

atf

animal
task
force

A European Public-Private Partnership



EAAP

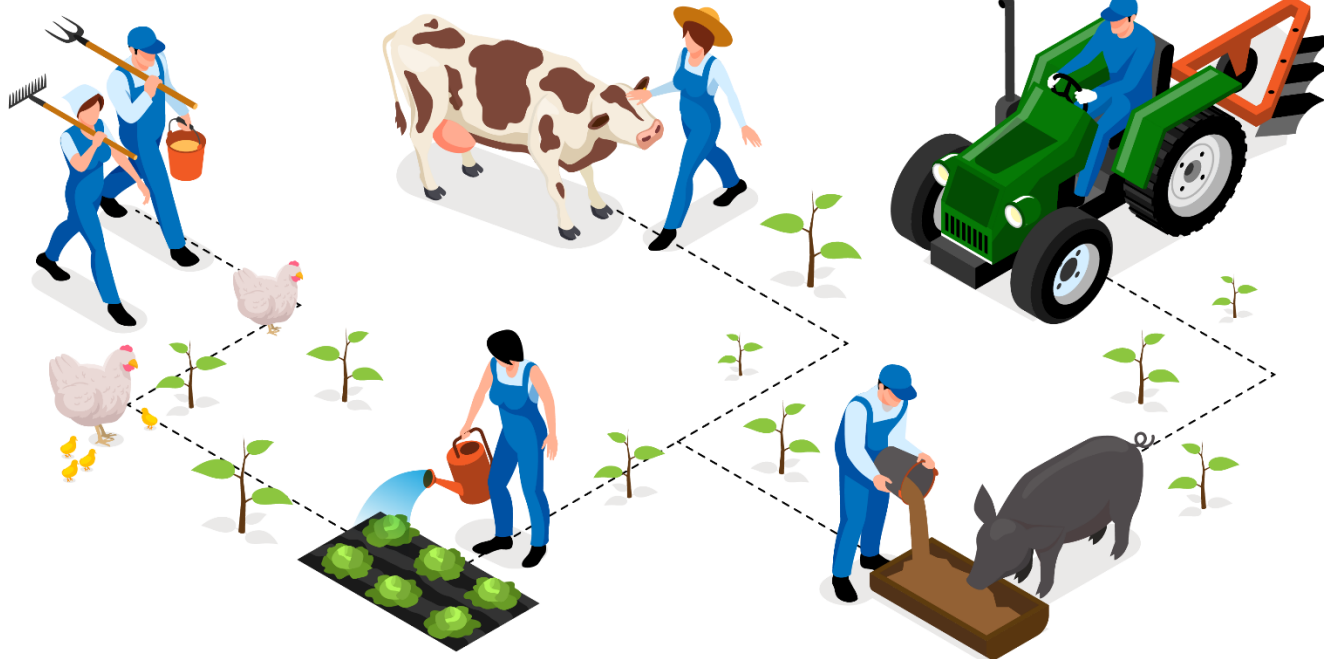
European Federation of Animal Science



3rd one-day symposium of the Animal Task Force & the EAAP Commission on Livestock Farming Systems:

Sustainable livestock farming – defining metrics and rationalising trade-offs?

'SUSTAINABLE LIVESTOCK SYSTEMS'
– what does this mean?



Friend or Foe?

The role of animal-source
foods in healthy and
environmentally sustainable
diets

Lutz Merbold, Ty Beal, Christopher D Gardner,
Mario Herrero, Lora L Iannotti, Stella Nordhagen,
and Anne Mottet



Motivation

plenty of discussions about:

- the health consequences of animal sources foods, and
- environmental negativities of livestock agriculture
- often polarizing

difficulty of keeping track on the literature and lack of a comprehensive review

-> Invited Review



The Journal of Nutrition
Volume 153, Issue 2, February 2023, Pages 409-425



Critical Review

Friend or Foe? The Role of Animal-Source Foods in Healthy and Environmentally Sustainable Diets

Ty Beal^{1,2}, Christopher D. Gardner³, Mario Herrero⁴, Lora L. Iannotti⁵, Lutz Merbold⁶, Stella Nordhagen⁷, Anne Mottet⁸

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<https://doi.org/10.1016/j.tjnut.2022.10.016>

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Abstract

Scientific and political discussions around the role of animal-source foods (ASFs) in healthy and environmentally sustainable diets are often polarizing. To bring clarity to this important topic, we critically reviewed the evidence on the health and environmental benefits and risks of ASFs, focusing on primary trade-offs and tensions, and summarized the evidence on alternative proteins and protein-rich foods. ASFs are rich in bioavailable nutrients commonly lacking globally and can make important contributions to food and nutrition security. Many populations in Sub-Saharan Africa and South Asia could benefit from increased consumption of ASFs through improved nutrient intakes and reduced



FAO principles: Sustainable healthy diets...



-are based on a great variety of unprocessed or minimally processed foods, balanced across food groups, while restricting highly processed foods and beverages
- ... include wholegrains, legumes, nuts and an abundance and variety of fruits and vegetables
- ... can include moderate amounts of eggs, dairy, poultry and fish; and small amounts of red meat
- ... include safe and clean drinking water as the fluid of choice
- ... reduce food loss and waste



FAO principles: Sustainable healthy diets...



nutrient dense foods

Jeudi 26 janvier 2023

**Une alimentation saine et durable:
nous avons le choix 3 fois par jour**

10^e Conférence Agroscope sur la durabilité



FAO principles: Sustainable healthy diets...





a lot has happened since «Friend or Foe»

Special Issue in Animal Frontiers «The societal role of meat – what the sciences says» - Eds. Peer Ederer & Frederic Leroy

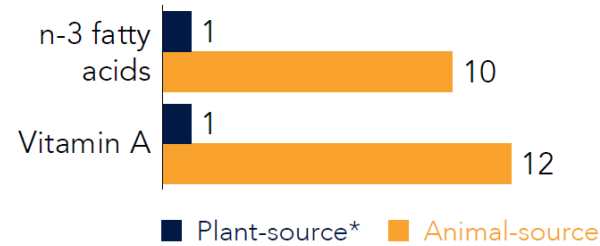




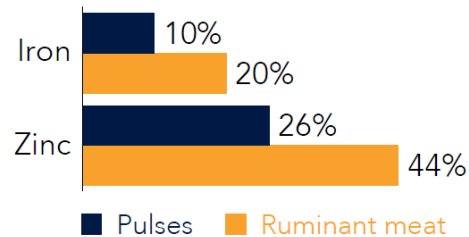
Livestock & Human Health: Benefits

Nutrient bioavailability

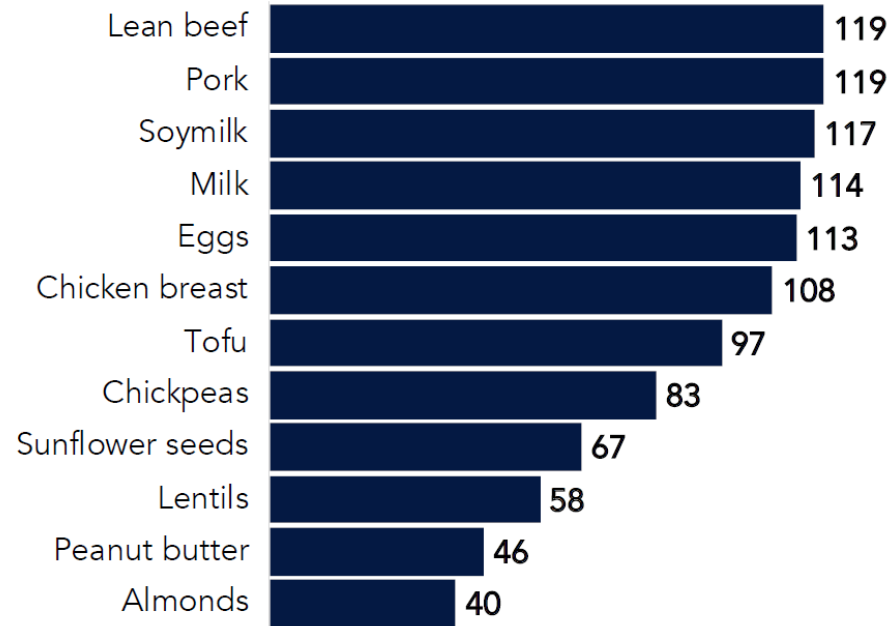
Bioavailability (proportion of plant-source)^{1.pdf}



Bioavailability (% absorbed)



Digestible indispensable amino acids scores (DIAAS)

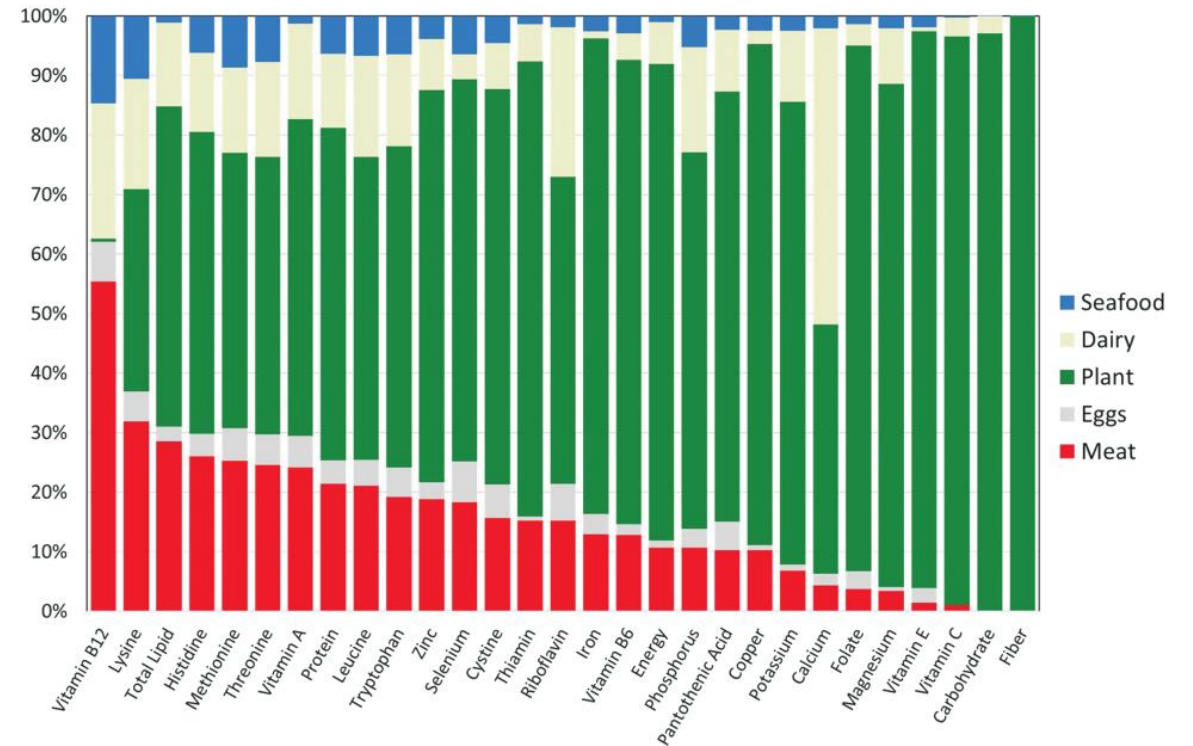
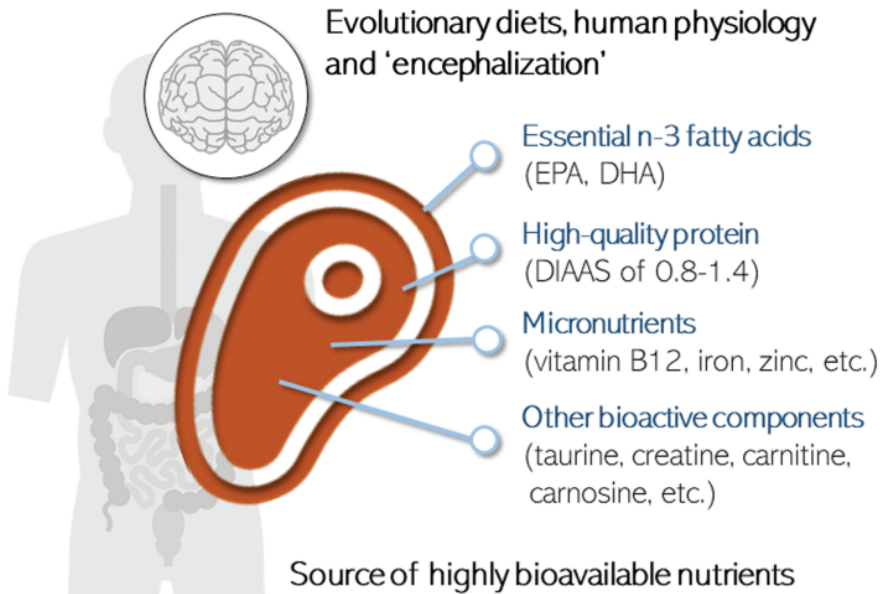


Beal et al. 2023

- Nutritional composition: bioavailable vitamins and minerals (B12, D, A, iron and zinc), long-chain n-3 fatty acids and amino acids
- only soy products come in some cases close to ASF



Livestock & Human Health: Benefits



- ASF provide a broad spectrum of nutrients
- Populations that consume little ASF tend to suffer from associated health problems associated with low intake of specific micronutrients or from deficient quality protein



Livestock & Human Health: Risks

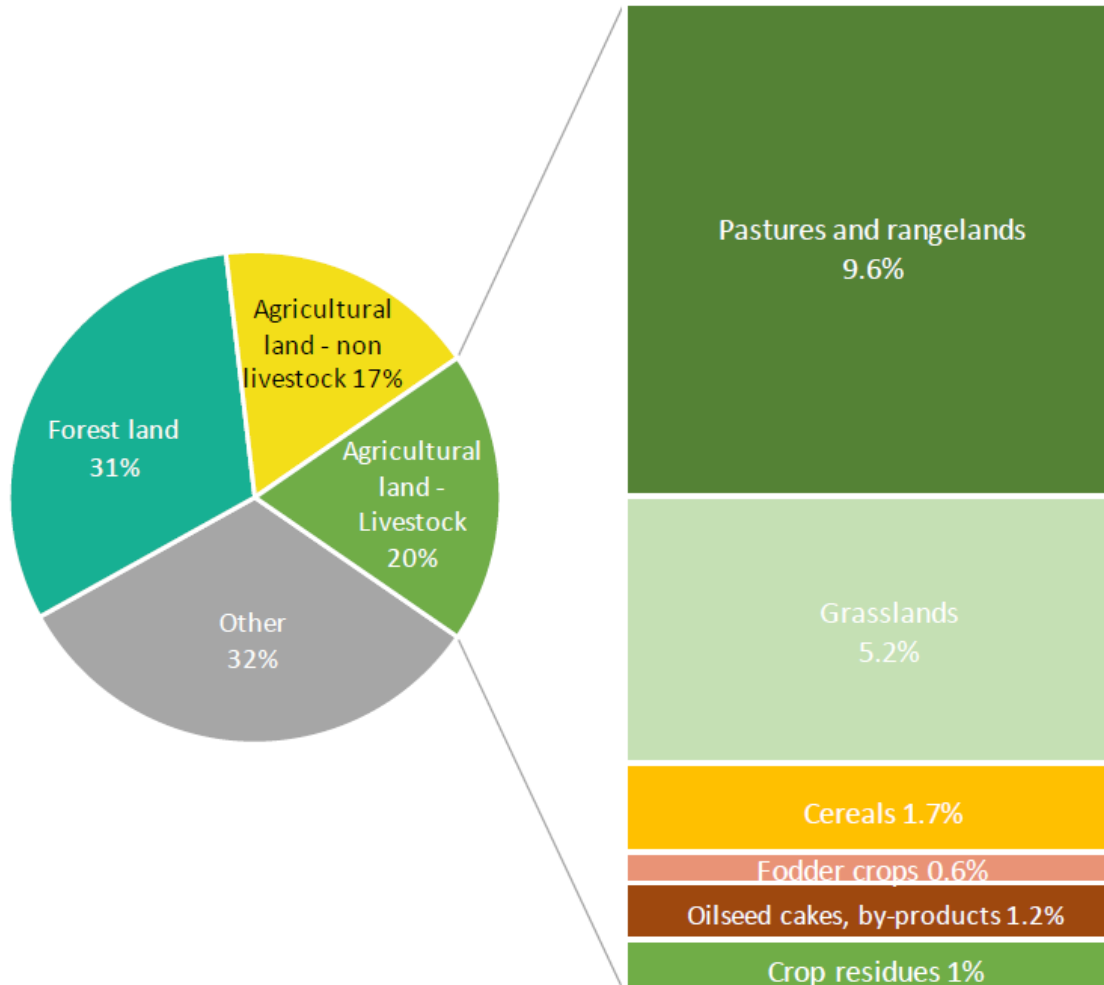
- Excessive consumption of ASF and not in combination with plant-rich diets can lead to NCDs (diabetes, cholesterol etc.) – ie. processed meat, uncured meat & saturated fat Beal et al. 2023

- Grading of Recommendations Assessment, Development, and Evaluation (GRADE) system
 - > a reduction of meat intake below the current levels of consumption is not sufficiently supported to warrant public policy for health reasons
 - > dietary recommendations should focus on healthy meal patterns tailored to individual needs Johnston et al. 2023

- > need for nutrient-dense foods with high quality proteins and greater variety within and across food groups - dietary recommendations for children Iannotti et al. 2022



Livestock & Environment: Land



1.38 billion ha of land that is unsuitable for arable farming is used for food production via ruminants

0.7 of the 2 billion ha of grassland currently used for livestock farming could also be used for arable production (though with other negativities). In addition, 0.55 billion ha of arable land – 40% of the world’s farmland – is currently used to grow animal feed.

Arable land, equivalent to 30% of global arable land, with regional differences

Allocation of part of the arable land used primarily for oilseeds and grains

Beal et al. 2023

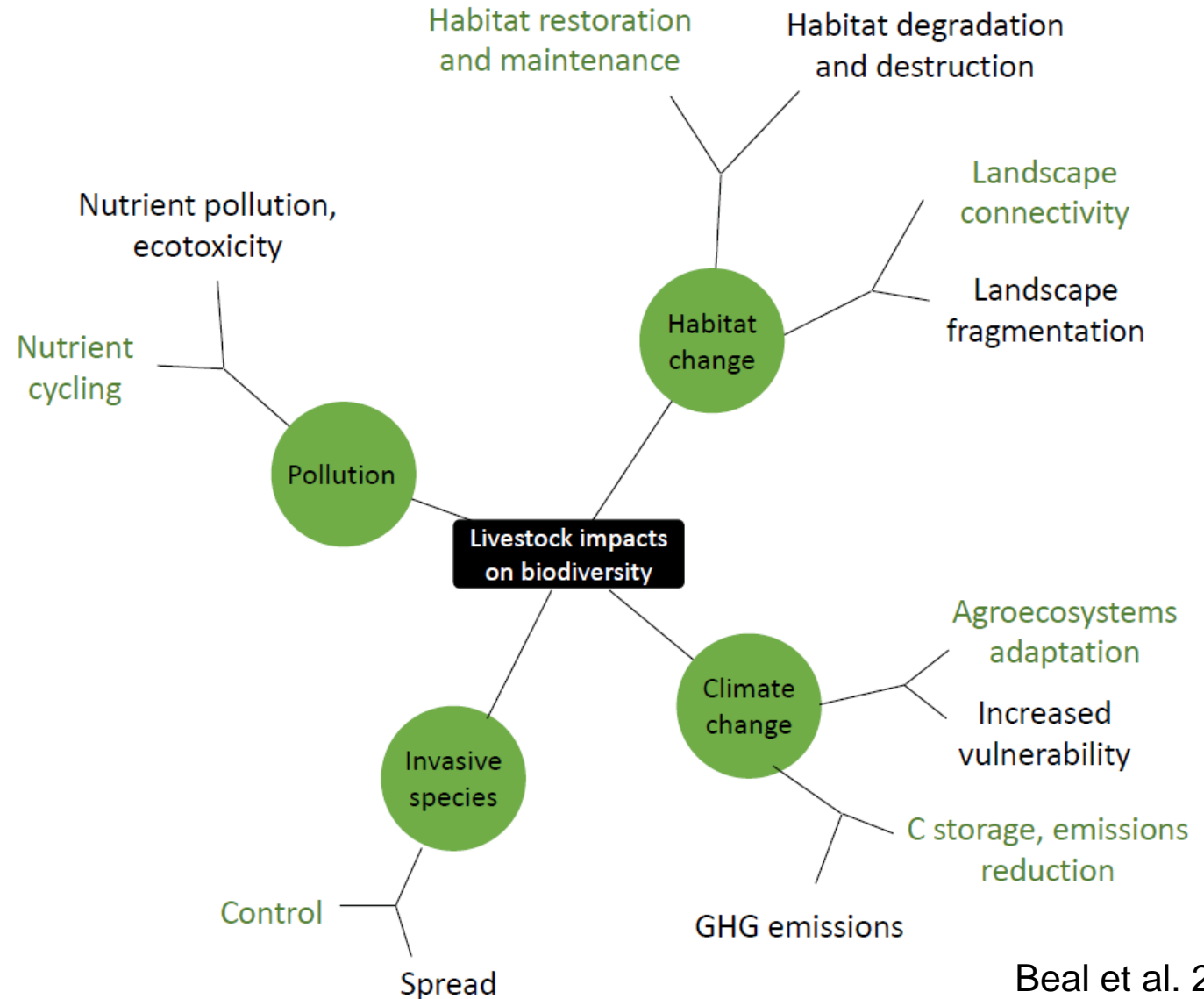


Livestock & Environment: Biodiversity

Simplified impacts on biodiversity (+/-)

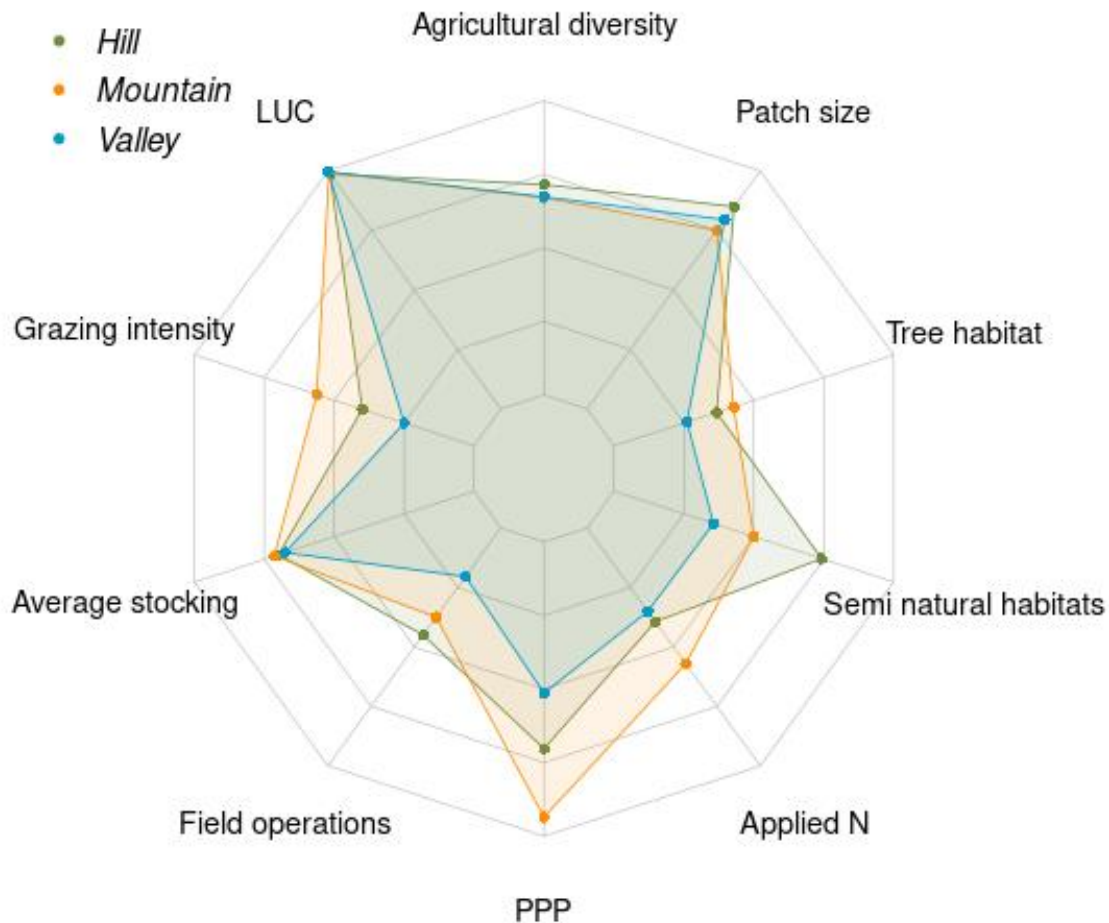
long history of livestock husbandry in Europe has led to extremely biodiverse ecosystem types

overfertilization and pollutants from livestock farming endanger biodiversity





Livestock & Environment: Biodiversity



- Assessing biodiversity in swiss agricultural systems via proxy data from an existing monitoring network
- 10 drivers of biodiversity
- “Planned” vs “unplanned” biodiversity

-> Systems with livestock have higher landscape biodiversity

-> in parallel continuous assessment of other environmental dimension

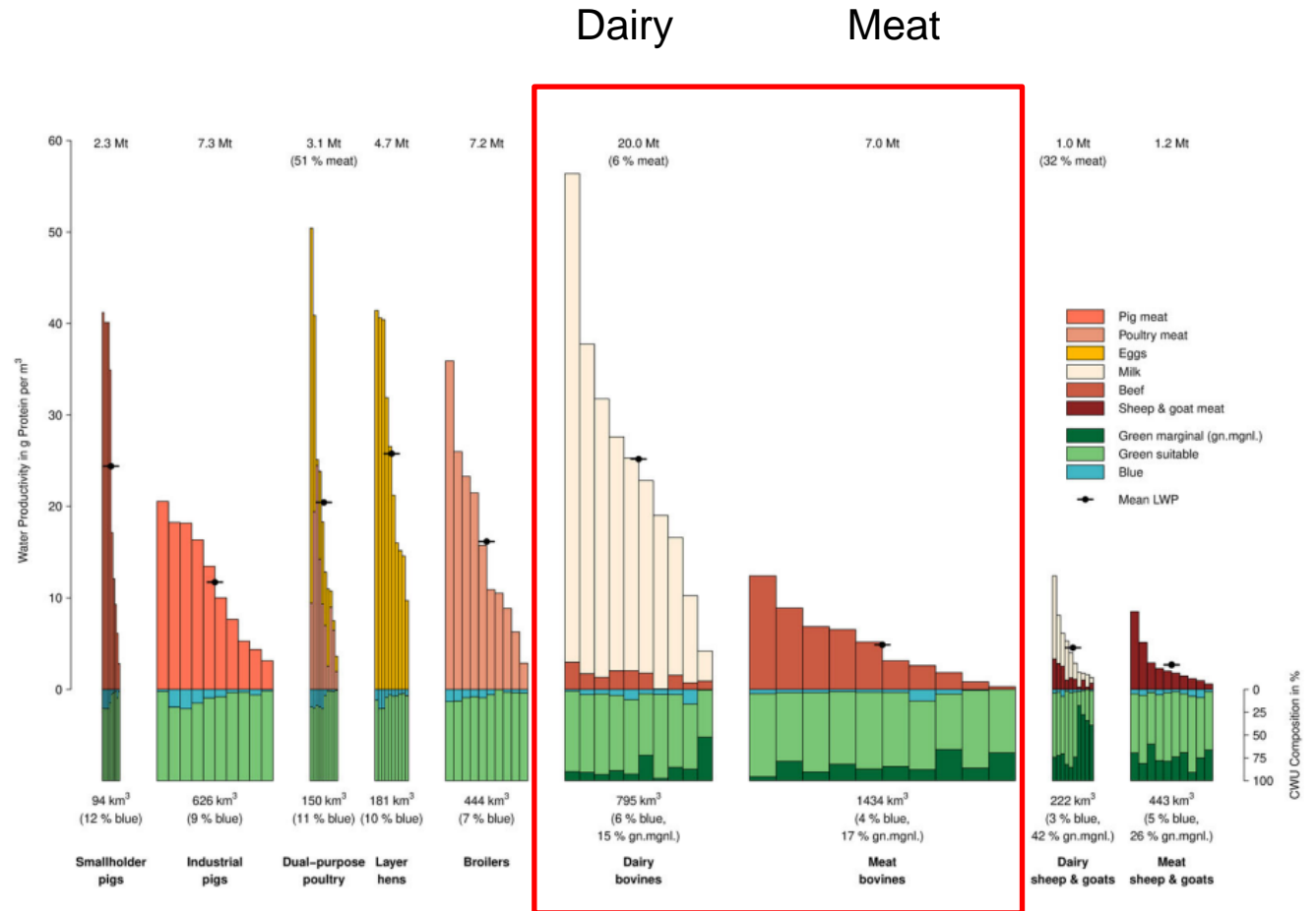
Example for three regions in Switzerland

Gilgen et al. in prep.



Livestock & Environment: Water

- Livestock uses 41% of total CWU for agricultural biomass for human use (Consumptive Water Use)
- 9 livestock systems, 3 types of water
- Problem of sanitation and climate (losses in gaseous form) affects livestock, humans and wildlife



Heinke et al. 2020



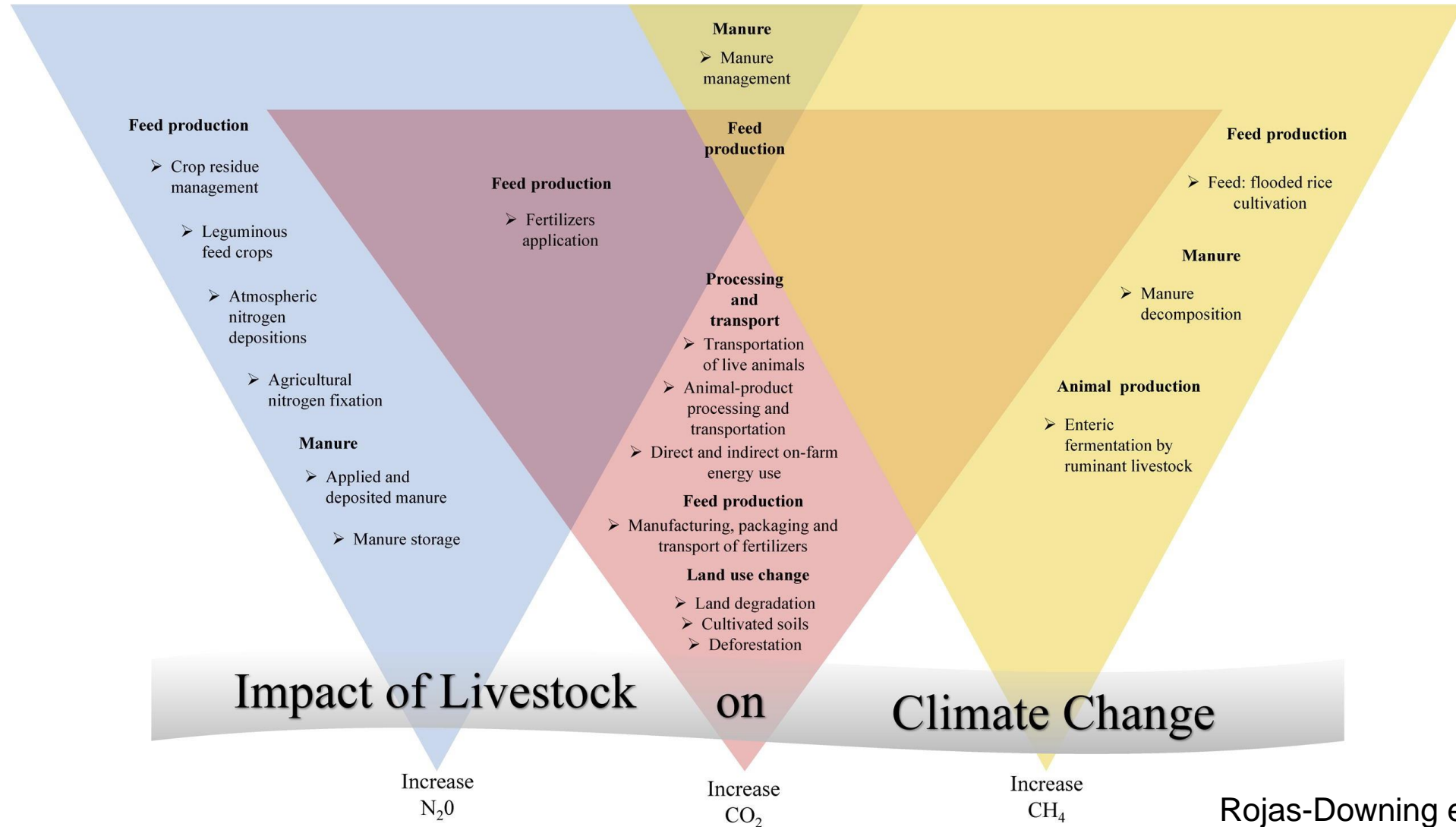
Livestock & Environment: Soils

- Majority of food (95%) is grown on soils
- Livestock manure allows to move organic matter, nutrients and water within agroecosystems
- Soil management to improve fertility via enhance availability of nutrients (50% of all cultivated areas use draught power from livestock)
- Frequent tillage however can also favor erosion, while trampling can cause compaction -> leading to erosion or reduced infiltration
- Manure can substitute the use mineral fertilizers (current price shocks) and is beneficial to build organic matter
- Excessive use of manures or inappropriate handling leads to emissions and leaching and health aspects

Beal et al. 2023



Livestock & Environment: Climate

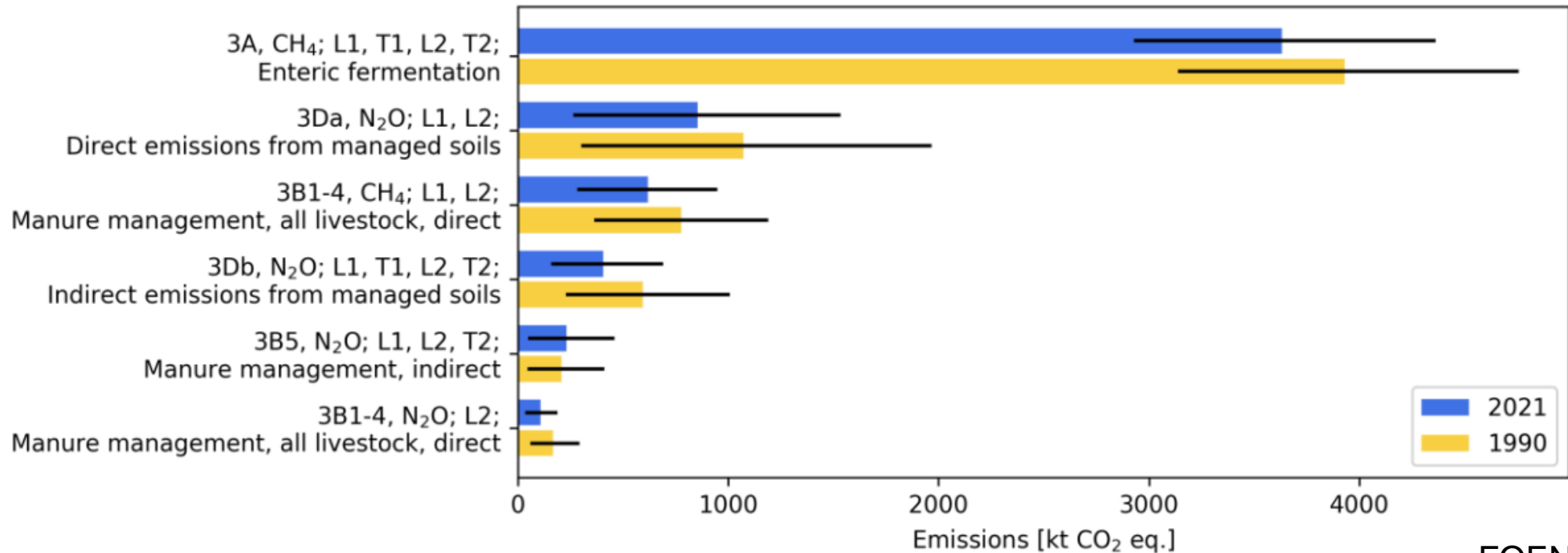


Rojas-Downing et al. 2017



Livestock & Environment: Climate

- Agriculture is the third biggest contributor to greenhouse gas emissions
- Methane from enteric fermentation is a large part of this



FOEN 2023

- **Metrics are not a bottleneck: established methods are available to answer specific questions**



Livestock & Environment: Climate

Mitigation

Supply-Side

- (i) improve efficiency and productivity;
- (ii) better integrate ruminants in the circular bioeconomy
- (iii) increase soil organic carbon content, particularly in pastures

Demand-Side

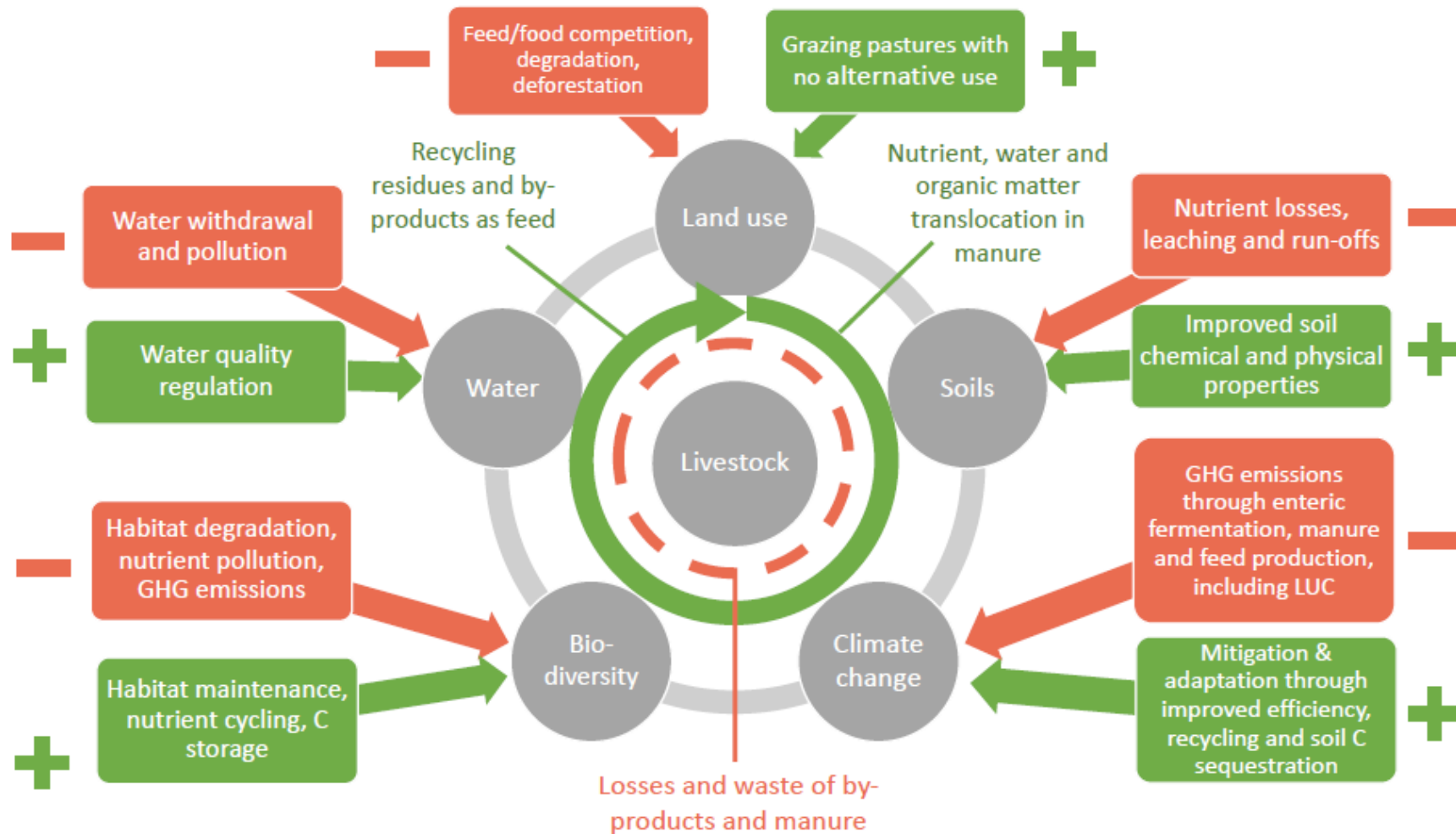
- (i) shift to balanced, sustainable, and healthy diets + 20%
- (ii) reducing food loss and waste

Adaptation

- Mobility & ability to consume diverse feed resources
- Animal genetic resources
- Circularity



Livestock & Environmental: Summary



Beal et al. 2023



Livestock & Environment: Circularity

- minimizing external inputs and losses, reusing waste, and regenerating ecosystems
- enhancing the benefits and reducing the negative impacts of livestock production
- potential to provide a significant share of daily protein requirements
- could help achieve healthier diets if diets adjusted to nutritional requirements

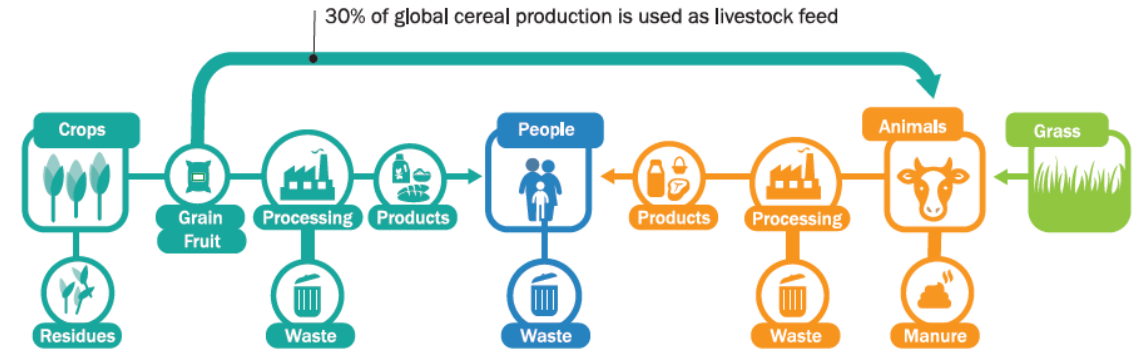
-> **still lots of knowledge gaps**

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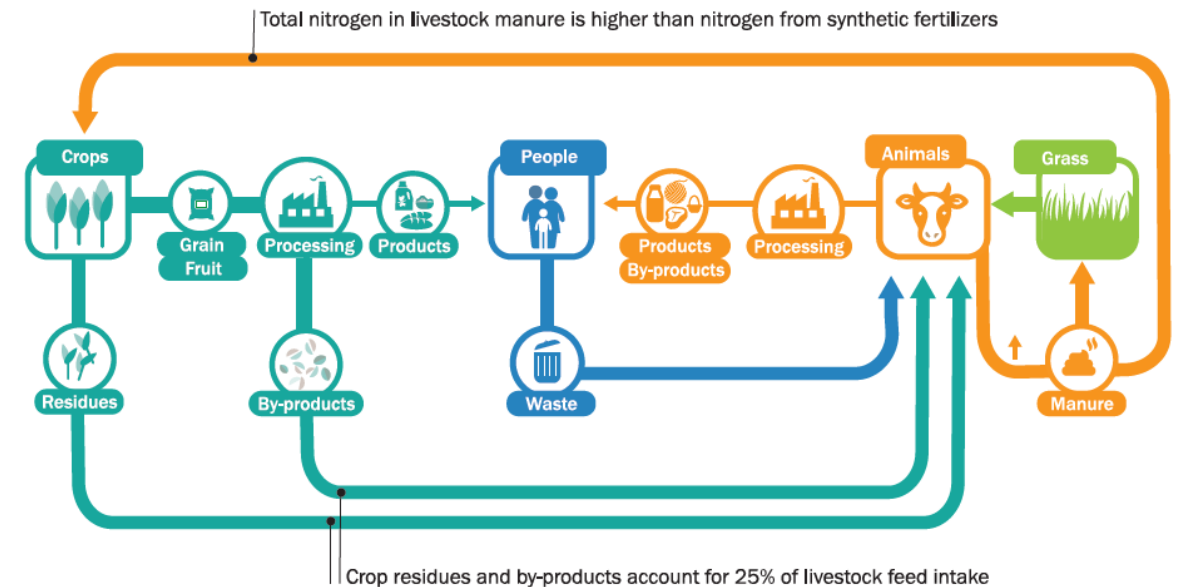
Lutz Merbold et al.

LINEAR

Beal et al. 2023



CIRCULAR





Livestock & Environment: Climate

Metrics that combine environmental impact and nutrition are a bottleneck

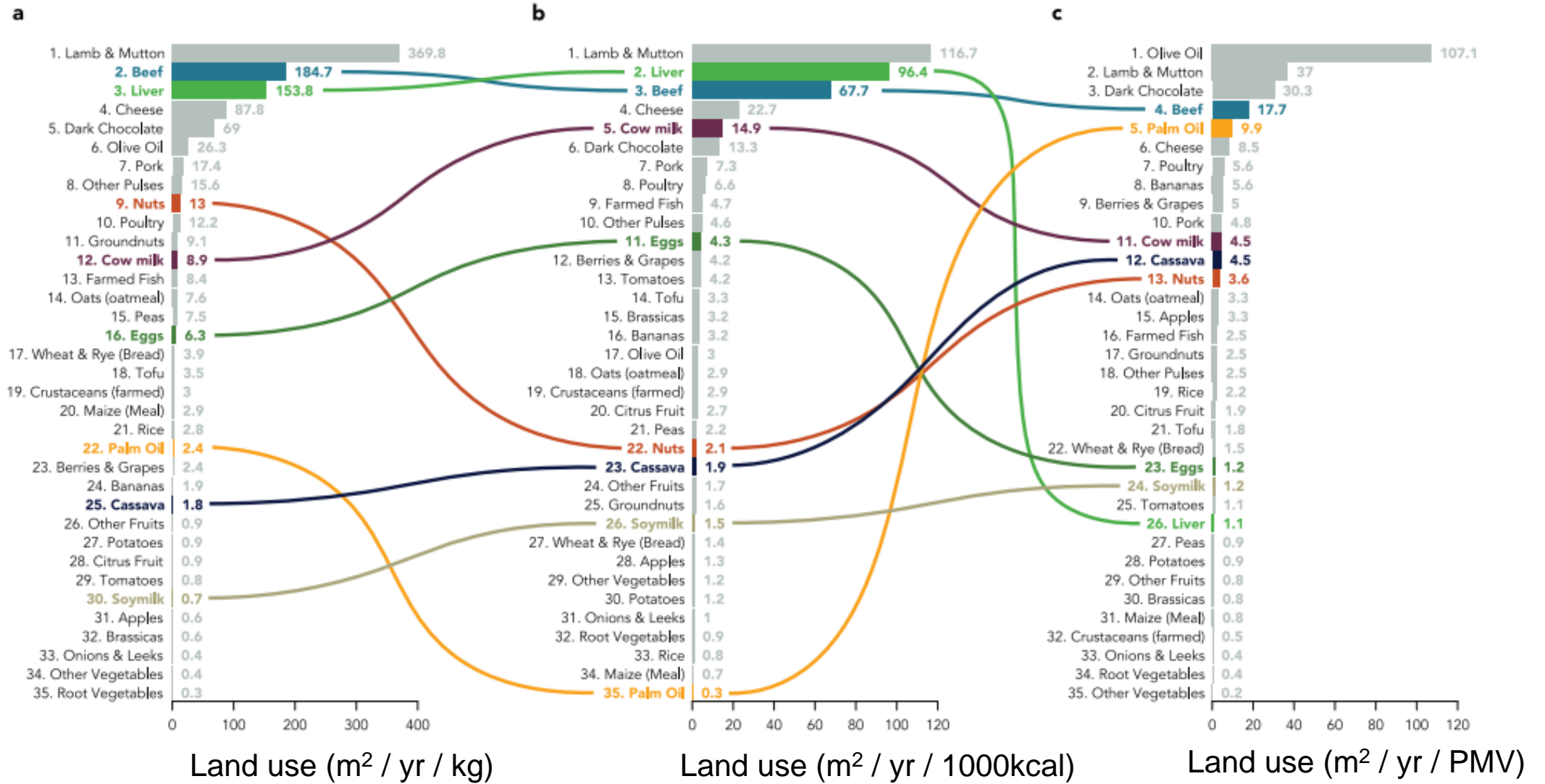
- GHG emissions per kg of products, per kilocalorie, or per kilogram of protein
- Few studies use nutritional density
- no agreed-upon or established method for defining a nutritional functional unit

McLaren et al. 2022

but, there seems to be light at the end of the tunnel.....



Livestock & Environment: Land Use & Nutrition





Livestock & Environment & Nutrition

Rank	Land Use footprint (m ² *yr to obtain PMV)	Carbon footprint (kg CO ₂ eq to obtain PMV)	Freshwater withdrawals (L to obtain PMV)	Acidification potential (g SO ₂ eq to obtain PMV)	Eutrophication potential (g PO ₄ ³⁻ eq to obtain PMV)
Highest Footprint					
1	Olive Oil	Palm Oil	Olive Oil	Olive Oil	Olive Oil
2	Lamb & Mutton	Olive Oil	Rice	Palm Oil	Farmed Fish
3	Dark Chocolate	Dark Chocolate	Nuts	Poultry	Palm Oil
4	Beef	Beef	Farmed Fish	Pork	Crustaceans (farmed)
5	Palm Oil	Crustaceans (farmed)	Apples	Beef	Dark Chocolate
6	Cheese	Poultry	Berries & Grapes	Berries & Grapes	Beef
7	Poultry	Farmed Fish	Crustaceans (farmed)	Tomatoes	Rice
8	Bananas	Lamb & Mutton	Cheese	Crustaceans (farmed)	Poultry
9	Berries & Grapes	Rice	Tomatoes	Rice	Pork
10	Pork	Pork	Groundnuts	Dark Chocolate	Berries & Grapes
11	Cow milk	Cassava	Pork	Farmed Fish	Tomatoes
12	Cassava	Berries & Grapes	Bananas	Bananas	Lamb & Mutton
13	Nuts	Tomatoes	Cow milk	Apples	Cheese
14	Oats (oatmeal)	Bananas	Poultry	Cheese	Bananas
15	Apples	Cheese	Wheat & Rye (Bread)	Lamb & Mutton	Apples
16	Farmed Fish	Apples	Dark Chocolate	Nuts	Brassicas
17	Groundnuts	Soy milk	Oats (oatmeal)	Brassicas	Nuts
18	Other Pulses	Cow milk	Beef	Eggs	Cow milk
19	Rice	Tofu	Lamb & Mutton	Cow milk	Oats (oatmeal)
20	Citrus Fruit	Oats (oatmeal)	Citrus Fruit	Citrus Fruit	Citrus Fruit
21	Tofu	Other Fruits	Brassicas	Cassava	Eggs
22	Wheat & Rye (Bread)	Eggs	Other Fruits	Groundnuts	Groundnuts
23	Eggs	Groundnuts	Eggs	Other Fruits	Potatoes
24	Soy milk	Citrus Fruit	Tofu	Wheat & Rye (Bread)	Tofu
25	Tomatoes	Brassicas	Other Pulses	Oats (oatmeal)	Onions & Leeks
26	Liver	Wheat & Rye (Bread)	Other Vegetables	Soy milk	Wheat & Rye (Bread)
27	Peas	Potatoes	Potatoes	Other Vegetables	Other Pulses
28	Potatoes	Root Vegetables	Maize (Meal)	Potatoes	Other Fruits
29	Other Fruits	Onions & Leeks	Soy milk	Other Pulses	Soy milk
30	Brassicas	Maize (Meal)	Peas	Onions & Leeks	Root Vegetables
31	Maize (Meal)	Other Vegetables	Root Vegetables	Tofu	Cassava
32	Crustaceans (farmed)	Other Pulses	Palm Oil	Root Vegetables	Other Vegetables
33	Onions & Leeks	Liver	Onions & Leeks	Maize (Meal)	Liver
34	Root Vegetables	Nuts	Liver	Liver	Maize (Meal)
Lowest Footprint					
35	Other Vegetables	Peas	Cassava	Peas	Peas

- Ranking changes for environmental dimension when levelled for priority micronutrient value (PMV)
- Livestock «compartments» have different impacts



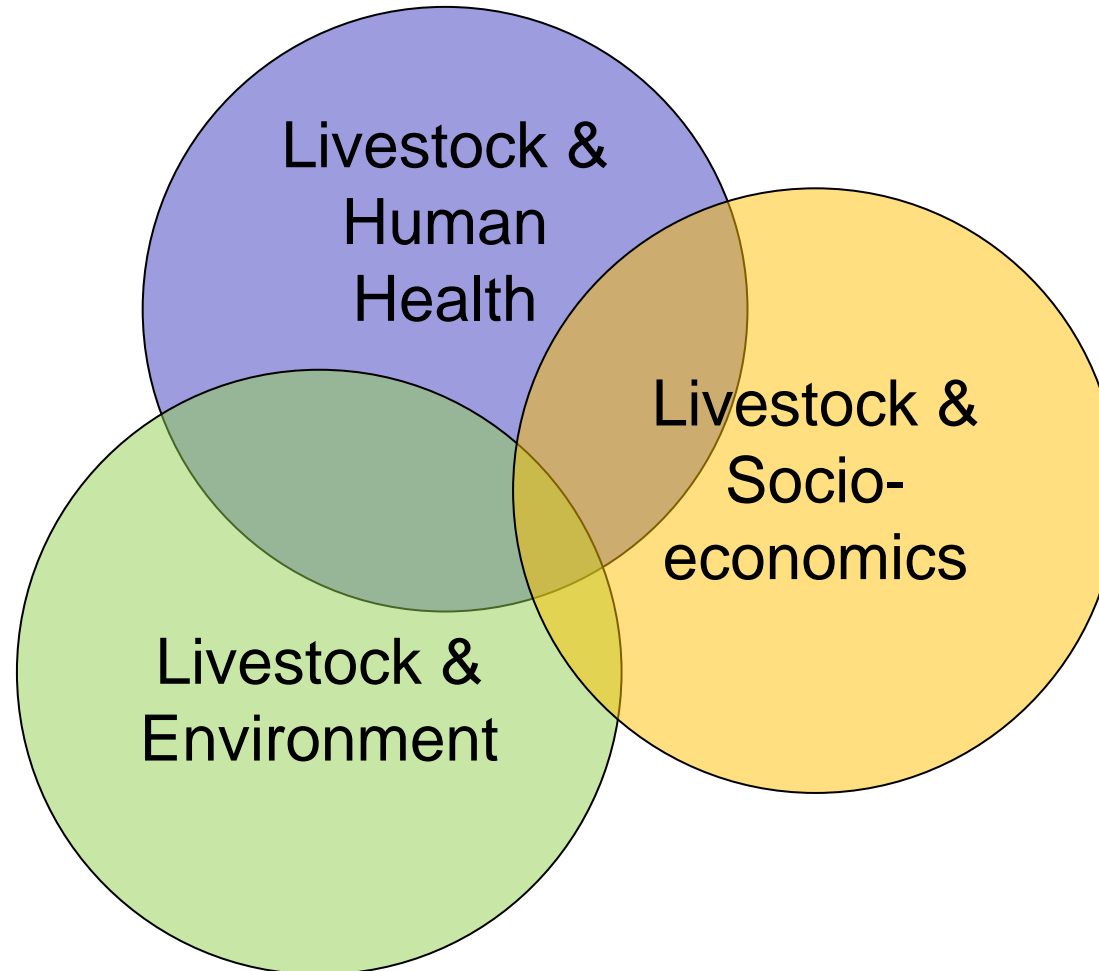
Summary

- ASF are a diverse group of foods that have unique properties and can contribute to healthy & sustainable diets
- Health consequences have been reported – yet this is likely related to imbalanced diets (a diet is a mix from various ingredients)
- ASF production has in general a large environmental impact if not produced in accordance with the local system boundaries
- However, if livestock is part of circular system, various co-benefits besides food security and nutrition can be achieved (biodiversity, GHG mitigation etc.)
- There is **no one-size-fits-all approach**, however ASFs, including meat, dairy, eggs, and aquatic **ASFs, do play important and distinct roles in achieving healthy and sustainable food systems** in different contexts worldwide and will continue to do so **for the foreseeable future**



What is still needed? - Capacities

We need more integrated research to **assess systems dynamically** from **multiple viewpoints** across temporal and spatial **scales**

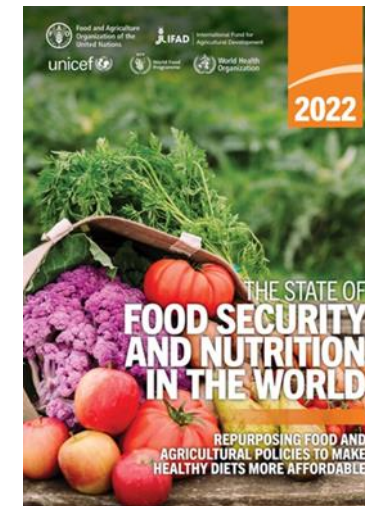


We need the necessary **capacities** for this endeavour (institutional, infrastructures and trained staff, policy influence, extension, consumers)



What is still needed? – Affordability assessment

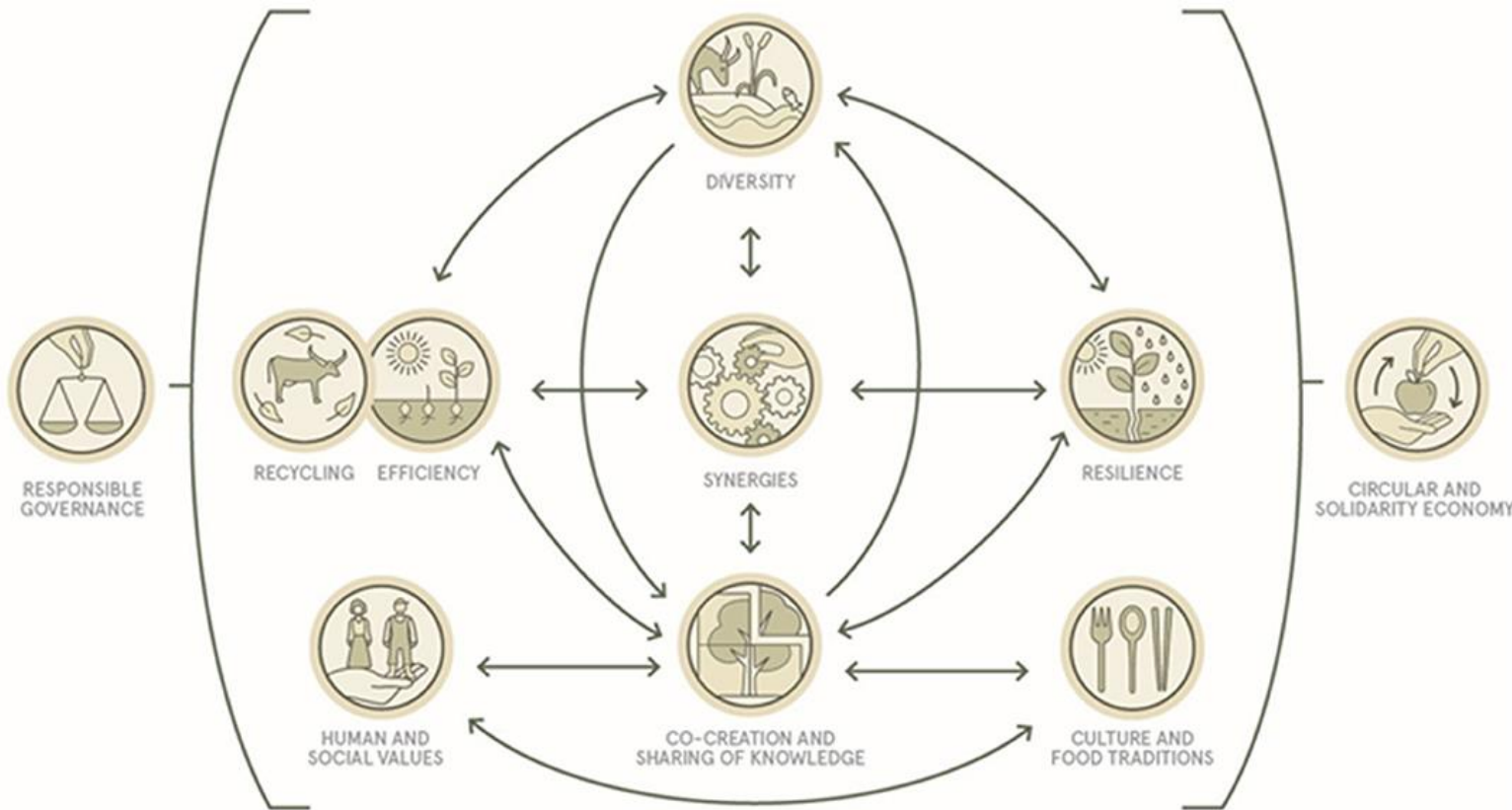
Energy sufficient	Nutrient adequate (minimum diversity)	Healthy (FAO/Dietary Guidelines)
Starchy staples	Starchy staples	Whole grains
Vegetable oils	Animal source foods	Total protein foods, dairy, seafood
Sugar	Legumes	Legumes, beans, plant proteins
	Vegetables	Vegetables (dark green)
	Fruits	Fruits (whole)
	Fats and oils	PUFA+MUFA/SFA ratio
		Limit starchy staples, sugar, satfat
Lowest cost ~1\$	Medium cost 3\$	Highest cost 5\$ (FAO report)



Drewsnowski Sustainability Day 2023 and check Will Masters: Food Price in Nutrition project



Sustainability Assessment of the Agriculture & Food System following 10 Elements of Agroecology



Tool for Agroecological Performance Evaluation (TAPE) - basis

- range of indicators – ecological, social, economical
- expansion with detailed in-depth indicators at national scale

Mottet et al. 2020

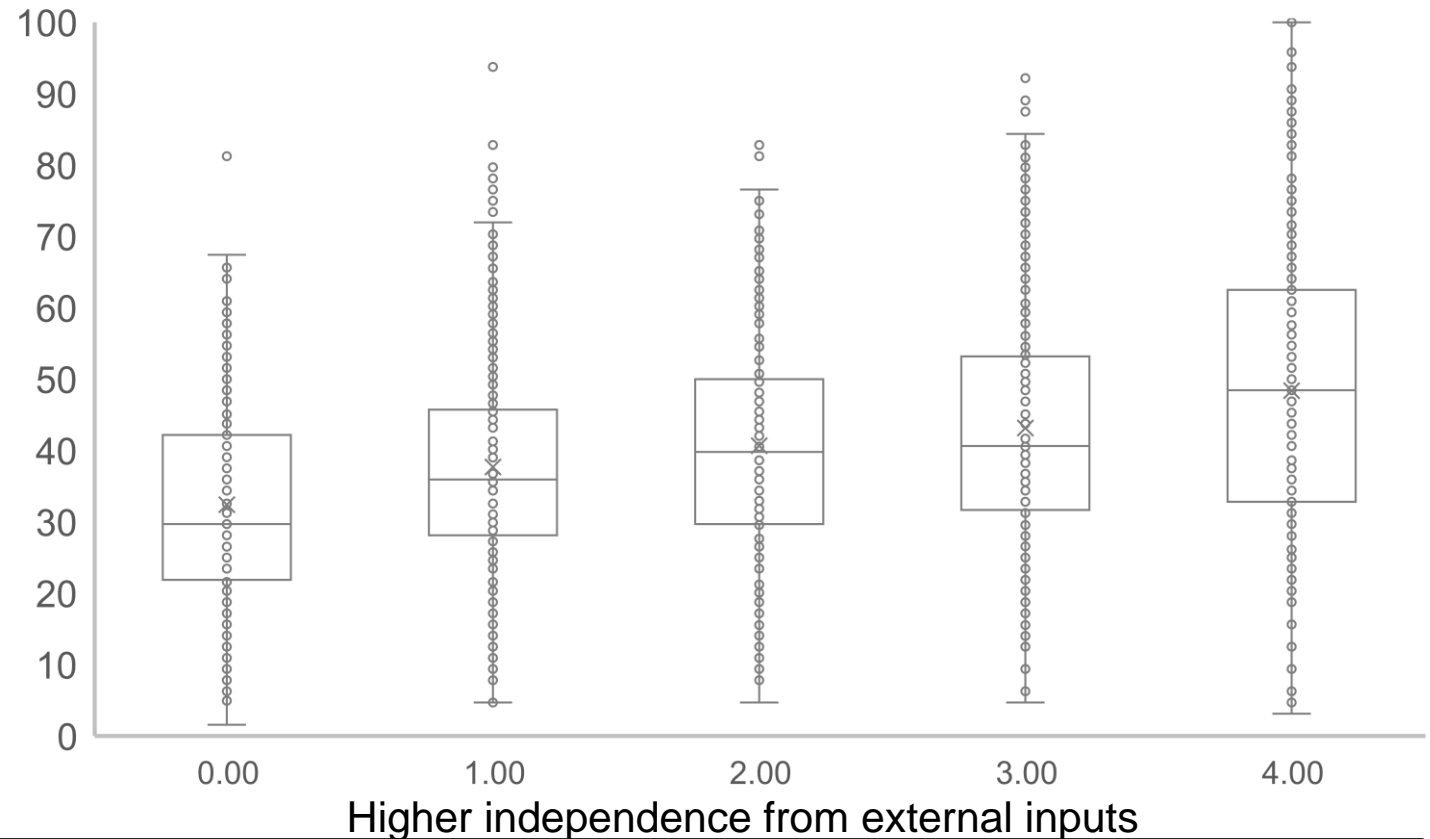


Sustainability Assessment of the Agriculture & Food System following 10 Elements of Agroecology

Resilience:

- Stability of income/production + capacity to recover
- Existence of social mechanisms to reduce vulnerability
- Environmental resilience + capacity to adapt to climate change
- Diversity of production and sources of incomes...

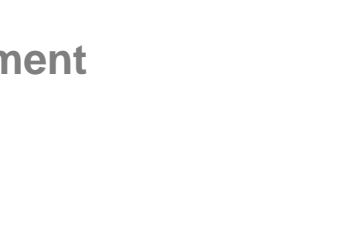
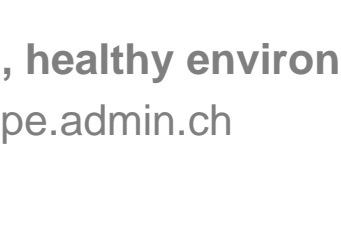
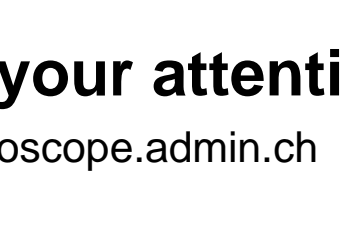
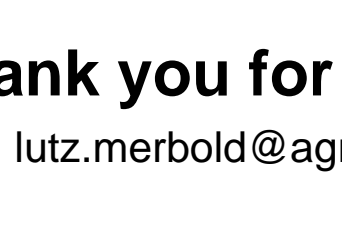
Average resilience per score of external inputs (livestock only)



Mottet et al. WAAP 2023

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Lutz Merbold et al.



Thank you for your attention

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