Technische Universität München

Can we do without livestock?

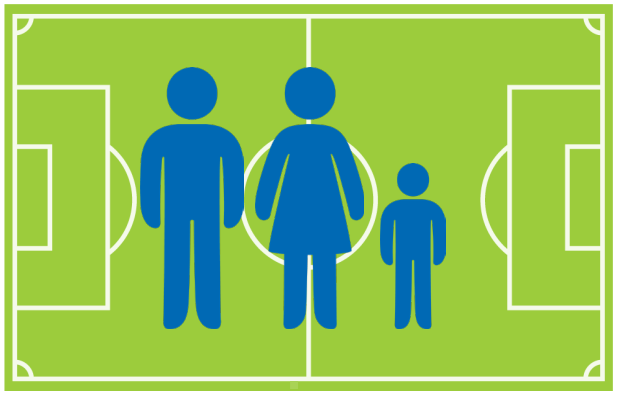
W. Windisch
TUM School of Life Sciences
Technical University Munich

1 Stop with food competition by livestock

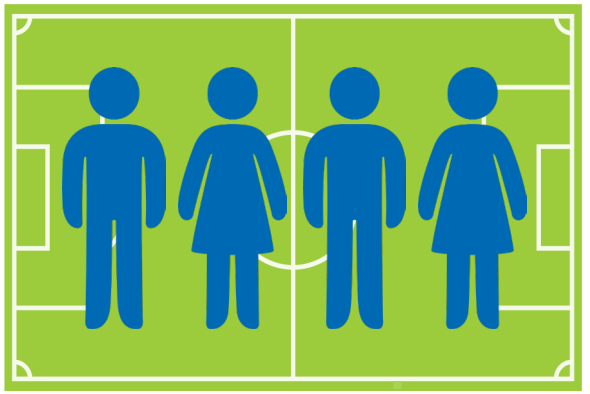
Globally available arable land becomes scarce

Arable area, globally available per human

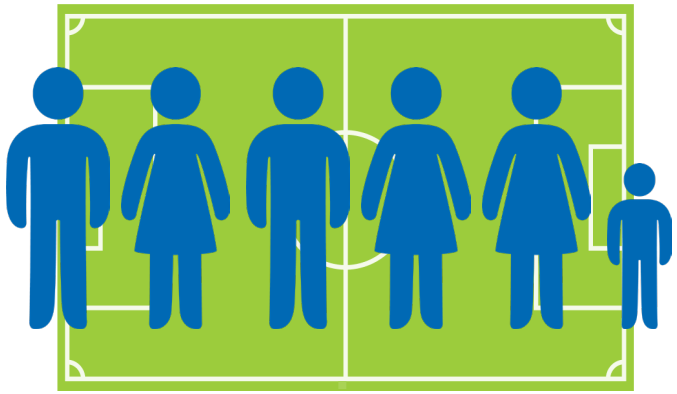
4 Bn. humans
3.800 m^2 per person



8 Bn. humans
1.800 m^2 per person



10 Bn. humans
1.400 m^2 per person



1970 **2023** **2050**

Plate before trough

? Do we have to completely stop livestock feeding?

- Current livestock production consumes 1/3 of global harvest of cereals and corn, and more than 3/4 of global harvest of soybean, partially associated with land use change. This is a burden to environment and climate. (e.g., Ritchie and Roser 2021, Ritchie, 2023)

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- Food competition to humans by livestock must be terminated.

2 Most of agricultural biomass in non-edible

Arable land provides mainly non-edible biomass

straw/kernel 1:1

bran/flour 2:1

Only 1/3 of harvested biomass ends up in wheat flour

Image up left from Elmschrat modified by VH-Halle – own work, CC BY-SA 4.0, https://commons.wikimedia.org/w/index.php?curid=11032439

Image wheat kernels : public domain, https://commons.wikimedia.org/w/index.php?curid=2226027

Image wheat flour from Mudd1 – own work, CC BY-SA 3.0, https://commons.wikimedia.org/w/index.php?curid=19147085

Imafe bran: https://commons.wikimedia.org/w/index.php?curid=545348

Grassland generates non-edible biomass only

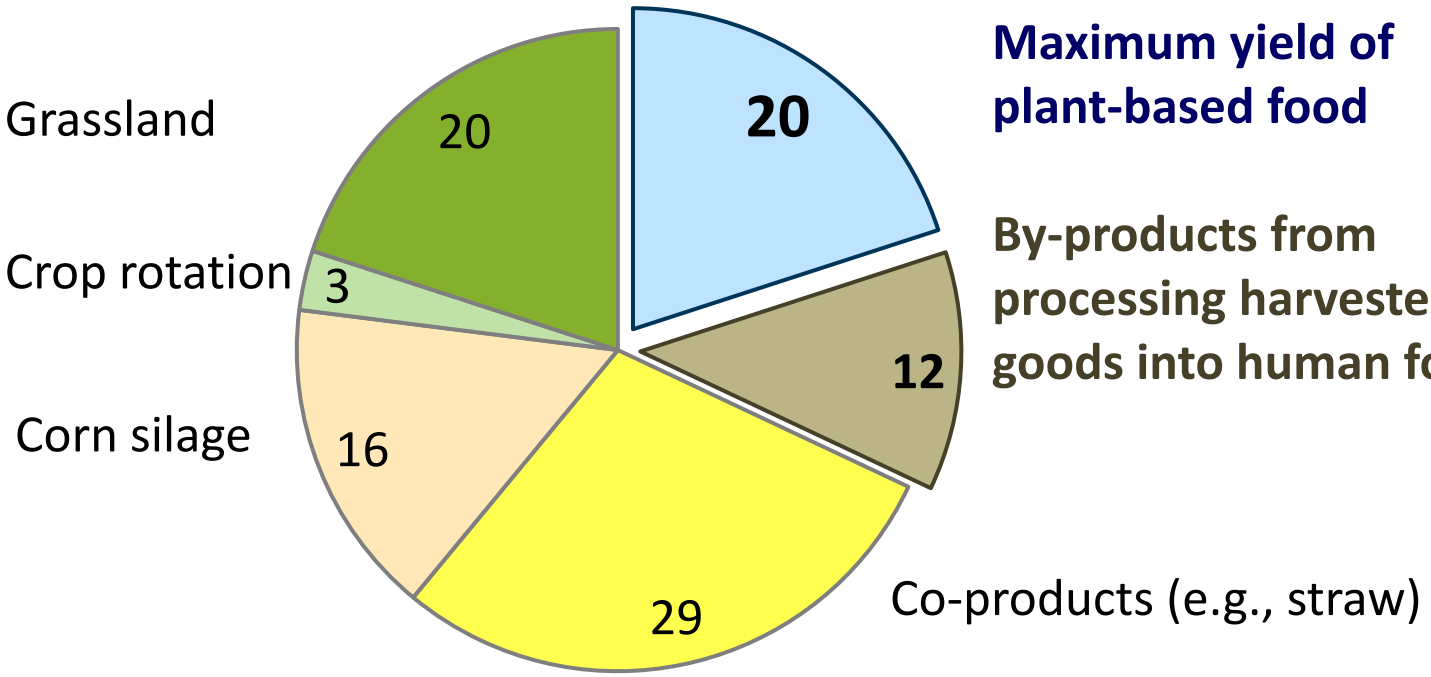
Absolute grassland – not arable
(too steep, too stony, too cold, too dry, too wet, too far away, flooding zone, …)

Absolute grassland covers large proportions of total agricultural areas:

globally:	>70%
intensive crop regions:	30%

Most of agricultural biomass is non-edible

E.g., Germany: Distribution (%) of biomass harvested in total (120 Mio MT DM/year) (%)

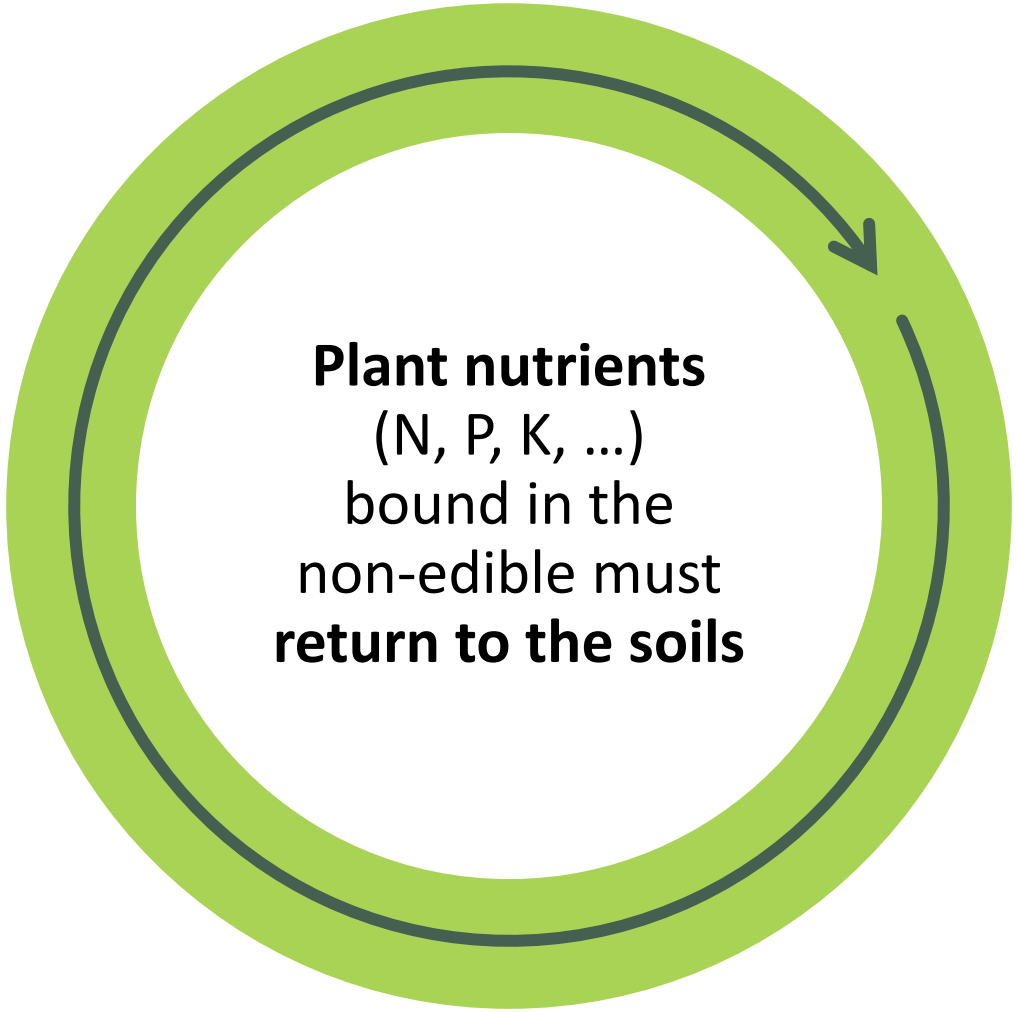


1 kg of plant-based food entails at least 4 kg of non-edible biomass.

Source: Vorndran et al. (2023)

3 Circularity of non-edible biomass is essential to agriculture

Back into the agricultural circulation of matter!



- **Rotting, compost, …:**
  uncontrolled degradation, low fertilizing efficiency, low plant harvests and high rate of emissions.
- **Fermentation to biogas (CH_4), using residues as fertilizer:**
  storable, targeted application, high fertilizing efficiency, high plant harvest.
- **Feeding to livestock, using dung as fertilizer:**
  storable, targeted application, high fertilizing efficiency, high plant harvest.

High quality food from non-edible biomass

3.g., bread
100 g protein
3000 kcal

e.g., 3 kg milk,
or 0.5 kg meat:
100 g protein
1500 kcal

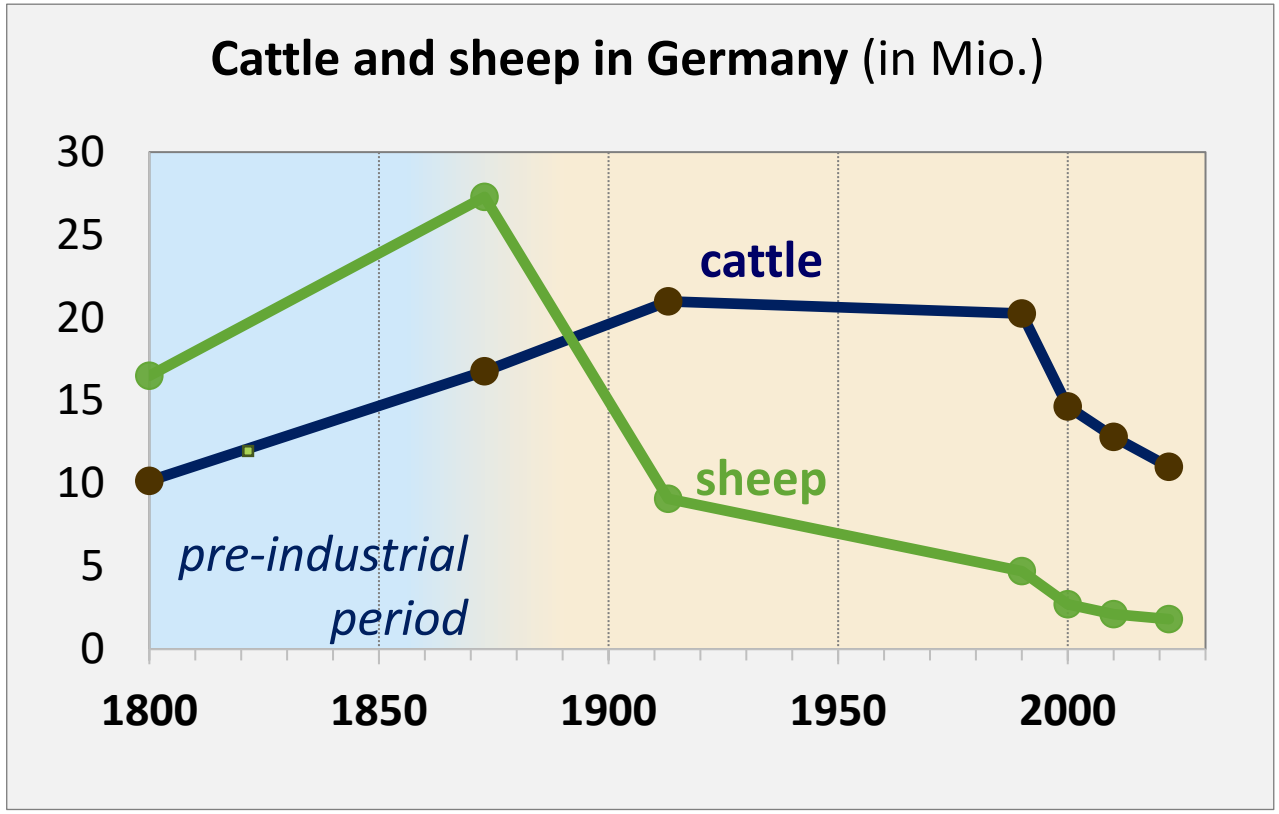
Ratio at least 1:4

Net gain from
non-edible biomass:
at least 50% more food
from the same area
without food competition

4

CLIMATE KILLER COW
is a misleading narrative

Central Europe: homework already done



Source: Schulze, 2014; bmel-statistik.de; Kuhla and Viereck, 2022

Current situation (Germany):

- Less ruminating livestock than in pre-industrial times.
- Less emission of CH_4 from livestock production than in pre-industrial times
  (Kuhla and Viereck, 2022).

CO_2 equivalents (e.g., GWP 100) massively overrate the climate impact of European ruminants

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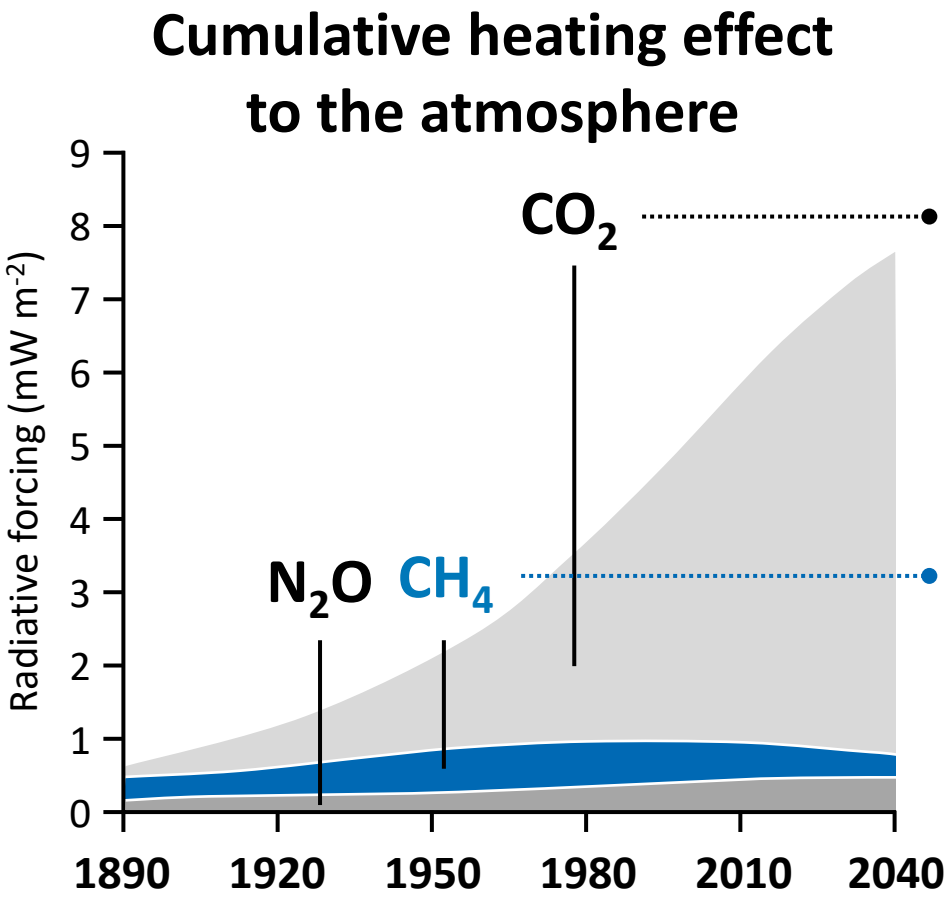


Weak greenhouse gas, but extremely persistent.

Emissions from fossil sources will **accumulate**.

Very strong greenhouse gas, but quickly degraded.

No accumulation as long as the rate of emission does not increase.

At constant head counts and production intensity:

- CH_4 emissions don't further heat up the climate.
- Elimination of ruminants hardly affects climate.

Strong climate impact only at rising intensification of ruminant production (e.g., South America, South Asia)

Source: Guggenberger et al. 2022, Austria

5 Too many as well as too few livestock harm environment and climate

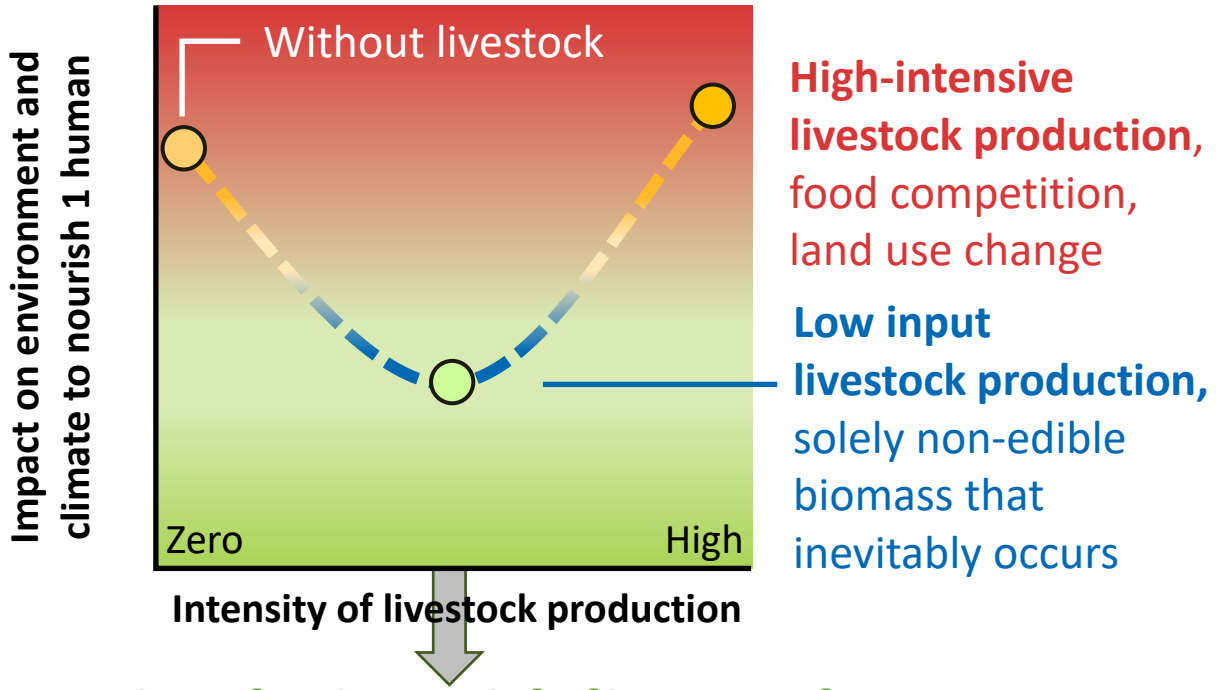
The non-edible biomass must not be spoiled!

Circularity of non-edible biomass occurs independent of the pathway (rotting, biogas, livestock feed). Emissions are virtually the same (CH_4 is not relevant)**.**

Abstinence from feeding to livestock destroys top-quality human food without helping environment and climate.

Nourishing 1 human without livestock rises plant production intensity:

- more <u>arable</u> land, water, …
- more emissions (fuel, fertilizer, …)



Circularity with livestock **denotes the minimum impact on environment and climate**

Circularity with livestock denotes the minimum impact on environment and climate

(Van Zanten et al. 2018)

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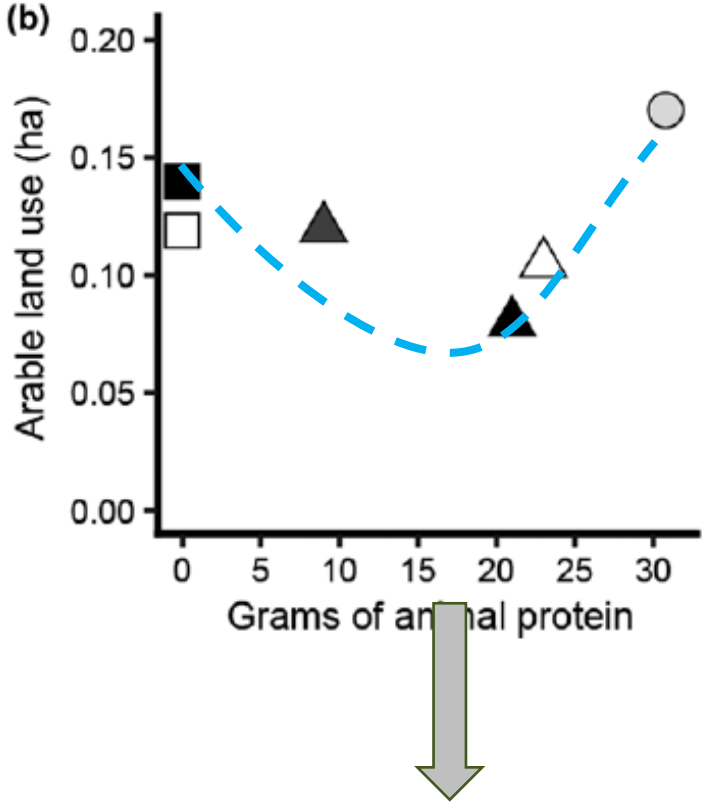
RESEARCH REVIEW

WILEY Globa

Defining a land boundary for sustainable livestock consumption

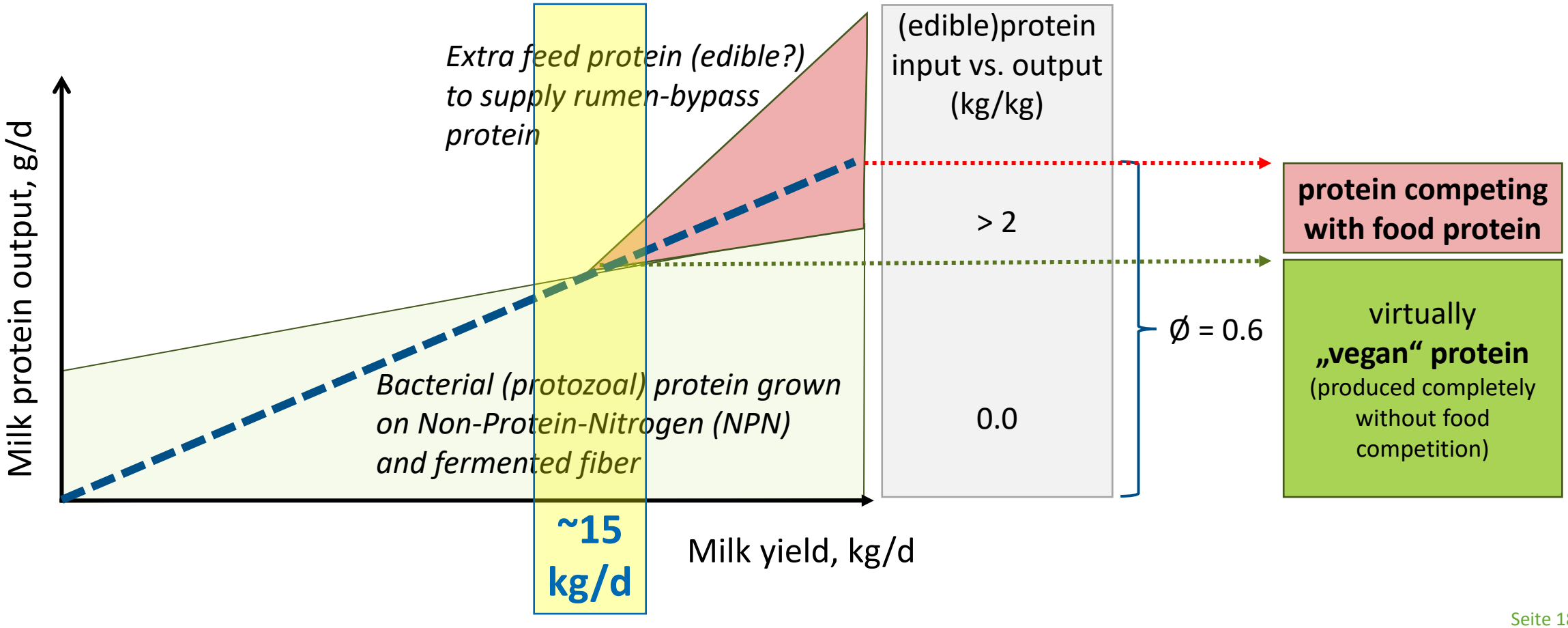
Hannah H. E. Van Zanten[1] | Mario Herrero[2] | Ollie Van Hal[1] | Elin Röös[3] | Adrian Muller[4,5] | Tara Garnett[6] | Pierre J. Gerber[1,7] | Christian Schader[4] | Imke J. M. De Boer[1]



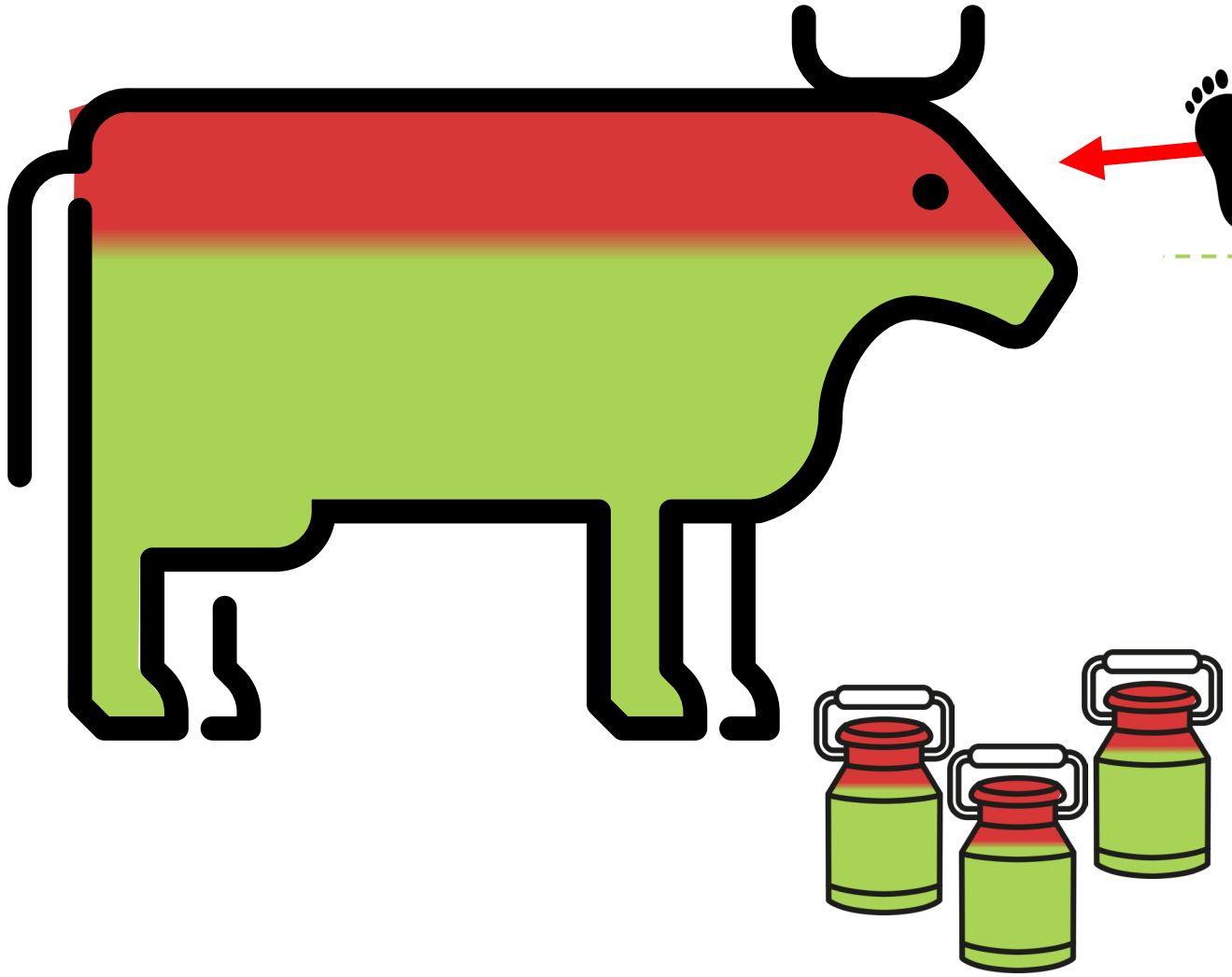
Circularity with livestock

Scenarios based on overall means only may loose important information

Intensive livestock production contains at least two different types of footprints



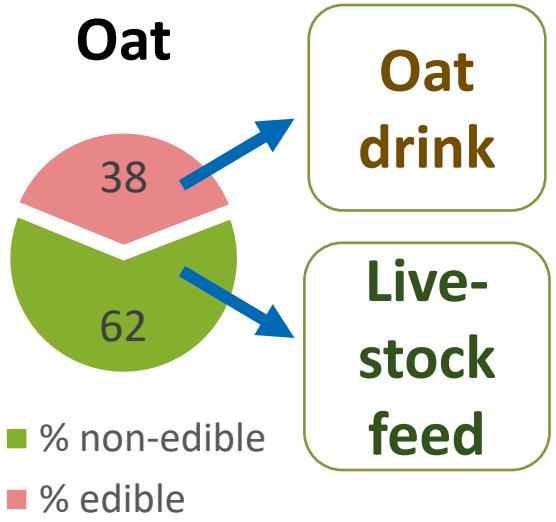
Sustainable livestock production: eliminate high footprints rather than head counts



Food competition and land use change harm environment and climate

Livestock production within circularity protects environment and climate

Circularity with livestock is indispensable even to plant based ‘alternatives’



1 glass of oat drink entails another glass of cow milk

Lupins:	30% edible,	70% feed
Soybean:	70% edible,	30% feed

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6 Summary and outlook

Can we do without livestock?

We cannot do without livestock; it is an indispensable part of agricultural circularity.

Nourishing humans with minimum impact on environment and climate requires local balance between plant production and livestock.

Analogy to energy transition

	Energy transition	Livestock transition
Away from	Fossil energy	Food competition, land use change
Moving to	Renewable energy: sunlight, wind, …	Inevitably occurring, non-edible biomass
Limitations	Quantity, storage	Quantity, feed value
Impact on the consumer	Low supply, high price	Less products, higher price
Response	Explore all available sources, optimise efficiency factors	Optimise feed value, feeding efficiency and livestock management