Impact of livestock on climate change

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OBJECTIVES

- Identify the problems of this impact according to different sectors of livestock
- Seek and reflect on possible strategies to mitigate these problems

METHODOLOGY

- Bibliographic review of the impact of livestock on climate change
- Main sources: Web of Science, Google Scholar, Our World in Data and FAOSTAT.

CLIMATE CHANGE

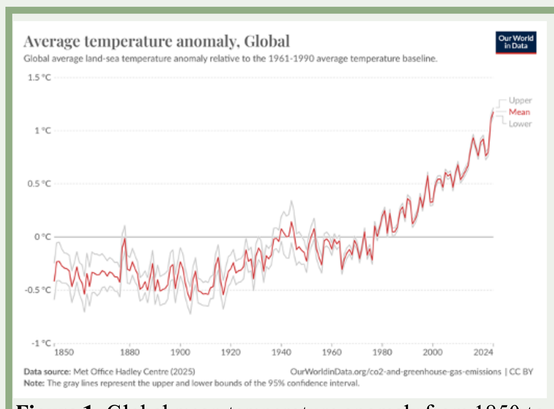

Figure 1. Global mean temperature anomaly from 1850 to 2024 relative to the baseline mean temperature of 1961-1990 (Ritchie *et al*., 2023).

Livestock significantly contributes to climate change via **greenhouse gas** (GHG) **emissions** → mainly carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O) → about 50 Gt annually.

Rising temperatures also lead to **heat stress** in animals, affecting welfare, fertility, and productivity.

AGRICULTURE

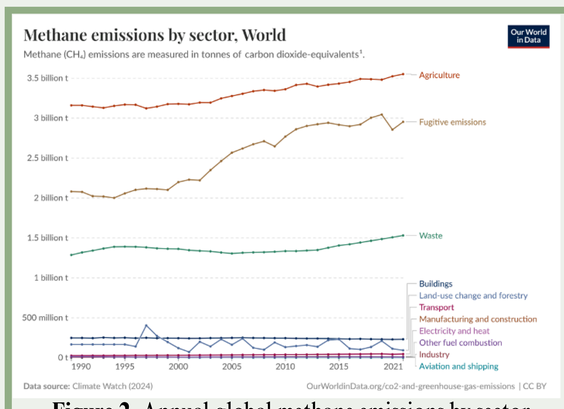

Figure 2. Annual global methane emissions by sector (Climate Watch with processing by Our World in Data, 2024).

80% of CH_4 from agriculture originates from livestock.

- 90% from **enteric fermentation**.
- 10% from **manure**.

IMPACT OF RUMINANT HUSBANDRY

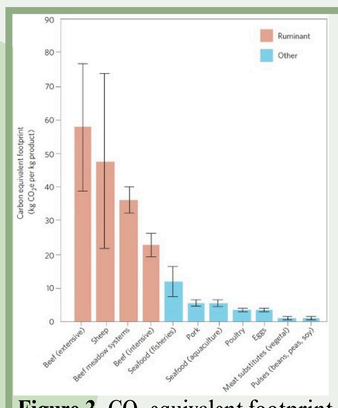

Figure 3. CO_2 equivalent footprint by animal species and production systems (Ripple *et al*., 2014).

- Ruminants are the largest CH_4 source and the most land-demanding of all livestock.
- Their meat has the highest GHG footprint and remains a focus of climate policy discussions.

Their contribution to climate change is significant, making ruminant systems a subject of ongoing debate.

"Pros"

- Critical for **food security** in marginal lands.
- Can improve **pasture productivity** and **soil carbon sequestration** when well managed.

"Cons"

- **High carbon footprint**: 19-48 times higher than plant-based proteins.
- Largest land use leading to **deforestation** and **biodiversity loss**.
- **Major CH_4 emitter** with strong warming potential.

IMPACT OF MONOGASTRIC ANIMAL HUSBANDRY

Although monogastric animals like pigs and chickens emit less CH_4 than ruminants, their environmental impact remains significant due to feed-related emissions and manure management.

Pigs

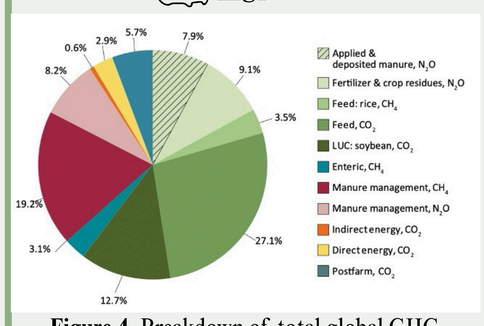

Figure 4. Breakdown of total global GHG emissions by category for pig supply chains (MacLeod *et al*., 2013).

- Carbon footprint: Lower than ruminants, but **3-10 times higher** than plant-based proteins.
- Main GHG source: **feed-related CO_2 emissions** (cultivation, processing, transport).
- **Manure** handling emits **CH_4**.
- **Soy-based feed** is the driver of deforestation and land use change.
- Add to **pollution** from **nitrogen** and **phosphorus**.

Chicken

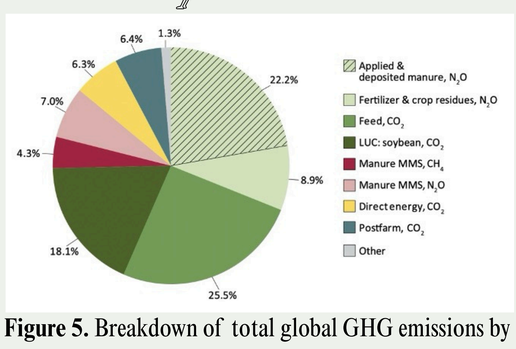

Figure 5. Breakdown of total global GHG emissions by category for chicken meat and egg supply chains (MacLeod *et al*., 2013).

- **Lowest GHG footprint** of all livestock.
- Need **less land** per protein unit.
- Still dependent on **high-impact feed systems**.
- Excrete nitrogen and phosphorus → Nutrient **pollution** of **soil** and **water**.

MITIGATION STRATEGIES

Agriculture

Reducing CH_4 emissions can be addressed from both the supply and demand sides.

- **Supply side** → Strategies such as improved grazing and manure management can enhance soil carbon sequestration and reduce emissions.
- **Demand side** → Lowering livestock product consumption and food waste helps reduce land use and overall environmental impact.

Ruminant husbandry

In the ruminant sector, it is important that mitigation strategies improve animal productivity.

- **Synthetic methane inhibitors** (e.g. 3-Nitrooxypropanol)→ They could fully block the formation of CH_4 in the rumen.
- **Methane inhibitor vaccines** → Aim to reduce methanogen populations, still under development.
- **Genetic selection** → Breeding low CH_4 emission animals.
- **Diet improvements**→ Use of nitrates and more digestable forage.
- **Seaweed additives** (*Asparagopsis*) → Reduce CH_4 emissions, under research.

Monogastric animal husbandry

In the porcine sector, mitigation strategies focused on energy efficiency and practices for the "final stage" of production are prioritized more.

- **Anaerobic digestion** → Treats manure, reducing CH_4 emissions and producing biogas as renewable energy.
- **Local feed ingredients** → Lower transport-related emissions.
- **Precision feeding** → Tailoring nutrient supply to each animal improves efficiency and minimizes nitrogen and phosphorus waste.

CONCLUSIONS

- **It is a highly complex challenge that has generated an ongoing debate that is difficult to solve**.
- **Veterinarians must raise awareness among farmers.**
- **Promote research into equitable and inclusive mitigation techniques without discrimination**.
- **We all suffer the consequences of climate change, so it should be a priority in governments around the world.**