Environmental impact and sustainability deliveries in dairy farming

Ass. Prof., Dr. Anders Herlin

Agenda

- Opinions on environmental impact and sustainability
- What is agriculture? The dairy farm
- What is sustainability in agriculture?
- Methods matters
- Resource considerations – from grass to milk
- Caring for soil fertility and resilience
- Conclusions on sustainability delivery

Opinions on environment and sustainability in animal farming

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Avoiding meat and dairy is 'single biggest way' to reduce your impact on Earth

Biggest analysis to date reveals huge footprint of livestock - it provides just 18% of calories but takes up 83% of farmland

mian Carrington
vironment editor

31 May 2018 20.00 CEST

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Cattle at an illegal settlement in the Jamanxim National Forest, northern Brazil. The 1.3m hectare forest is today a microcosm of what happens in the Amazon, where vast areas of land are prey to illegal woodcutters, stock breeders and gold miners. Photograph: Antonio Scorza/AFP/Getty Images

Opinions on environment and sustainability in animal farming

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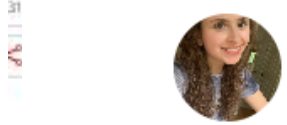
Is Almond Milk Bad for the Environment?

Industries: Food Level



By **Stephanie Safdie** updated 6 Jun 2024
US Copywriter at Greenly

Plant-based milks are so popular these days, that odds are – you take your coffee with oat milk or almond milk instead of traditional cow's milk. Even cafes in Paris are catching onto the trend, as they begin to offer lattes or a chocolat chaud with almond milk or other plant-based milk options.

Opinions on environment and sustainability in animal farming

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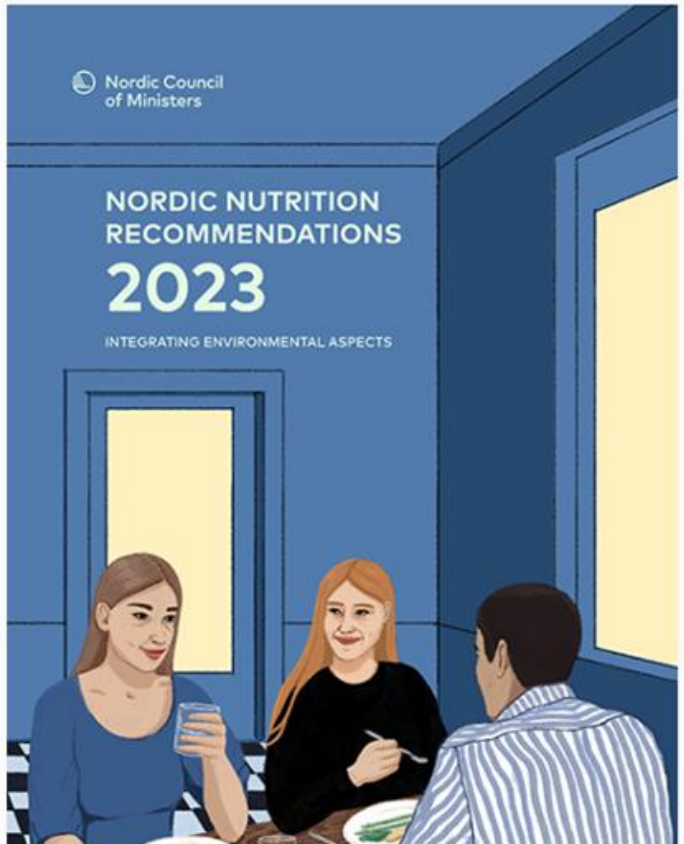
New milestones in the sustainable food discussion

Nordic Nutrition Recommendations 2023

Integrating Environmental Aspects



The Planetary Health Diet

The EAT-Lancet Commission presents a global planetary health diet that is healthy for both people and planet. Discover the report's key takeaways and specific actions that we all can take to contribute to the Great Food Transformation.

Analysis outlines pathway to health, equity, and a liveable planet

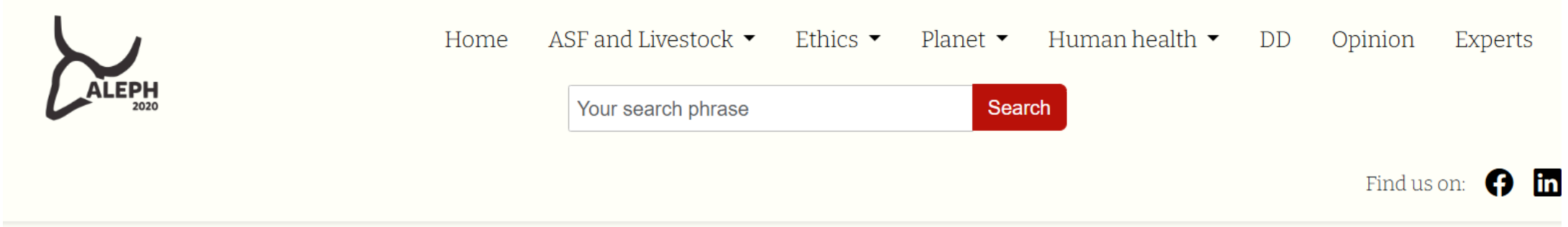
OCTOBER 3, 2025

The 2025 EAT-*Lancet* Commission today released its Report on Healthy, Sustainable Just Food Systems, presenting the most comprehensive global scientific evaluation systems to date.

Key findings:

- Shifting global diets could prevent up to 15 million premature deaths per year.
- Food systems are the largest contributor to the transgression of five planetary boundaries.
- Food systems currently account for roughly 30% of total greenhouse gas emissio globally. Transforming food systems could cut these emissions by more than half.
- Fewer than 1% of the world's population is currently in the 'safe and just space', wl people's rights and food needs are met within planetary boundaries.
- The wealthiest 30% of people drive more than 70% of food-related environmental impacts.

However, there are scientific based voices asking for a balanced debate https://www.aleph2020.org/



Animal-Sourced Foods in Ethical, Sustainable, and Healthy Diets

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ALEPH2020 - a dynamic white paper on the role of livestock farming in global agrifood systems and diets

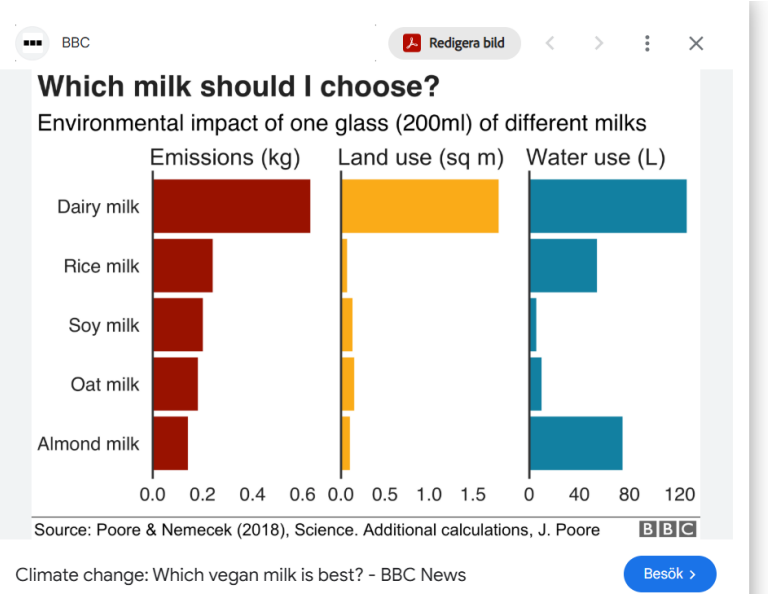
"Livestock systems must progress on the basis of the highest scientific standards. They are too precious to society to become the victim of simplification, reductionism or zealotry" (Dublin Declaration).

Livestock as villains and policy making

Prevailing views

- "Agriculture has large climate emissions and livestock is the main cause for this. "
  - "Livestock should be removed or reduced from agriculture."
  - "By only growing plant food, climate emissions from food production will decrease. "
  - "Assuming that plants/crops are, in essence, climate neutral or low impact."
- "New diets and dietary guidelines connects diet and agricultural production. "
  - "Dairy and red meat is claimed to be unhealthy and should be minimized. "
  - "And dairy and red meat production is harmful to the environment and the climate, do not drink or eat it. "
  - "Because one should not eat dairy and red meat, it should not be produced either... "
  - "..and by the way, red meat is unhealthy anyway".

However, The claimed link from dairy and red meat to the lack of sustainability of agriculture is never substantiated from a systems perspective



What is agriculture?

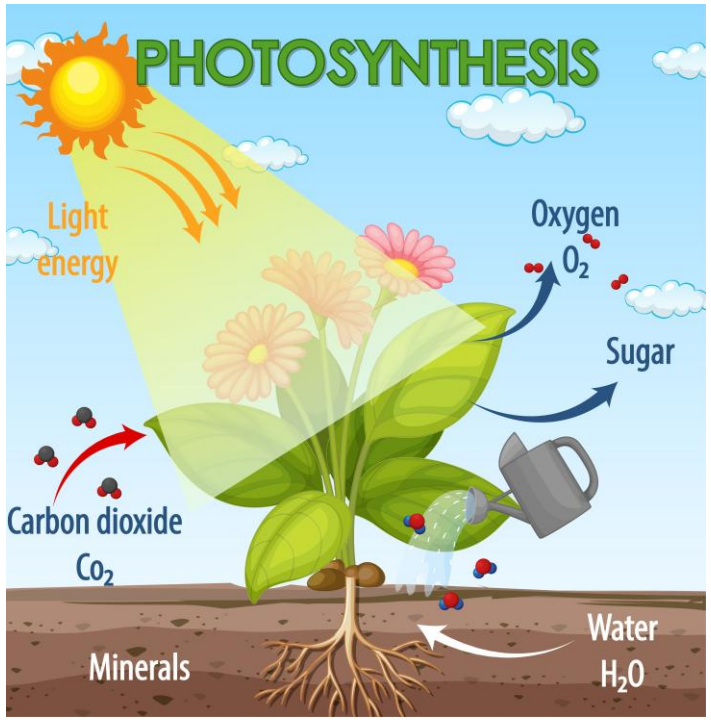
Current definitions are not good enough

- ”What is agriculture?”

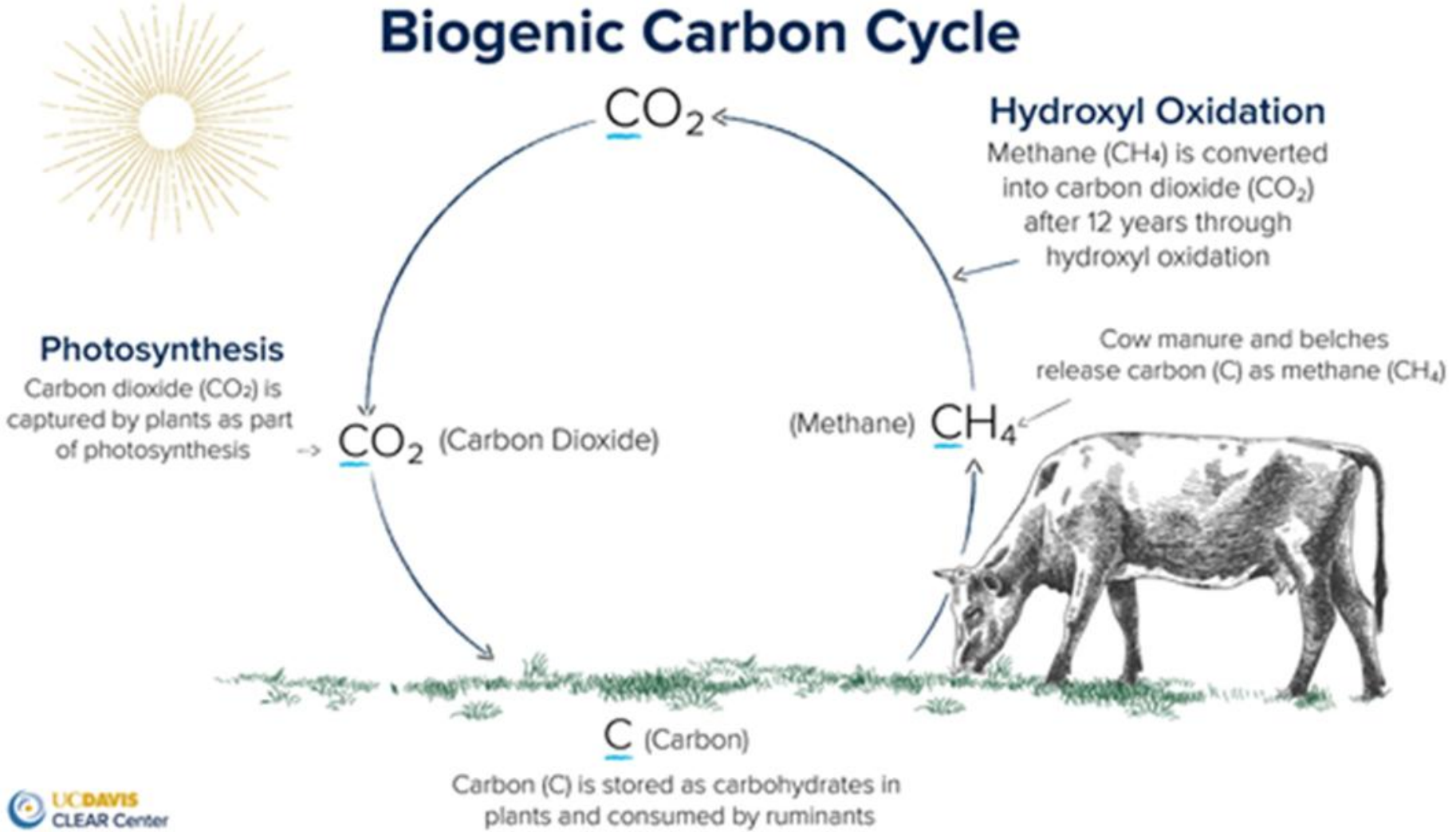
Agriculture is **the art and science of cultivating the soil, growing crops, and raising livestock**. (National Geographic)
Agriculture **encompasses crop and livestock production, aquaculture fisheries and forestry** for food and non-food products. (Wikipedia)
Agriculture is the **practice of cultivating natural resources** to sustain human life and provide economic gain. (Maryville university)

- **Photosynthetic primary production**; Everything upwards in the system depends on it. Production and economy and ecosystem services;

More to come!



What is agriculture?



The dairy farm

is an agricultural operation focused on raising female livestock, most commonly cows, for the purpose of producing milk and other dairy products.

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Inputs
Capital
Energy
Plant nutrients
Minerals
Feeds
Services
Other

Assets in the dairy farm:
Animals
Capital
Buildings
Soil health, fertility, resilience, etc
Water
Biodiversity
Equipment
Human skills
Social stability

Outputs
Milk
Beef
Market crops
Capital
Services
Benefits for society

Environmental impact
Green Houses Gases
Nutrient leakage
Gain or loss of biodiversity

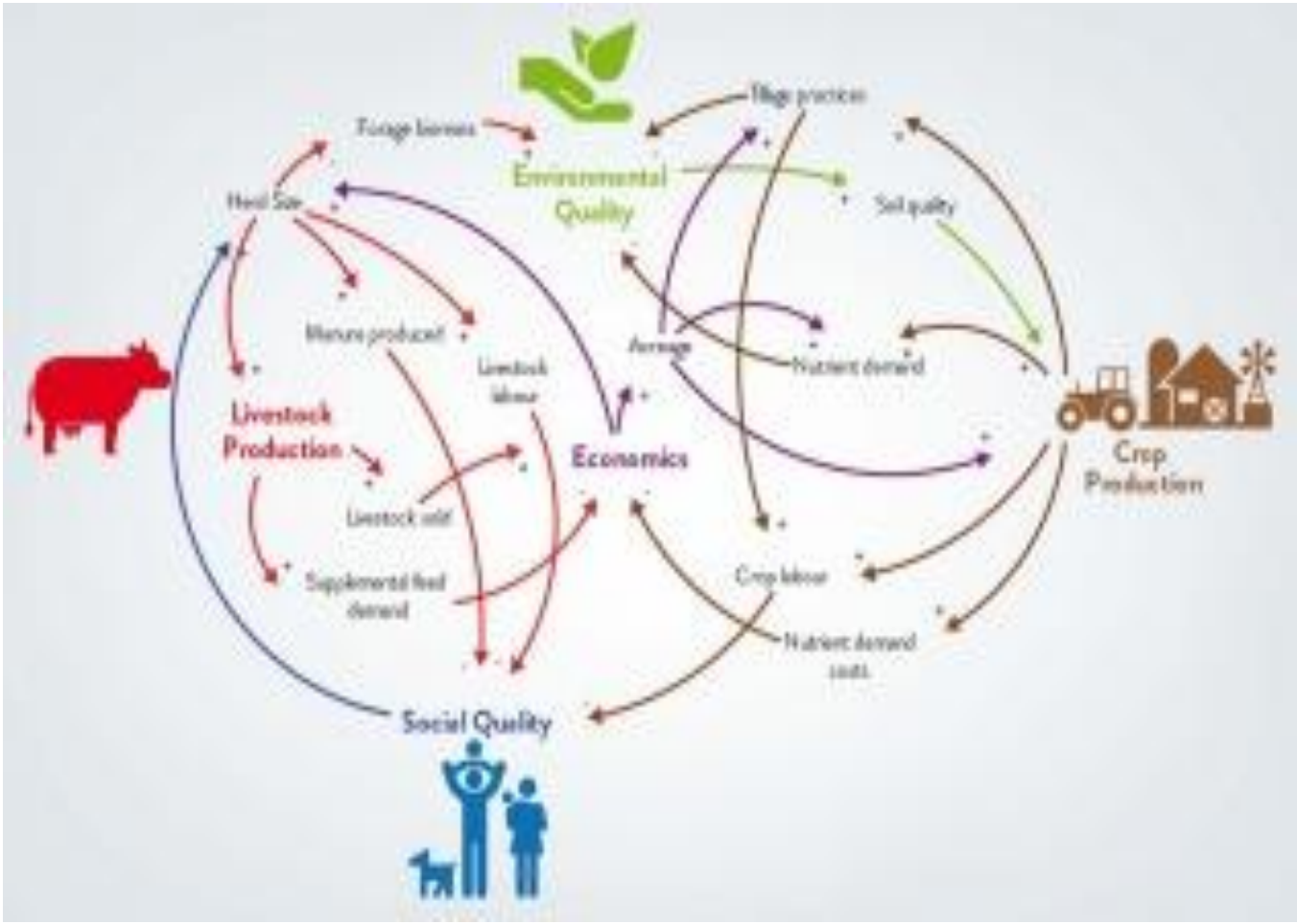
Management of the assets is the key to successfully operate a dairy farm

Complexity of agriculture

- Agriculture is a **complex multidimensional system**, linking resources, land, crop, animals and practices
  - over **short and long-term timelines**, resulting in various multidimensional effects on the external environment,
  - Including social and societal viability in the process of **producing food/nutrients for humans**
- A challenge to **totally capture agriculture in calculations and models**
- **Sustainability is a measure of the survivability** of the system
- No change can be done to the **whole system before consequences have been assessed with proper models**

Agriculture is a system

- Holistic approach
- Complex relationships
- Casual pathways
- Dynamic processes
  - Casual feedback loops
- Multidimensional out-come
  - Crops, animals, economy, environment, social quality
- Make predictions (instead of scenarios)



(Walters et al., 2016)

Sustainability in a system

- **Sustainability** of food production is a **systems property**.

  Therefore, products from a sustainable production system unit (farm), are all equally sustainable primary products

Most food production systems many parts of the world are coupled, multi-product systems using an **integrated animal-plant-land system**. This must be represented in the assessments.

Methods matter

- Life Cycle Analysis (LCA)
  - Environmental assessment method used in **industry** to evaluate a product's, service's, or process's environmental impact from raw material extraction through manufacturing, use, and end-of-life disposal or recycling
  - Often used to assess agricultural products but criticized for lack of capturing the complexity of agriculture

Functional Unit (FU)

- Use of Functional unit (FU) – *a measure of the product's environmental impact*
  - One-dimension **but food systems are complex and multifunctional**
  - Inventory snap shot – ”average performance” – producing generalizations – instead of site-specific ecological conditions
- Often use of Carbon Dioxide (CO_2-eq) as numerator but also other
- and Denominator (the product)
  - Per mass unit (most common)
  - Per content of protein (e.g. 100 g protein)
  - Nutrient content

CO_2-eq is the sum of Carbon Dioxide, Methane and Nitrous Oxide (adjusted for warming potential)

FU: per mass unit or protein

Based on Mass unit, per kg:

- In numerous papers
- Also in media ”food – climate lists” :Consequences for policy decisions by organizations

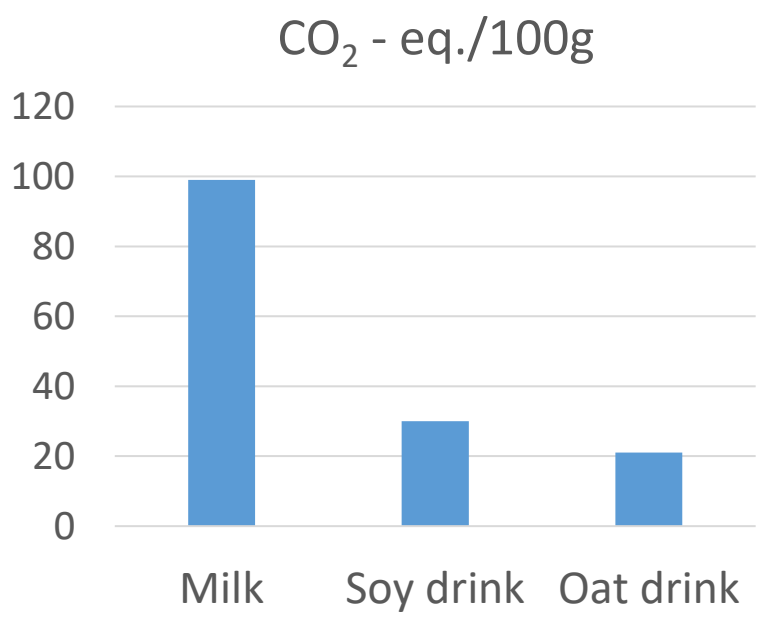
Based on protein content

- Amino acid profile not considered,
- Biological value of plant protein lower than for animal protein, not considered
- FU – e.g CO_2-eq / protein content ratios undervalues ruminants ability to produce high quality proteins from simple nitrogen compounds

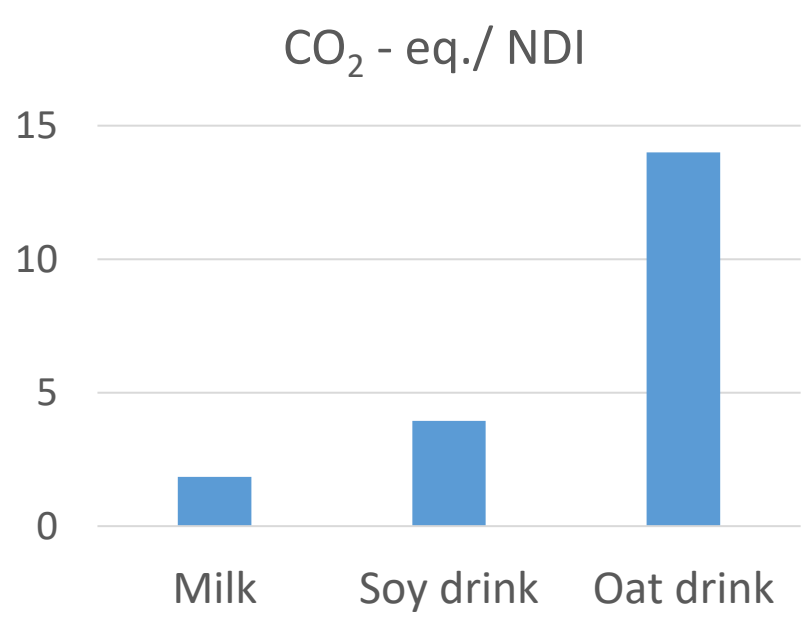
Funtional Unit: Mass unit vs. Nutrient Density

- Human nutrient demands, RDI –22 nutrients, daily recommended daily nutrient intake
- Climate impact of drinks

Climate impact Mass based:



Climate impact; Nutrient Density



Recalculated from Smedman et al. (2010)

Resource considerations – upcycling, grass to milk

Human edible protein efficiency (competition with humans)

- Grass cows: Production: 6350 kg*3,4% protein=216 kg human edible protein protein
- Intake of 0 kg of human edible protein
- Human edible protein feed efficiency =216/0 - infinitely high

- Cows on normal feed rations – human edible protein feed efficiency varies on type of diet but mostly more human edible protein produced, than was put in

LIVESTOCK TURN FOOD WE CAN'T EAT INTO PROTEIN

Alternative protein companies argue that it's more efficient to feed humans crops that are currently used for livestock feed, but **86%** of global livestock feed consists of things **humans cannot digest** with nearly half coming from **grass.**

ONLY 14%
EDIBLE BY HUMANS

Global livestock feed intake. Share of main feed types consumed by livestock supply chains (both ruminants and monogastric species) in 2010.[1]

1. Mottet, Anne. "Livestock: On Our Plates or Eating at Our Table? A New Analysis of the Feed/Food Debate." Global Food Security, Elsevier, 10 Jan. 2017, www.sciencedirect.com/science/article/abs/pii/S2211912416300013?via%3Dihub.

www.sacredcow.info

Caring for soil fertility and resilience

- Soil-C is crucially important for the sustainablitiy of agricultural land:
  - Land–use change devestating impact but can also improve SOC
  - Soil fertility, soil structure
  - Water holding capacity, drought resistance
  - Resistance to soil erosion, loss of arable land
  - Fate of pollutants
  - Global carbon cycle – C-sequstration
- Different animal feed production systems have different impact on soil-carbon
- Perennial grasses, clover and lucerne significantly improve soil carbon content, but annual crops such as cereals and legumes to a lesser extent
- Loss of soil carbon in soils with only crop production compared to crop rotations with grass/clover/lucerne for 2+ years

(Mogensen et al., 2014)

(Stanley et al., 2018)

(Stevens, 2018)

Conclusions on sustainability delivery by animal agriculture with animal source foods

- **Nutrients to humans**
  - Health benefits, lower healthcare costs, improved quality of life, safeguarding nutrition of children, adolescents, fertile women, the elderly
- **Food security animals**, especially ruminants feed on biomass that humans can't digest but still produces high quality food/nutrients even during times of hardship, droughts when crop farming fails.
- **Improved soil health and soil fertility** with crop rotation including grass, clover and pasture, and animal manure and permanent pastures
- **Improved soil resilience with higher organic carbon** in the soil; resistance to erosion, higher water holding capacity
- **Improved social life**, higher farmer income, family support
- **Rural social and economic impact**, supporting businesses and societal support and development
- Utilization of **varying climate and ecological conditions**, using areas where cash crops are not profitable or cannot be cultivated
- **Positive impact on biodiversity, fewer cows means loss of biodiversity**

Thank you for your attention!