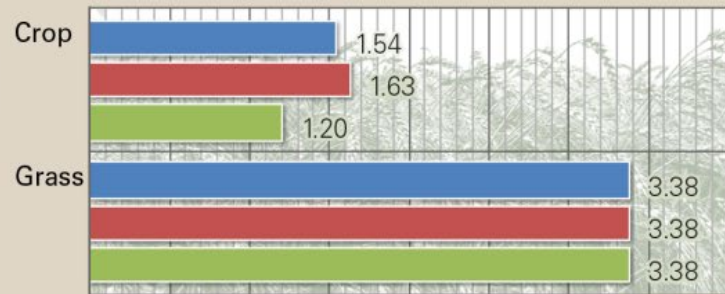


## Land use

Billion hectares

Land occupation:

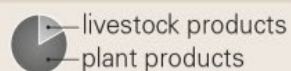
- Current situation: Base year
- 2050: Reference scenario
- 2050: Food - not feed



## Diets

### Energy intake

Kcal/cap/day



total: 2,763



Current situation:  
Base year

total: 3,028



2050:  
Reference Scenario

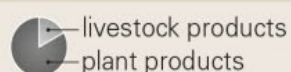
total: 3,028



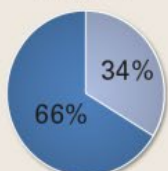
2050:  
Food - not feed

### Protein intake

G Protein/cap/day

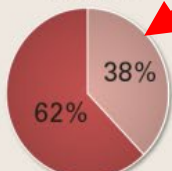


total: 77



Current situation:  
Base year

total: 82



2050:  
Reference Scenario

total: 78

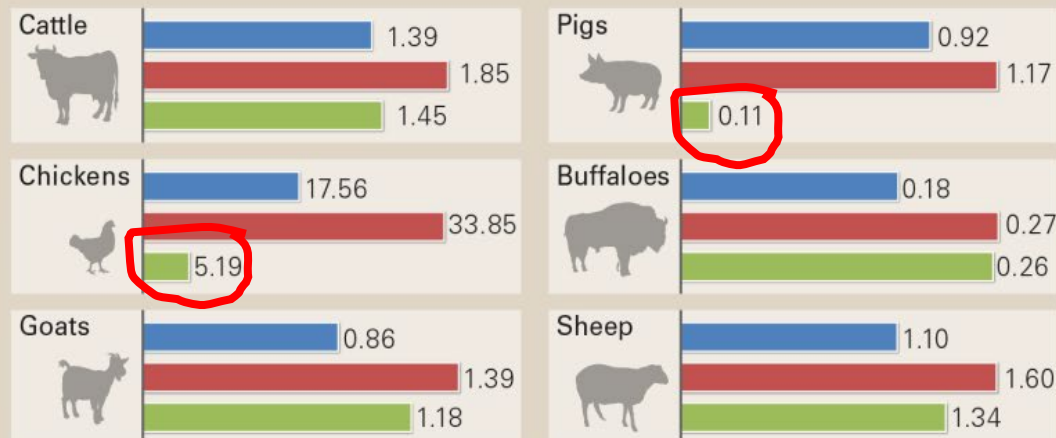


2050:  
Food - not feed

## Livestock

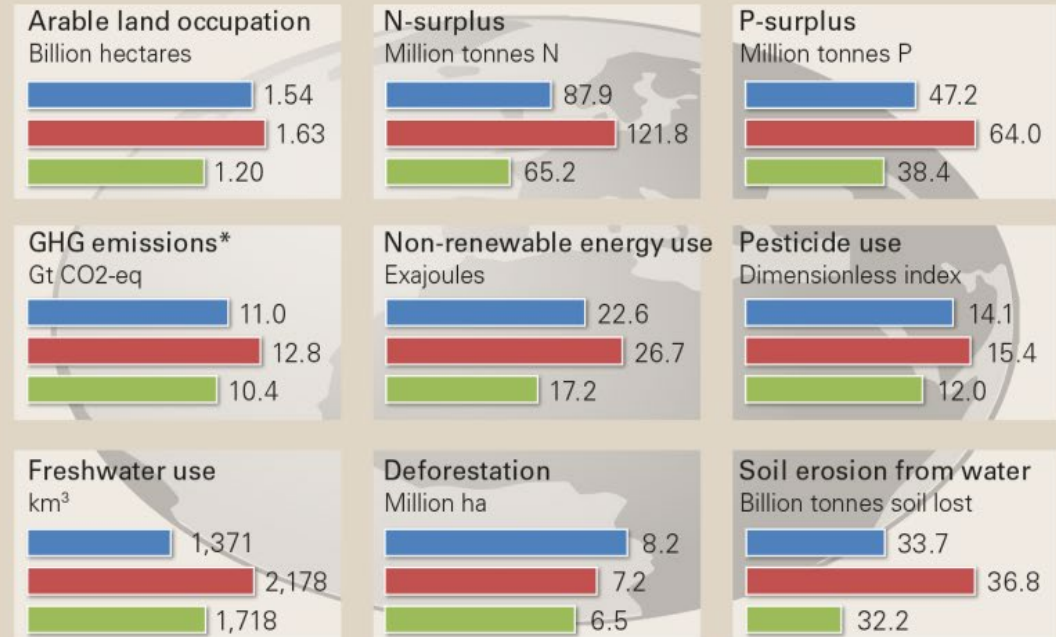
Billion animals

Current situation: Base year 2050: Reference Scenario 2050: Food - not feed



## Environment

Current situation: Base year 2050: Reference Scenario 2050: Food - not feed



\* GHG emissions include emissions from input provision, deforestation and organic soils.

## Modelling of "Feed no Food"

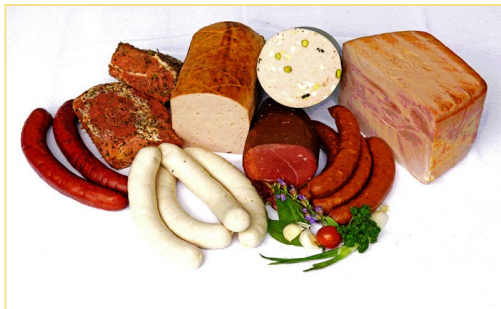
SOLm model of FiBL and  
FAO)

Schader C., Müller A., Scialabba N.E., Hecht J., Isensee A., Erb K.H., Smith P., Makkar H.P.S., Klocke P., Leiber F., Schwegler P., Stolze M. & Niggli U. (2015): Impacts of feeding less food-competing feedstuffs to livestock on global food system sustainability. *Journal of the Royal Society Interface* 12(113): 20150891.



## Trends in sustainable protein supply of the future

- Shift from livestock-based proteins to plant-based (peas, beans, soybeans, lentils, lupins, chickpeas etc.).
- Roughage-based ruminant production (80 to 90 % on grassland).
- Increasing quantities of by-products of plant production and processing.
- Food waste reintegration (technically possible, legally still restricted/prohibited).
- Alternatives like insects, algae: topical in research.
- Stem-cell production of muscle and fat fibres: not yet upgradable



# Conclusions

- Sustainable food production within safe planetary boundaries is only possible with sustainable nutrition.
- Sustainable livestock farming and sustainable grassland management are crucial for achieving the SDGs (especially food security).
- A reduction of at least 50% in animal protein will occur, but only slowly.
- A shift within the livestock spectrum (monogastric -> ruminant) will be necessary.