Vision for a sustainable livestock sector

UNIVERSITÄT FÜR BODENKULTUR WIEN
University of Natural Resources and Life Sciences, Vienna

Conference: Scientific facts on the environmental impact of livestock farming

Swiss Association for Animal Sciences SVT

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Live “sustainability”

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- Hans Carl von Carlowitz in Saxony (1713): "sustainable" use of wood
- "live in such a way that other and future people (living beings) can also live well“
- Club of Rome (Meadows et al. 1972): "Limits to Growth“
  - “…establish a **condition of ecological and economic stability** that is **sustainable far into the future**.”
- Brundtland Commission report (WCED 1987):
  - “Sustainable development is **development that meets the needs of the present** without compromising the ability of **future generations** to meet their own needs

1. Environmental and climate protection
2. Social & economic systems for the benefit of all people

SUSTAINABLE DEVELOPMENT GOALS

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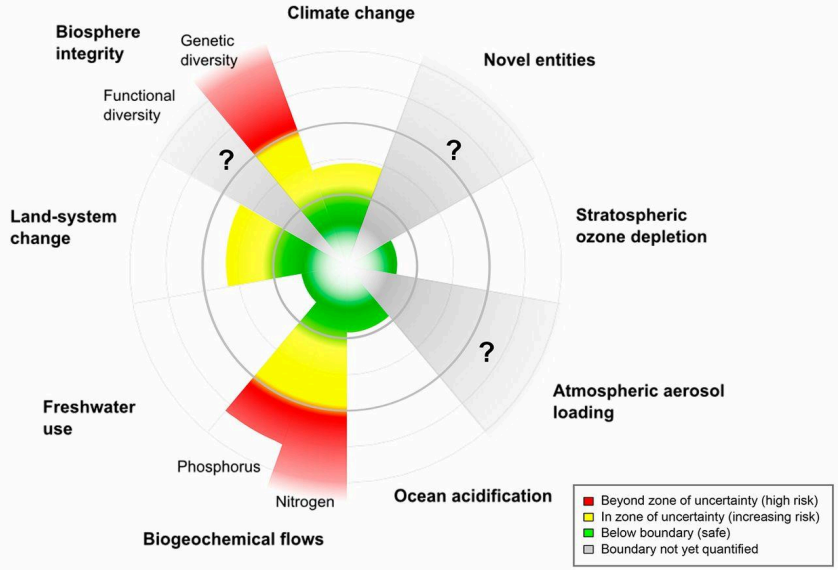
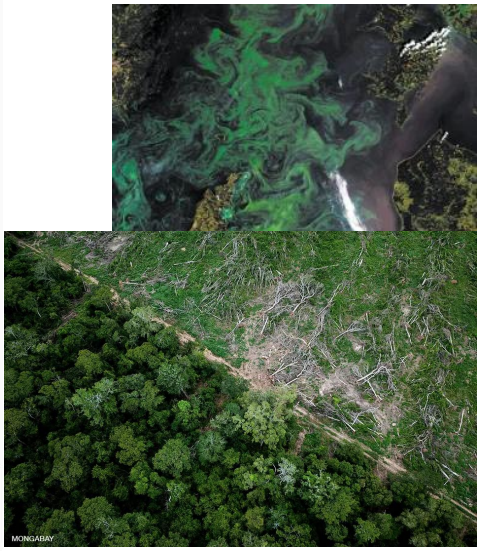
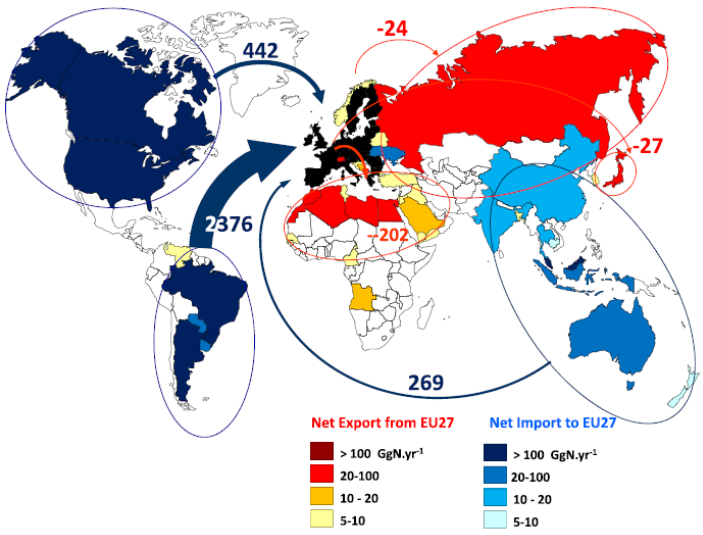
Sustainable livestock farming is important for many SDGs!

What are the most urgent environmental problems? (according to Steffen et al. 2015)





Nitrogen-flows from and to EU-27 (according to Leip et al., 2015)



Environmental problems along the nitrogen-cascade (Leip et al., 2015)

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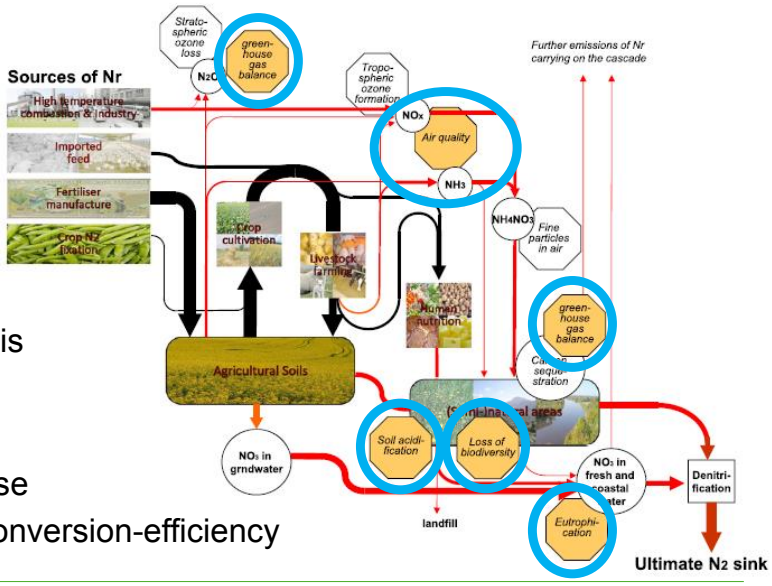
- Nitrogen (N) use with many effects
  1. Greenhouse gas N_2O
  2. Air pollutants (mainly NH_3)
  3. Terrestrial Acidification
  4. Biodiversity losses
  5. Marine Eutrophication

  → Assessed with Life Cycle Analysis
- Further indicators inter alia for…
  - Freshwater (P-) Eutrophication
  - Energy- and mineral ressources use
  - Land use- or human edible food conversion-efficiency



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Specific sustainability aspects of animal husbandry

- Climate-friendly animal husbandry
- Livestock, air & water pollution
- Livestock and biodiversity loss

Climate impacts of livestock – globally and in Europe

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- Livestock globally: 16.5% of anthropogenic CO_2-eq (Twine, 2021)
- 32% of global CH_4 emissions from livestock (UNEP, 2021)
- 53% of global N_2O emissions related to livestock (Gerber et al., 2013)

- **Europa**: 10% of anthropogenic CO_2-eq from sector agriculture (Leip u.a., 2015)
  - 20% if associated CO_2-eq from other sectors and continents are taken into account
  - 39% of all agricultural CO_2-eq imported into Europe
  - Livestock: 81% of agricultural CO_2-eq

Global warming potential of European livestock products (according to Leip et al., 2010, updated)

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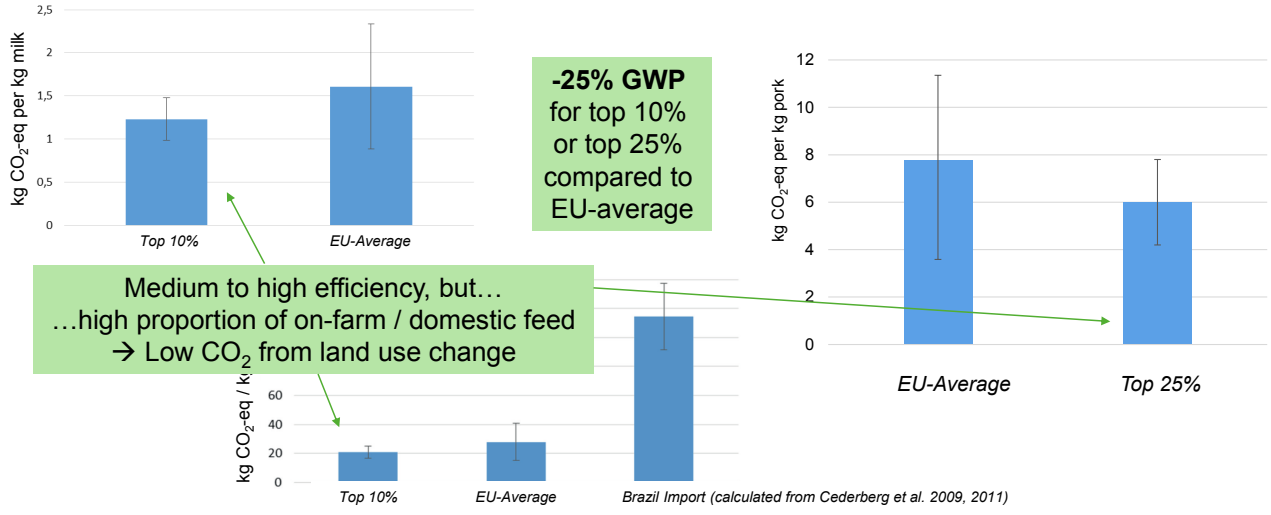
with estimation of variances and model uncertainties



Options to reduce greenhouse gas emissions from livestock production

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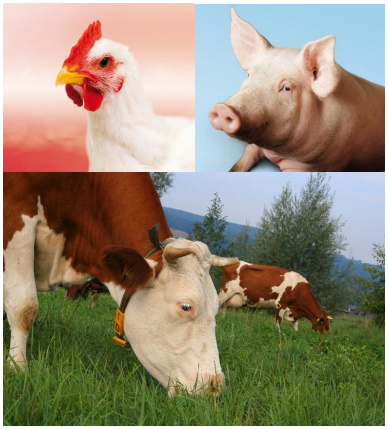
- Substitution of critical feedstuffs
- Feed additives and diet optimization
- Breeding – e.g. through dairy cows with equal performance but lower body mass (Hörtenhuber & Zollitsch, 2016)
  - 5 – 10 % emission reduction → Average life day performance
- Site-adapted intensity
- Ruminants: Increased forage quality (Hörtenhuber et al., 2010)
  - -1.5 % CO_2-eq per 0,5 MJ NEL / kg DM
- Ruminants: Pasture (Hörtenhuber u.a., 2010)
  - -2 % CO_2-eq per 10 % grazing time (as annual budget)
- Low-emission livestock housing systems, manure treatment
- Manure for biogas production (Hörtenhuber et al., 2010)



Emission reduction through feed additives (example of plant-based active ingredients in "Phytopass")

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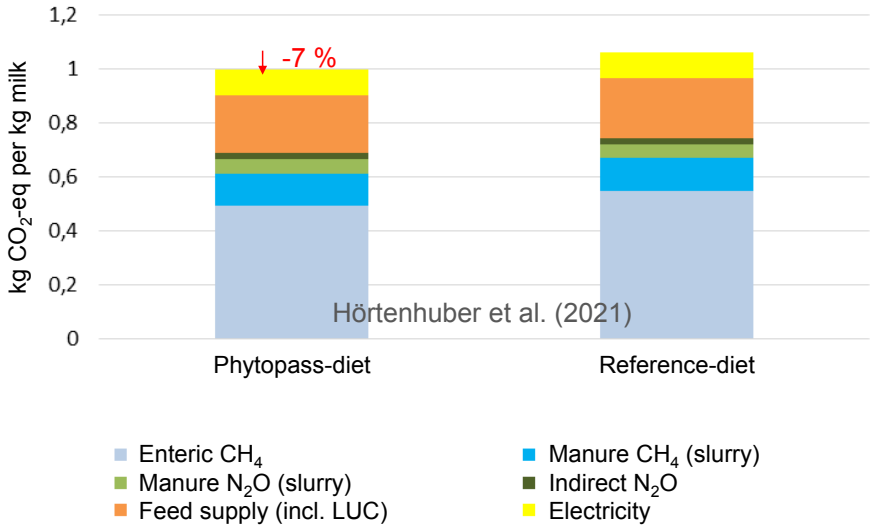

-7% CO_2-eq along value chain through increased outputs & reduced CH_4 emissions. (partly compensated by slightly higher environmental impacts of feed production or farm manure management)

→ Active ingredients: mainly tannins, saponins, essential oils

Comparable results can also be expected for similar additives such as "Agolin" (see Belanche et al., 2020)

Comparison of livestock products' global warming potentials per kg protein

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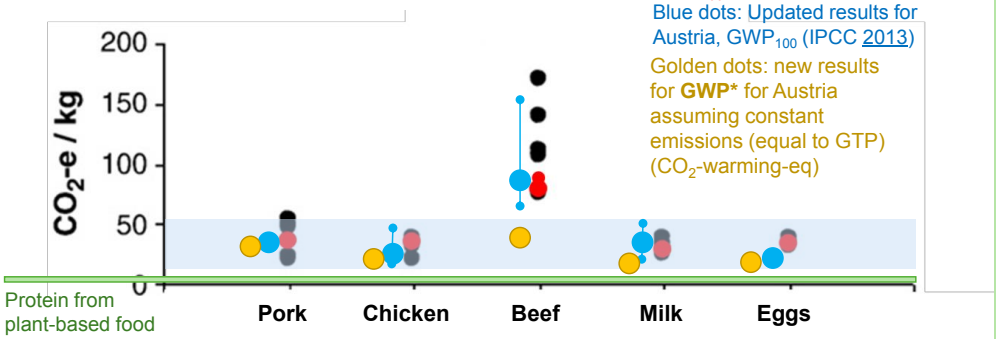

Black dots:
From international studies (de Vries & de Boer, 2010)
Red dots: Results for Austria, GWP_{100} (IPCC 2007)
Blue dots: Updated results for Austria, GWP_{100} (IPCC 2013)
Golden dots: new results for **GWP*** for Austria assuming constant emissions (equal to GTP) (CO_2-warming-eq)

Protein from plant-based food (cereals, grain legumes,…)

GWP* according to Hörtenhuber et al. (2022)

The **continuous reduction of CH_4-emissions**, **especially from dairy and pig production,** lead to ***declining warming*** instead of just reduced emissions.

→ Achieved through increased breeding and fattening performances, together with declining animal numbers.

Yield reductions & soil losses

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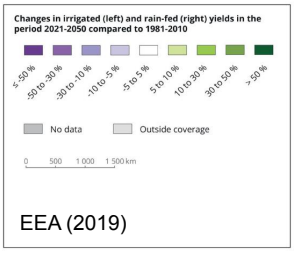
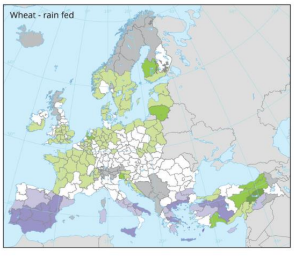
- Forecast of climate change yield decline until 2050: 30% on Austria's arable land
- Soil loss as another risk → Forecast Federal Environment Agency Austria: another 7.5% of agricultural area built up with infrastructure by 2050
- **Efficient use of limited areas!**
  - Especially of arable land

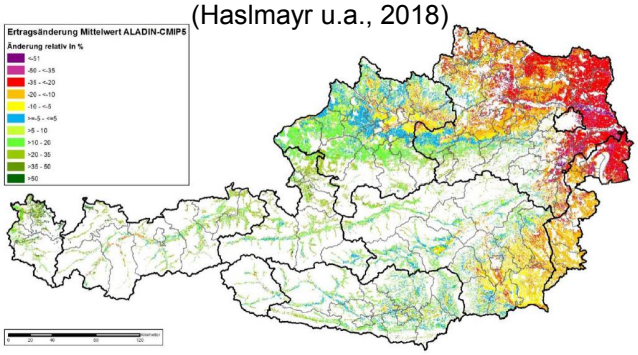
→ **Efficient use of feed!**



EEA (2019)



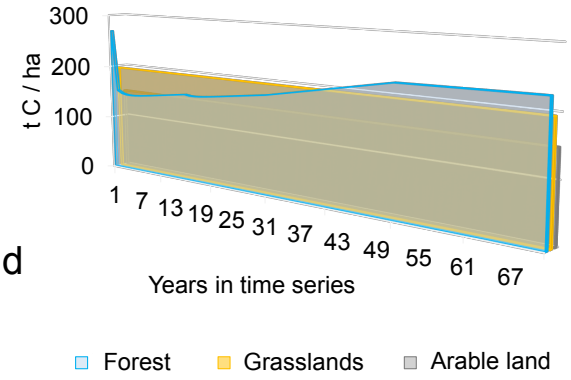
Ertragsprognose für 2050 (Haslmayr u.a., 2018)



SVT-Tagung | 13. April 2022 | S. Hörtenhuber

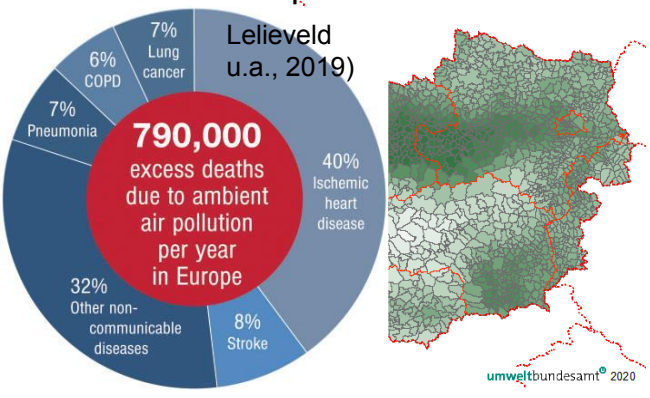
Soil carbon

- Many measures possible to enrich soil carbon to increase resilience (EEA, 2019), among others…
  - Reduced tillage, no-till
  - Cover crops
  - Diversification of crops and crop rotations
  - Medium management intensity in grassland (Bohner et al., 2016)
  - Prevent erosion (windbreaks,...)
- Carbon sink: 1 ha of permanent grassland stores about as much C as 1 ha of forest and significantly more than arable land (according to Houghton & Hackler, 2001, for temperate climate in Europe)



NH_3 & nitrogen-deposition

- Ammonia (NH_3) & particulate matter: most important air pollutant from livestock
- 82% of NH_3 from livestock (Leip et al., 2015); → Slurry store cover, band spreading,...
- 50% NH_3-reduction in agriculture: -50.000 deaths in Europe
- Air pollution (partly) responsible for 16% of deaths in Europe (reduction of life expectancy by 2.4 years; Lelieveld u.a., 2019)
- Connection with covid-deaths (air pollutant-related pre-diseases)
- With NH_3 also N-deposition from animal husbandry → Causes acidification, eutrophication (nitrate), indirect greenhouse gases (N_2O), loss of biodiversity



Nitrogen losses, eutrophication & drinking water supply

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- Eutrophication of water bodies: costs of 3.8 - 4.4 billion euros per year in the Baltic Sea region (HELCOM, 2018)
- Cost of drinking water nitrate removal: up to + 62% of the cost of water (Oelmann et al., 2017)

- Significant advantage of permanent grassland-based production! (Eder et al., 2015; Kolbe, 2002)
- Advantage of organic production, especially on arable land! (Kolbe, 2002)

Kolbe (2002): % N leaching / N-input		
	Grassland	Arable land
Conventional (integrated)	11.0%	24.7% - 26.6%
organic	10.2%	17.5%

Biodiversity Conservation

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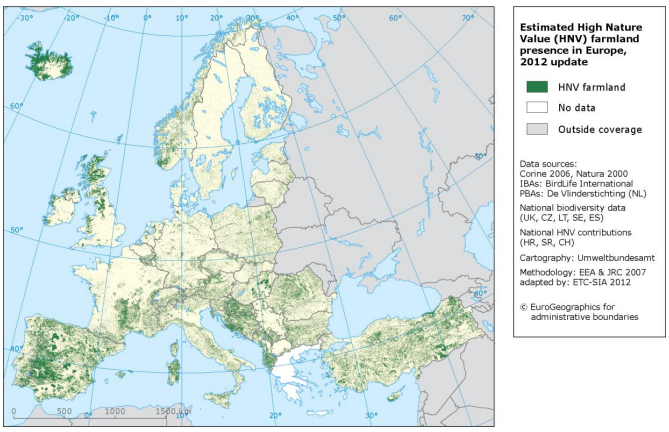
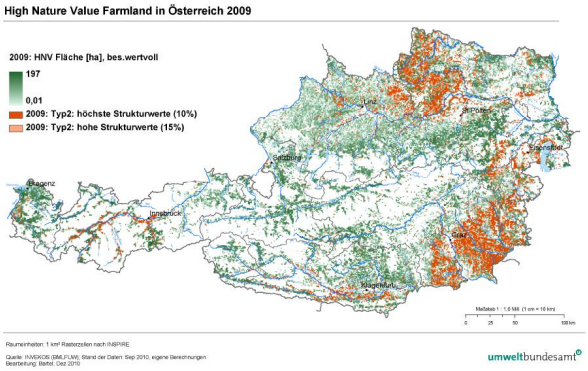
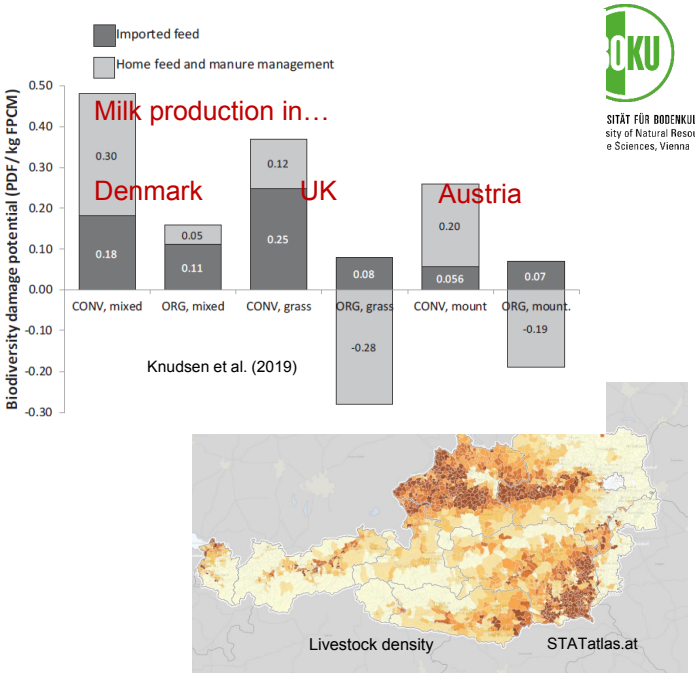
- Terrestrial biodiversity: 34% of biodiversity lost to agriculture (livestock, cropland, N and GHG emissions; Leip et al., 2015)
  - 76% of losses due to livestock
- 50% of global GDP (€40 trillion) depend on services provided by intact nature (EU, 2020)
- Assessed costs: 3% of the annual EU-GDP due to biodiversity losses (EU, 2020)
- Provide opportunities for conservation
  - Goal: 30% of EU-areas
  - High Nature Value Farmland (HNVF)
  - Organic agriculture



Livestock, HNVF and plant diversity

- High proportion of biodiversity-relevant areas due to "extensive" to "medium-intensive" livestock farming (especially cattle)





Specific sustainability aspects of animal husbandry

- Ecosystem Services
- Human-edible feed conversion efficiency
- Animal health and welfare

Sustainable livestock farming has a future!

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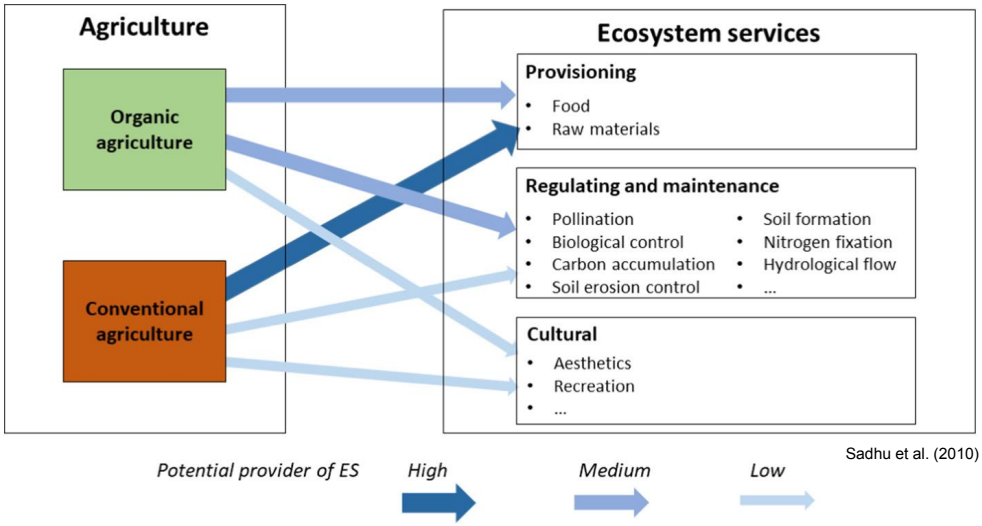
Important:
Low negative climate and environmental impacts
plus high positive ecosystem services!



Sadhu et al. (2010)

Efficiency: conversion ratio of human-edible protein instead of FCR (feed amounts)

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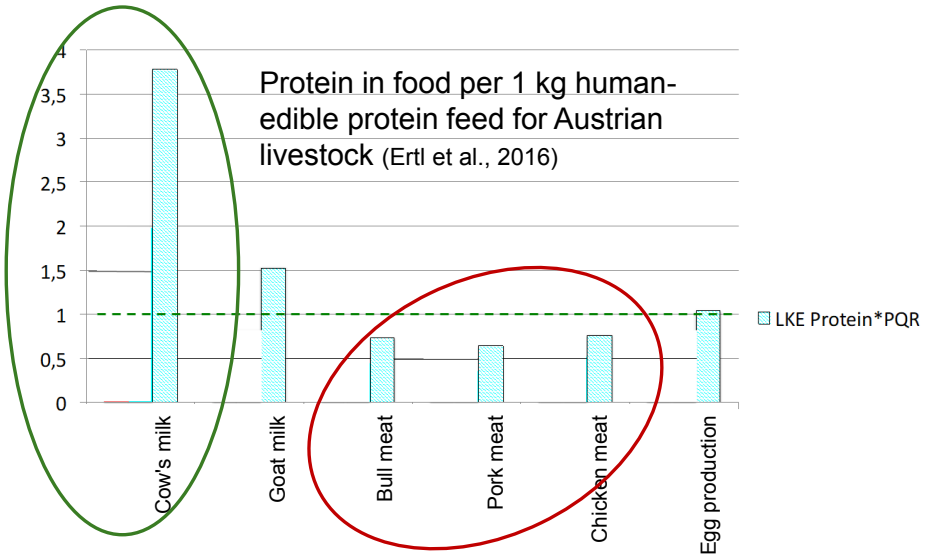

Livestock as a basis for value added in many rural regions

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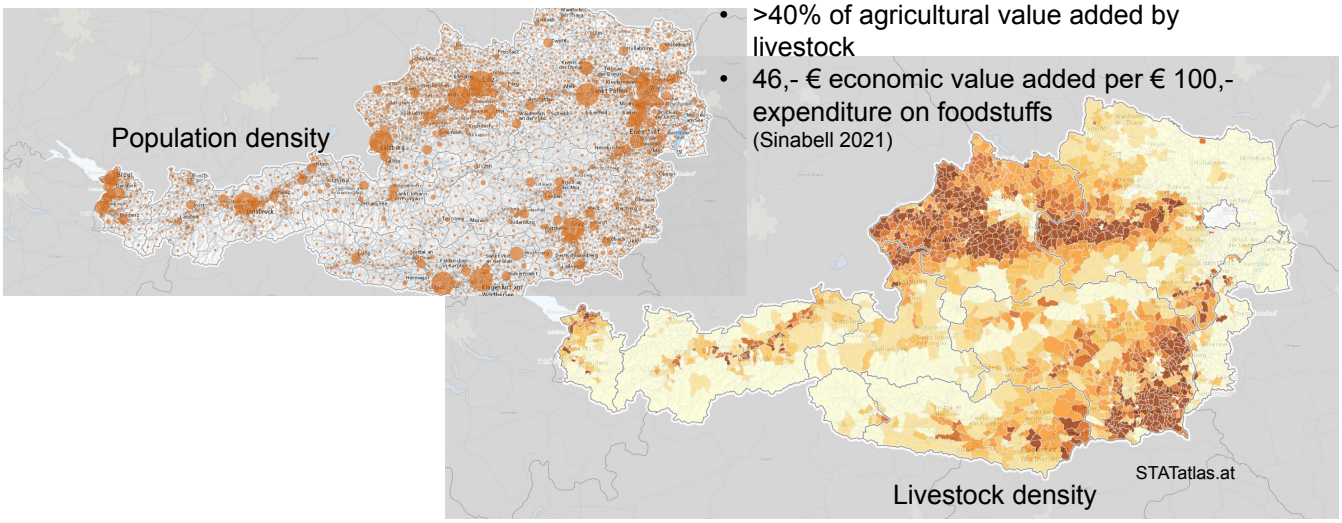
- >40% of agricultural value added by livestock
- 46,- € economic value added per € 100,- expenditure on foodstuffs (Sinabell 2021)



Efficiency vs. animal health and welfare

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- Efficiency is important... but also health and animal welfare! → Cow-calf systems?!
- Breeding for high performance with an increase in genetic diseases
  - e.g. Complex Vertebral Malformations (CVM) in Holstein Frisian cattle (van Marle-Köster & Visser, 2021)
- Consideration of functional characteristics as an opportunity to reduce illnesses and medications


Ghanem & Nishibori (2008)

Comparison of ROSS 308 and JA 757 (32 and 31 days)
→ ROSS 308 with sign. higher gross margin, but.....
…34% instead of 2% animals were clearly lame!
…8-fold mortality under exaktly similar study conditions (Niebuhr u.a., 2016)

Higher animal welfare = higher efficiency

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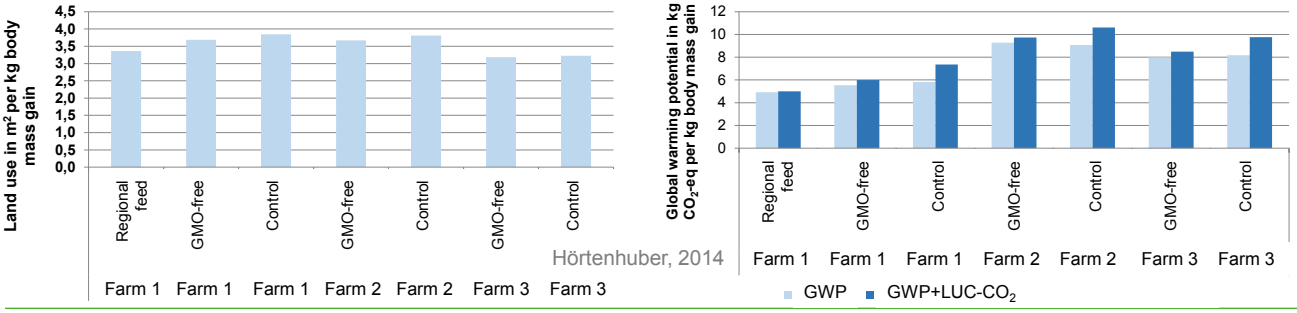
- Example fattening pigs:
  - Animals in animal welfare-optimized houses with straw & more space: ø 3% better feed conversion, consistently lower environmental impacts! (Hörtenhuber, 2014, in: Schodl, 2017)
  - Additional costs: + 6,- € to + 48,5 € for houses (space), bedding and additional work → 40% to 70% compensated by public funds → rest by product price → High satisfaction of farmers (Kirner & Stürmer, 2021)



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Specific sustainability aspects of animal husbandry

- 3 aspects of sustainability: efficiency, consistency, sufficiency
- Trade-offs and synergies

Where are efficiency gains still possible?

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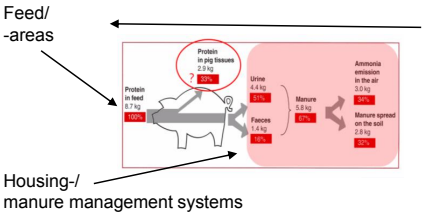
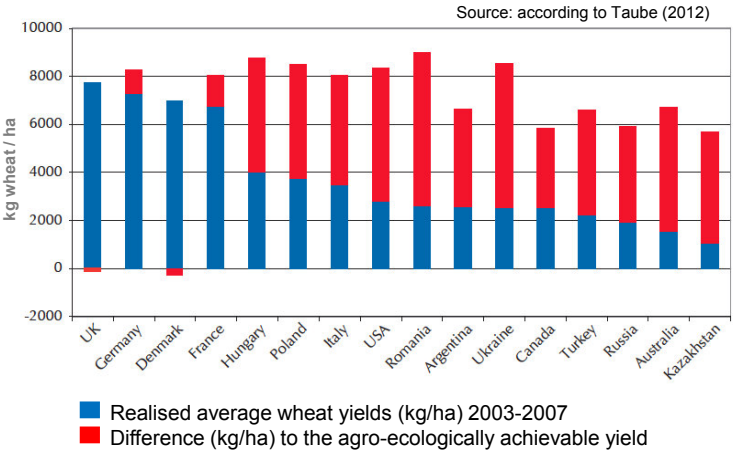
- Do not evaluate livestock (husbandry & feeding) isolated, but in connection with its surrounding (e.g. feed production)!



- In animals and on (arable) land in Central and Western Europe, efficiency largely realised?!
- Productivity increases i.a. in Eastern Europe



Trade-offs of „sustainable intensification“

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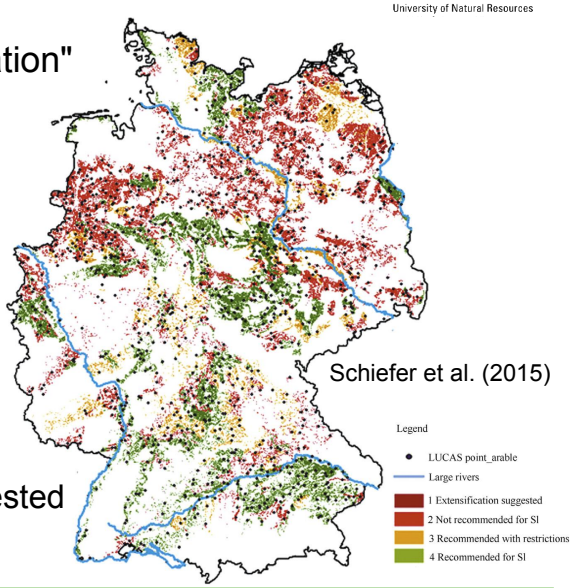
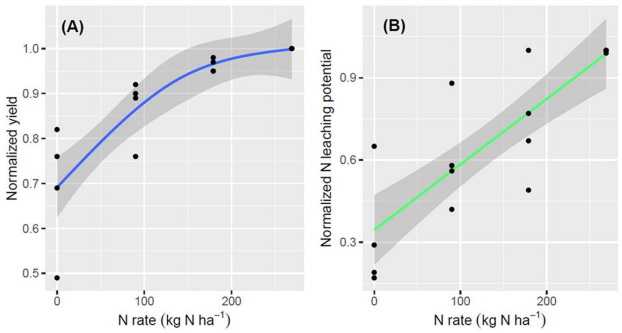
- Yield increases through "sustainable intensification" in crop production? → Biodiversity and soil protection potentially reduced!
- Schiefer et al. (2015): Analysis, which areas in Germany could be intensified
  - 6 soil quality indicators:
    → organic C, clay & silt content, pH, cation exchange capacity, soil depth, slope gradient
  - *Results:*
  - 39% of arable land still allow some intensification - partly with restrictions
  - 61% NOT! → partly reduction of intensity suggested

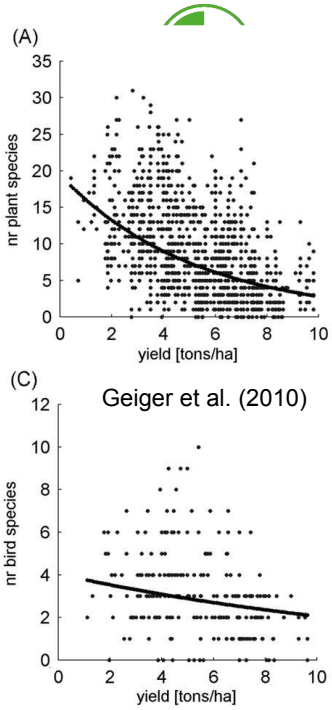


Schiefer et al. (2015)

Trade-offs of intensification

- Intensification shows declines in species diversity (in plants, beetles, or birds; Geiger et al., 2010)
- Intensification causes nitrate losses to increase linearly, but crop yields do not (Greer & Pittelkow, 2018)





Geiger et al. (2010)

Sustainability: consistency complementing efficiency

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Food losses & waste:

>30% of food lost along value chain (FAO 2011)

Approx. **300 kg per person** & year in developed countries (FAO 2011)

Approx. **50 kg food per person & year** in **households** in Austria
→ **300 € per household & year** (European Commission 2018)

Follow-up costs of US$1.7 trillion per year (FAO 2011)

Nature does not know waste and landfills, but cascading use!
→ Recyclable resources instead of food-grade feed in animal husbandry
→ Excrements in biogas plants

Sustainability: Consistency and sufficiency complementing efficiency

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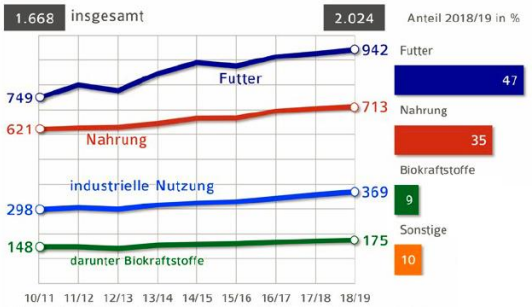
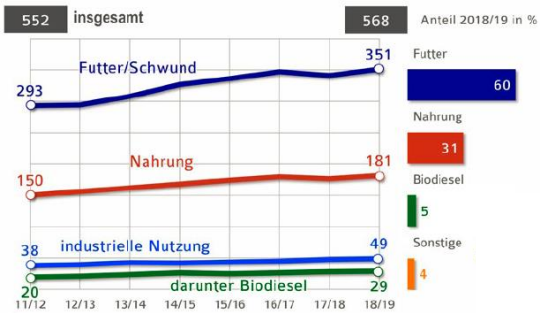
- Often no cascading & animal needs-based use of co-products as feed
  → e.g. waste bread in biogas plant instead of animal feed (i.a. for pigs)
  → Austrian grain consumption: 17% food, 31% industrial use, 52% feed

Consumption cereals worldwide 2018/19



UFOP (2020)

Consumption of oilseeds worldwide 2018/19



Sustainability: Sufficiency complementing efficiency → Healthy diet, protein requirement recommendation and actual consumption

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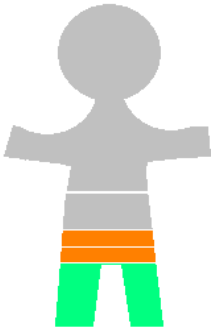
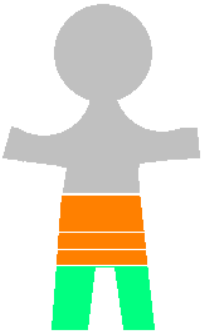


Sources: Gesellschaft für Ernährung (2013) and Austrian nutrition reports (2009, 2017)

animal-based

plant-based



Protein recommendation for person with 75 kg:

<u>22 kg per year</u>

67 % plant-based, 33 % animal-based

Protein consumption for average Austrian person with 75 kg:

<u>33 kg per year</u>

40 % plant-based, 60 % animal-based

Sustainability: Sufficiency complementing efficiency → Healthy diet / NUTRI-Score

- Too much animal protein → Risk factor (red) meat consumption
- Meat provides 40% of the crude protein (CP) in Austria
- Protein alternative: legumes (fiber, vitamin B1, B6, folic acid, magnesium, zinc)

Legumes (0.2% CP)
Vegetables & Potatoes (9% CP)

NUTRI-SCORE

A B C D E

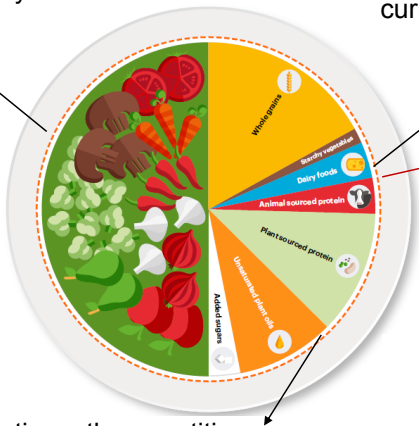
Cereal products (23% CP) **Meat products (40% CP)**

Dairy products (20% CP)

Sustainability & Health combined

Vegetables: 4 times more than currently eaten in Austria!

Animal products: about 1 third of the amount currently eaten in Austria!

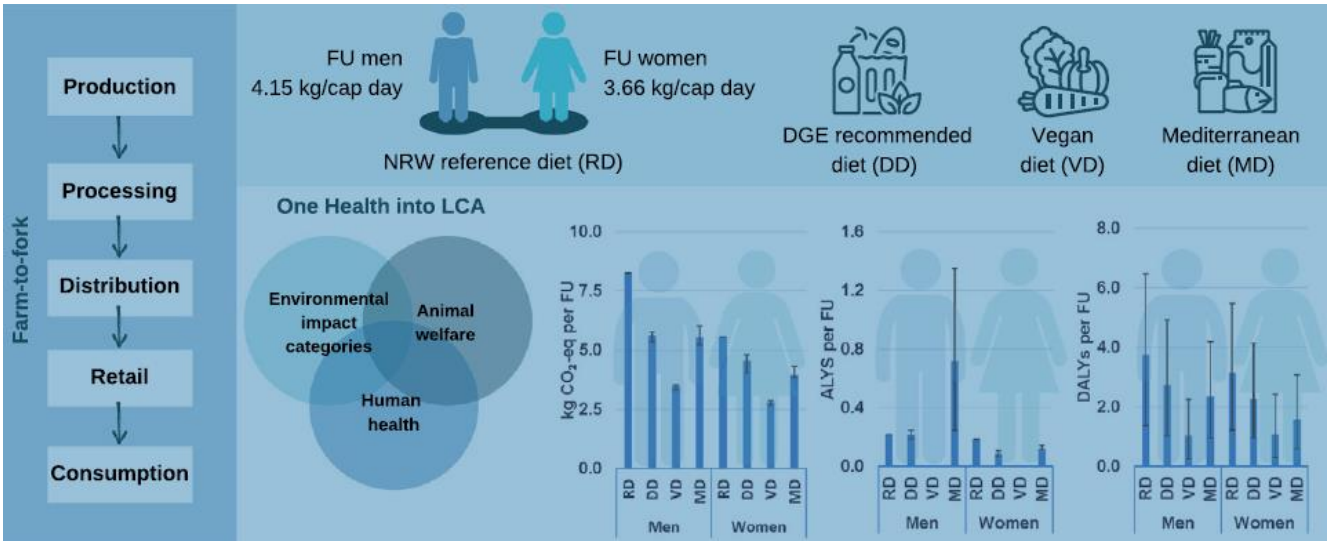


Plant protein/oils: many times the quantities currently eaten in Austria!

Health for humans, animals, planet (resources like soils, water, air,...)

Lancet Commission, Willett et al. (2019)

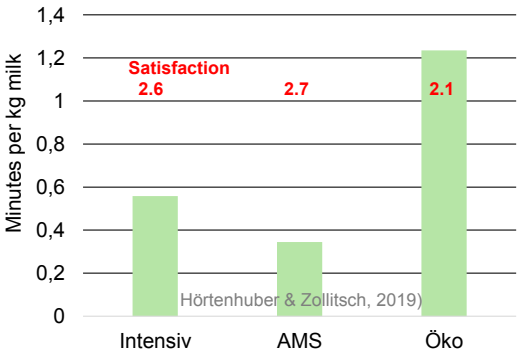
„One Health“: Merging human health, animal health & ecology (Paris et al., 2022)



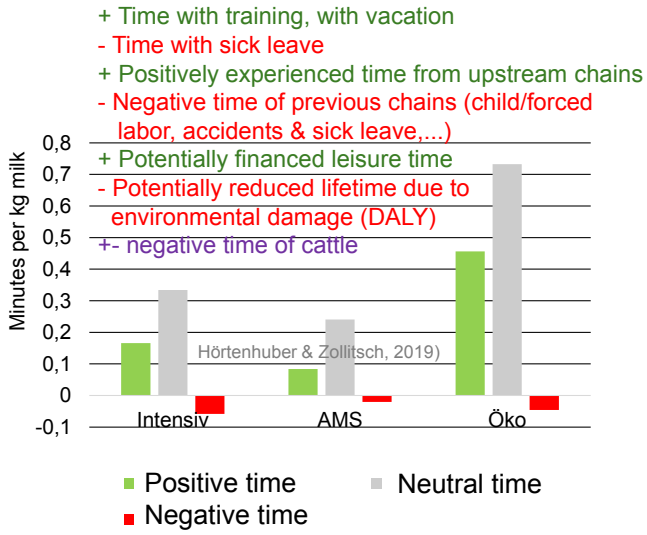
„One Welfare“: Social balance of life/work time * Quality of people & animals (1)

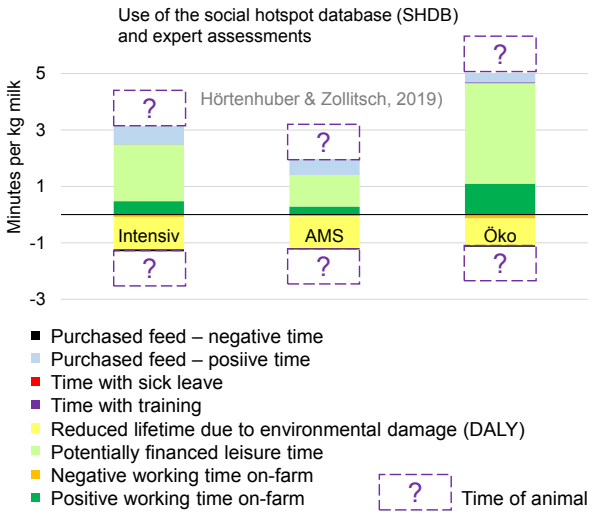
- Case study: 3 Austrian dairy family farms (Hörtenhuber & Zollitsch, 2019)
- Farm 1: Intensive / "integrated", favorable location, specialized on dairy cattle (+cash crops), high milk yield
- Farm 2: Automatic milking system (AMS), favorable location, specialized, highly technical (also feeding partially automated)
- Farm 3: Ecological, mountain location, sideline, hardly any concentrate feeds

Working time per kg milk & satisfaction with activities (grading scale 1 = good to 5 = bad)



„One Welfare“: Social balance of life/work time * Quality of people (& animals) (2)





Conclusions (1)

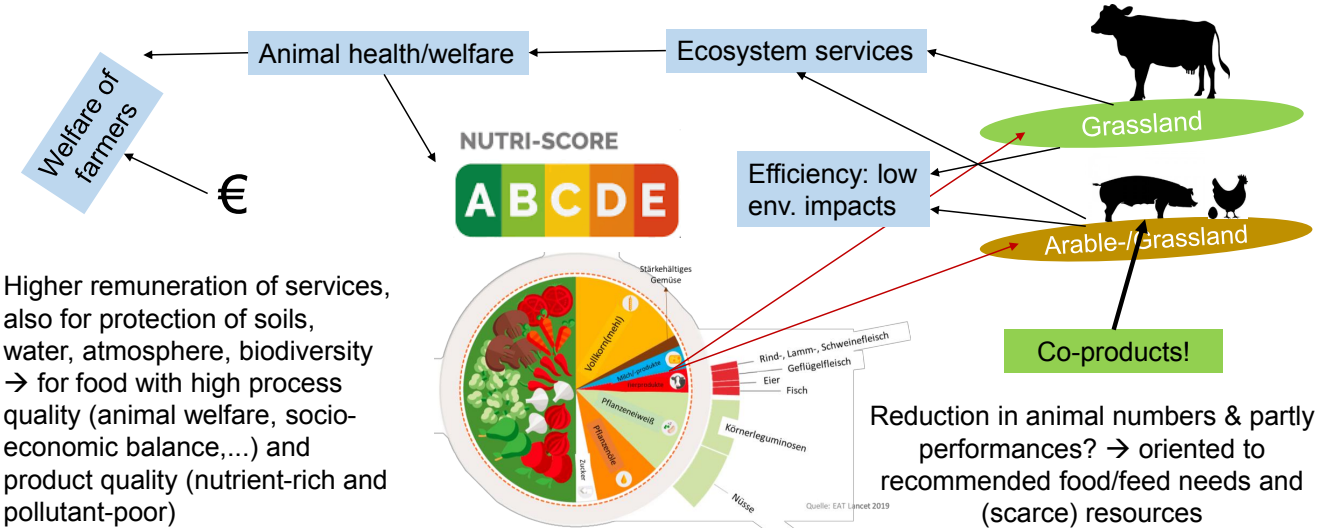
- GHG per kg protein: animal products comparable, but plant products much better
- Livestock causes relevant amounts of greenhouse gases, but...
- ... "Good" animal husbandry: low (GHG-,…) emissions (-25%) than EU average
- ...important mitigation measures can still be realised
- ...continuous CH_4 reduction with important contribution against global warming
- ...important contribution to economic value added
- ...soil, water and biodiversity protection of (permanent) grassland-based (rather extensive) animal husbandry

Conclusions (2)

- Goals of sustainable agriculture: Optimization of...
- …Efficiency:
  - Low environmental impact and at the same time as high as possible positive ecosystem services
  - Utilization of (scarce) resources: arable land, food-grade feed
- …Consistency and sufficiency
  - Utilization of by-products and wastes
  - Nutrition aligned with (protein) recommendations
- ...Animal health and welfare
- ...Last but not least: Welfare of the farmers

Synergies / Vision

The vision for 2050: "Livestock production oriented toward ONE WELFARE: healthy nutrition, animal health & welfare, ecosystem services and low environmental impact."



Higher remuneration of services, also for protection of soils, water, atmosphere, biodiversity → for food with high process quality (animal welfare, socio-economic balance,...) and product quality (nutrient-rich and pollutant-poor)

Reduction in animal numbers & partly performances? → oriented to recommended food/feed needs and (scarce) resources

Thank you... for your attention!

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... to Prof. Werner Zollitsch and colleagues

Questions?

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