



# Pathways to reduce the environmental impacts of food production

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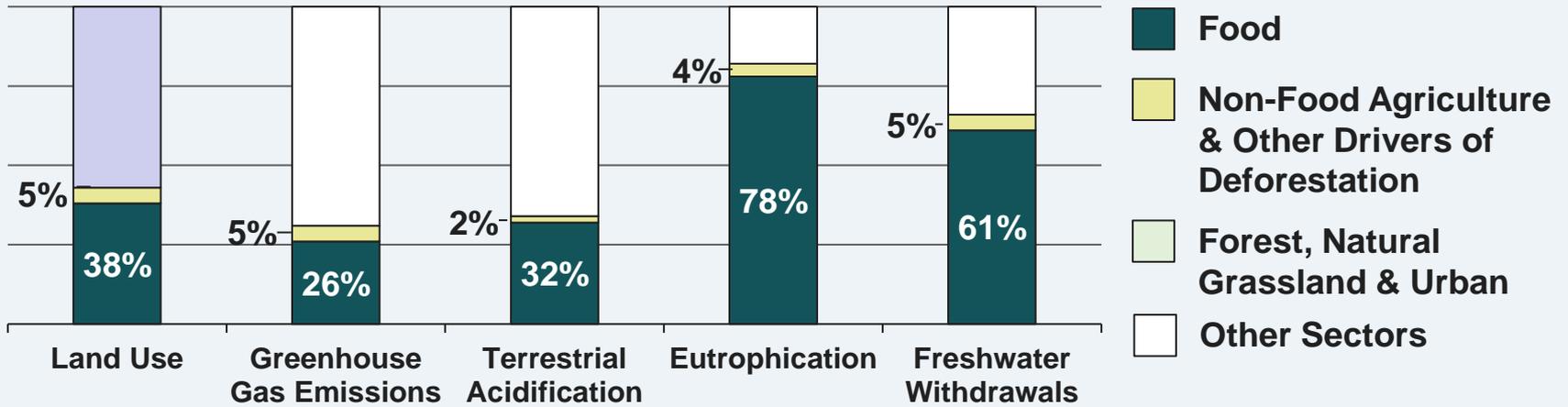
# Overview

- Meta-analysis of LCAs of food
- Food production:
  - High *variability* offers mitigation options for producers
  - *Skewed distributions*: few producers cause high environmental impacts
  - Different *mitigation strategies* needed
  - *Animal vs. plant proteins*
- Supply chains
  - Contributions of *supply chain phases*
  - Role of transports: Domestic or imported food
- Consumption patterns:
  - *Changing diets*
- Take-home messages

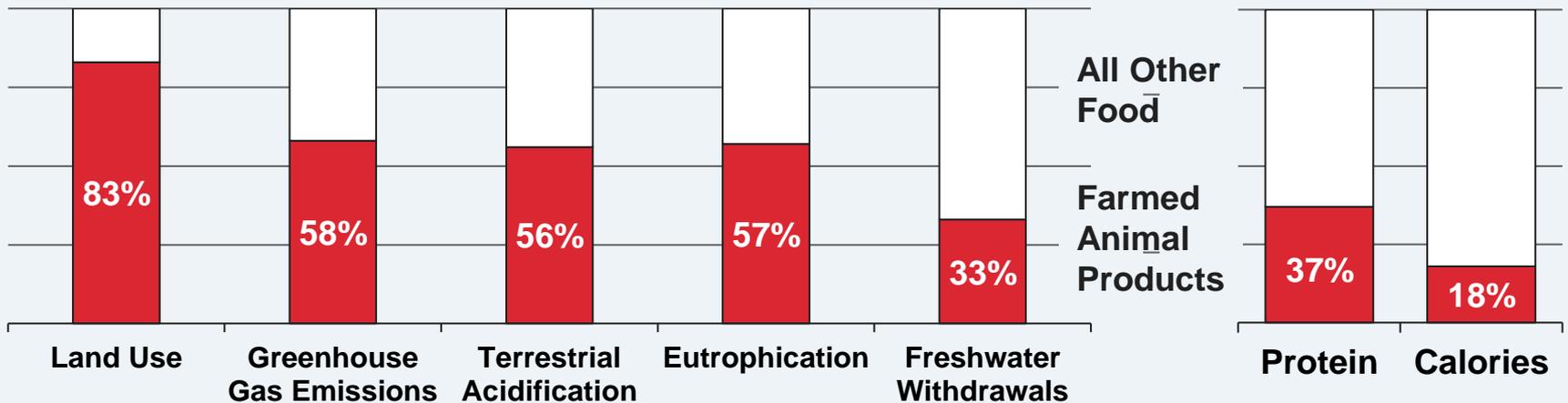


# The importance of the food sector and **animal-based foods**

## Share of the food sector on global environmental impacts



## Share of **animal products** on global environmental impacts of food



# Life Cycle Assessment (LCA)-based meta-analysis for 40 food groups

- Comprehensive meta-analysis:
  - 1500 LCA studies analysed
  - 570 studies included with feedbacks of 140 authors
- Harmonisation, consolidation and filling data gaps
- Randomisation and re-sampling
- Weighting by country and production system
- Systematic quantification of variability
- 5 environmental indicators:
  1. Climate change (greenhouse gas emissions)
  2. Terrestrial acidification
  3. Eutrophication (N & P)
  4. Land use (land occupation)
  5. Water scarcity



**Reducing food's environmental impacts through producers and consumers**  
J. Poore<sup>1,2\*</sup> and T. Nemecek<sup>3</sup>

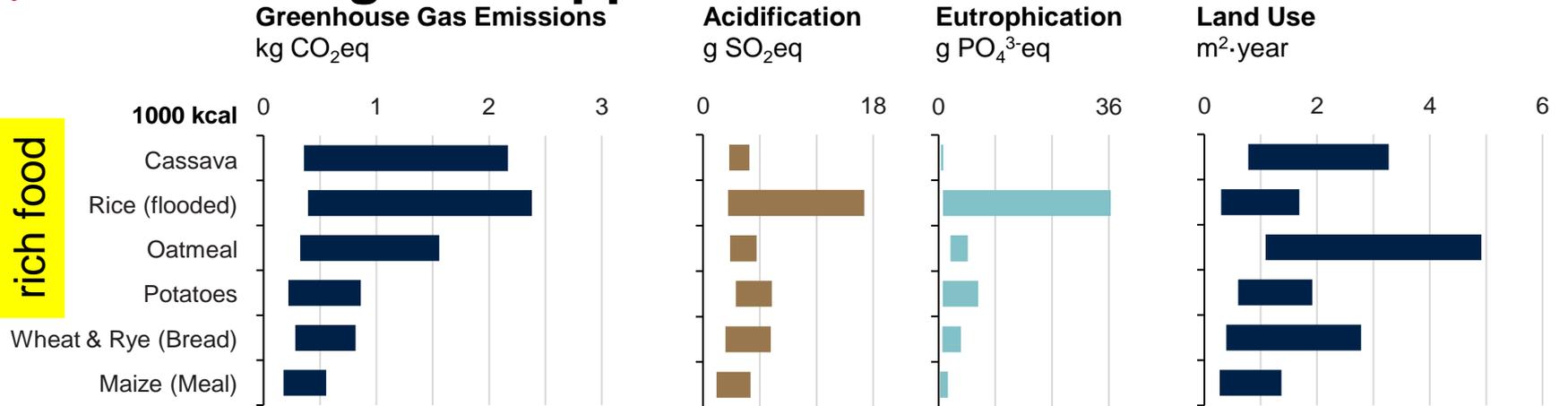
On farmed products: Environmental impacts of food and how can we mitigate them?

Poore J. & Nemecek T., 2018. Reducing food's environmental impacts through producers and consumers. Science 360, 987-998.

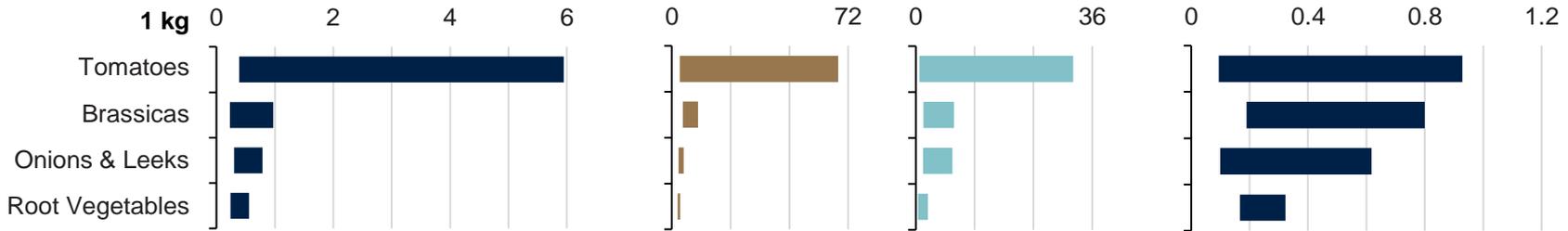


# High variability of environmental impacts create mitigation opportunities

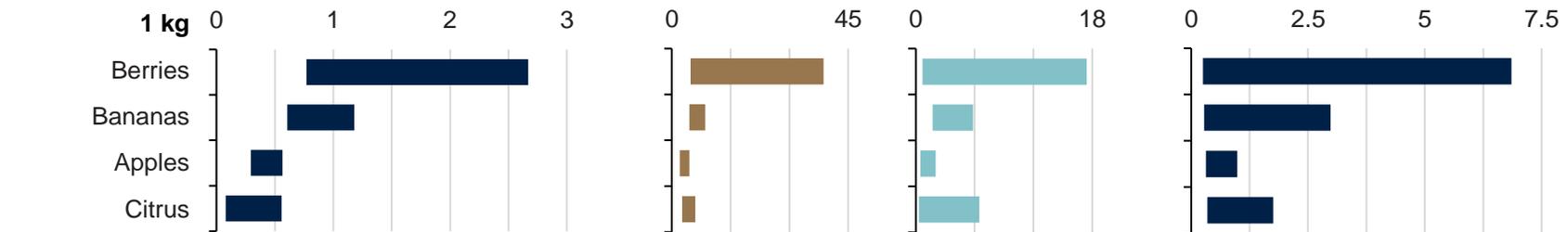
Starch rich food



Vegetables



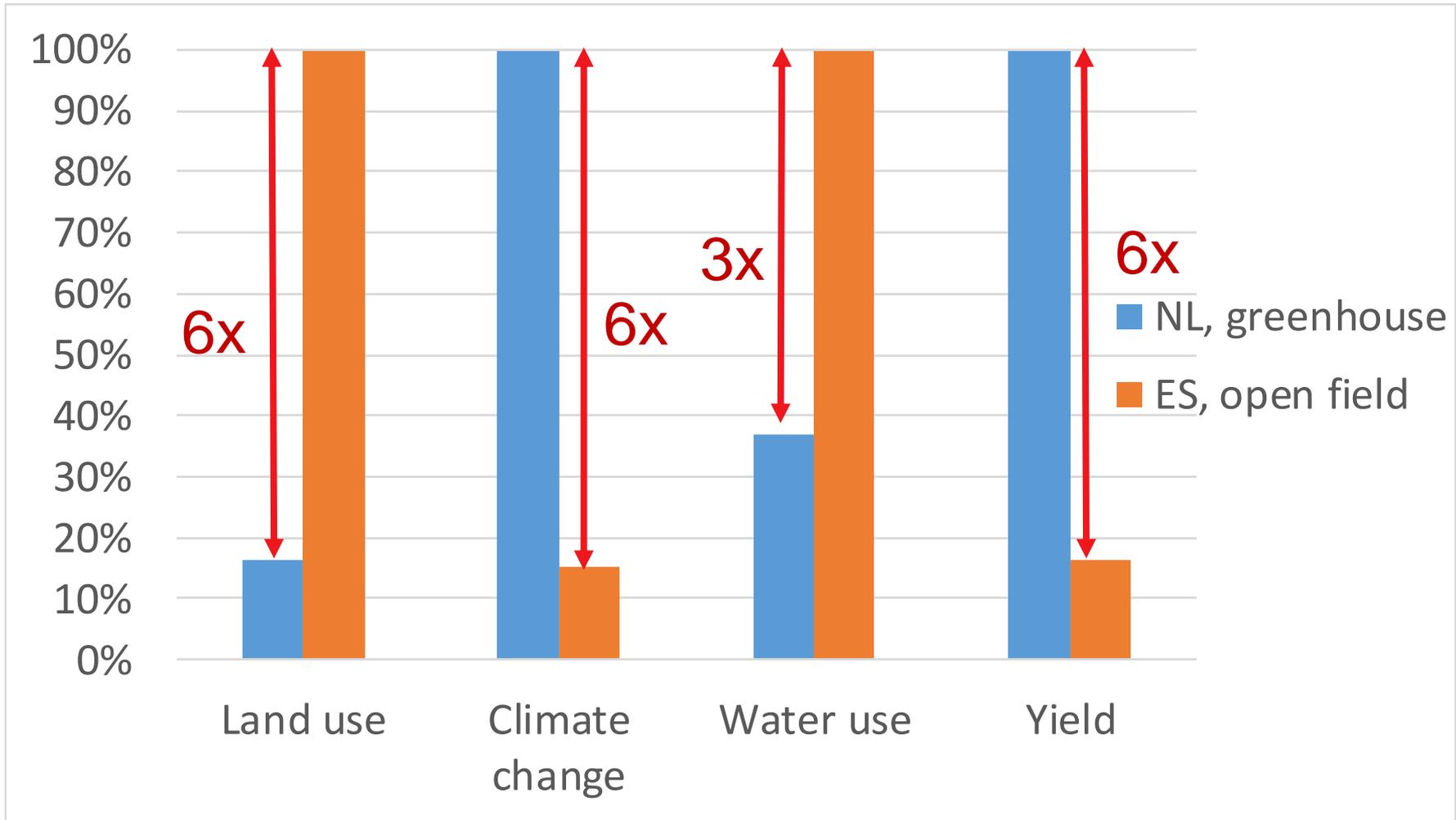
Fruits



Climate change:  
 Ratio 90./10. percentile = 4.4  
 Ratio 95./05. percentile = 8.3



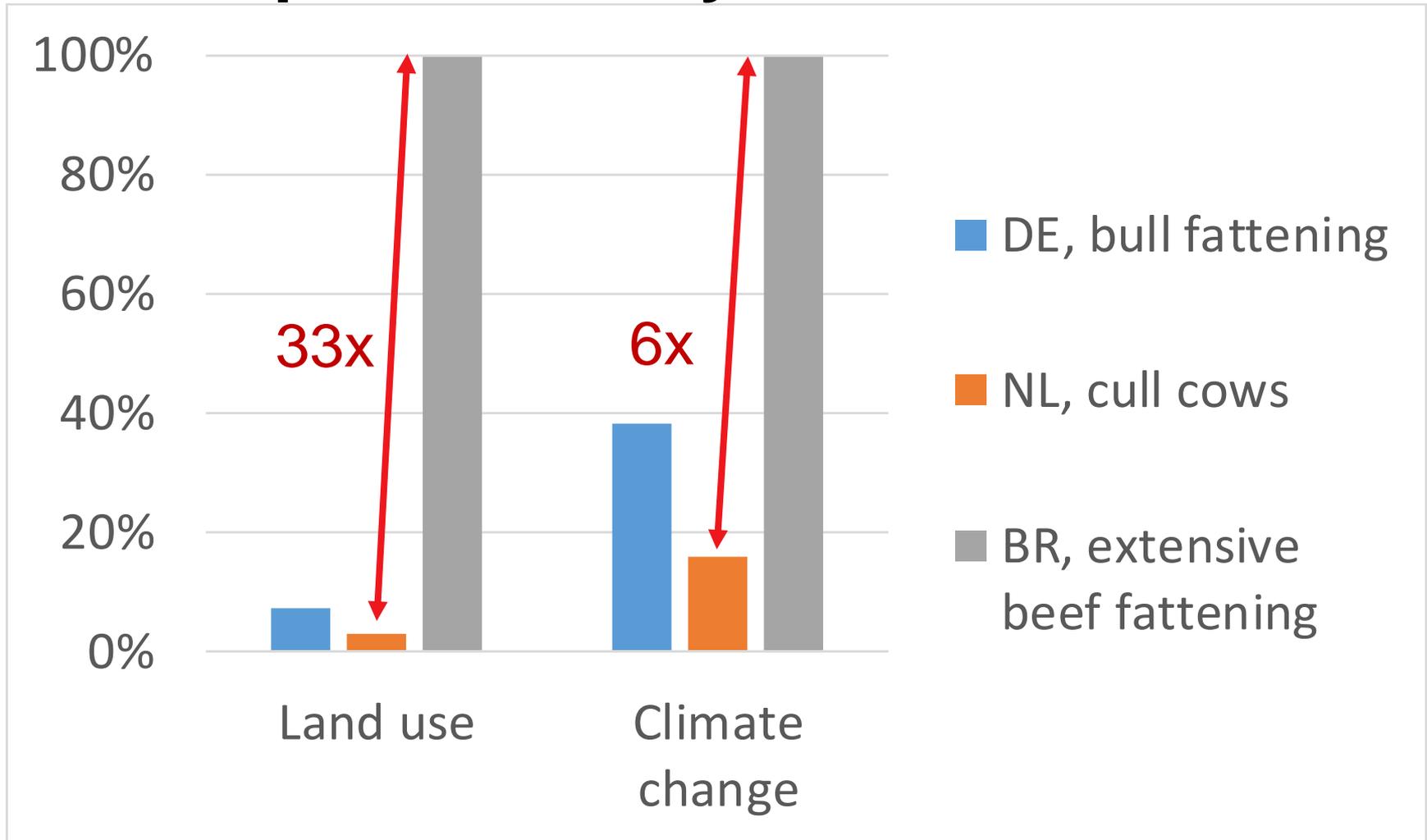
# Variability of impacts: greenhouse vs. open field tomatoes



On farmed products: Environmental impacts of food and how can we mitigate them?  
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# Variability of impacts: Beef production systems

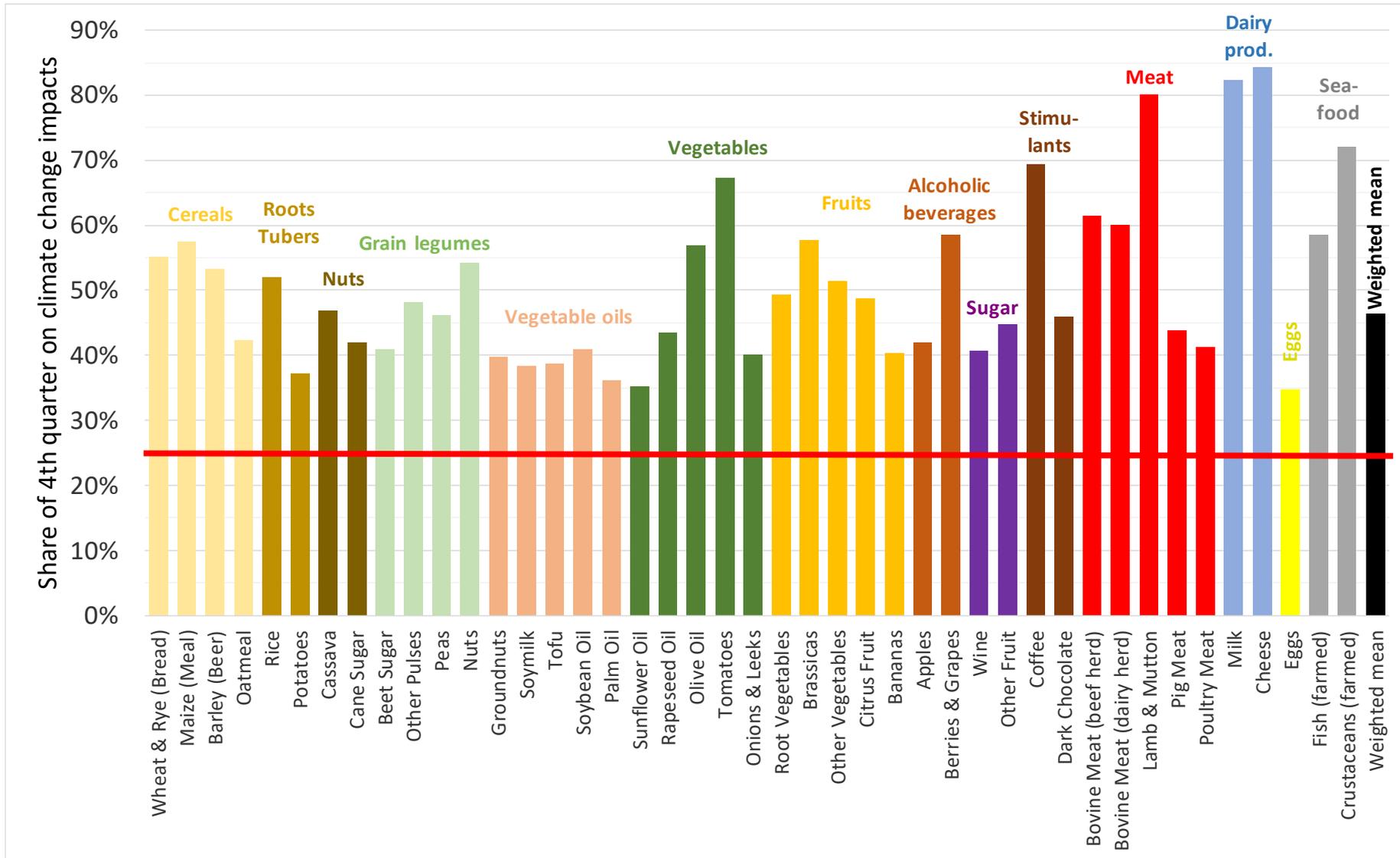


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Source: Poole & Nemecek (2018), Science 360 (6392), 987-992. 7



# Skewed distribution: the worst quarter causes almost half of the climate impacts



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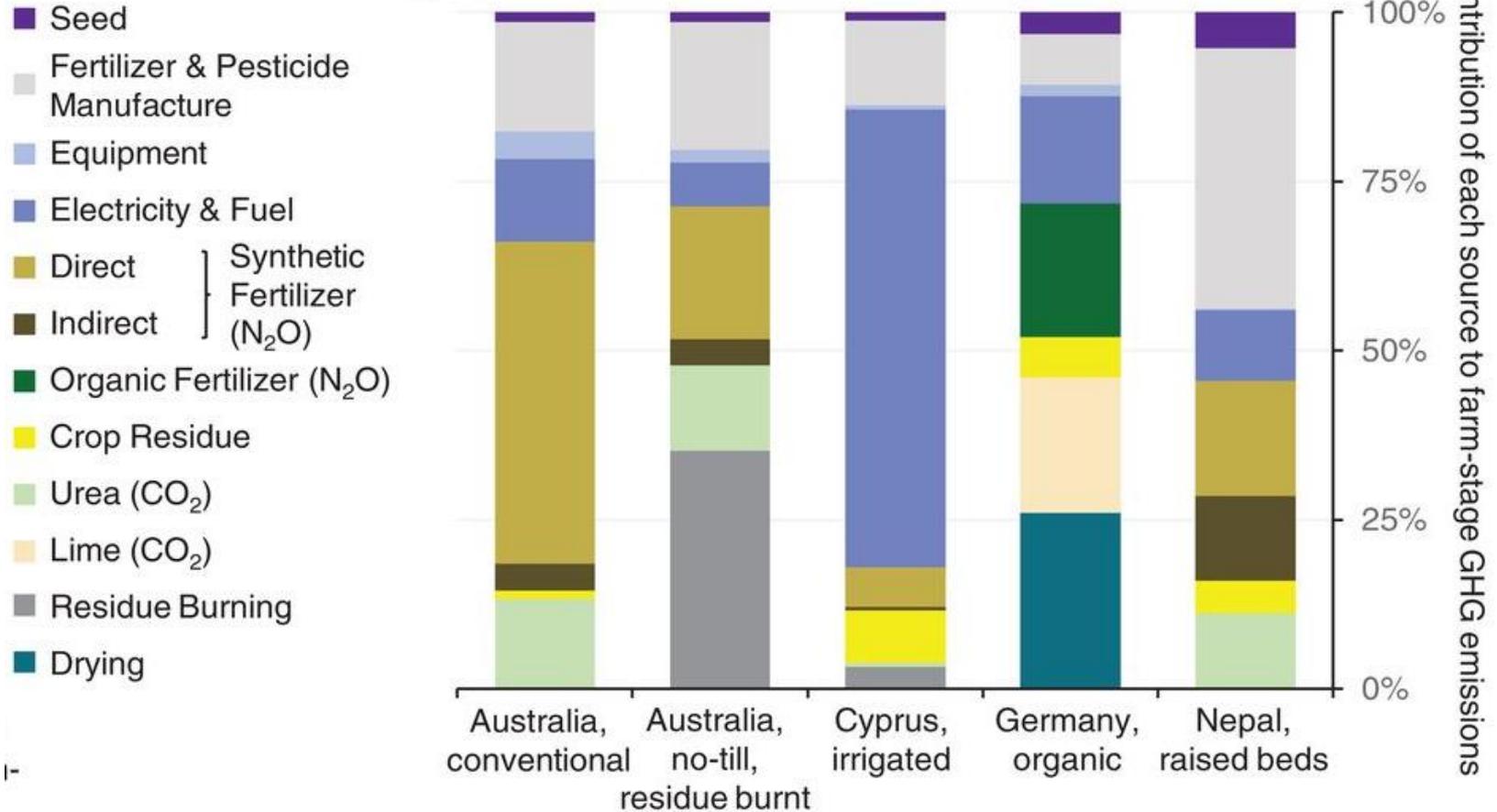


# Different sources of impacts

## → environmental-friendly solutions are individual

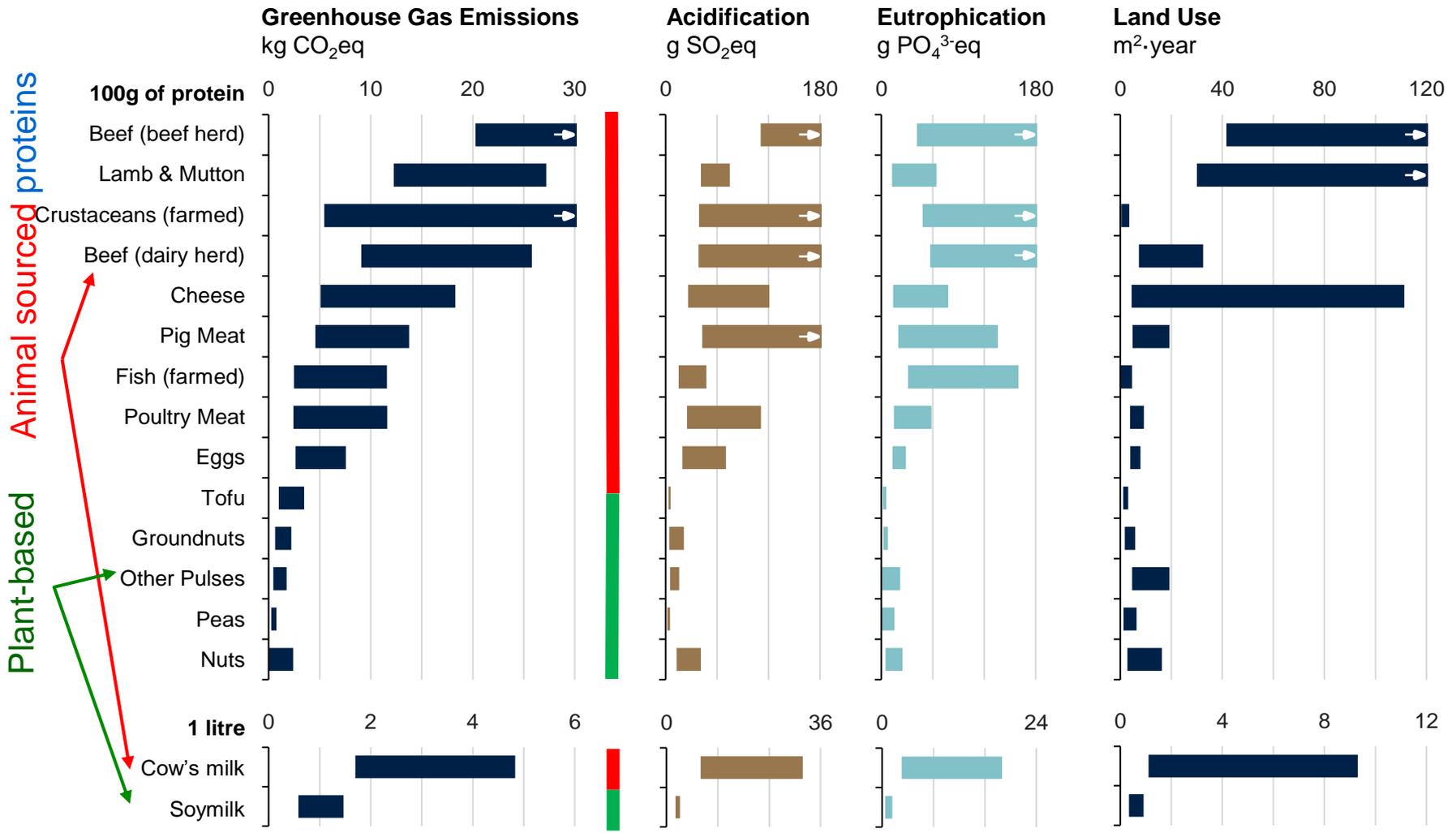
Contributions of emission sources to total farm-stage GHG emissions.

### C Below median GHG emissions wheat farms





- The variability between supply chains is huge
- Plant-based protein-rich foods have much lower impacts than animal-based foods

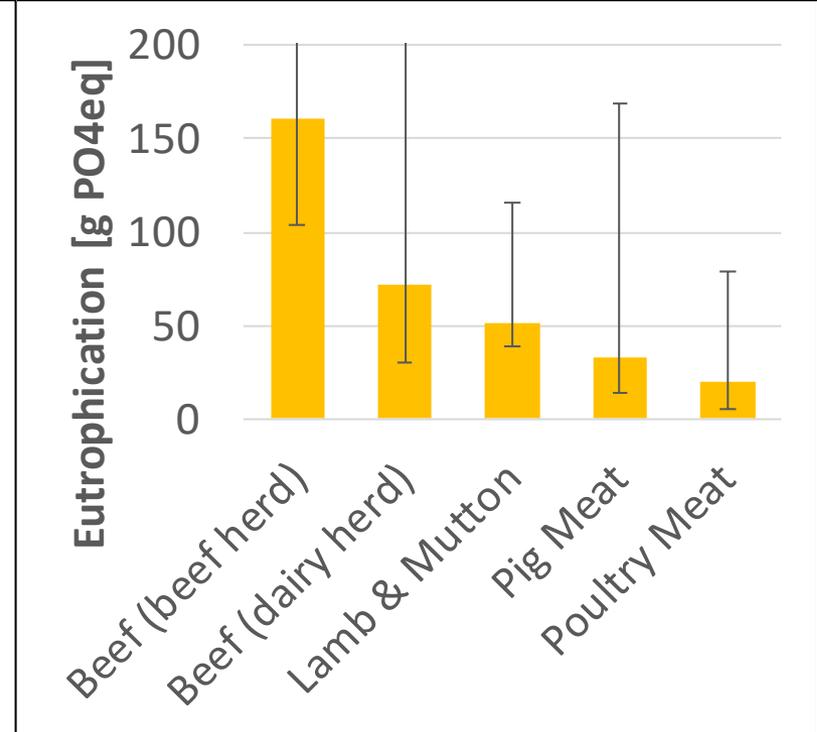
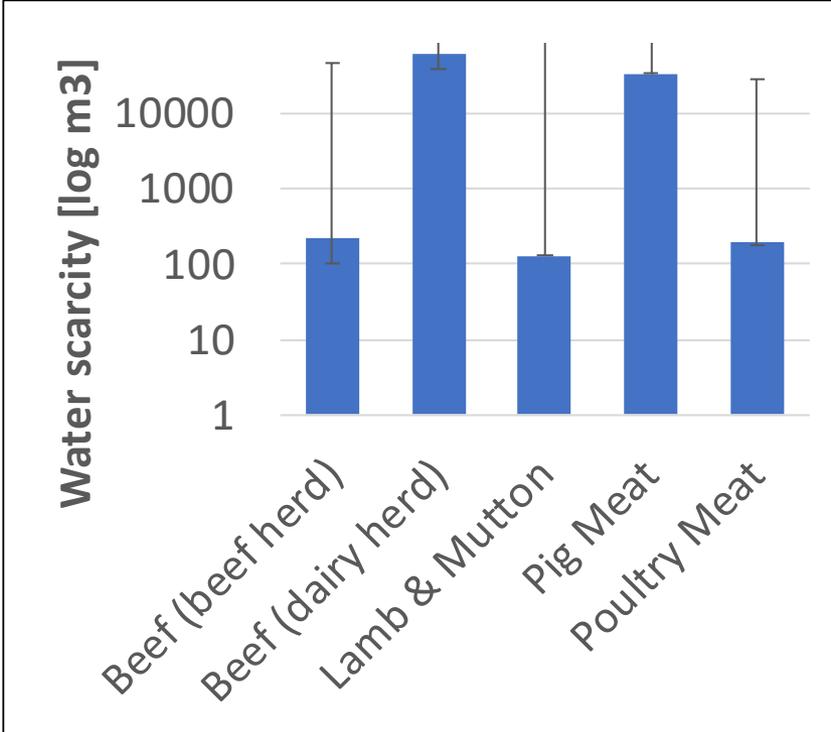
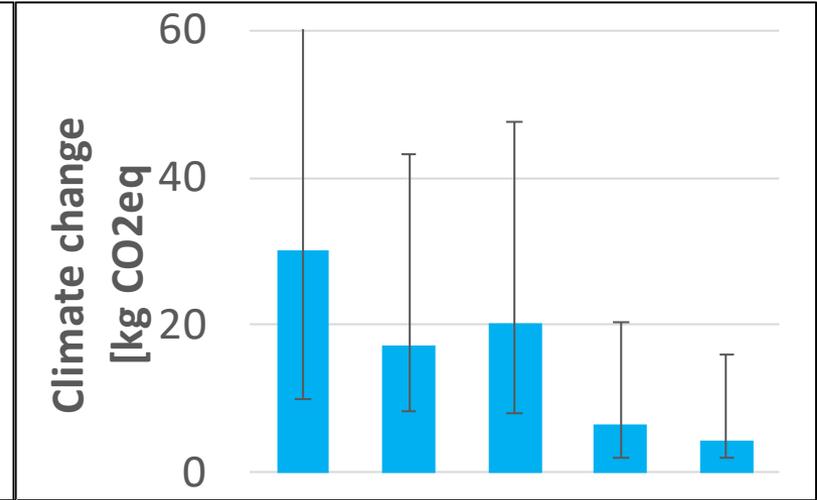
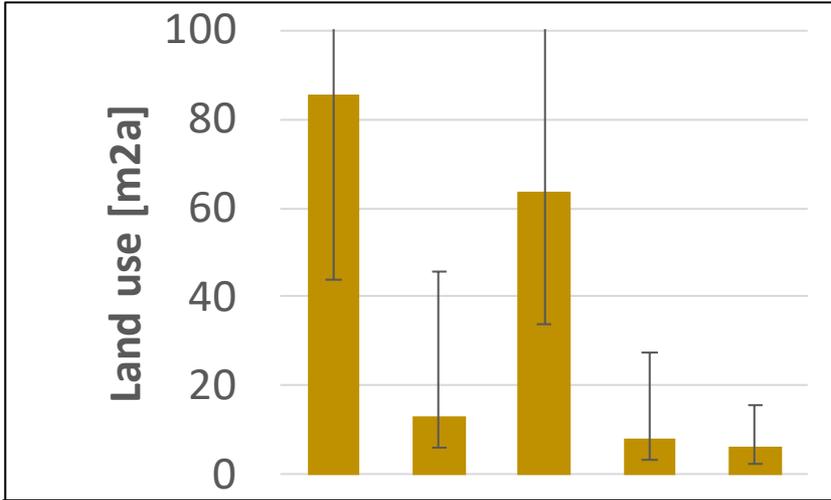


On farmed products: Environmental impacts of food and how can we mitigate them?





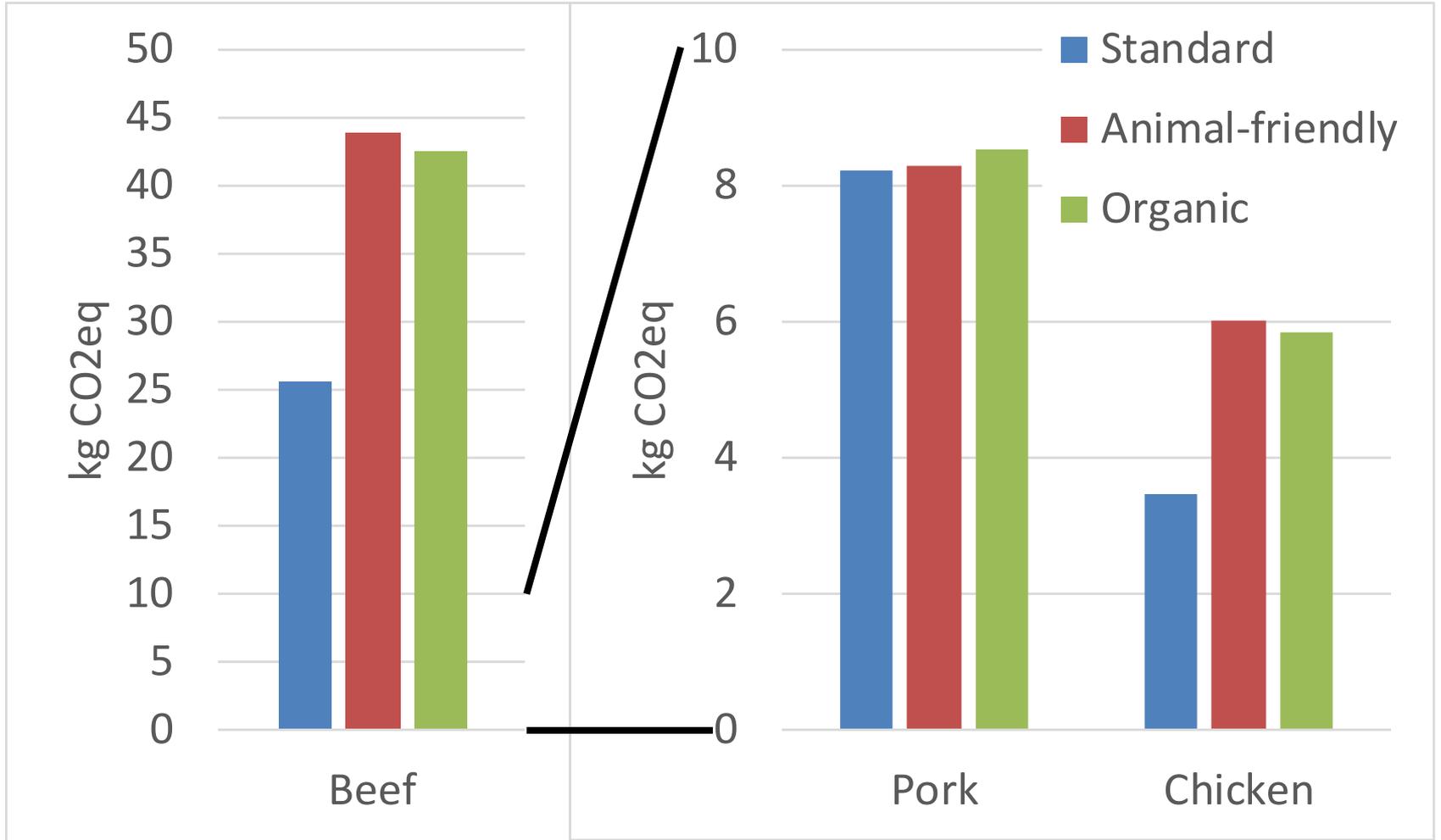
# Large differences between meat categories (per 100g protein)



Source: Poore & Nemecek (2018), Science 360 (6392), 987-992.



# Swiss meat production (per kg meat)

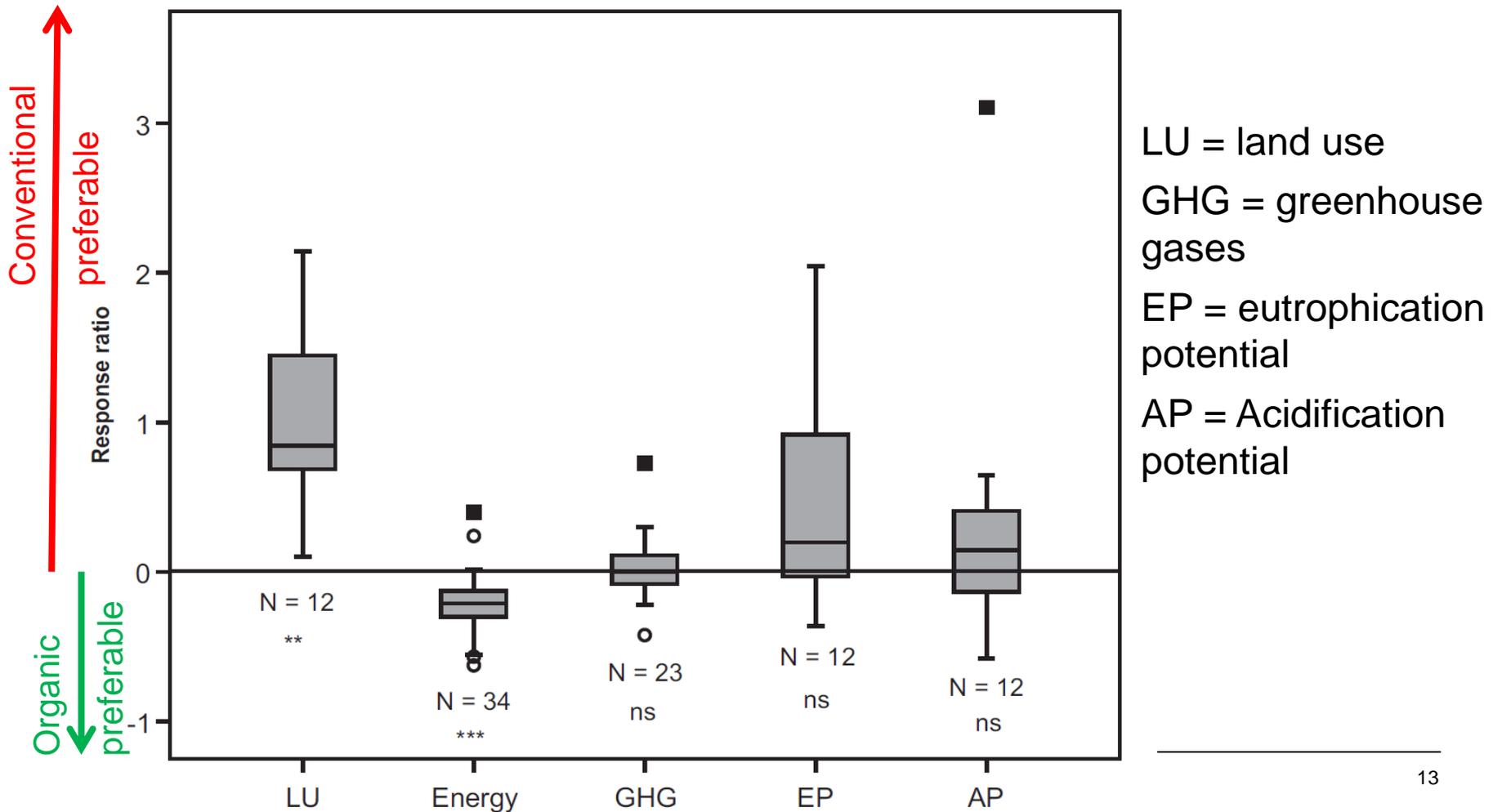


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# Meta-Analysis of conventional and organic products

## C LCA impacts per unit of product



Source: Tuomisto *et al.* (2012)



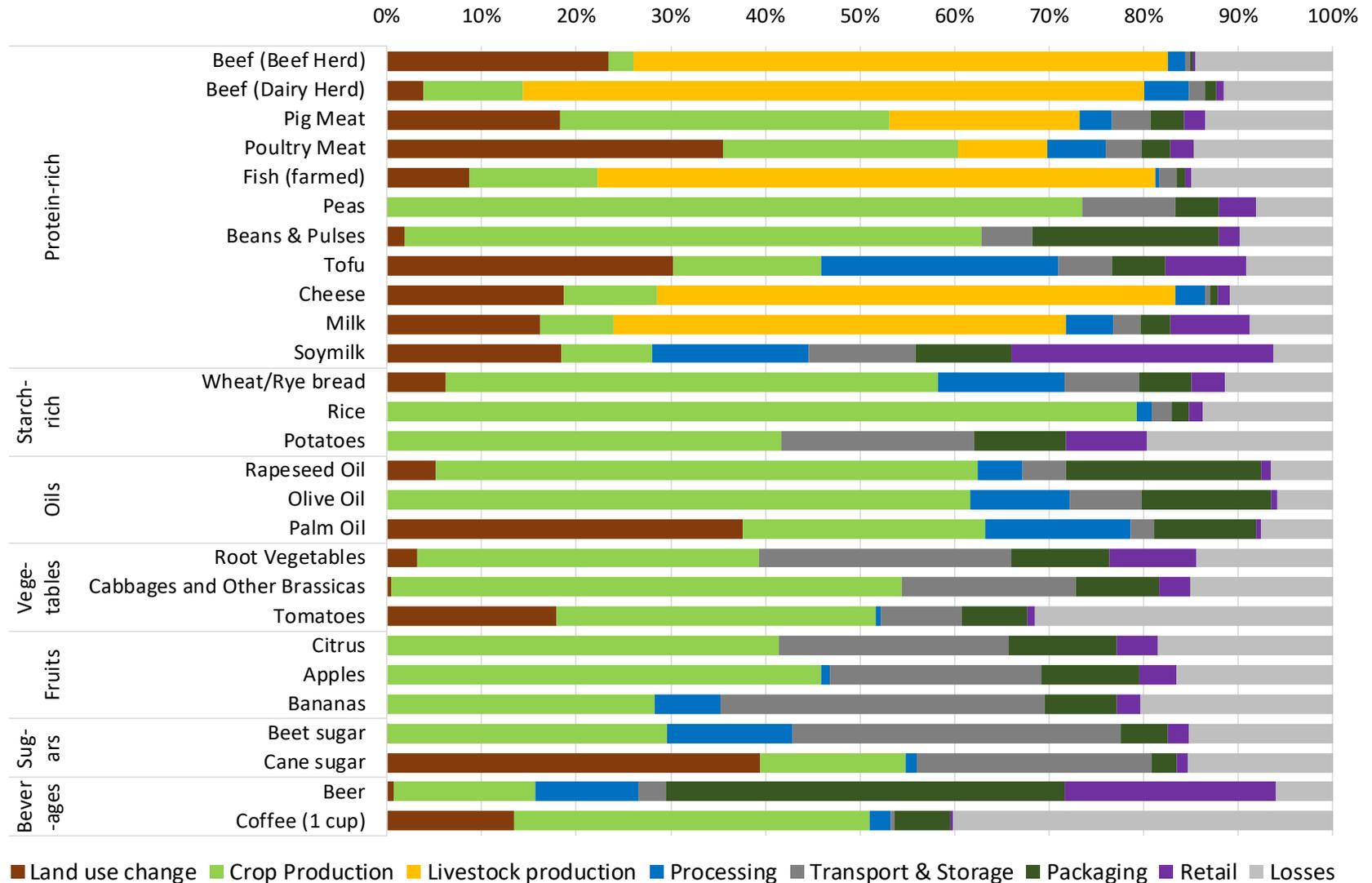
# Organic vs. conventional products

Organic farming:

- Lower yields → need more land
- + Lower resource consumption (energy, mineral resources)
- Similar impact on climate
- Tends to higher acidification and eutrophication
- + Lower ecotoxicity through pesticides (be careful with copper)
- + Positive for biodiversity
- + Favourable effects of organic fertilisers on soil quality



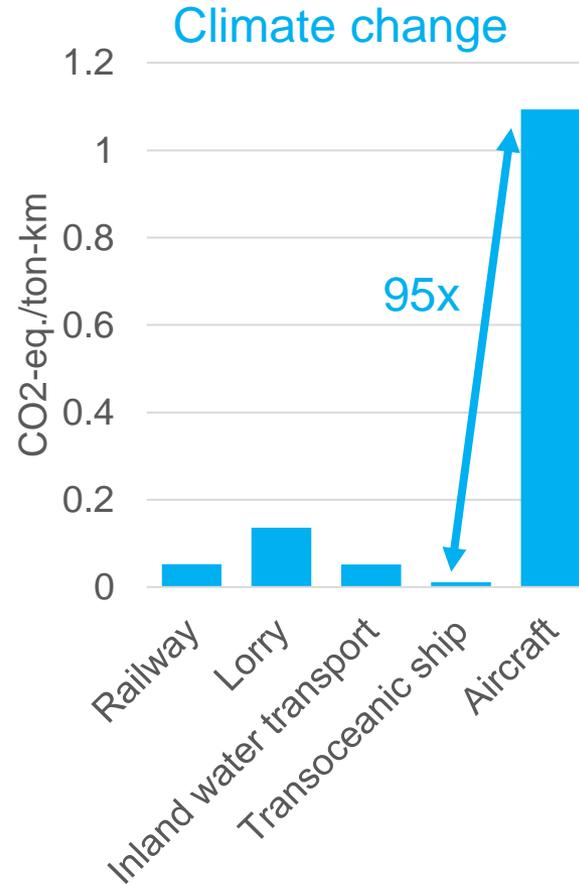
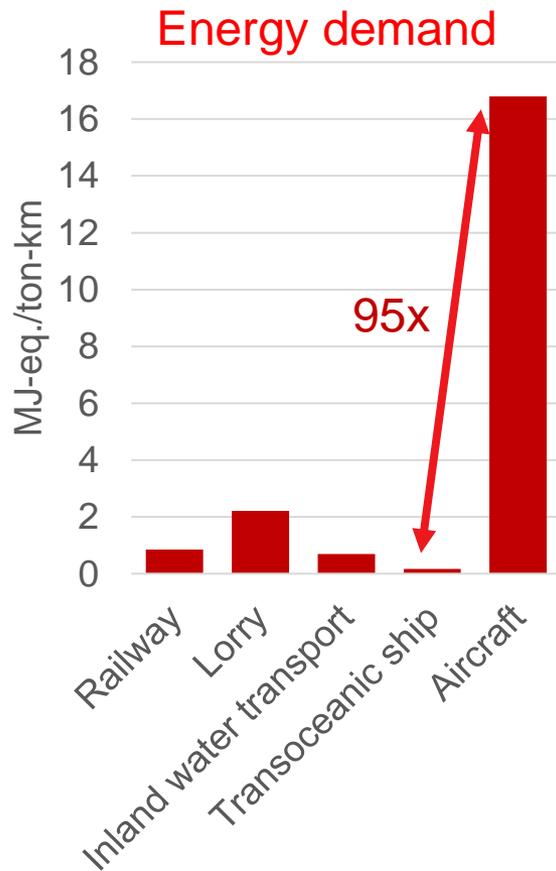
# Contribution of phases to the climate change impacts of food





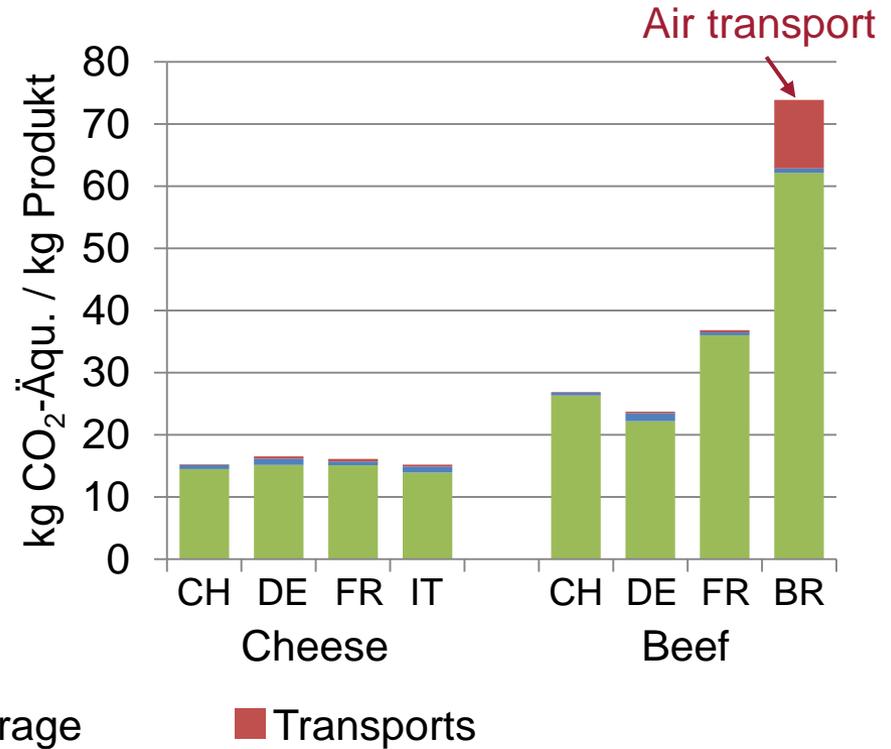
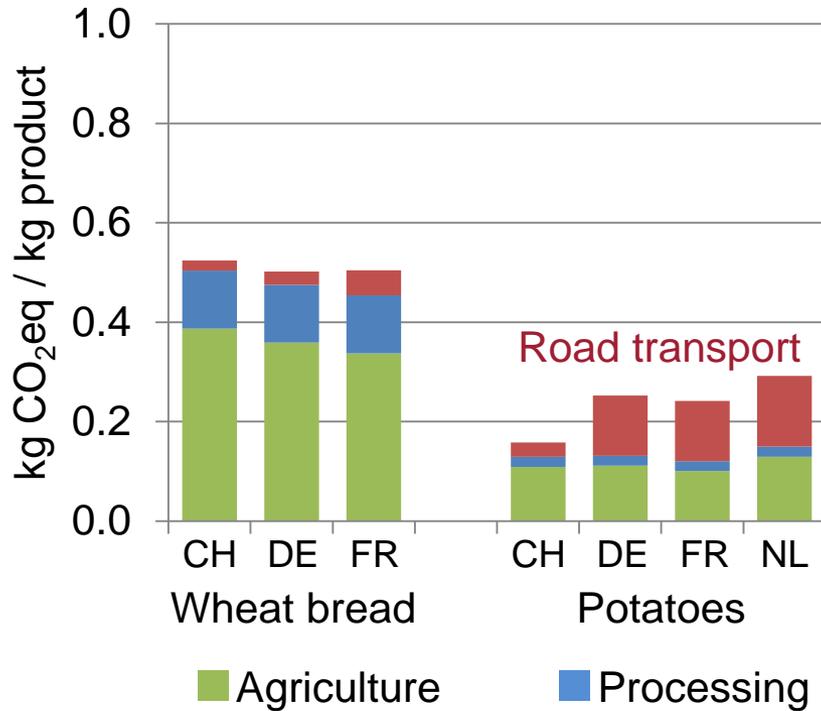
# Large differences between means of transport

→ it is not only a matter of food miles!





# Climate change impacts of domestic and imported food



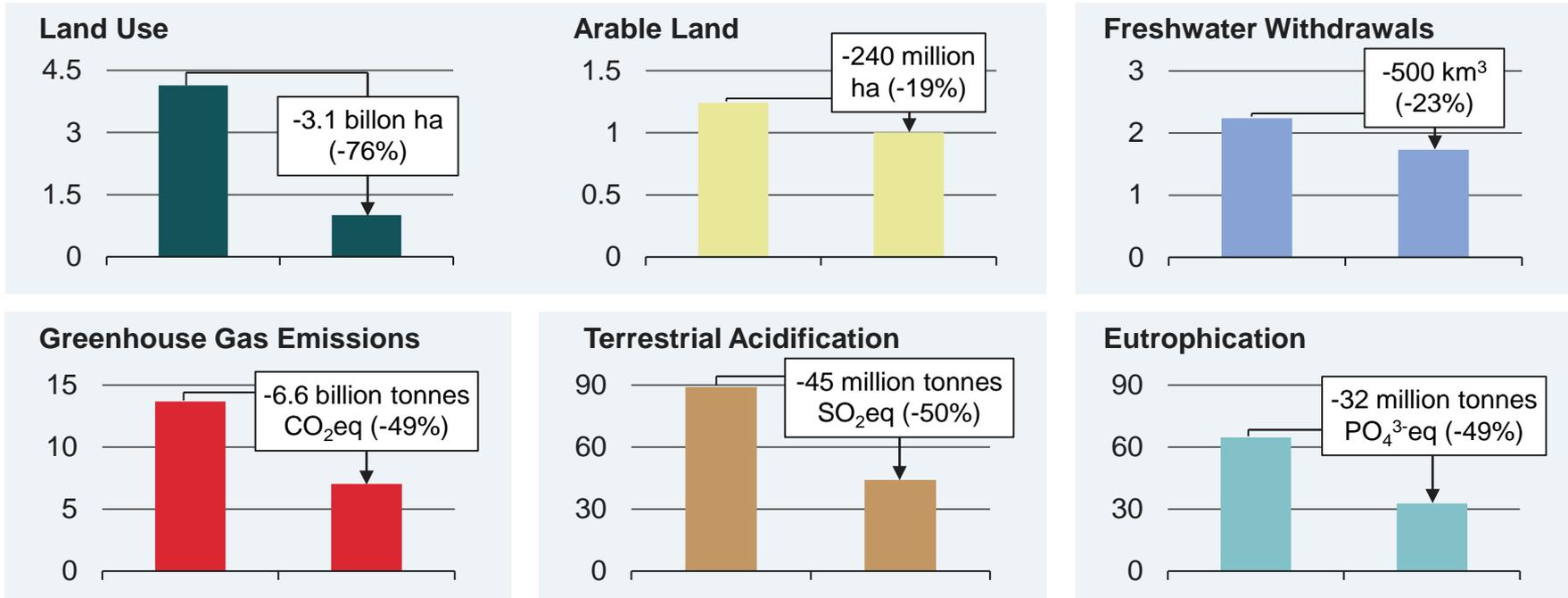
Source: Bystricky *et al.* (2014)



# Changing global diets

- Animal-product free diets could reduce most environmental impacts by 1/2

Global



- Halving consumption of animal-based products by avoiding the high-impact producers reduce most environmental impacts by 1/3 → synergistic effects:

- |   |  |  |
|---|--|--|
| <ul style="list-style-type: none"> <li>Climate change</li> <li>Land use</li> <li>Acidification</li> <li>Eutrophication</li> </ul> | <ul style="list-style-type: none"> <li>-36%</li> <li>-51%</li> <li>-32%</li> <li>-27%</li> </ul> | } Synergistic effects of improved production and changed consumption |
|---|--|--|



# Major mitigation opportunities for food production

- Crop production:
  - The right crop at the right place:
    - Avoid crops on peat soils and deforested areas
    - Avoid areas with endangered species
    - Avoid growing crop with high water demand in arid areas
  - Avoid too low yields
  - Avoid unnecessary fertilisation, plant protection, and irrigation (as much as needed, not more, not less)
- Animal production:
  - Choose the adequate production system (e.g. beef from dairy systems)
  - Increase feed conversion efficiency
  - Produce and use feedstuffs with low environmental impacts



# Take-home messages

Production

Consumption

- Agriculture has a large share on the environmental impacts of food
- High variability within a product
  - Mitigation opportunities for producers
- Manifold reasons for high impacts and manifold ways to low impacts → needs context specific solutions
- Trade-offs are frequent → needs comprehensive analysis
- Consumers can:
  - Reduce their consumption of animal-based foods, mainly meat
  - Reduce food waste
  - Prefer local and seasonal production
  - Avoid food transported by air or from heated greenhouses
  - Prefer less processed food
  - Choose products with low environmental impacts → needs adequate information on environmental impacts
- All actors in the supply chain are needed to address this huge challenge



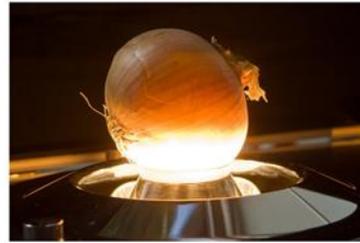
**Thank you for your attention**

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**Agroscope** good food, healthy environment

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# References

- Alig M., Grandl F., Mieleitner J., Nemecek T., Gaillard G., 2012. Ökobilanz von Rind-, Schweine- und Geflügelfleisch. Agroscope Reckenholz-Tänikon ART, Zürich, 151 p.
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