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Aspects on

Assessment of environmental impacts and services of animal food systems

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Agenda

- Background
- Life cycle analysis - Functional unit
- Soil - fundamental to food systems
- Systemic modelling

Background (I)

- Agriculture/food sector substantial part of human activities causing global warming
- Need for reliable tools to be used for policy and decision making

”Save the planet – change the food systems”

Background (II)

- Several difficulties regarding food production systems:
  - Functional unit(s), one-dimensional but food systems are **complex and multifunctional**
  - **Inventory snap shot** – ”average performance” vs. process orientation
  - Predictions and/or **Scenarios**

(Notarnicola et al., 2017; Ponsioen & van der Werf, 2017)

Life Cycle Analysis (LCA) - functional unit (FU)

- Definition FU (14044 standard by ISO (ISO, 2006))
  - the quantified performance of a product system for use as a reference unit.
  - should define the performance characteristics of the product.
- Important: – should be meaningful, e.g. improve practices in farming systems in relation to output in services, sustainability or nutrient quality

  (Reap et al., 2008)

- Results are used by policy makers in organizations and by individuals

LCA and Functional Unit (FU)

- Environmental burden, e.g. Carbon Foot Print (CO_2-eq)
  - Per mass unit
  - Per 100 g protein
  - Nutrient based
  - Arable Land Use (ALU)
  - Soil-C
  - (Biodiversity)

FU: per mass unit or protein

Per Mass unit:

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

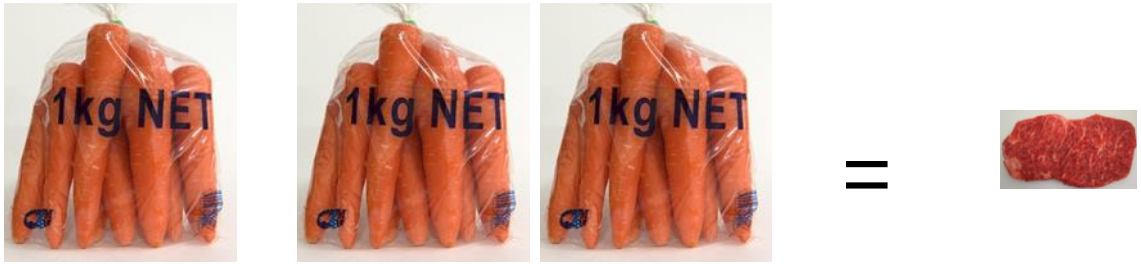
Protein content based

- One dimension
- Amino acid profile not considered, biological value of plant protein lower than in animal protein
- CO2-eq / protein ratios generally low for legumes < grains < monogastrics < ruminants (Clune et al., 2016)

Plant origin
Carrots CO_2-eq 0,2 (0,1-0,9)

Animal origin
Beef CO_2-eq 26 (10-40)

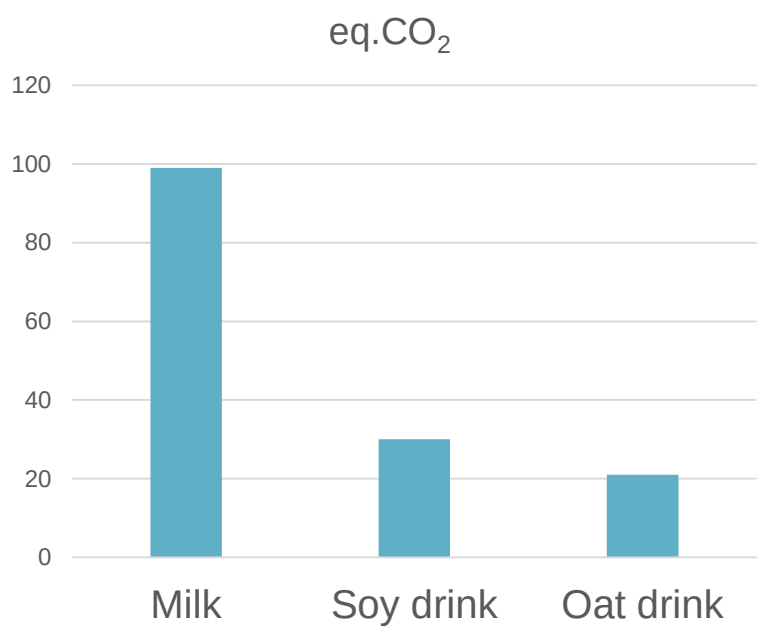
3 kg carrots to get the same amount of protein as in 100 g beef



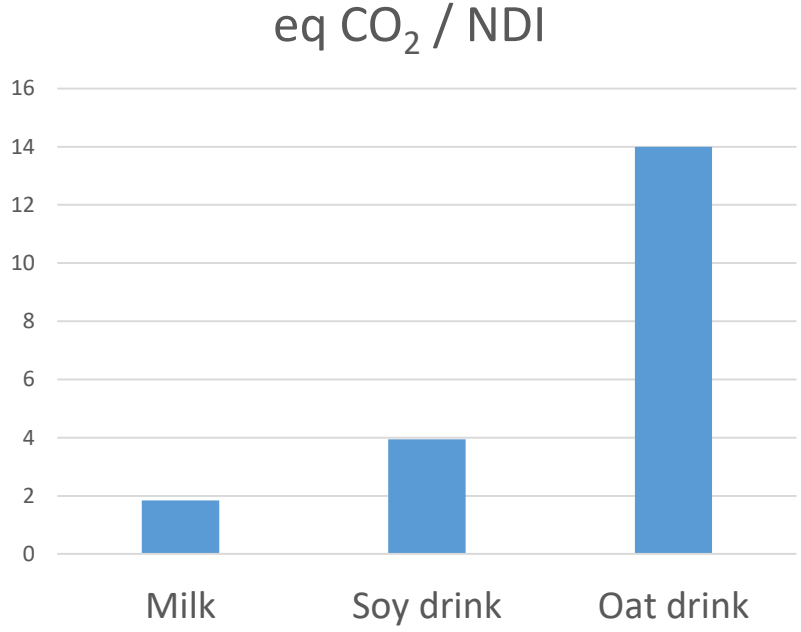
FU: Nutrient Density Index

- Human nutrient demands, RDI –22 nutrients, daily recommended daily nutrient intake
- Drinks explored

Mass based

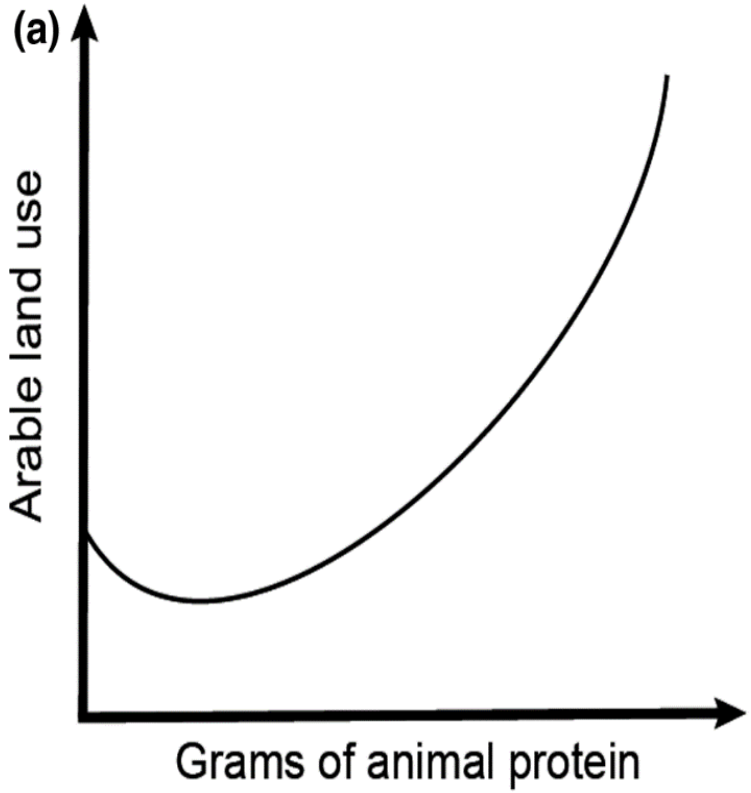


Climate impact to Nutrient Density

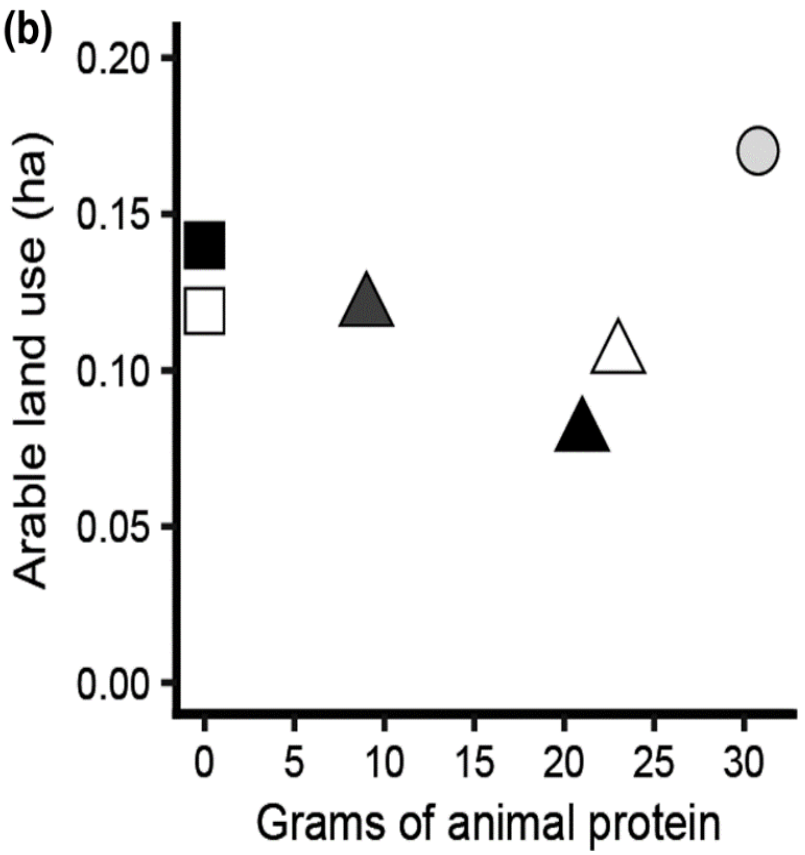


Recalculated from Smedman et al. (2010)

FU: Animal protein - Arable Land Use (ALU)



(Van Kernebeek et al., 2016)



(Zanteen et al., 2016)

Also studies on fat composition (omega-3) – on CO2-eq and ALU – more favorable for grass based systems vs. Intensive

(McAuliffe et al., 2018; Lee et al., 2018)

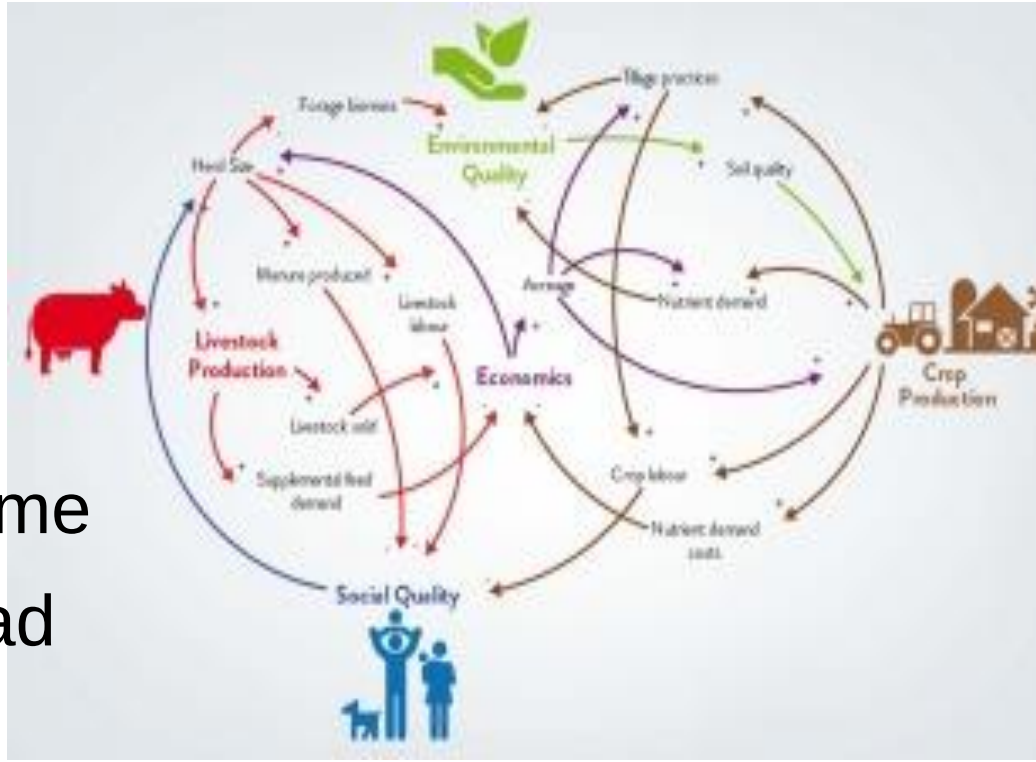
Importance of Soil-Carbon

- 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 food systems have different impact on soil-C
- Loss of soil carbon in soils with only crop production compared to crop rotations with temporary grasslands
- Suggests separate handling of Soil health as a FU and not only included in the total sum – soil health economy

(Mogensen et al., 2014) (Stanley et al., 2018) (Stevens, 2018)

Systems modelling

- Holistic approach
- Complex relationships
- Casual pathways
- Dynamic processes
- Multidimensional out-come
- Make predictions (instead of scenarios)



(Walters et al., 2016)

Conclusions

- **Improve communication** of assessments of food systems!
- **Single dimensional functional units** are not useful
- Food systems deliver several services and therefore needs **multidimensional assessments**
- **Soil-C/Soil-health** should be addressed and valued separately! **No soil – No food!!!**
- Need of a **substantial improvement** assessment methods for food systems - predictions and multidimensional assessments


Biodiversity – more important than you think
Thank you for your attention