Livestock-derived foods and sustainable healthy diets

Lora Iannotti, PhD

Associate Professor

Director, E3 Nutrition Lab

Washington University in St. Louis

Presentation outline

1. Introduction
    - The public discourse
    - Disparities: LDF consumption patterns

2. Health and nutrition implications
    - Nutrient bioavailability of LDFs
    - LDFs through the lifecycle

3. Sustainable production of livestock-derived foods
    - Challenges
    - Opportunities

4. Conclusions
    - Summary: Key Messages
    - Next steps for taking action

E3 Nutrition Lab

E3 Nutrition Lab
Maternal & child nutrition solutions

Research to identify interventions that promote healthy growth and development in the most vulnerable populations globally, with the following criteria:

Equitably accessed

Evolutionarily appropriate

Environmentally sustainable

Research sites: Ecuador, Haiti, Kenya, Global

Role: scientific perspective and infuse evidence-base

Washington University in St. Louis

The public discourse

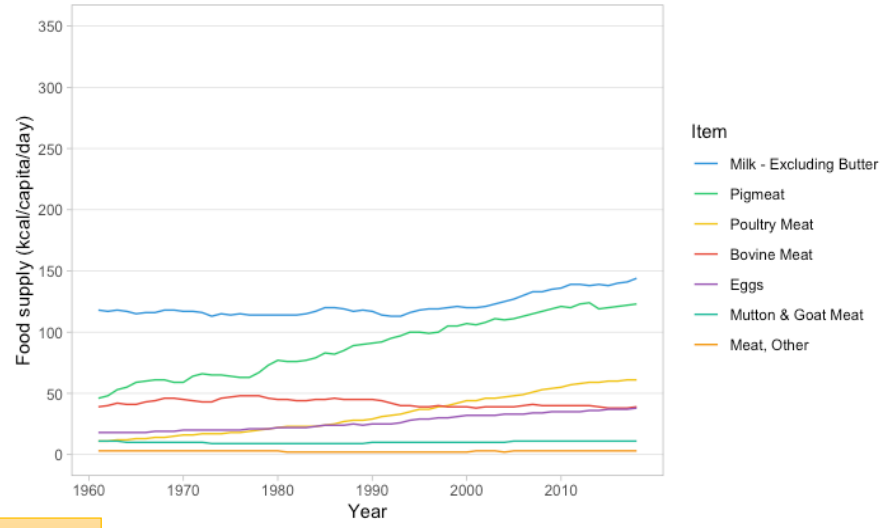
- LDFs as relate to environment and human health have garnered the public's attention - with some imbalance in the dialogue (Steinfeld et al. 2006)(Gerber et al. 2013)(EAT-*Lancet* 2019)

- Indisputable evidence that LDF production systems contribute to climate change and chronic disease burden….but they can and should play a vital role in achieving SDG2 (zero hunger), SDG12 (responsible consumption), SDG 13 climate action

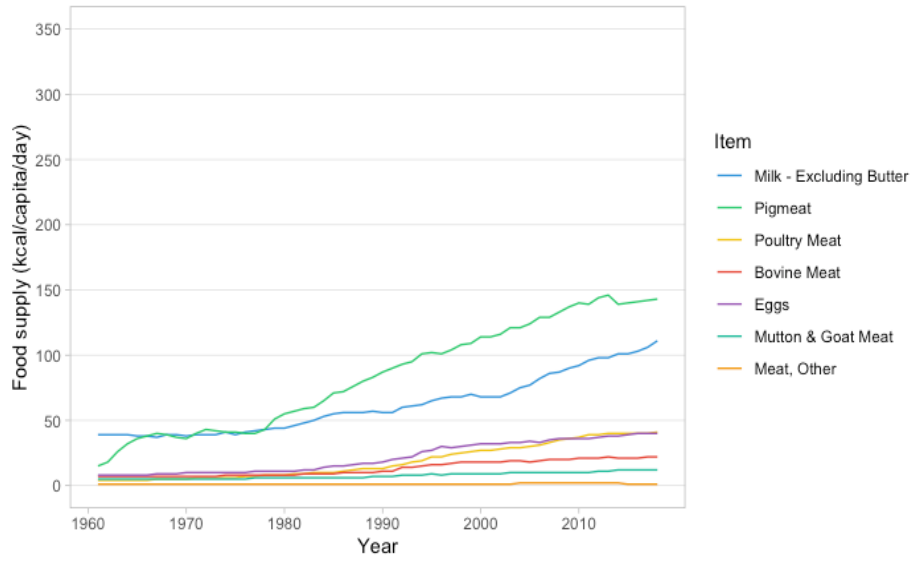
- Voices unheard
  - **Children and women**: 21.3% children stunted, 5.6% overweight (SOFI 2020); 1/3 of women reproductive age are anemic; hidden hunger widely prevalent
  - **Small-holder producers**: produce estimate 51–77 % of nutrients globally (Herrero et al. 2017); disproportionately affected by climate change
  - **Resource-poor populations**: low-income countries, poor communities globally

LDF consumption disparities

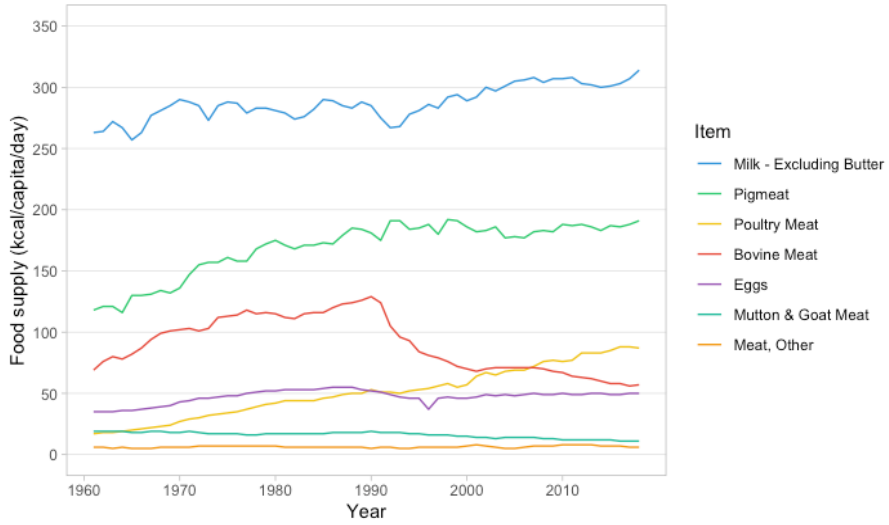
World



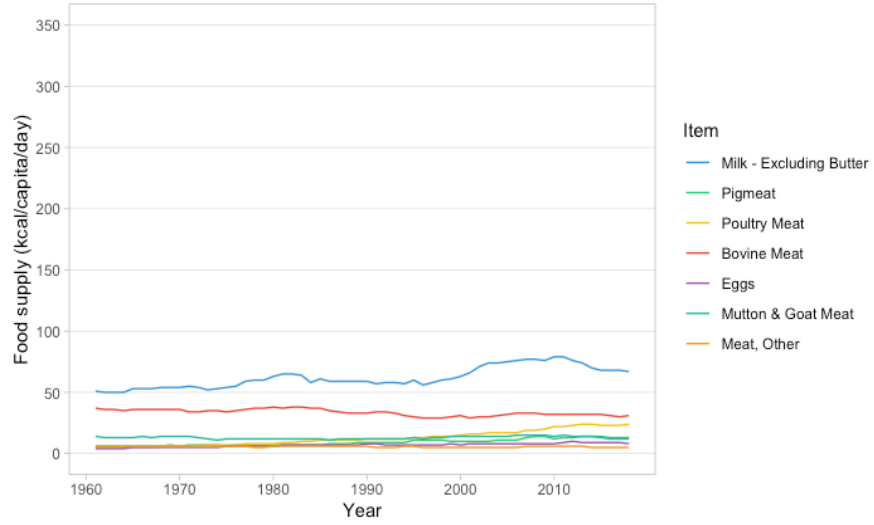
Asia



Europe



Africa



Poultry meat consumption disparities (FAOSTAT, 2018)

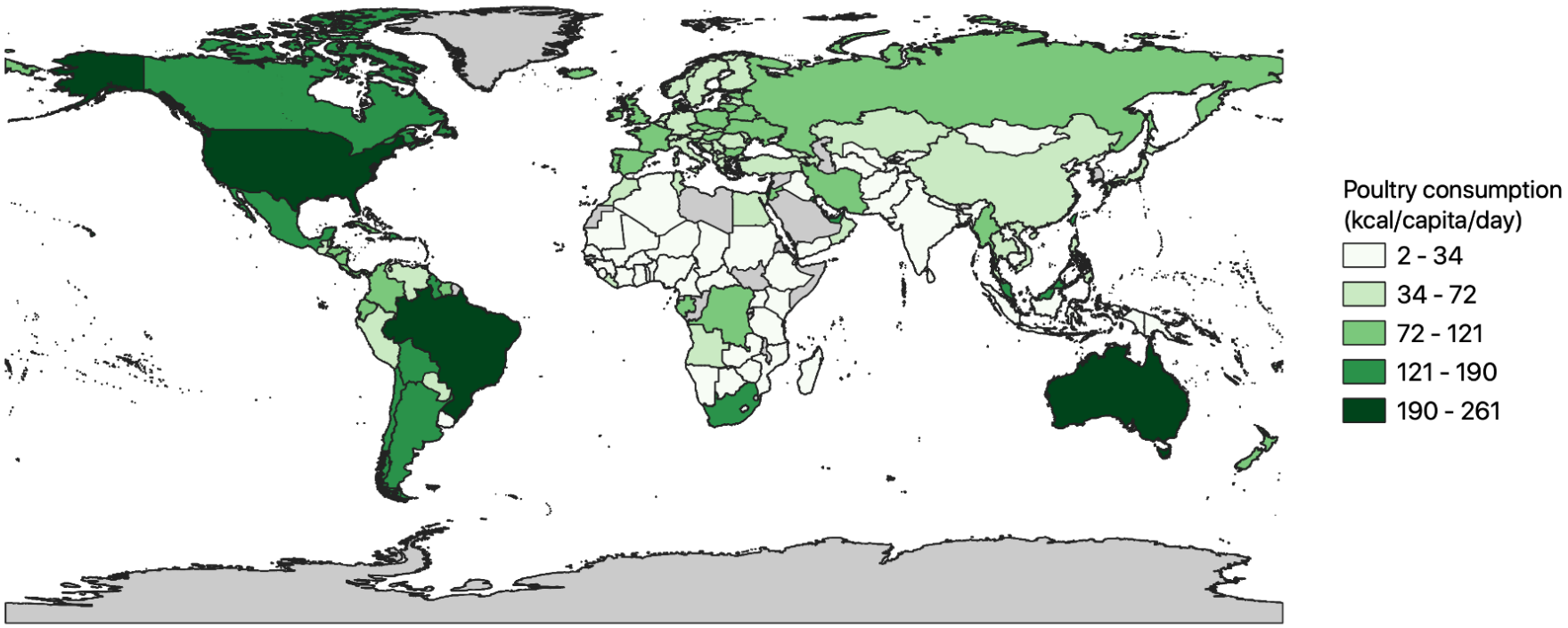


Photo credit: Lulun Project (G. Reinhart)

Nutrition & health implications

Livestock-derived foods

Evolutionary importance of LDFs

- *Homo erectus* (early hominin) ~1.8 mya
  - Anatomical differences from other *hominins* (*Australopithecus garhi* & *Homo habilis*), attributed to diet changes - animal source foods in particular.

Physical Differences

↑ Brain size – 3x the encephalization quotient
(brain mass to body mass) (Broadhurst et al. 1998)
↑ Taller height - 15% taller (Walker 1993)
↑ Larger body mass
↑ Longer legs (bipedalism)
↓ Smaller teeth
↓ Colon, ↑ small intestine (>56%)

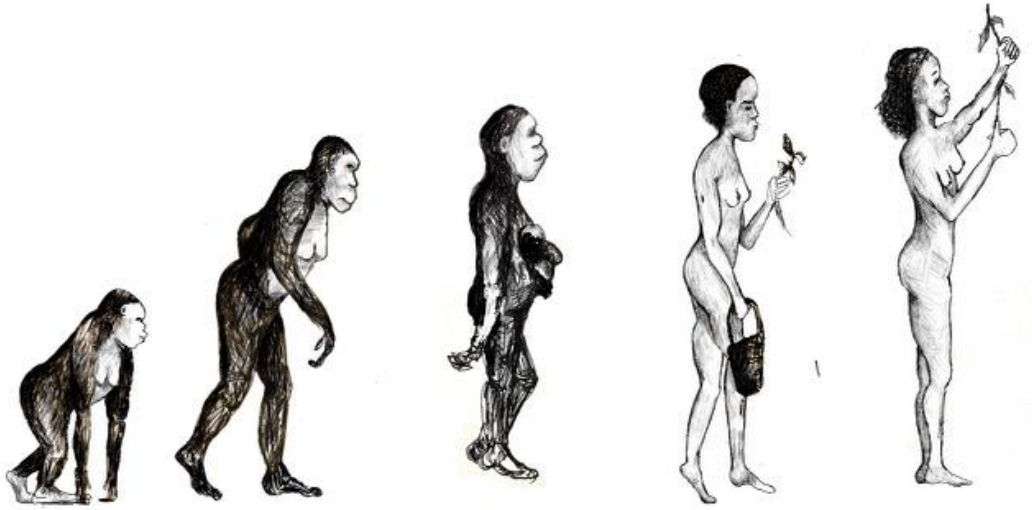


Image: Rene Iannotti

- Systematic review child evolutionary diets from H. erectus through early agriculture
  - Preliminary findings: 93 studies indicating ASF always present in child diets of GHF groups, together with a diverse range of others foods depending on environment.

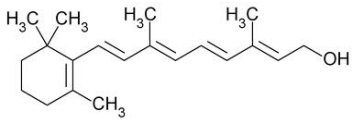
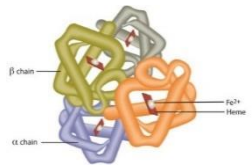
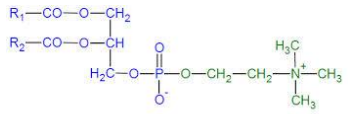
LDFs are nutrient-dense and bioavailable

- LDF comprise a vast array of foods, with differences in nutrient composition across/within species
  - Nutrient content may depend on animal feed and nutrition
  - Meat nutrients vary by tissue type (muscle vs organ)

- LDF nutrient composition examples:
  - **Protein**: Digestible indispensable amino acid score of eggs and milk >100%, compared to 37% rice, or 45% wheat
  - **Fatty acids**: DHA and other PUFA found in LDFs, but also saturated/trans fats
  - **Vitamins**: A, B12 and other B vitamins, D, choline
  - **Minerals**: Zn, Fe, Se concentrated in LDFs

- Bioactive factors linked to health outcomes
  - >26,000 distinguishable compounds in food (Barabasi et al. 2020)
  - TMAO in LDFs linked to mortality in adults with CVD

Nutrient matrix: bioavailability of LDFs

Nutrient	LDF Matrix	ASF vs PSF absorption rate
Vit A →		12-24x (ug)
Iron →		2x (mg)
Zinc →		2x (mg)
Choline →		-

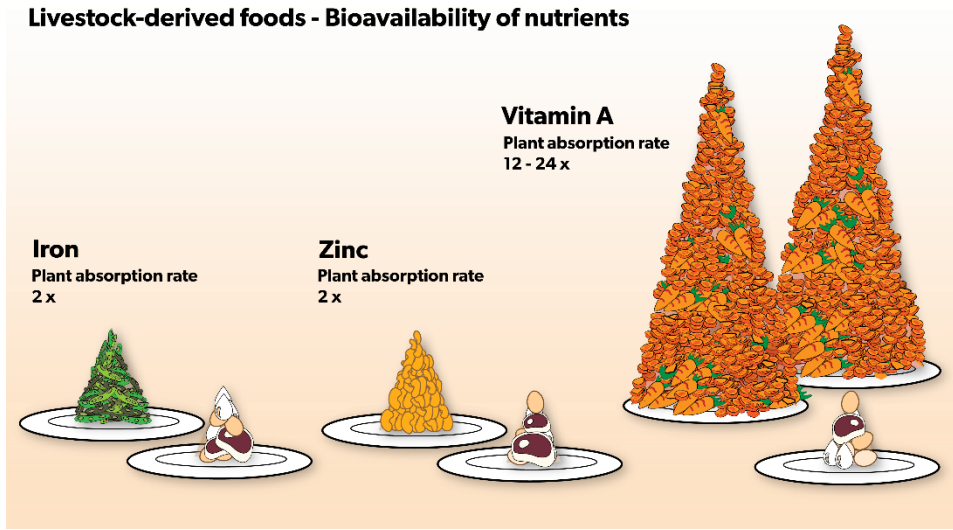


Image: ILRI (A. Slater)

Epidemiology of LDFs → human health

- Adults
  - **Processed meats** linked to colorectal/other cancers, cardiovascular disease, and diabetes
  - Prospective studies in high-income countries showed ↑all-cause mortality rates associated with **high red and processed meat** compared to low quantities; **no association or inverse for poultry** (Godfray et al. 2018)
  - **Red meat consumption** ranks toward bottom of DALYs, compared with other dietary risk factors (such as high sodium, low fruits and low grains), but evidence is still limited (GBD 2017)

- Infants and young children
  - Cochrane review five studies **ASF in 6-24 mo increased HAZ** (Eaton et al. 2019)
  - Systematic review ASF showed **reduced stunting in one RCT** and one cross-sectional study (Shapiro et al. 2019)

- School-age children
  - **Cognitive function improved** in meat group compared to milk & control groups; **improved growth** in both the milk and the meat groups (Neumann et al. 2007)
  - Children < 18 yrs from Asia showed meat consumption **increased risk of overweight/obesity** (Yang et al. 2012)

- Pregnant and lactating women
  - **Limited evidence on LDFs only**. Fish intake during pregnancy studied to compare risks of contamination vs no intake on offspring neurodevelopment (Starling et al. 2015)
  - Maternal supplementation with animal protein **increased birth weight** (Pimpin et al. 2019)
  - Poultry production modest **benefits on anemia** in women and children (Lambrecht et al. 2019)

LDFs through life course

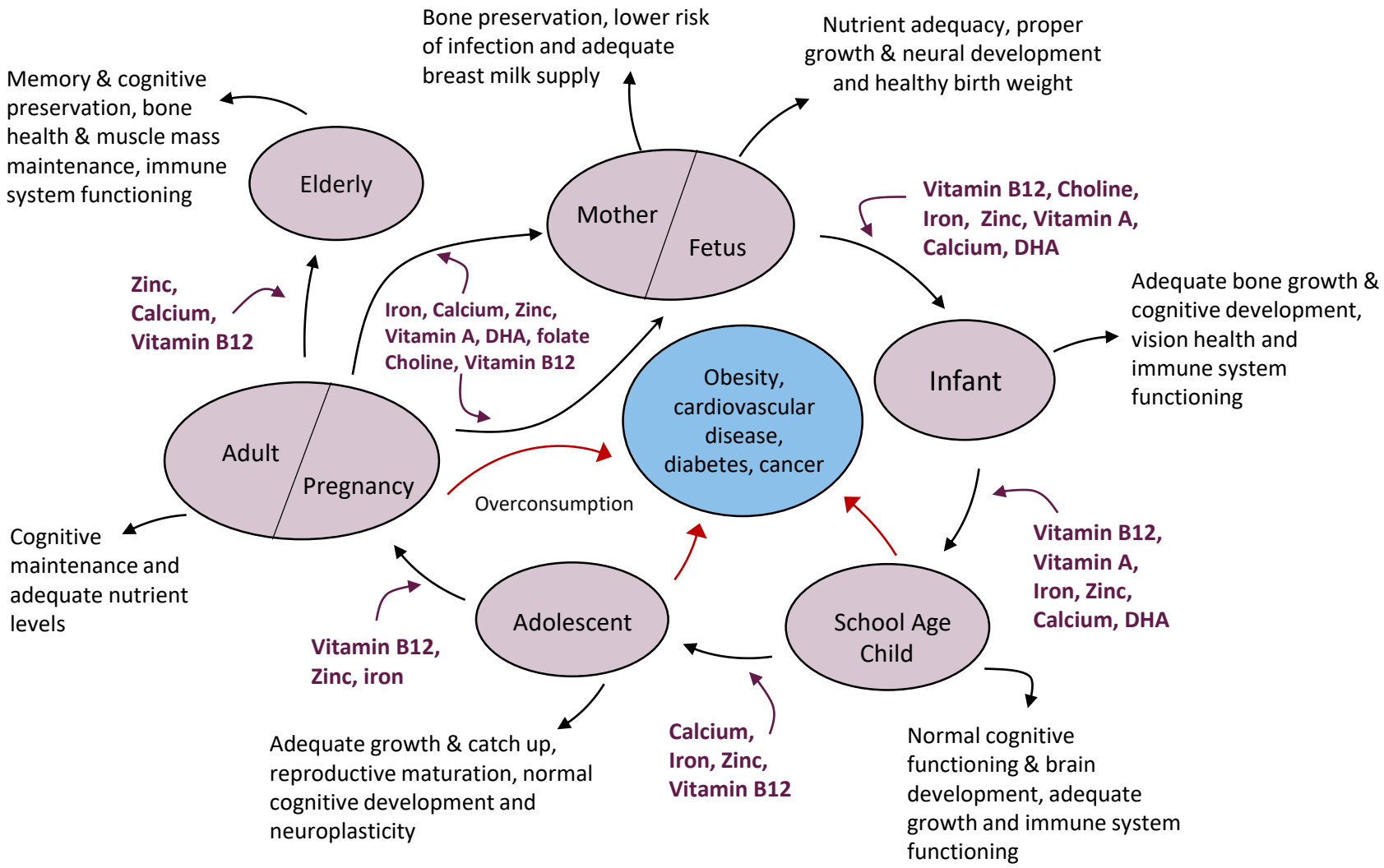


Photo credit: Lulun Project (G. Reinhart)

Sustainable livestock production

Livestock-derived foods

LDF production ⟷ environment and climate

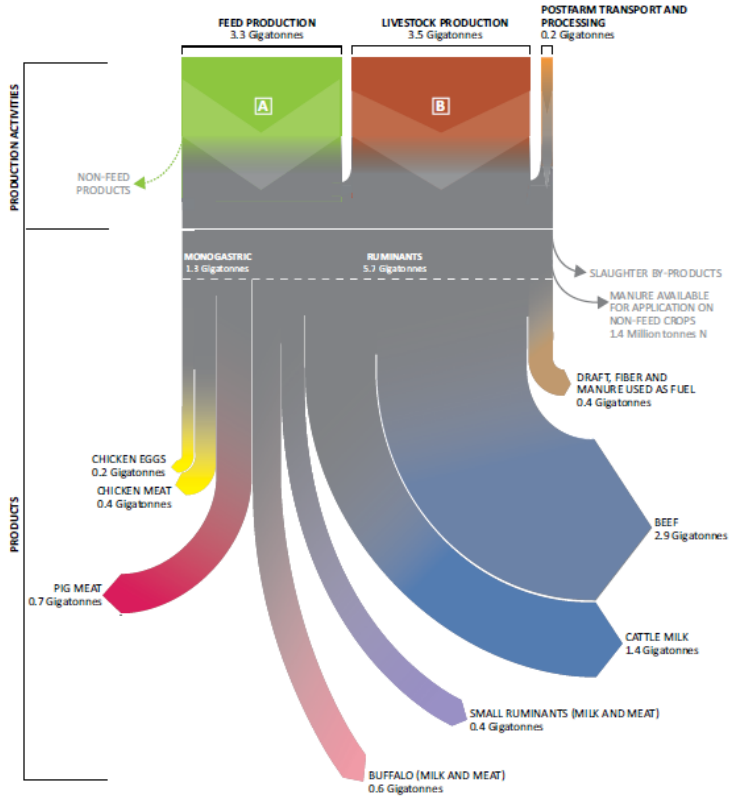
CHALLENGES

- **GHG emissions**: LDF production ~14.5%; food systems ~30% (Clark et al. 2019)(Gerber et al. 2013)
  - Feed production, enteric fermentation by ruminants, manure-storage and processing, transport
- **Fresh water use**: 87.2% green, 6.2% blue, and 6.6% grey
- **Biodiversity losses**: feed production, loss of top predators, extensive grazing in systems, narrowing of local livestock species/breeds

However, numbers are controversial…

- Data largely from OECD production systems
- Production, processing and supply-chain environments vary

Figure 4.
GHG emissions from global livestock supply chains



GHG EMISSIONS FROM GLOBAL LIVESTOCK SUPPLY CHAINS, BY PRODUCTION ACTIVITIES AND PRODUCTS

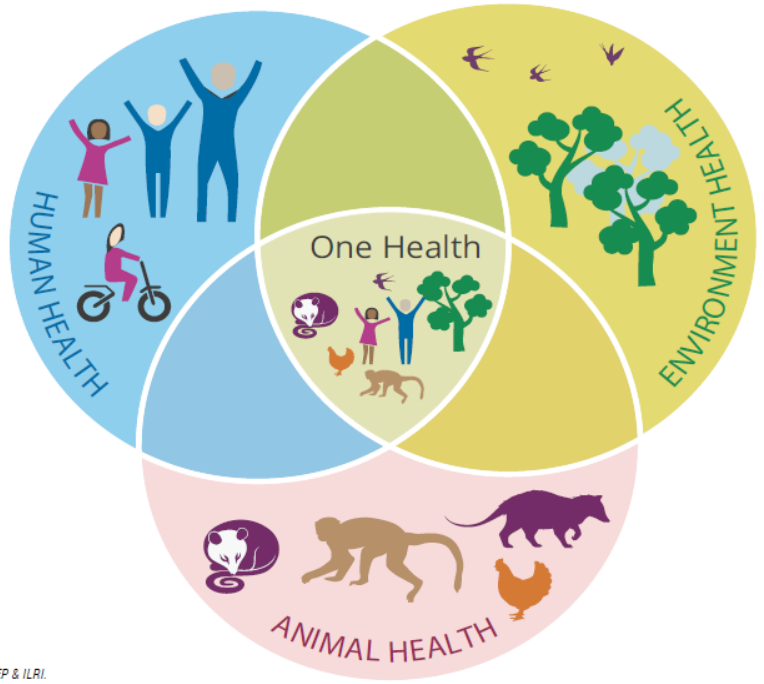
Source: *Gerber et al. (2013).*

LDF production ⟷ environment and climate

OPPORTUNITIES

- **Mixed production systems**: produce half of the world's food
  - In these systems, livestock provide draft power and manure to enrich soil biomass; inedible crop parts used for animal feed
- **Efficiencies improved through:** feed-conversion rates in chickens and pigs; animal health; quality feed; and herd management
- **Appropriate animal breeds**: local breeds adopted to local environments
- **Protecting animal health**: One Health approach to combat zoonotic disease and enhance animal health

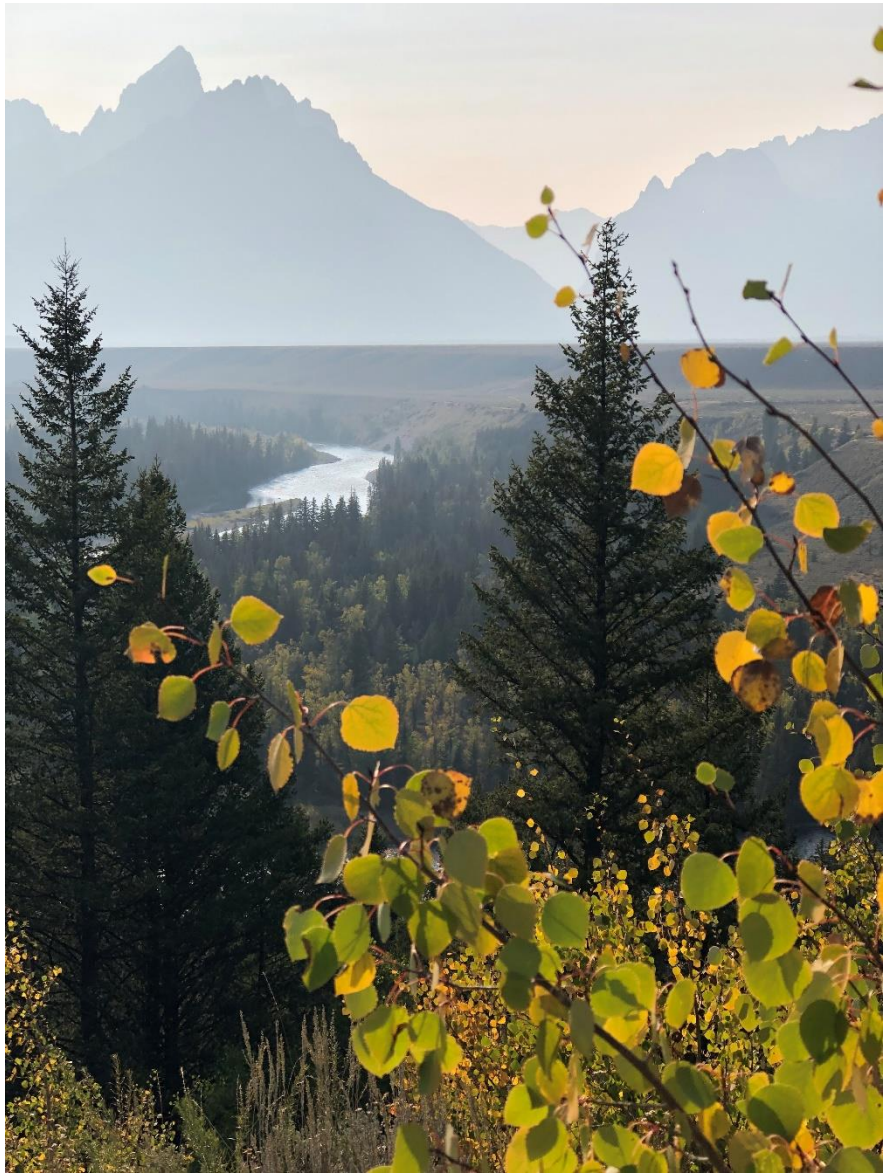
Figure 3.
One Health Framework



Source: *UNEP & ILRI.*

Conclusions

Livestock-derived foods



Summary – Key Messages

- Implications of LDFs depend on: 1) *context*, 2) *life course phase,* and 3) *production system*

  - Nutrition inequities prevail globally, notable LDF apparent dietary intake patterns
  - LDFs provide critical nutrients in bioavailable matrices. Thus LDFs can have vital impacts on human health, both in abundance and in scarcity
  - Ensure LDF access for children, pregnant/lactating women, and elderly
  - LDF production has serious impacts on the environment but opportunities exist to mitigate climate change and environment impacts

- Rebalance food systems and support sustainable, mixed production systems to safeguard human, animal, and planetary health

Taking action: enabling environment

- Equitable Food Systems
  - Food systems should espouse fair trade principles, sound environmental practices and access to diverse and high-quality diets for all.
  - Economic and political strategies: protect the affordability of LDFs in some populations and create disincentives to overconsume in others.

- Policies & Programs
  - Polices should ensure that people have access to LDFs at critical stages of life course.
  - Social and behavioural change strategies to increase awareness of the importance and risks associated with LDFs.
  - Food-based dietary guidelines set appropriate quantities of LDFs, drawing on locally available, biome-based foods.

Photo credit: Mazira Project

Taking action: planetary health

Photo credit: Lulun Project (G. Reinhart)

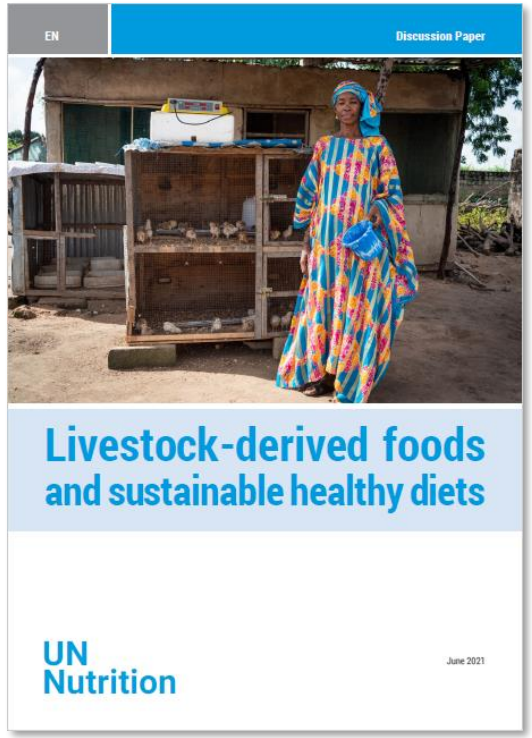
- Mitigating environment impacts of LDF production
  - Support mixed farming systems that embrace circular bioeconomy and pastoral systems.
  - Production systems adapted to local contexts and ecosystems
  - Transition some systems to more sustainable animal types (such as monogastric animals) and products (such as eggs or dairy).

- One Health principles
  - Small- and medium-scale producers should be integral to solutions, and women farmers focus for production inputs (animal health, credit and extension services).
  - Efficiencies could be gained through improved feed-conversion rates and the use of local breeds that have adapted to the environment.

Taking action: research and institutions

- Research: evidence-base for LDF in sustainable healthy diets
  - Test LDF interventions and health across all vulnerable groups.
  - Investigate approaches to optimizing biodiversity and dietary diversity, blending disciplines of ecology and public health nutrition.
  - Explore the bidirectionality of climate change and LDF production.

- Institutional commitments
  - UN Nutrition to play a leading role in orchestrating a concerted effort among Members, to achieve policy coherence and innovation.
  - ILRI and others in the CGIAR system committed to UN Decade on Nutrition and working to ensure availability, access and affordability of LDFs globally.



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