



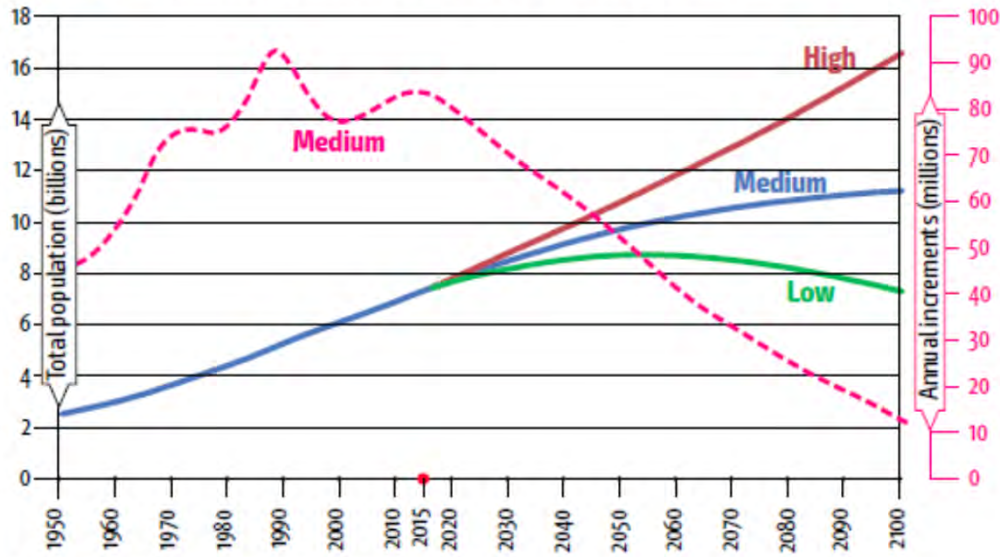
Kann biologische Landwirtschaft die Welt ernähren?

Adrian Müller (adrian.mueller@fibl.org)

Emeritenstamm ETHZ

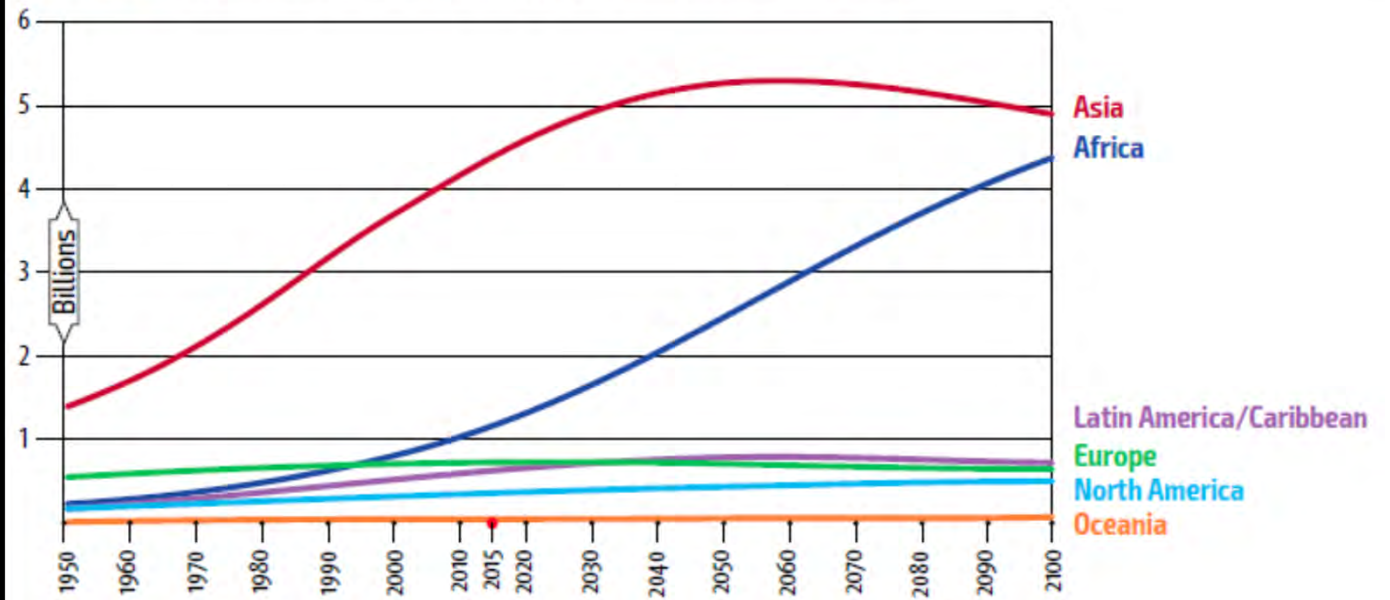
30. September 2019, Winterthur

Figure 1.1 Global population growth to 2100, by variant



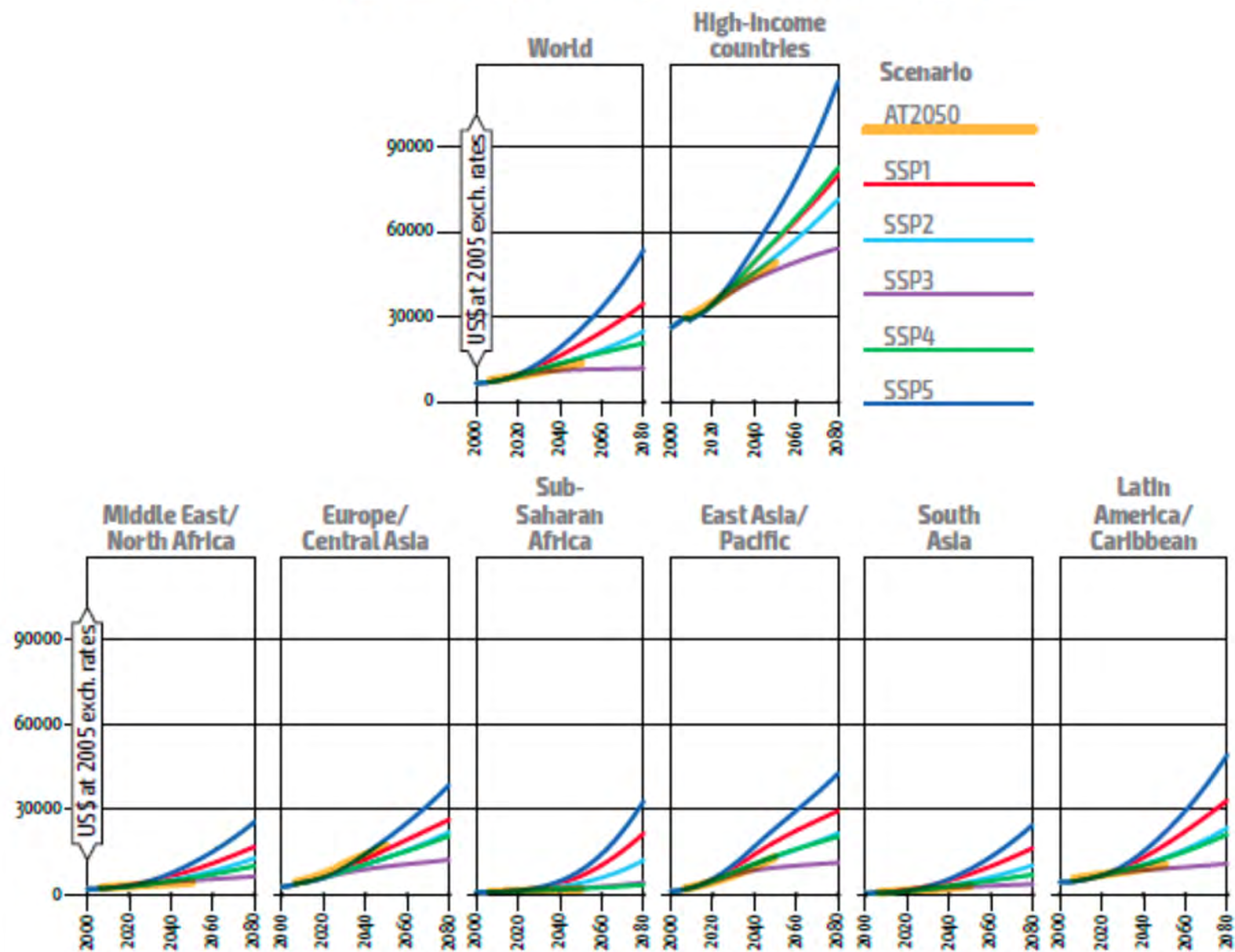
Note: Annual increments are 5-year averages.
Source: UN, 2015.

Figure 1.2 Population growth to 2100, by region (medium variant)



Source: UN, 2015.

Figure 2.2 Projections of per capita GDP growth, by region



Note: Regional groups do not include high-income countries.

Source: FAO Global Perspectives Studies, based on IIASA, 2016; Alexandratos and Bruinsma, 2012.

Figure 9.1a Per capita calorie intake by source, 1961-2050

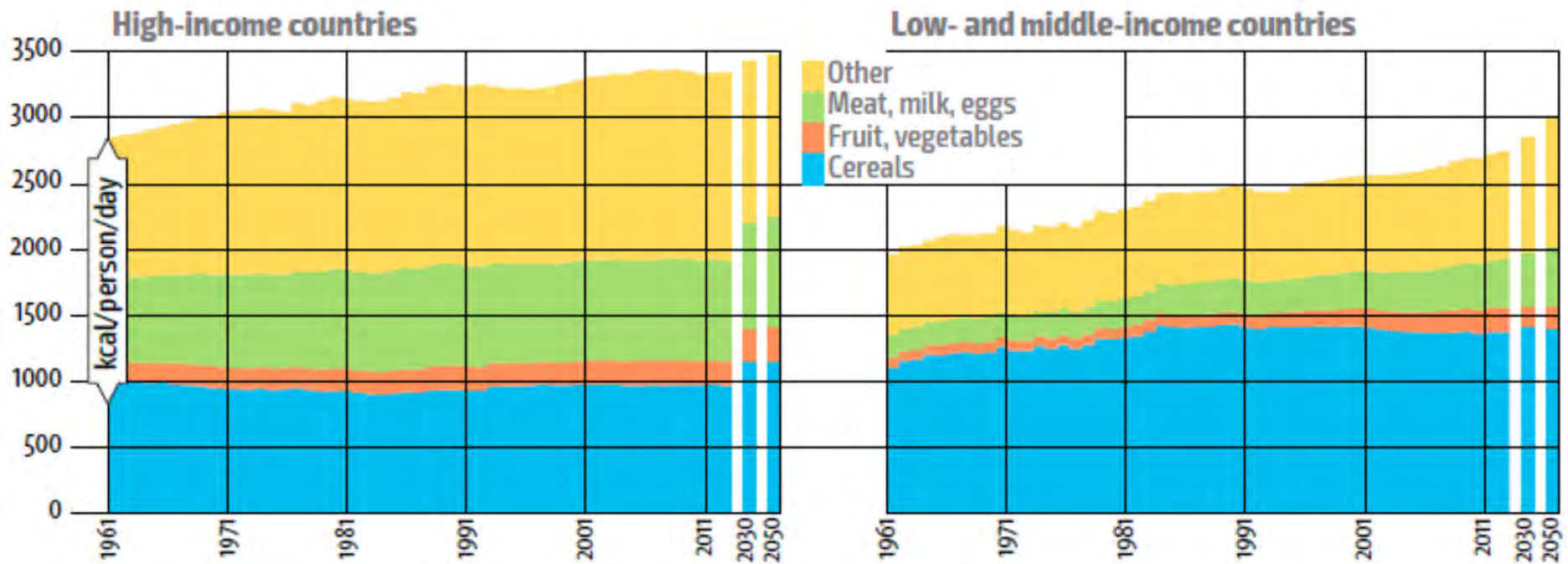


Figure 9.2a Per capita protein intake by source, 1961-2050

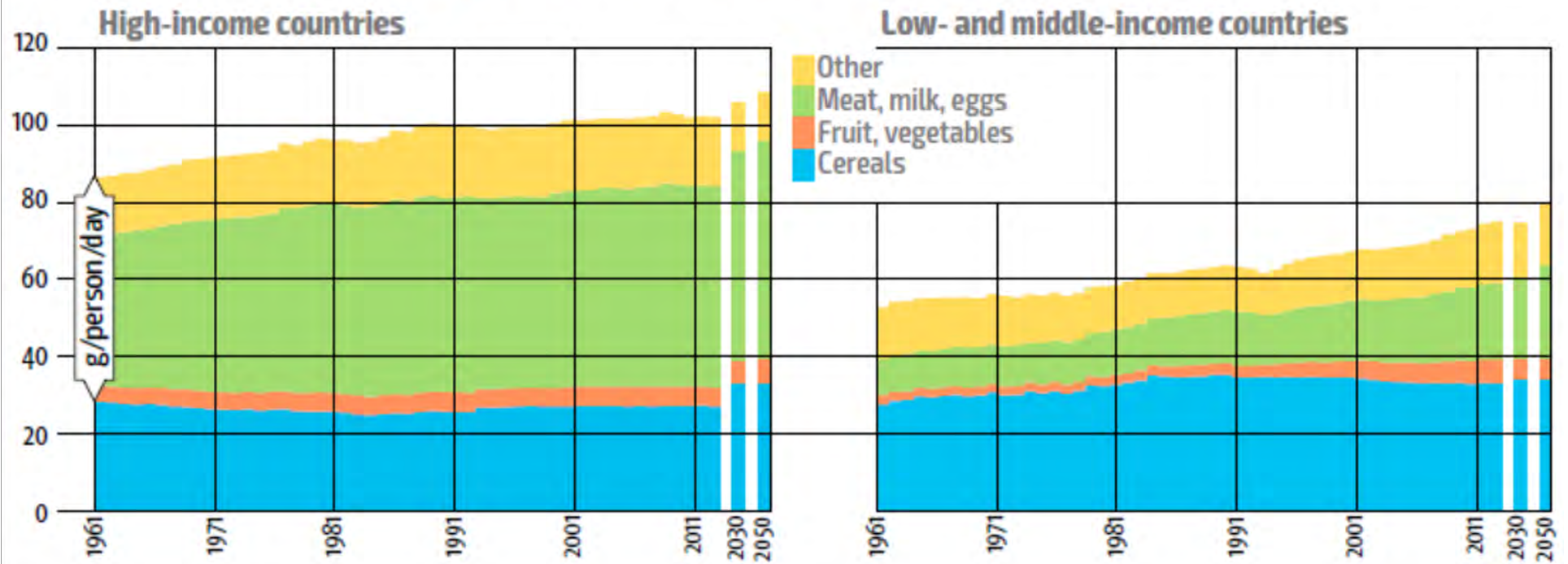
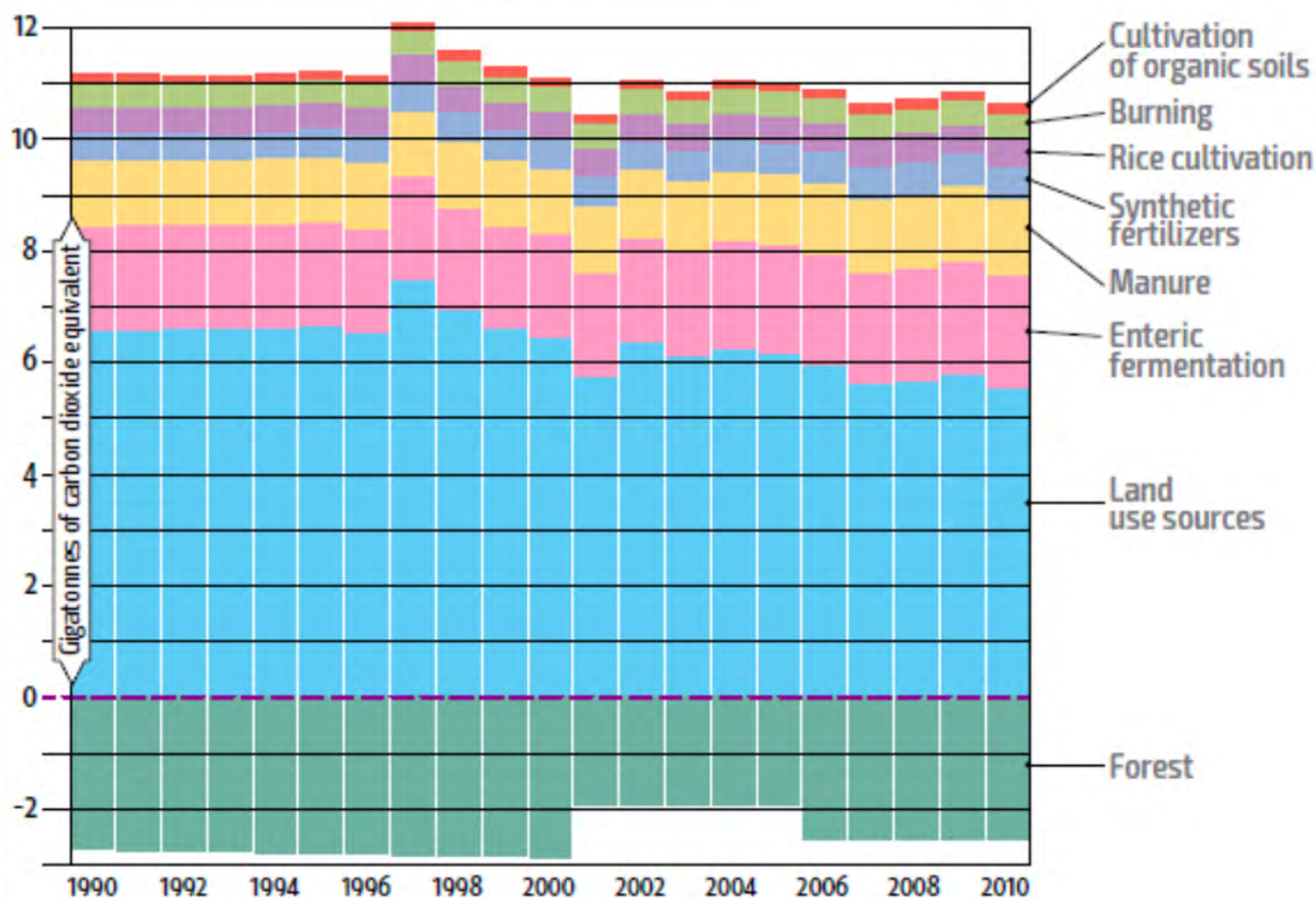


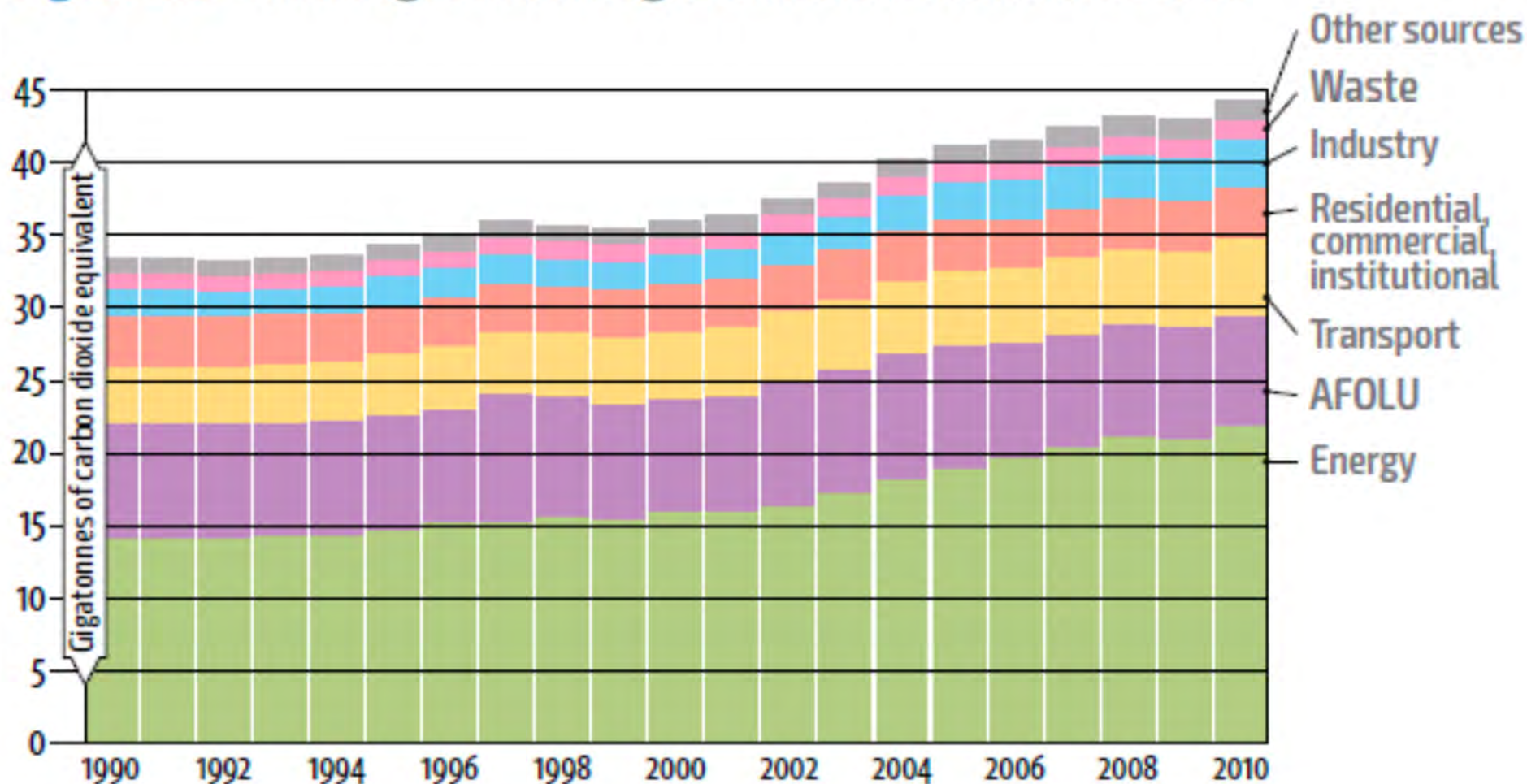
Figure 4.1 Annual greenhouse gas emissions from Agriculture, Forestry and Other Land Use (AFOLU)



Note: The classification of emissions is according to FAO, 2016c. 'Manure' includes 'manure left on pasture', 'manure management' and 'manure applied to soils'; 'Burning' includes 'burning - crop residues', 'burning - savanna' and 'crop residues'.

Source: FAO, 2016c (Metadata/emissions - agriculture).

Figure 4.2 Annual greenhouse gas emissions from all sectors



Note: 'Other sources' includes international bunkers.

Source: FAO, 2016b.

b) Stylized net global CO₂ emission pathways

Billion tonnes CO₂ per year (GtCO₂/yr)

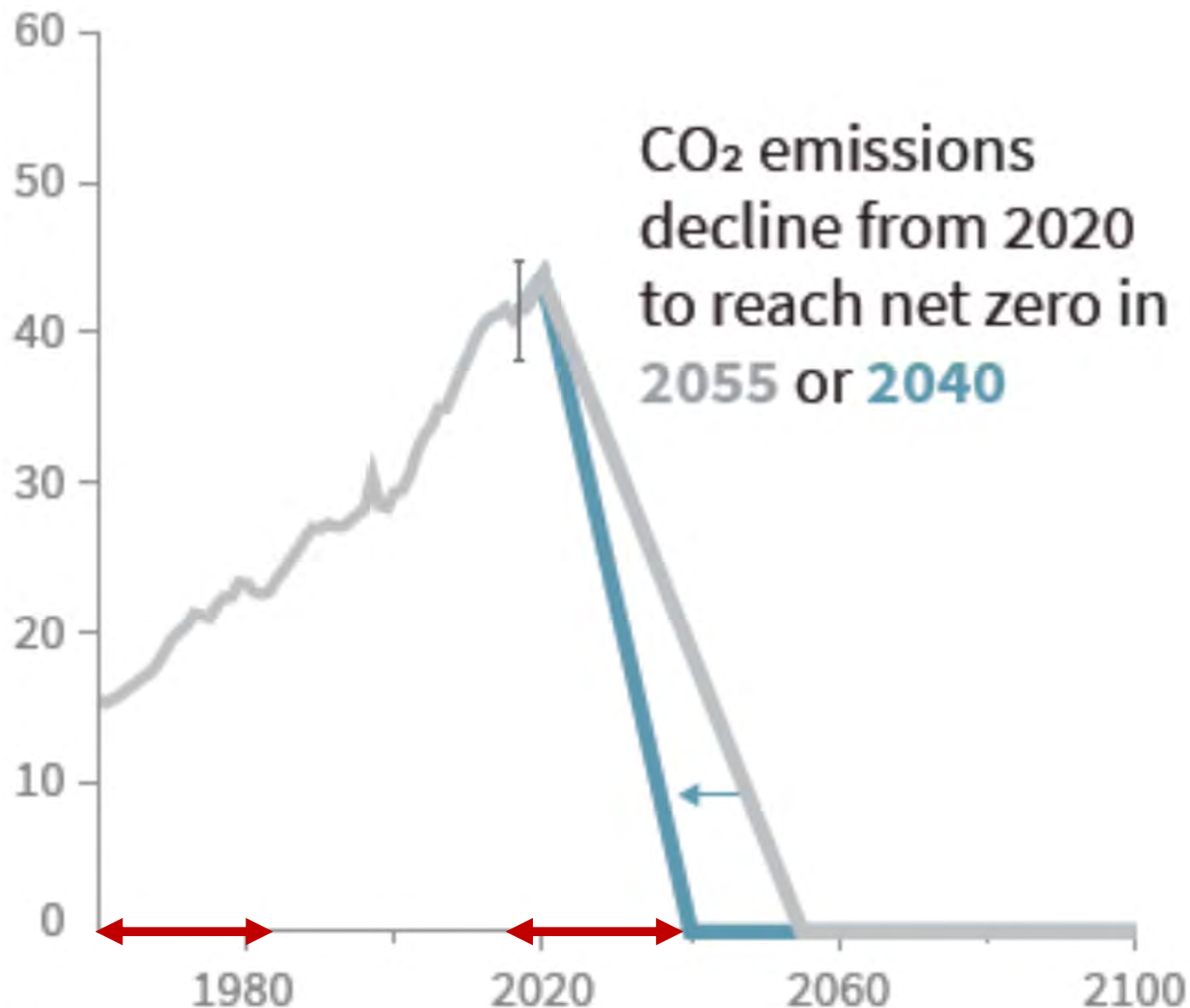
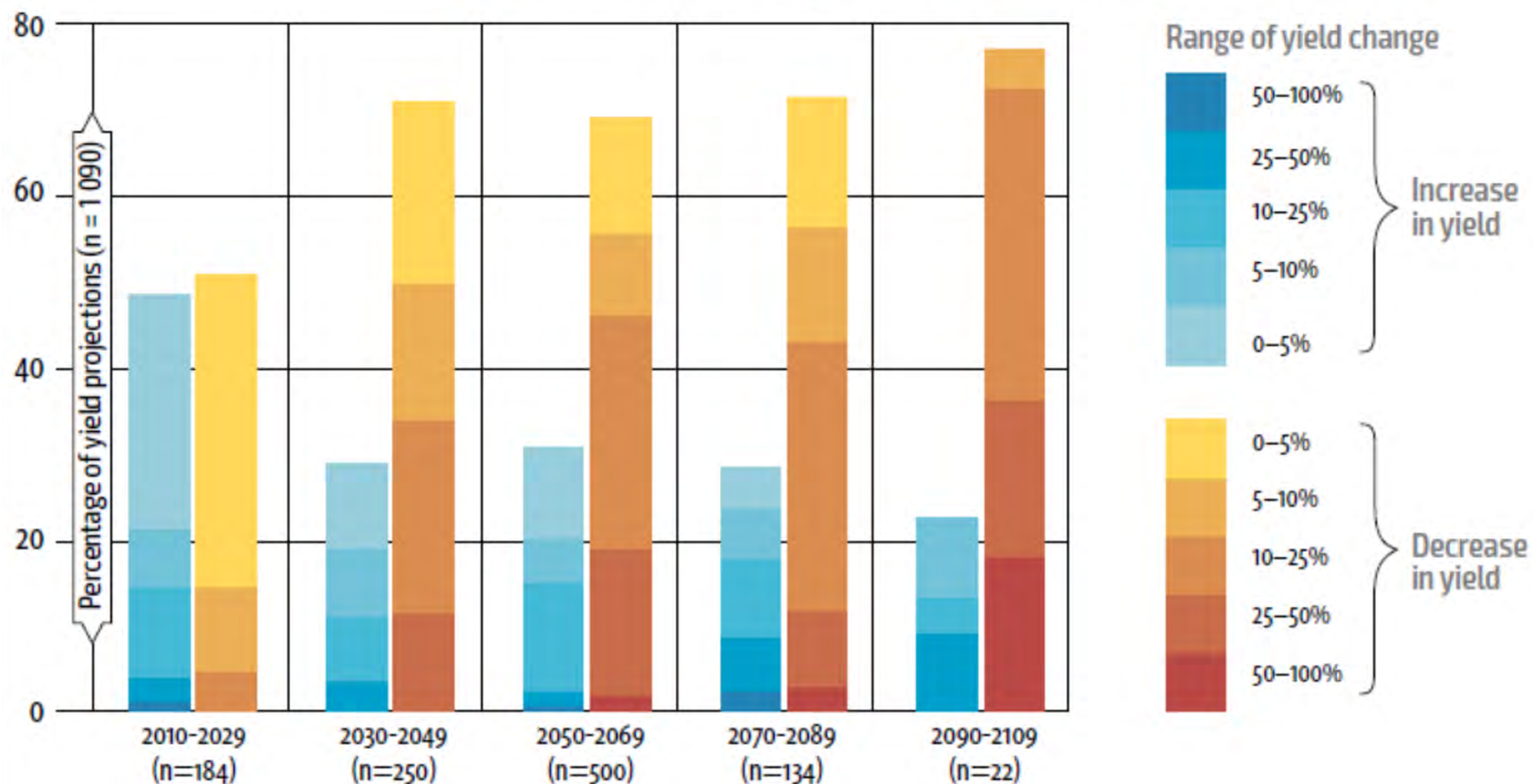
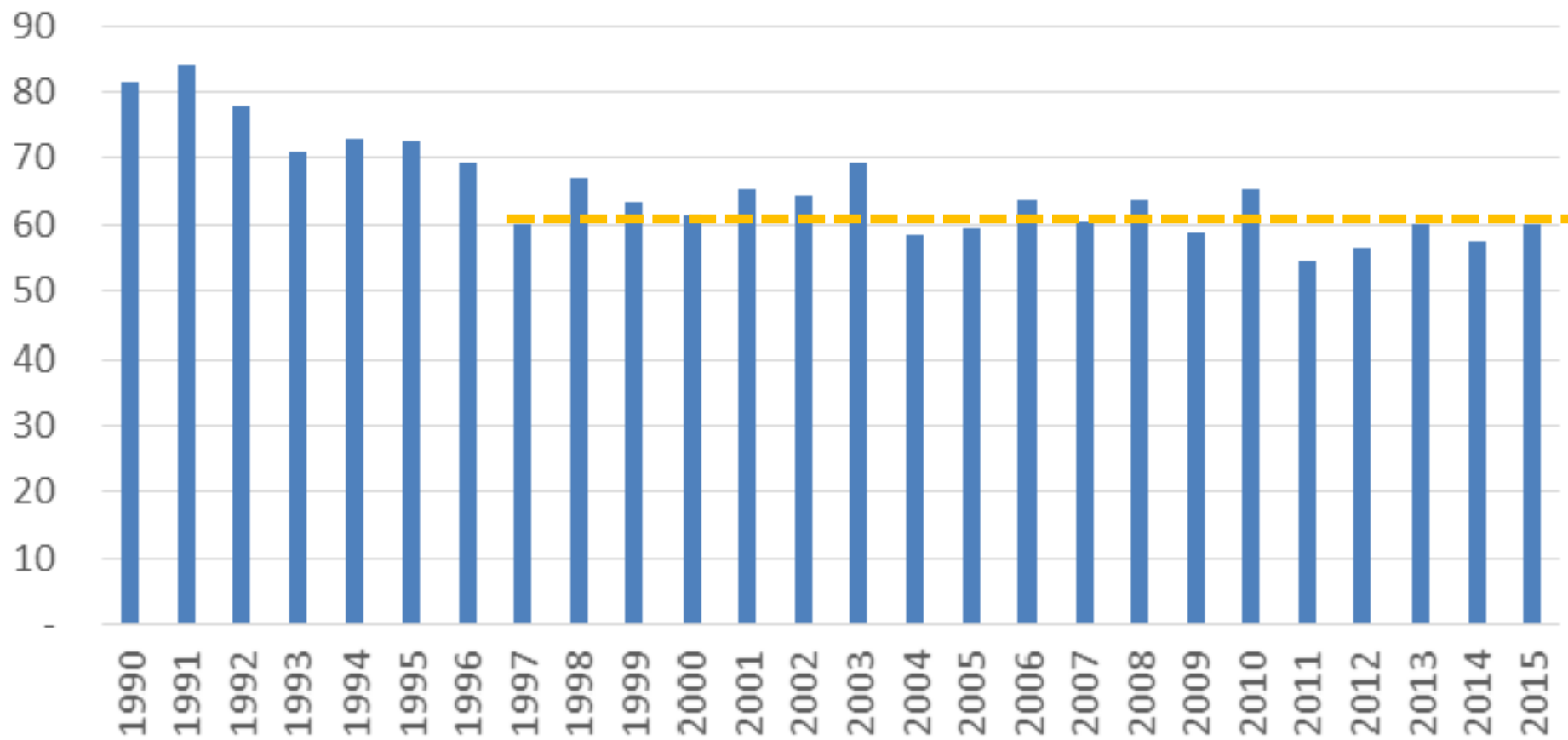


Figure 4.3 Projected changes in crop yields owing to climate change



Source: Porter et al., 2014, p.504.

Bruttoüberschuss pro Hektare (inkl. Sömmerungsflächen), kg/ha



Wäre biologische Landwirtschaft eine Lösung?

*"Organic Agriculture is a production system that sustains the health of soils, ecosystems and people. It relies on ecological processes, biodiversity and cycles adapted to local conditions, rather than the use of inputs with adverse effects. Organic Agriculture combines **tradition, innovation and science** to benefit the shared environment and promote **fair relationships** and a good **quality of life** for all involved."*

Prinzipien der IFOAM



Principle of Health

Healthy soil, plants, animals, humans = a healthy planet.



Principle of Ecology

Emulating and sustaining natural systems.



Principle of Fairness

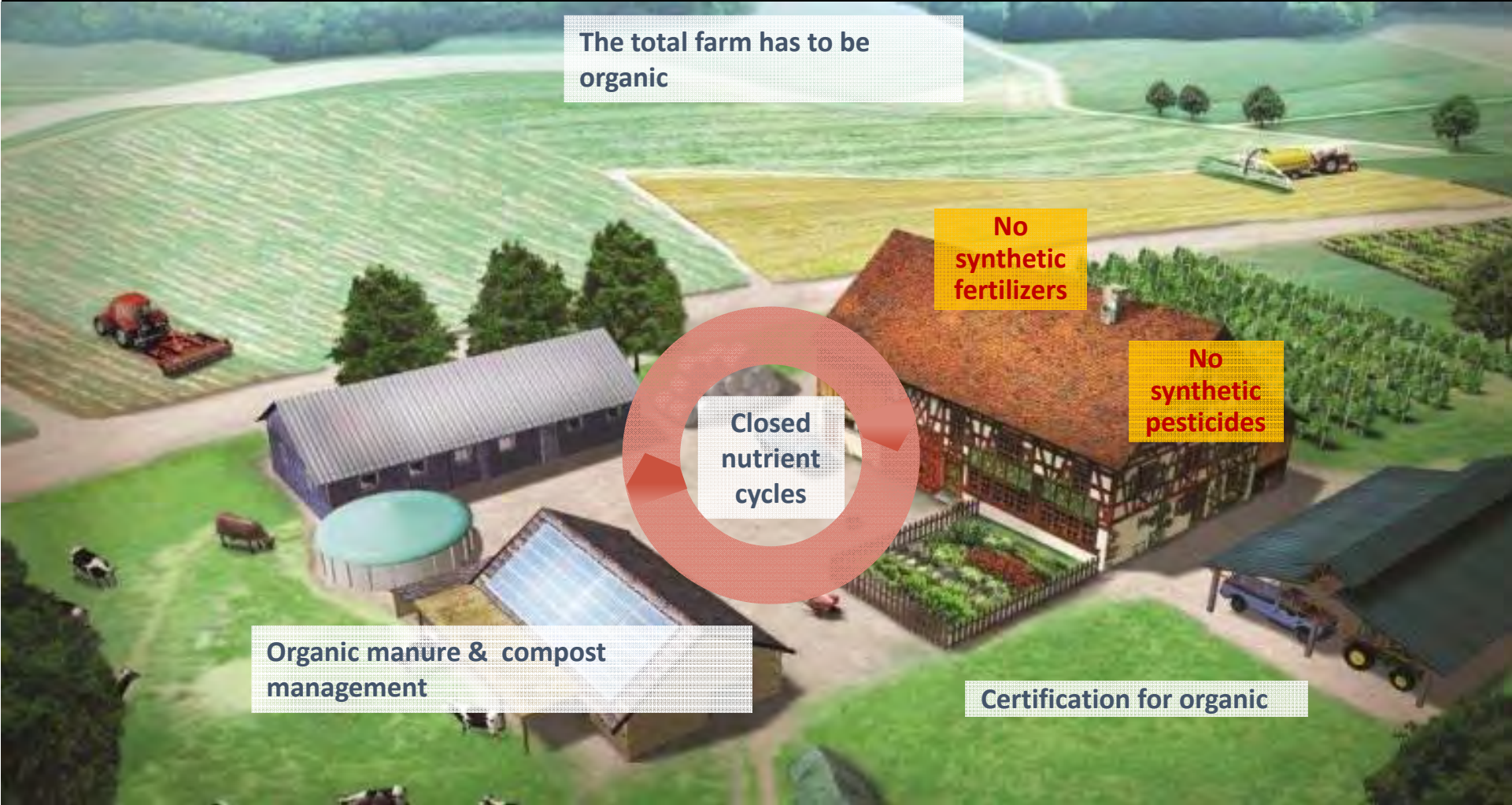
Equity, respect and justice for all living things.



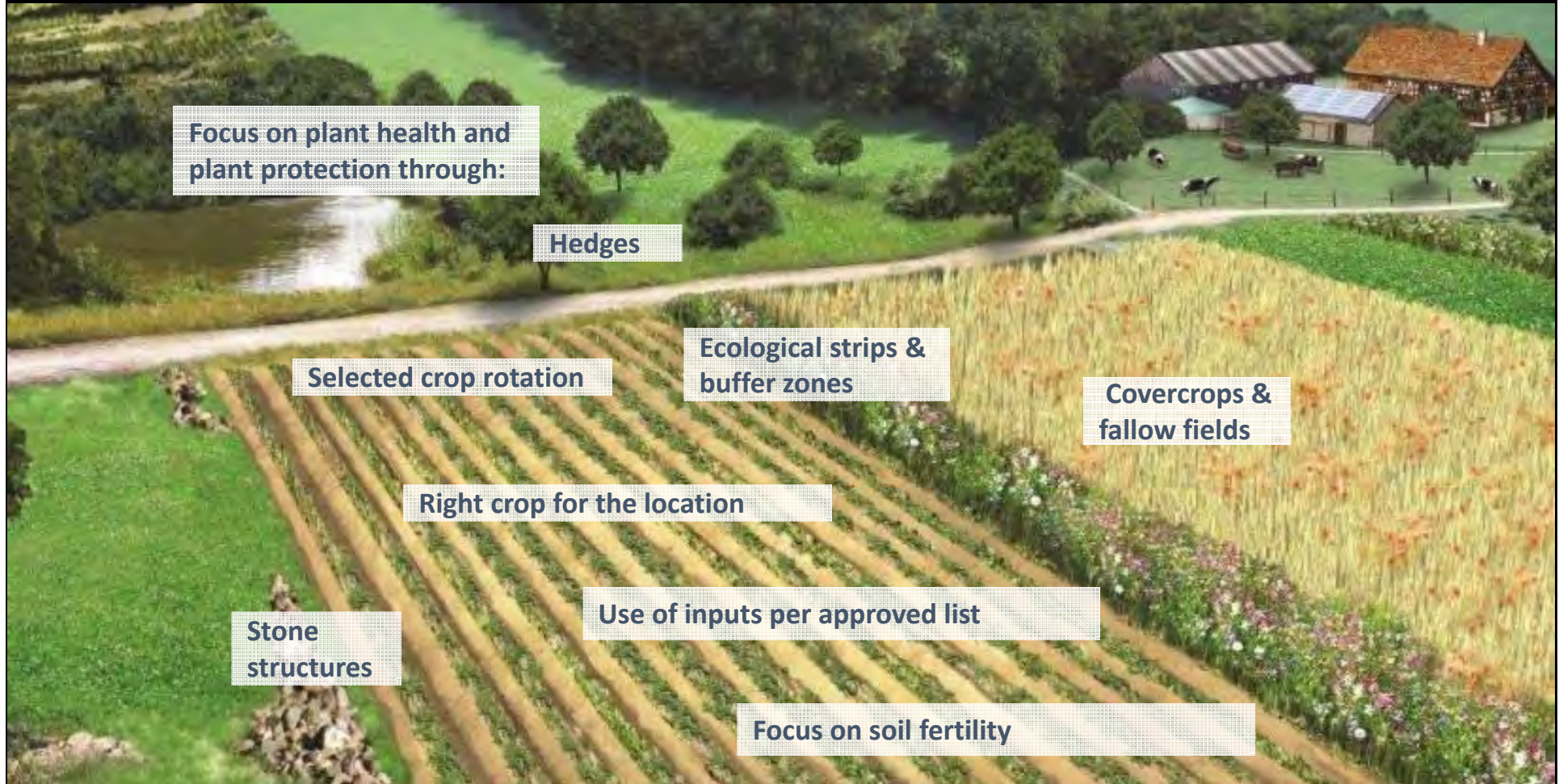
Principle of Care

For the generations to come.

In practice: a farm



In practice: crops



In practice: livestock



Dairy production:

Outside exposure in winter

Animal health:
homeopathy,
acupuncture

Daily grazing in
summer

Longevity

Grassland based
production / locally
sourced feed

Robust breeds

Limitation of
concentrate feed
levels

Beyond production: consumer

Picture: retailer

Label as an
alternative to
internalizing
external costs

Labelling –
Information
provision

Quality control

Beyond production: processing/trade

Picture: Processing plant

Traceability

Product characteristics vs. processing requirements

This directly Feeds back to production

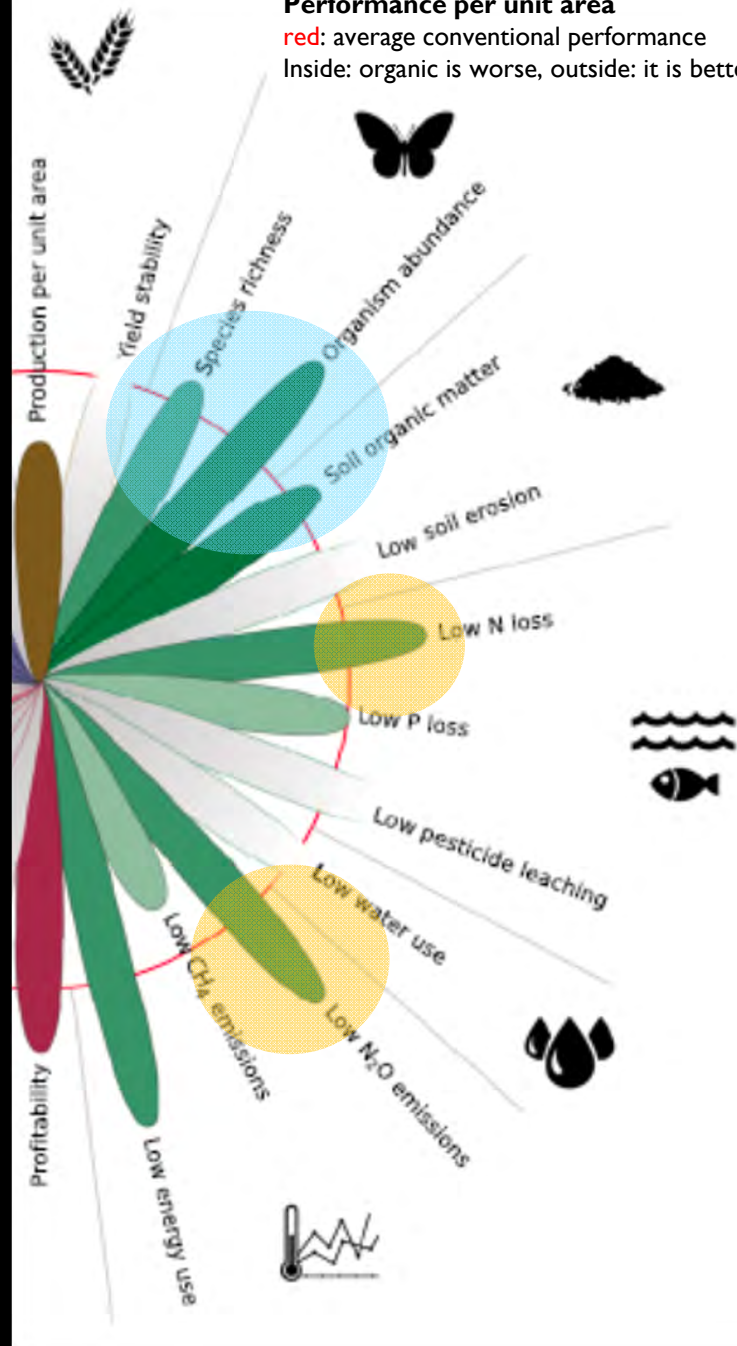
Was leistet der Biolandbau?

- nachhaltig, multidimensional, extensiv, wissensintensiv
- Ein Beispiel für agrarökologische, nachhaltige Produktion
- Ist es eine Option für alle Bauern und Standorte?



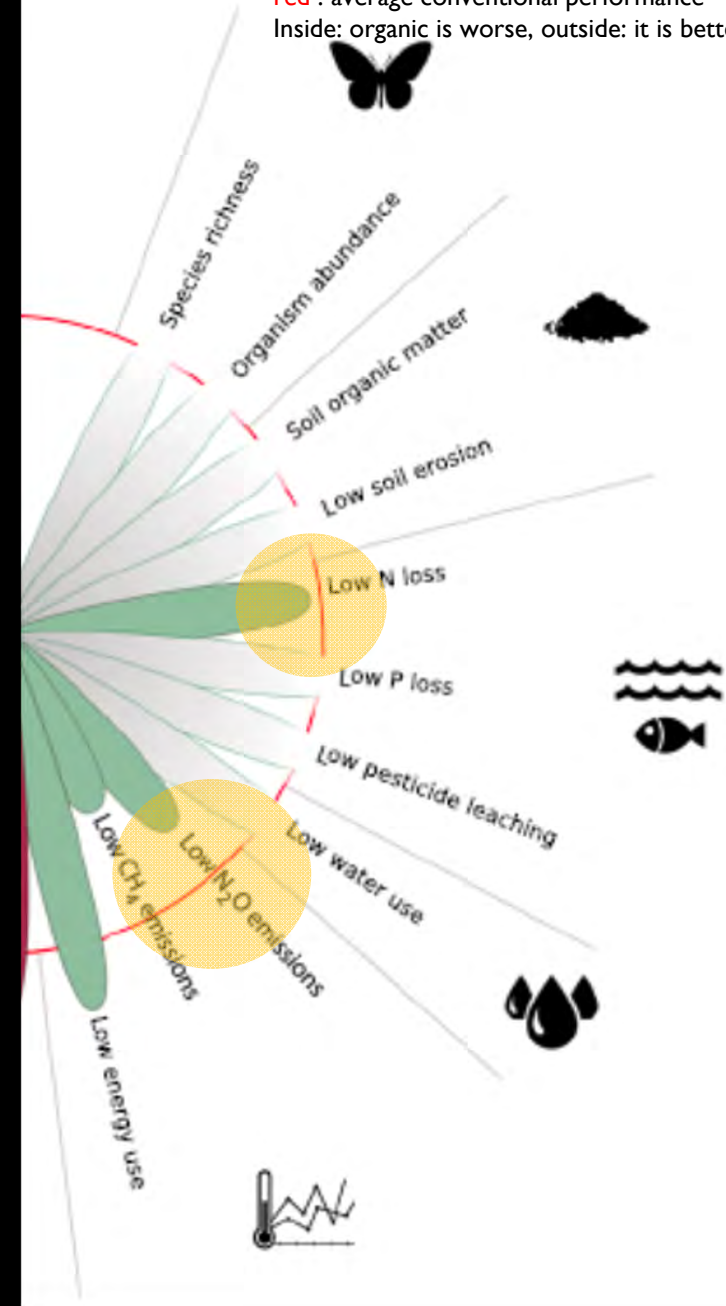
Performance per unit area

red: average conventional performance
Inside: organic is worse, outside: it is better



Performance per unit product

red: average conventional performance
Inside: organic is worse, outside: it is better



Profitabilität

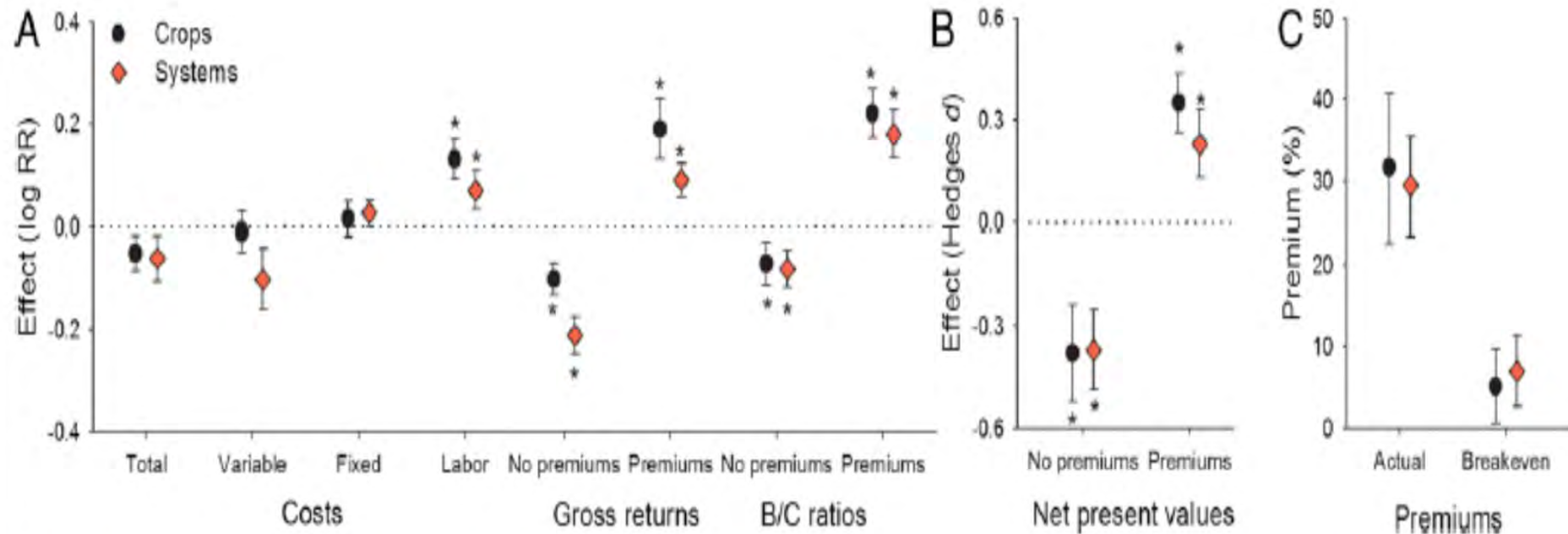
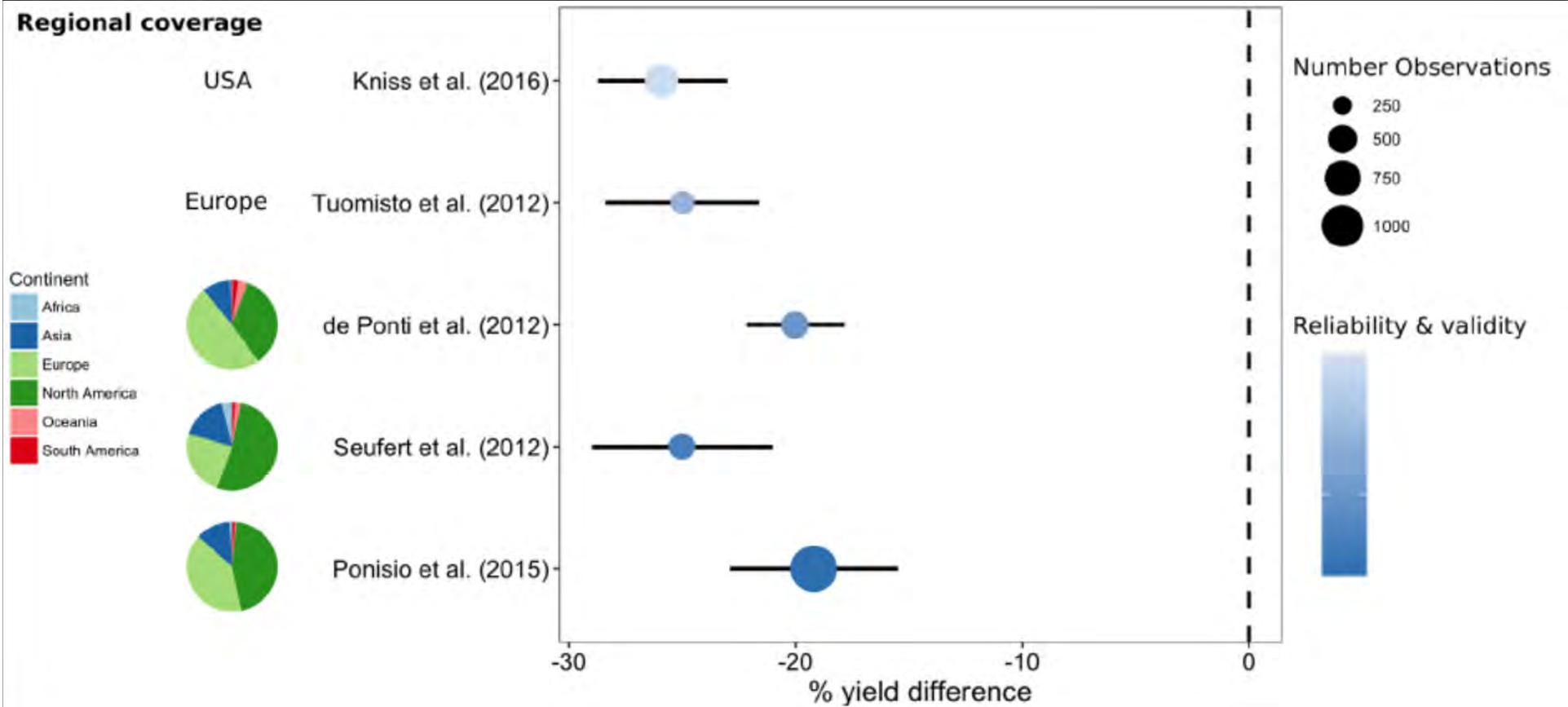


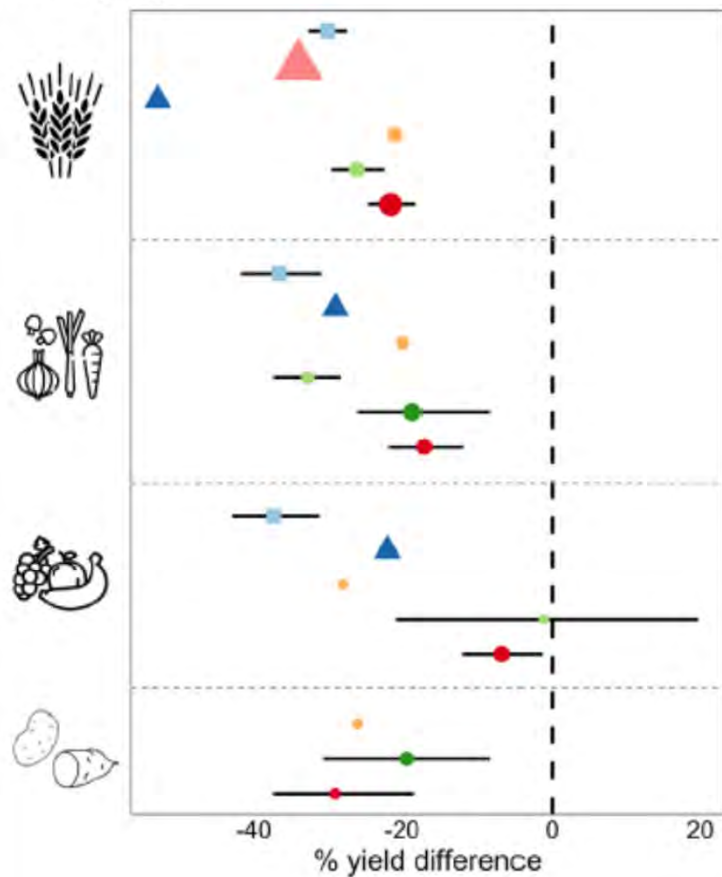
Fig. 1. Financial performance of organic compared with conventional crops and systems. Shown are the median log response-ratios (RR; \pm SE) for costs, gross returns, and benefit/cost (B/C) ratios (A), median Hedges d values (\pm SE) for net present values (B), and organic premiums awarded and breakeven premiums needed for organic net present values to match conventional net present values (C). In A and B, asterisks indicate significant differences from 0. Positive values indicate financial parameters were higher in organic agriculture compared with conventional agriculture.

Erträge

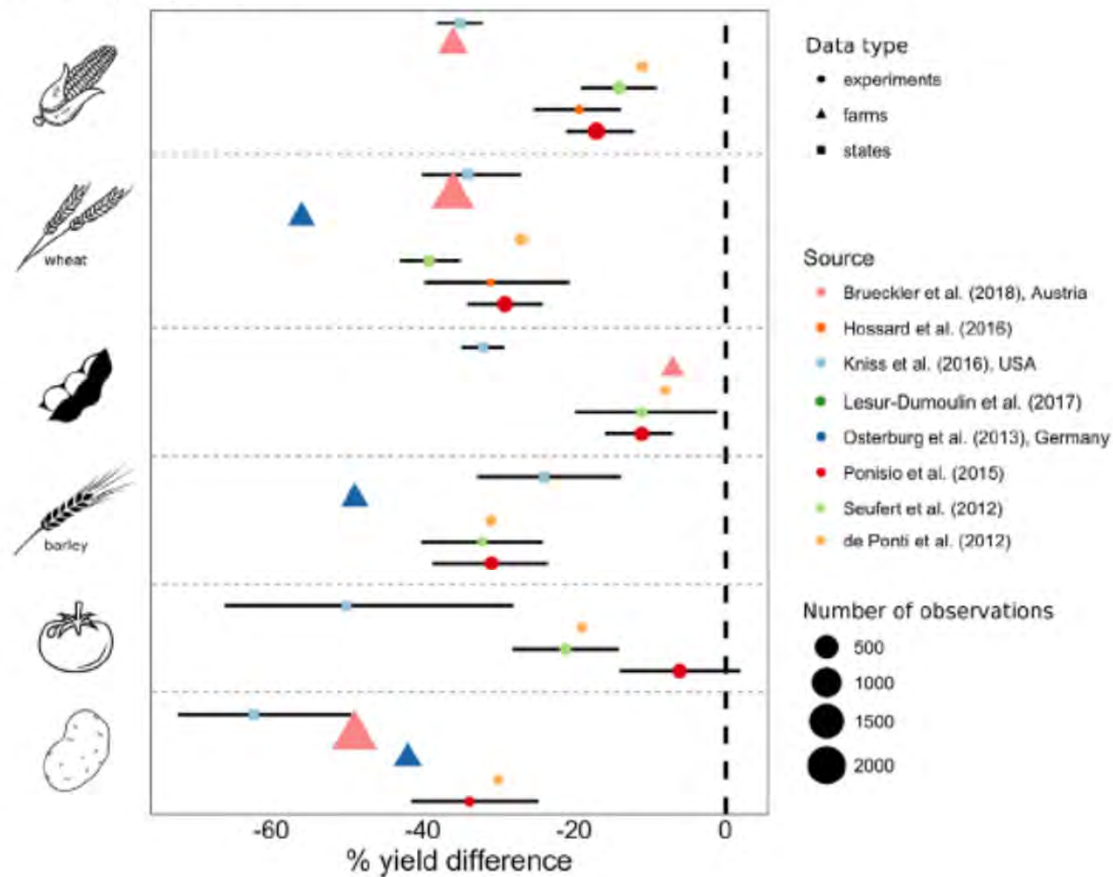
Regional coverage



A - Crop type



B - Crop species



Data type

- experiments
- ▲ farms
- states

Source

- Brueckler et al. (2018), Austria
- Hossard et al. (2016)
- Kniss et al. (2016), USA
- Lesur-Dumoulin et al. (2017)
- Osterburg et al. (2013), Germany
- Poniso et al. (2015)
- Seufert et al. (2012)
- de Ponti et al. (2012)

Number of observations

- 500
- 1000
- 1500
- 2000

Wie kann die biologische Landwirtschaft zu nachhaltigen Ernährungssystemen beitragen?

Es braucht einen umfassenden Ernährungssystemansatz, nicht nur eine Diskussion der landwirtschaftlichen Produktion.

Konsum und Verarbeitung sind auch zentral.

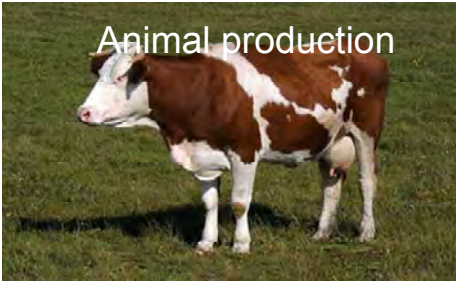
Inputs:

- Grasslands
- Other roughage
- Concentrates
- Electricity, fuels
- Buildings, infrastructure

- Emissions from manure management: CH₄, N and N₂O (direct and indirect: NO₃, NH₃)
- CH₄-Emissions from enteric fermentation
- Emissions from inputs

Outputs:

- Meat, milk, eggs
- Wool, skins, hides
- Bones, waste
- Manure



- Herd structure
- Animal sourced feed

- Grass
- Other roughage
- Concentrates
- By-products

- Manure

- Residues, compost, etc.



Outputs:

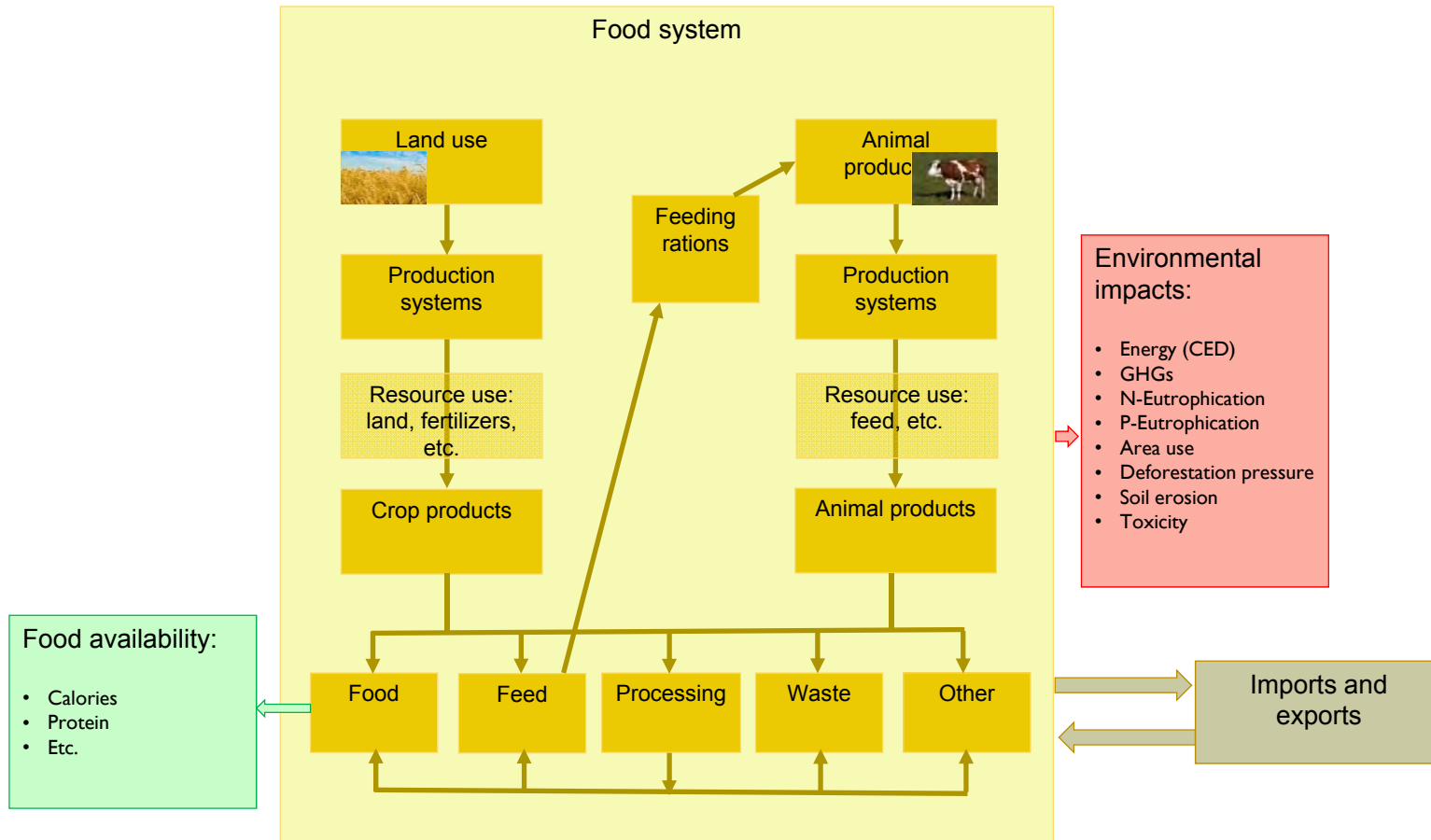
- Yields
- Residues

- Emissions from fertilizer application: N and N₂O (direct and indirect: NO₃, NH₃)
- CH₄-Emissions from rice
- Emissions from inputs

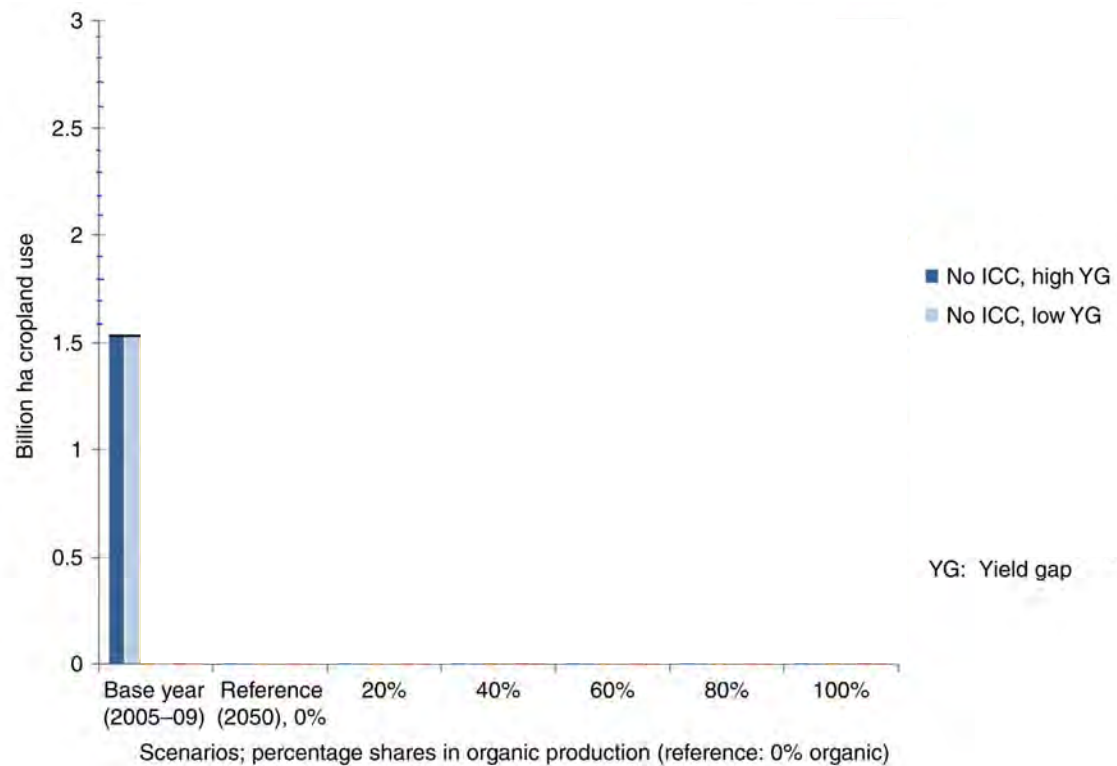
Inputs:

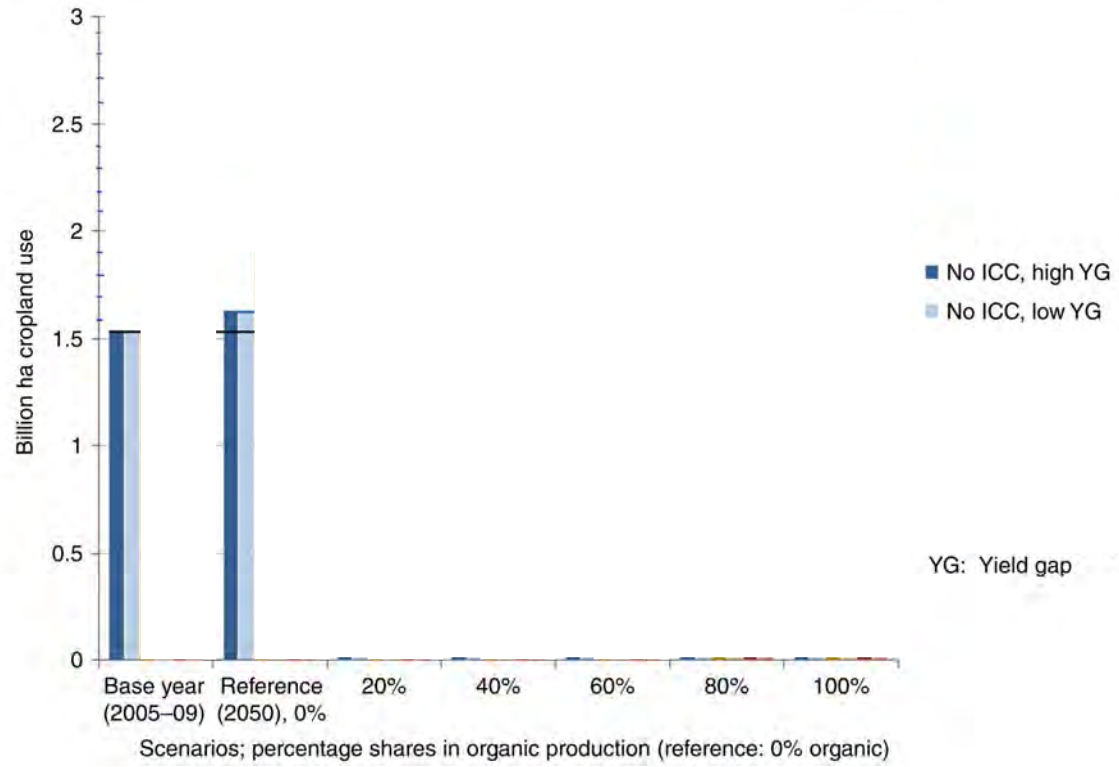
- Mineral fertilizers
- N-fixation
- N-deposition
- Seeds
- Plant protection
- Water
- Electricity, fuels
- Buildings, infrastructure

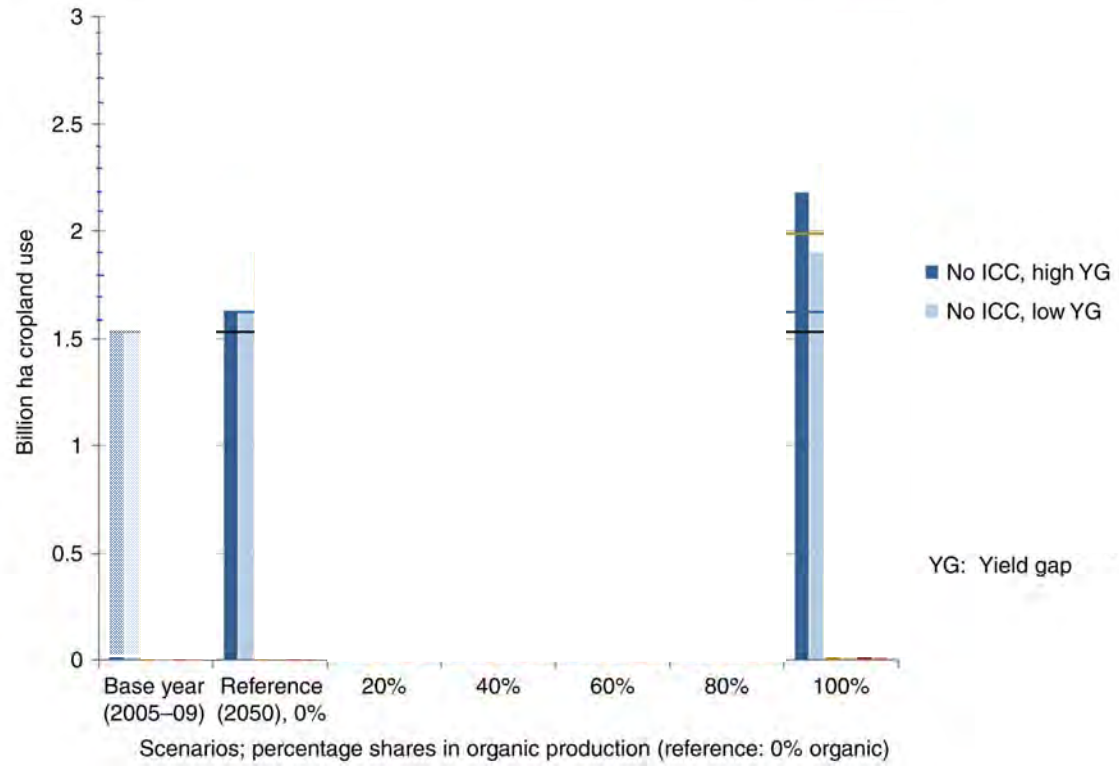
Structure of SOLm

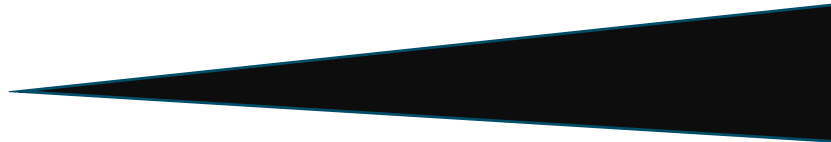
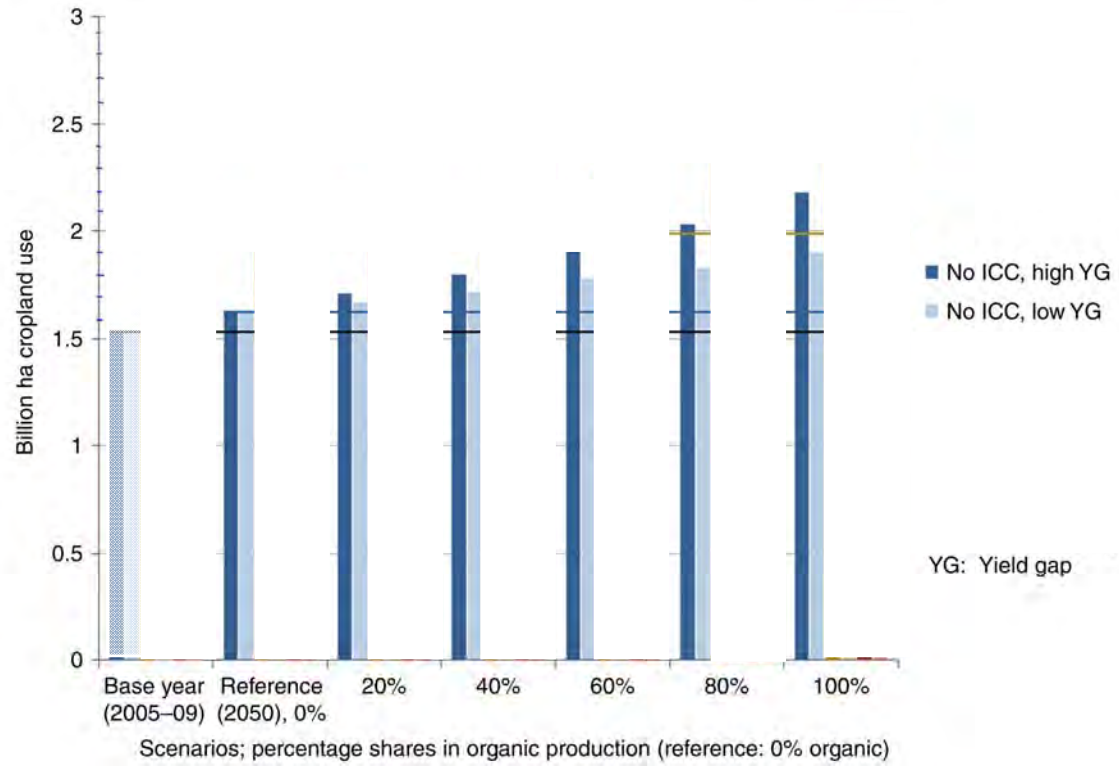


Flächenverbrauch





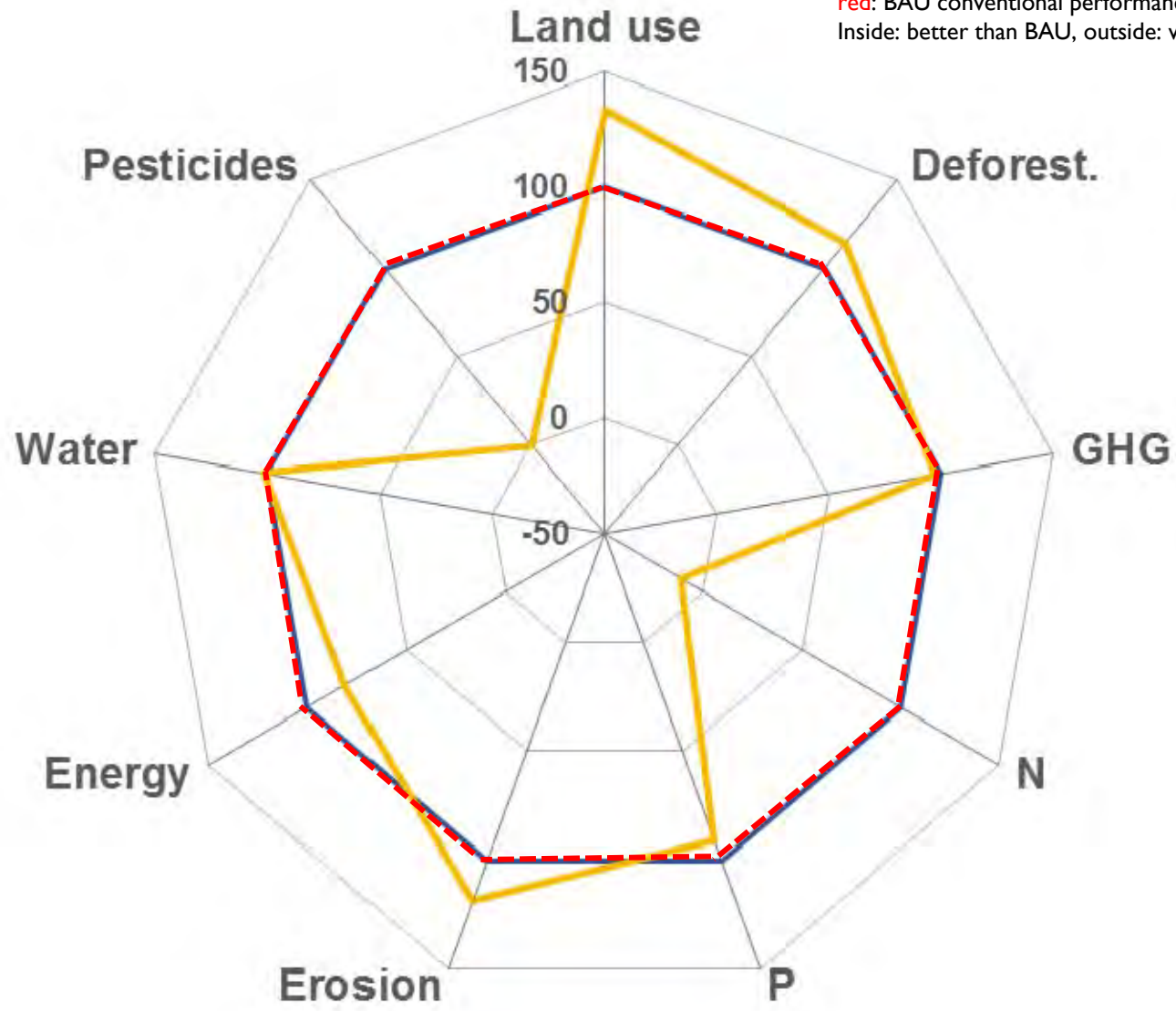




Wie kann die biologische Landwirtschaft zu nachhaltigen Ernährungssystemen beitragen?

Es geht nicht nur um Flächenverbrauch.

TOTAL performance
red: BAU conventional performance 2050
Inside: better than BAU, outside: worse



— Reference: 0% organic — 100% organic

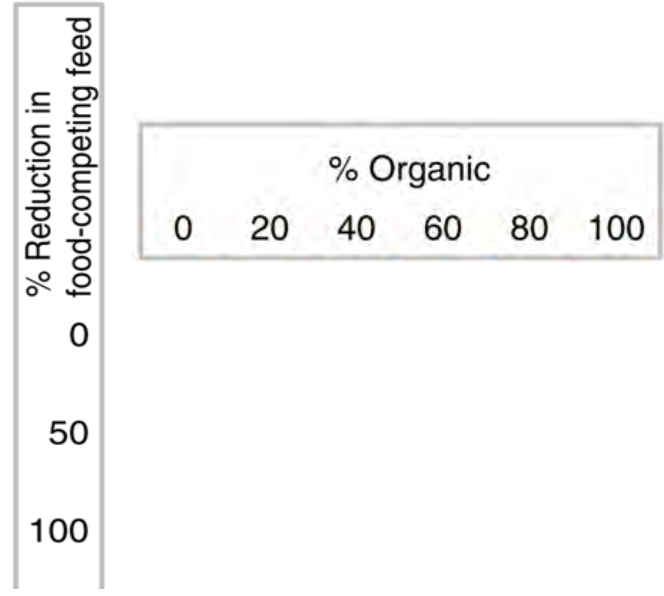
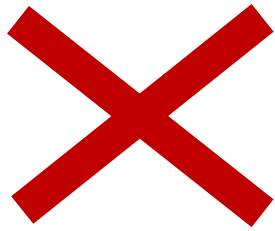
Was heist “die Welt ernähren”?

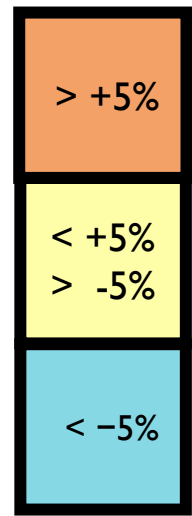
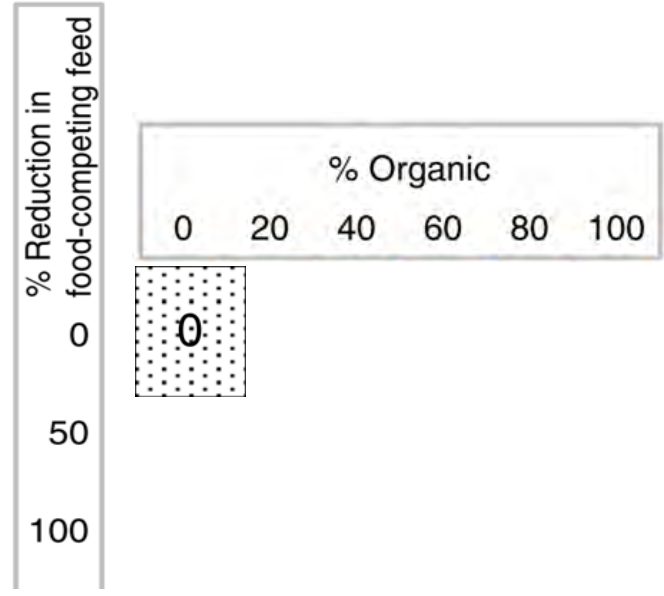
Picture:s: Food waste, Concentrate feed, animals

- Mehr als 9 Mrd Menschen in 2050
- FAO: über 3000 kcal/cap/day
- Hohe Anteile tierischer Produkte in der Ernährung

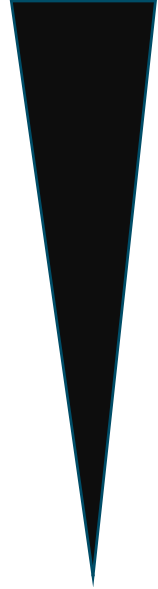
Once more: Land use

Muller et al. 2017; Courtesy: R. Zürcher





% Reduction in food-competing feed	% Organic					
	0	20	40	60	80	100
0	0	5	10	17	25	33
50	-16	-12	-8	-4	2	8
100	-26	-24	-20	-16	-12	-8



> +5%
< +5% > -5%
< -5%

Land use

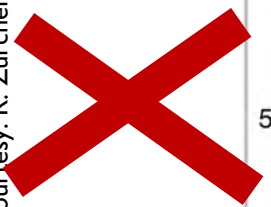
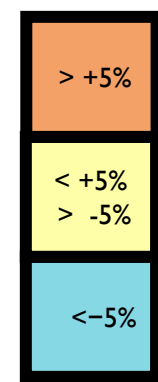
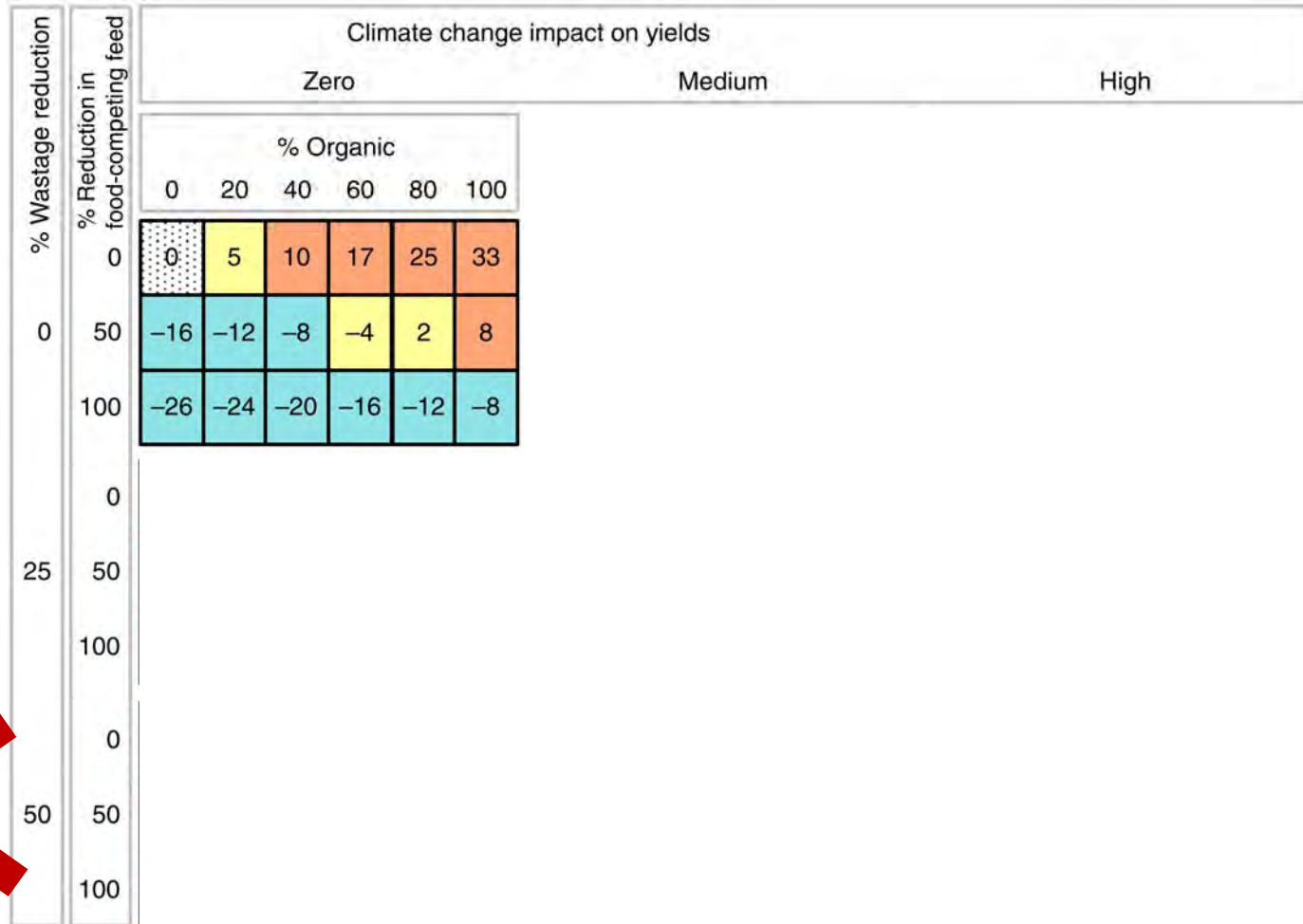
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	0	20	40	60	80	100
0	0	5	10	17	25	33
50	-16	-12	-8	-4	2	8
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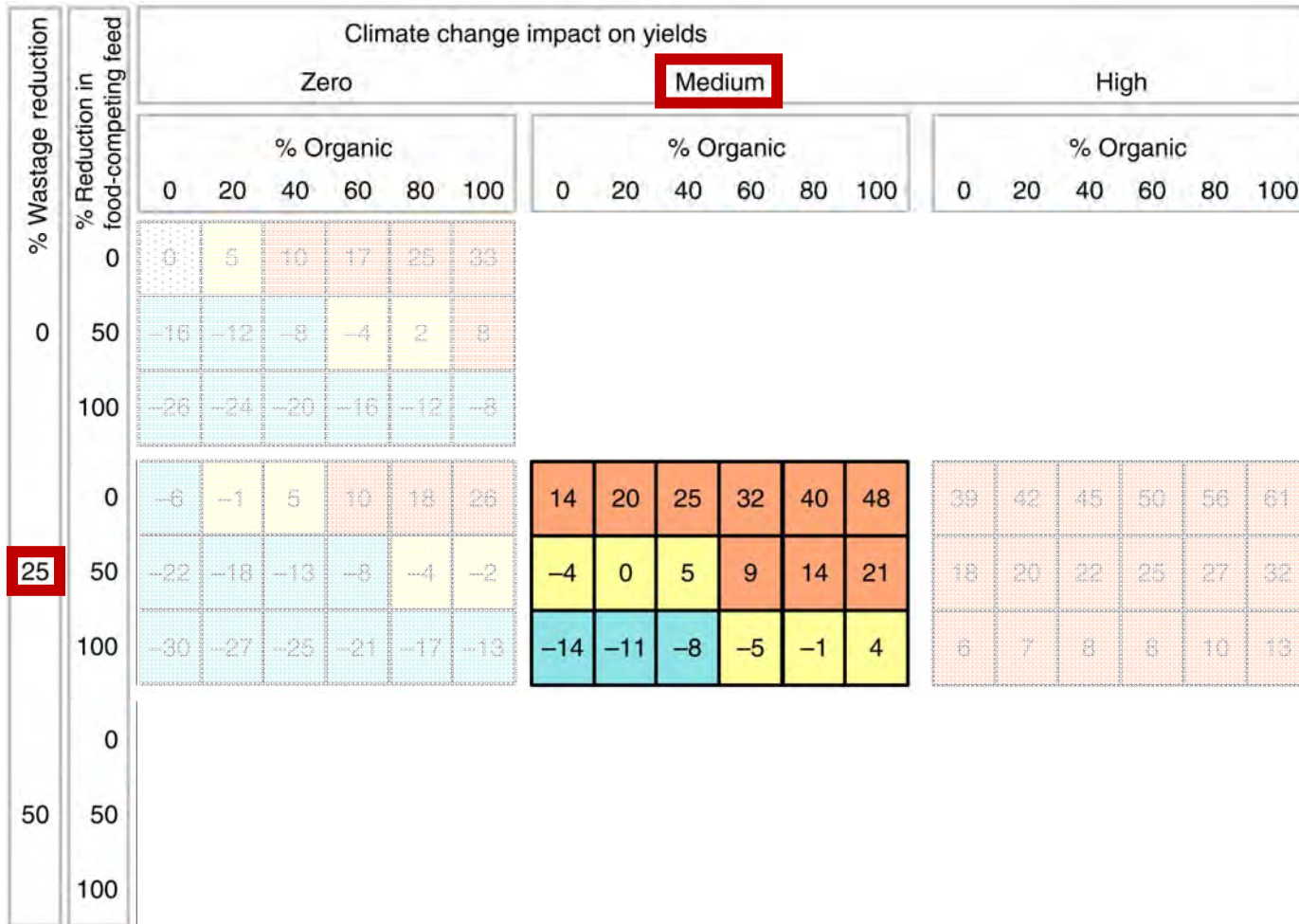
> +5%

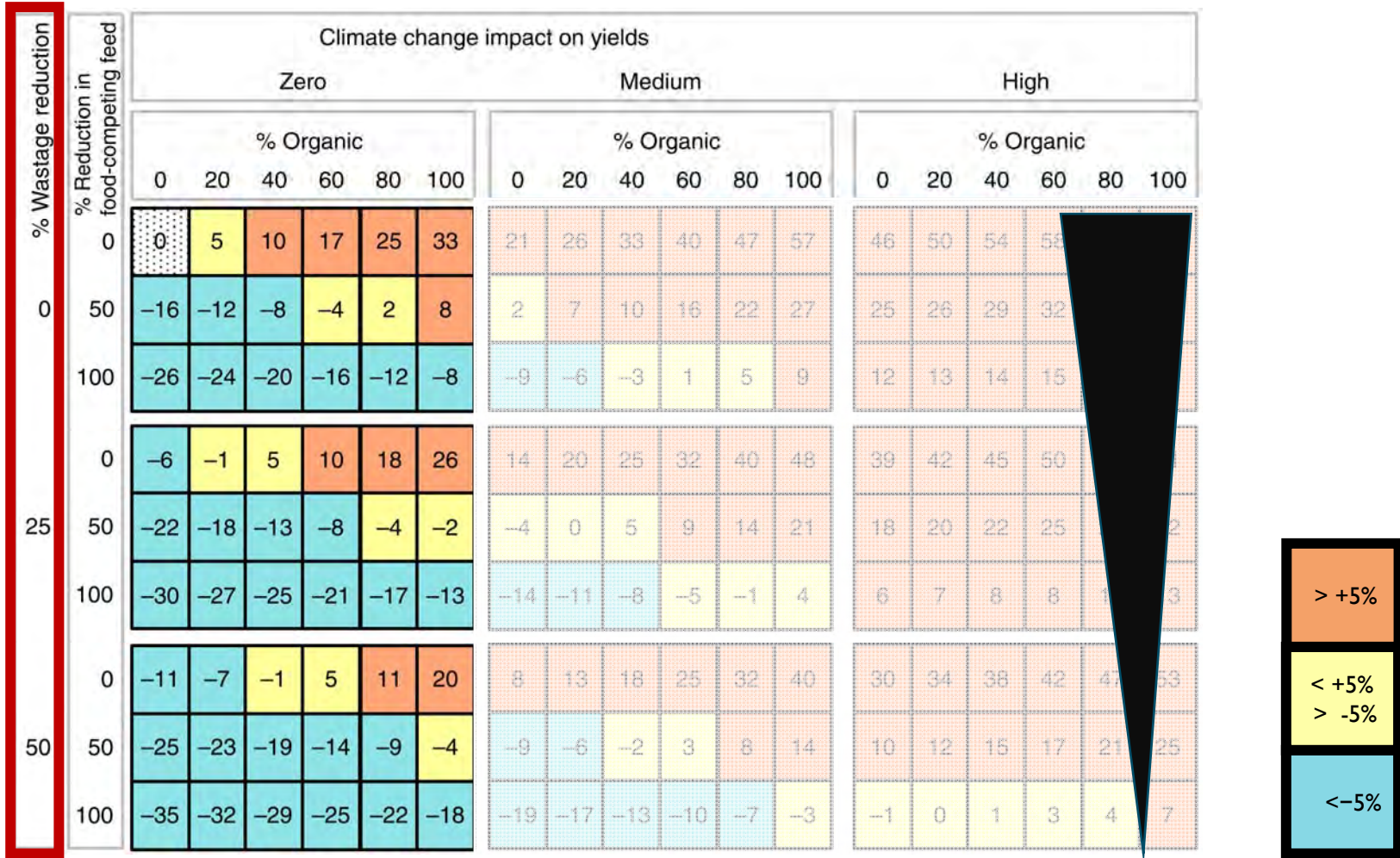
< +5%
> -5%

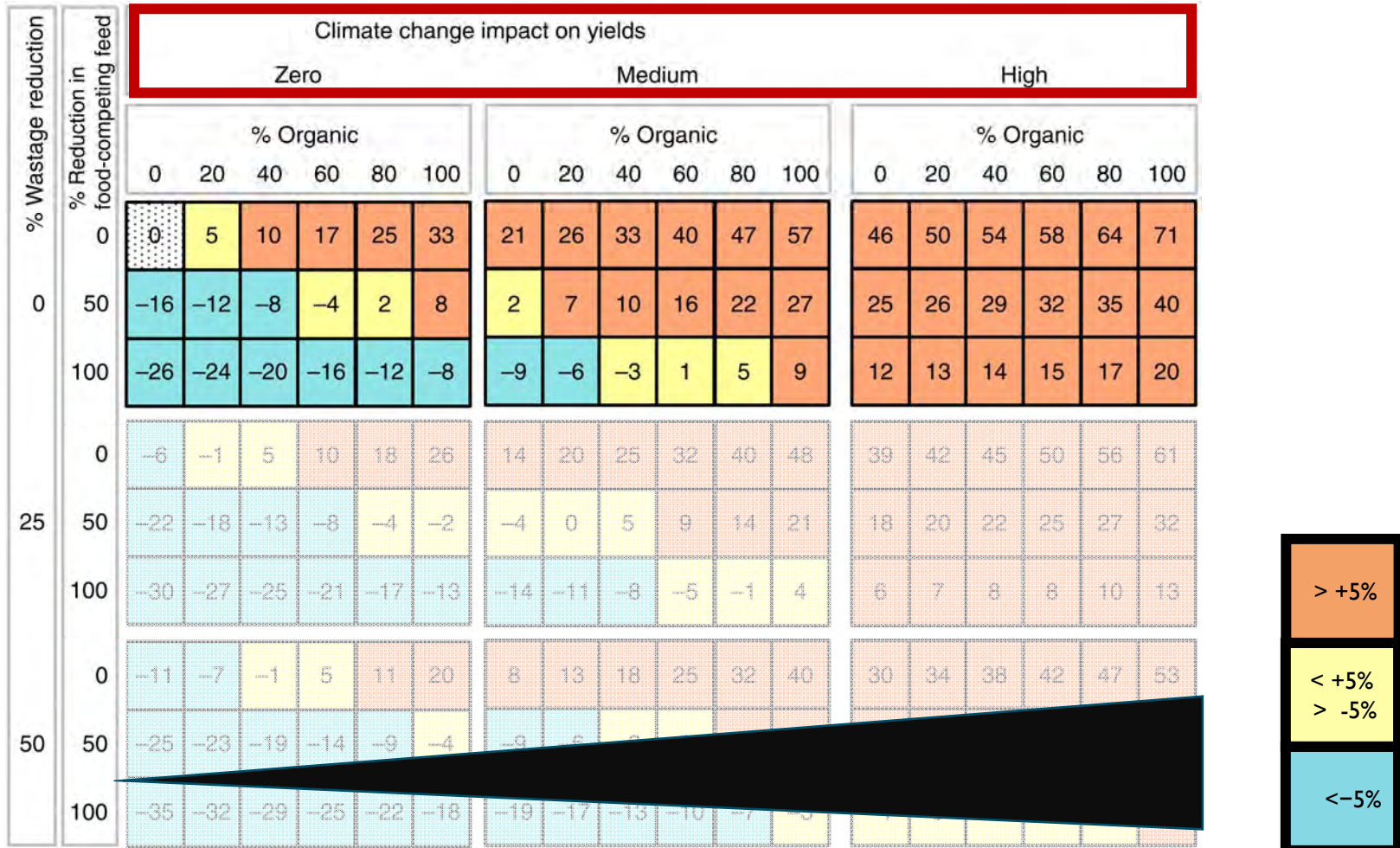
< -5%

Land use

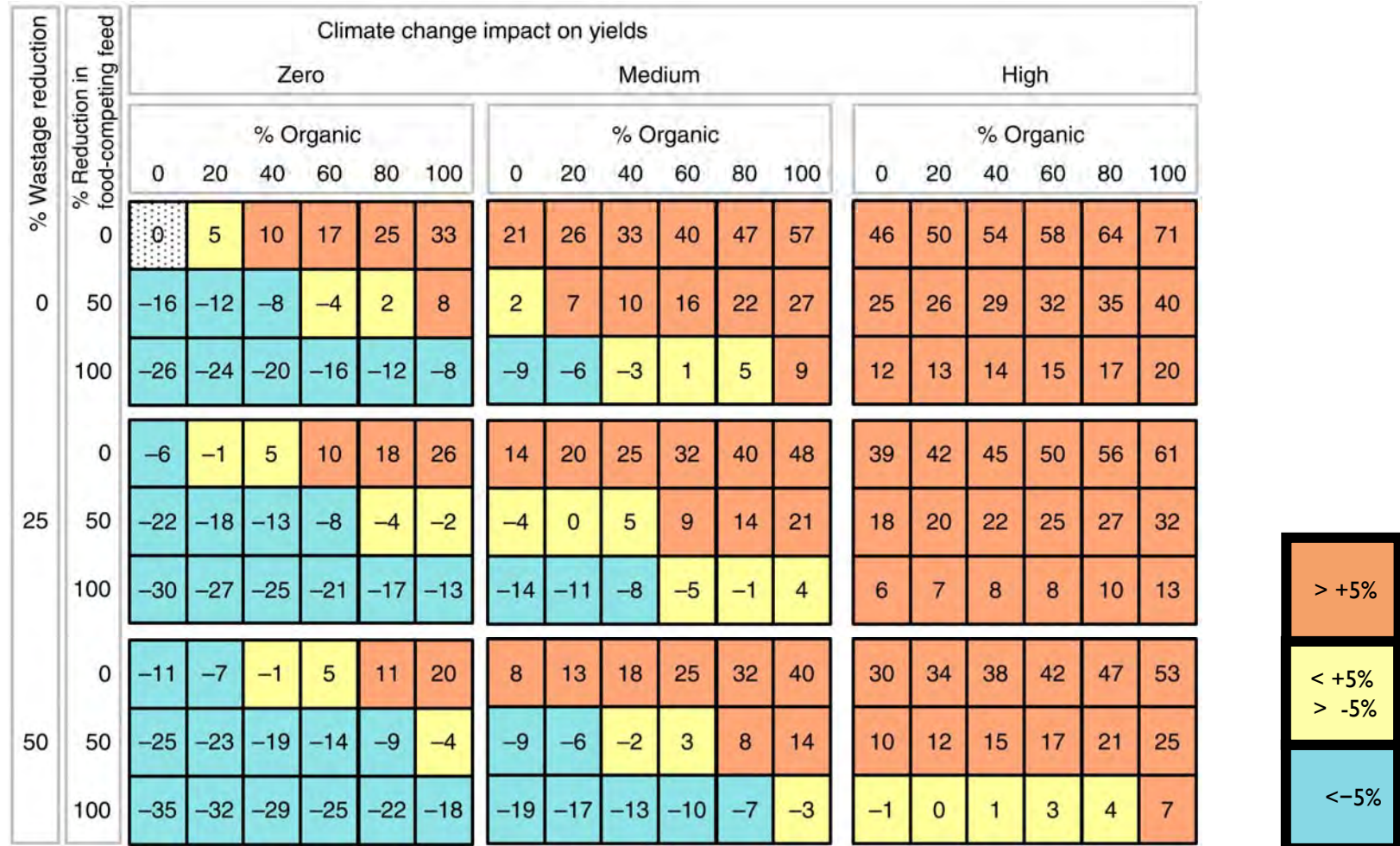








Land use



Wie kann die biologische Landwirtschaft zu nachhaltigen Ernährungssystemen beitragen?

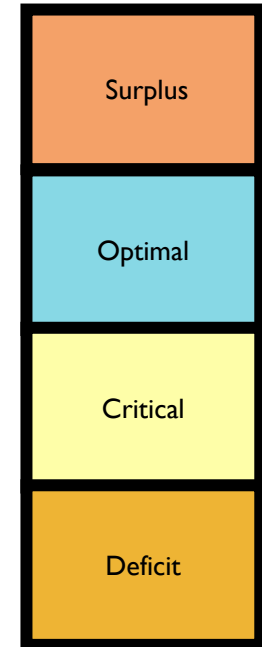
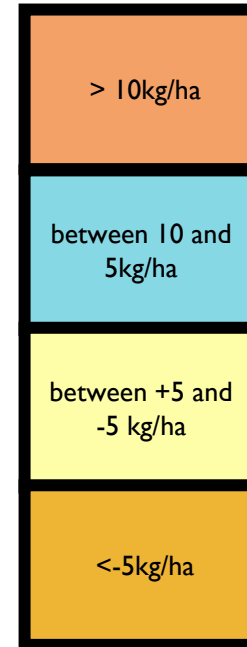
Nährstoffversorgung

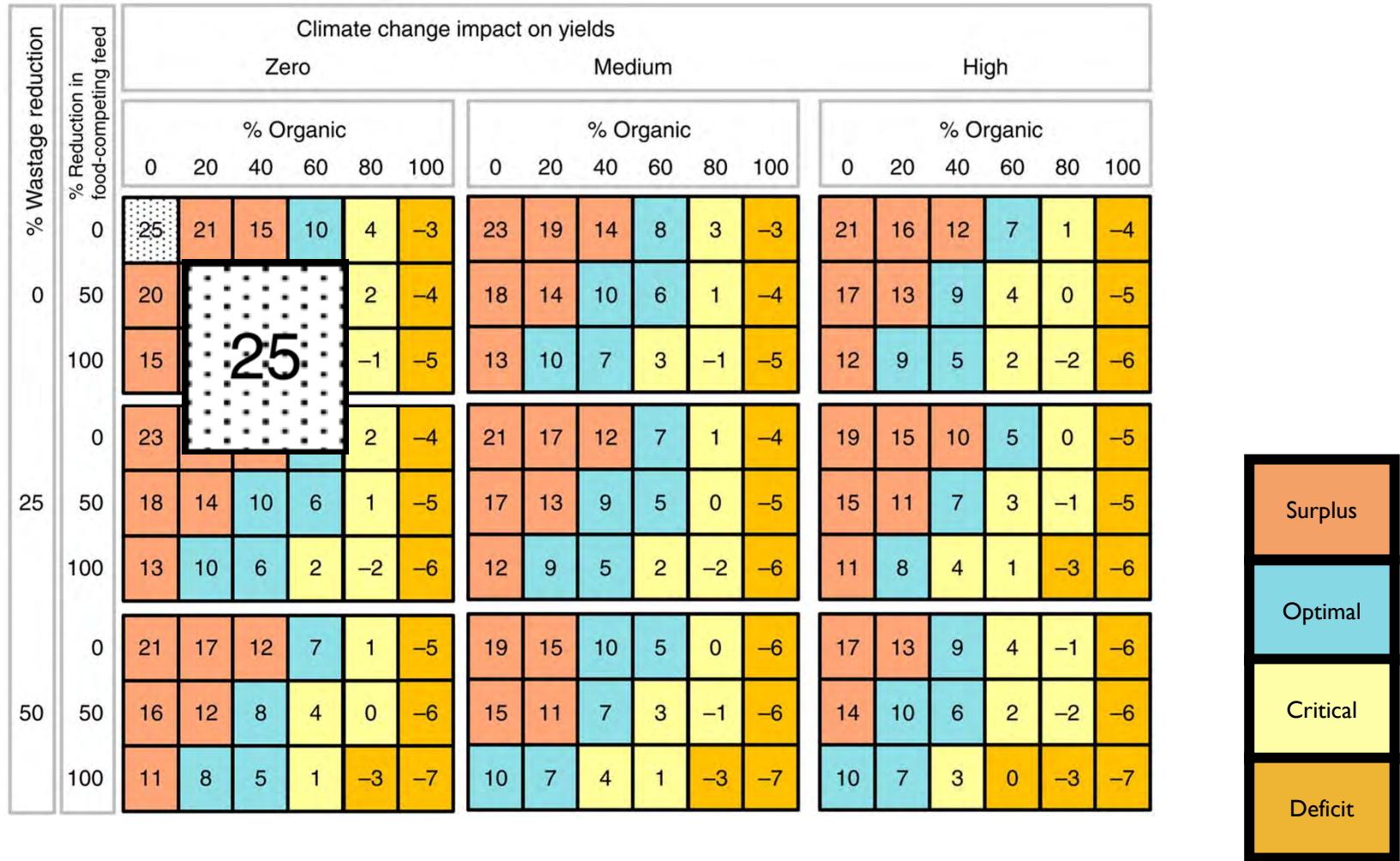
Nicht nur die Produkte,
sondern auch der Dünger wächst auf dem Feld

Es ist herausfordernd, eine ausreichende
Stickstoffversorgung zu gewährleisten

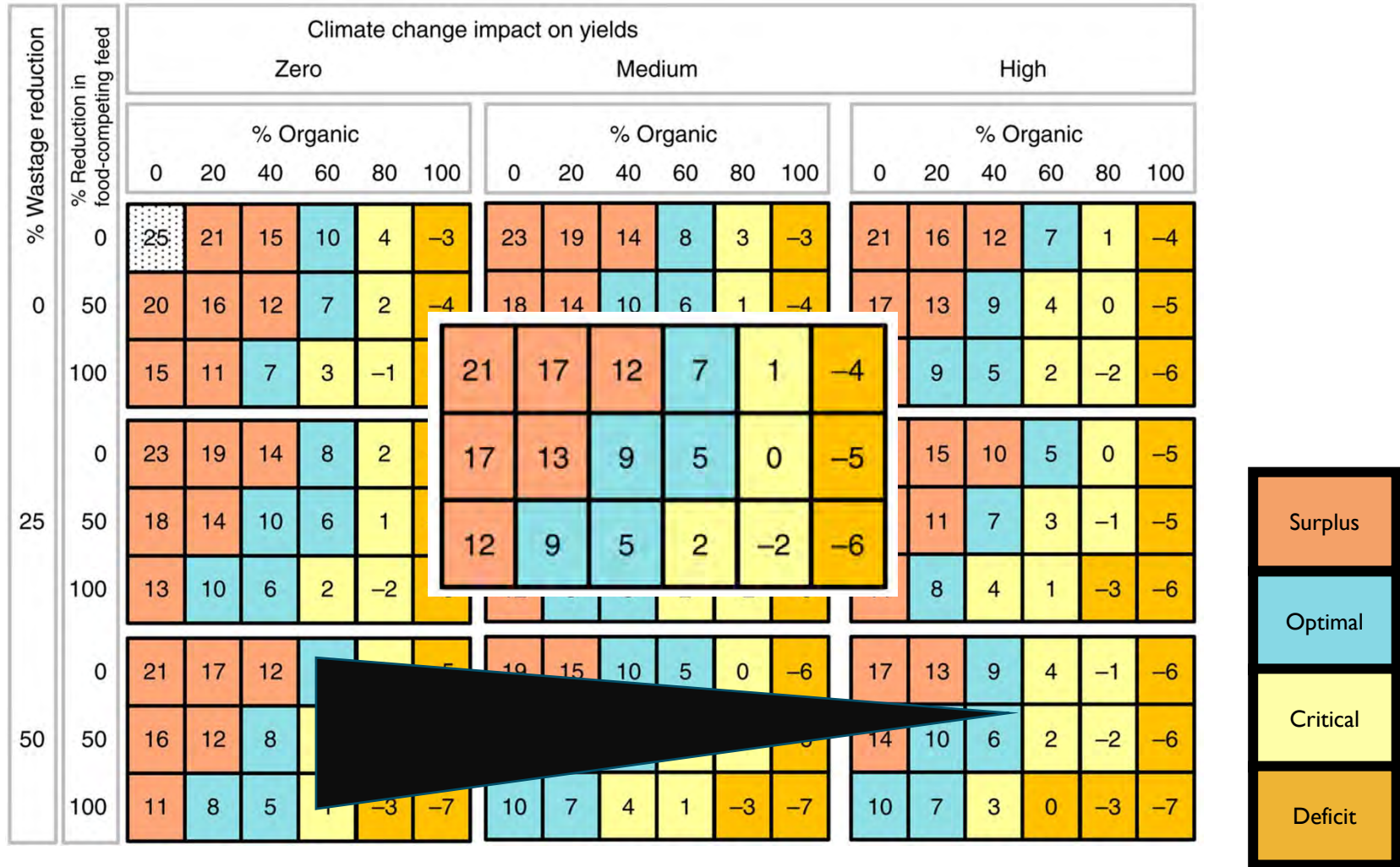


% Wastage reduction		Climate change impact on yields																	
		Zero						Medium						High					
		% Organic						% Organic						% Organic					
% Reduction in food-competing feed		0	20	40	60	80	100	0	20	40	60	80	100	0	20	40	60	80	100
0	0	25	21	15	10	4	-3	23	19	14	8	3	-3	21	16	12	7	1	-4
	50	20	16	12	7	2	-4	18	14	10	6	1	-4	17	13	9	4	0	-5
	100	15	11	7	3	-1	-5	13	10	7	3	-1	-5	12	9	5	2	-2	-6
25	0	23	19	14	8	2	-4	21	17	12	7	1	-4	19	15	10	5	0	-5
	50	18	14	10	6	1	-5	17	13	9	5	0	-5	15	11	7	3	-1	-5
	100	13	10	6	2	-2	-6	12	9	5	2	-2	-6	11	8	4	1	-3	-6
50	0	21	17	12	7	1	-5	19	15	10	5	0	-6	17	13	9	4	-1	-6
	50	16	12	8	4	0	-6	15	11	7	3	-1	-6	14	10	6	2	-2	-6
	100	11	8	5	1	-3	-7	10	7	4	1	-3	-7	10	7	3	0	-3	-7





N surplus

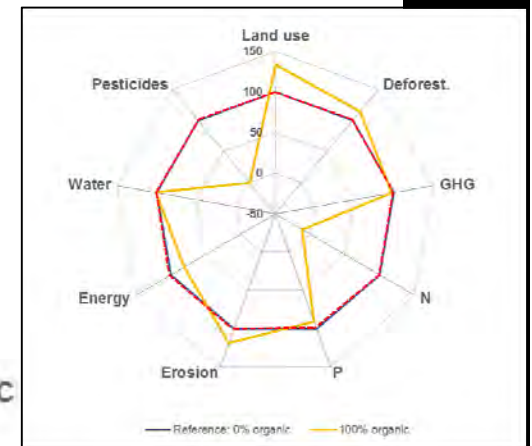
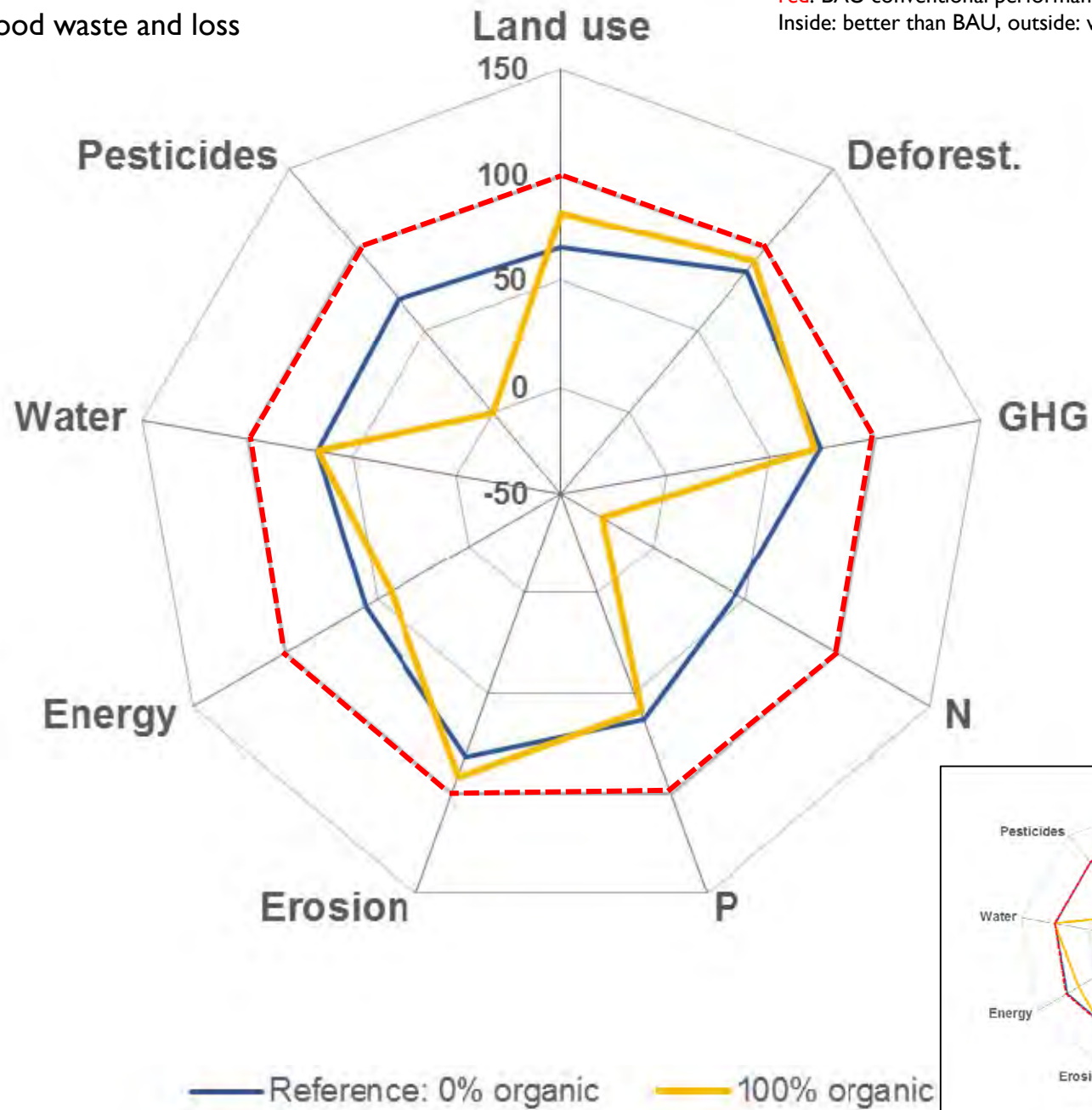


Wie kann die biologische Landwirtschaft zu nachhaltigen Ernährungssystemen beitragen?

Flächenverbrauch und Stickstoffüberschüsse-/Versorgung sind nur zwei Nachhaltigkeitsindikatoren unter vielen.

100% food competing feed
reduction
50% less food waste and loss

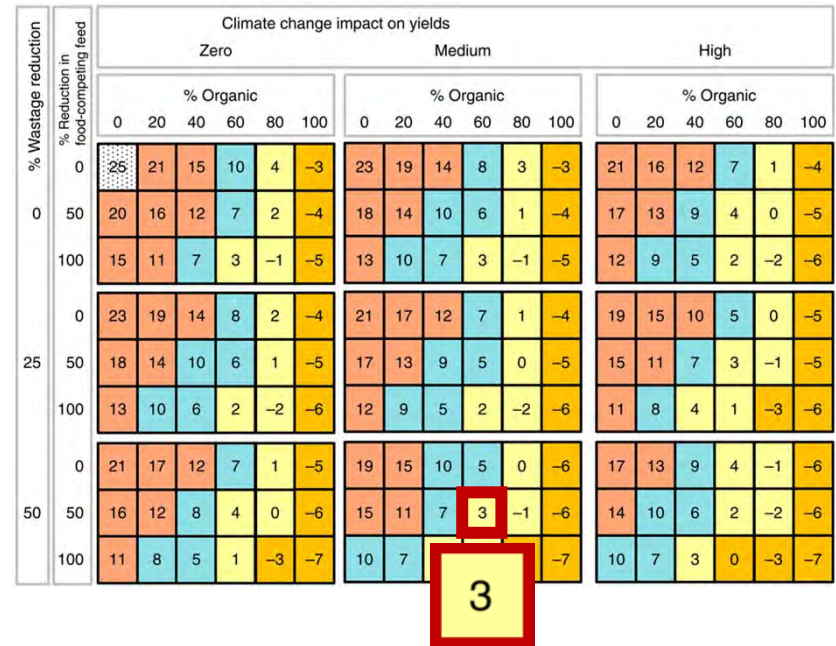
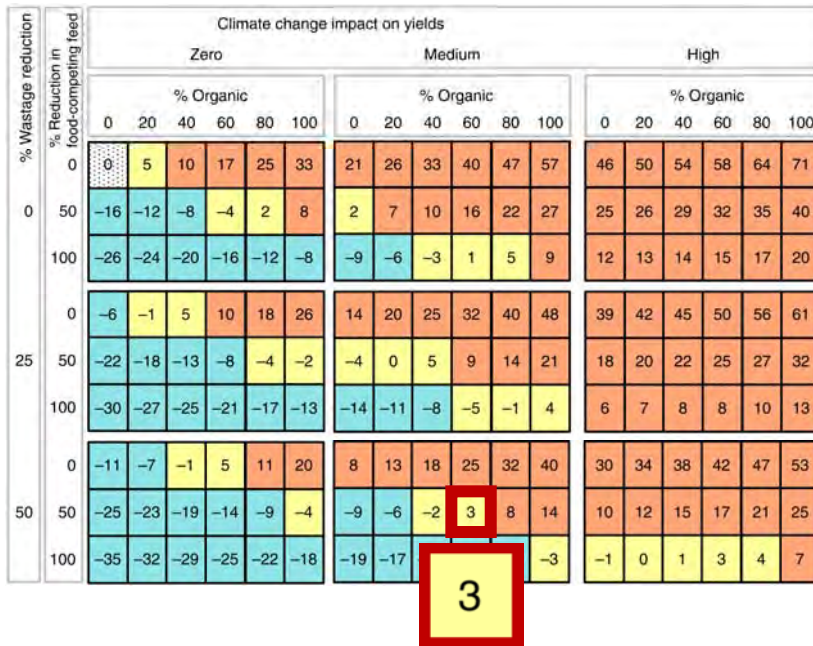
TOTAL performance
red: BAU conventional performance 2050
Inside: better than BAU, outside: worse



Wie kann die biologische Landwirtschaft zu nachhaltigen Ernährungssystemen beitragen?

Wir sind nicht primär an 100% biologischer Landwirtschaft interessiert;

Uns interessieren nachhaltige Ernährungssysteme
und welche Rolle die biologische Landwirtschaft
darin spielen kann.

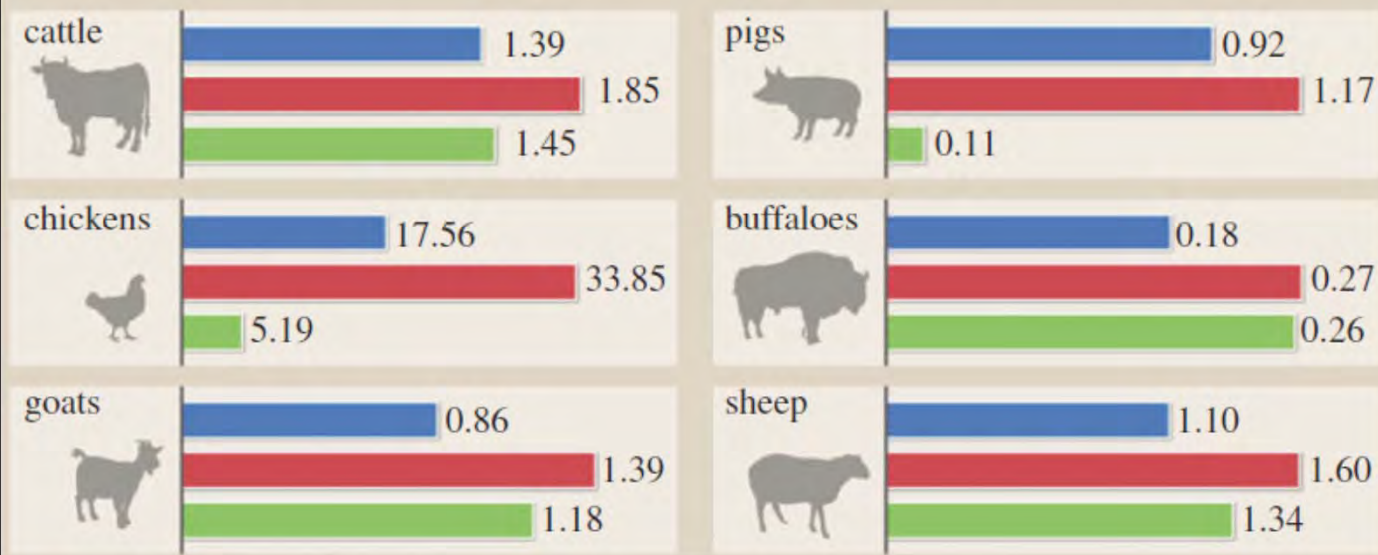


Wie kann die biologische Landwirtschaft zu nachhaltigen Ernährungssystemen beitragen?

Was essen wir eigentlich in diesen Szenarien?

billion animals

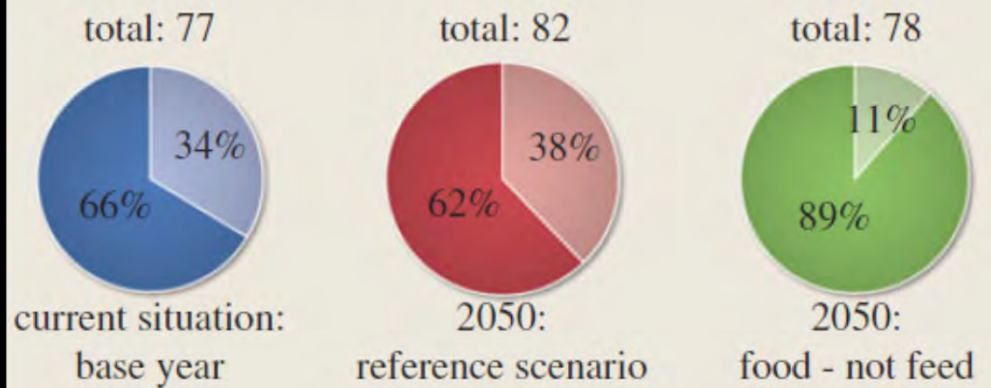
■ current situation: base year ■ 2050: reference scenario ■ 2050: food - not feed

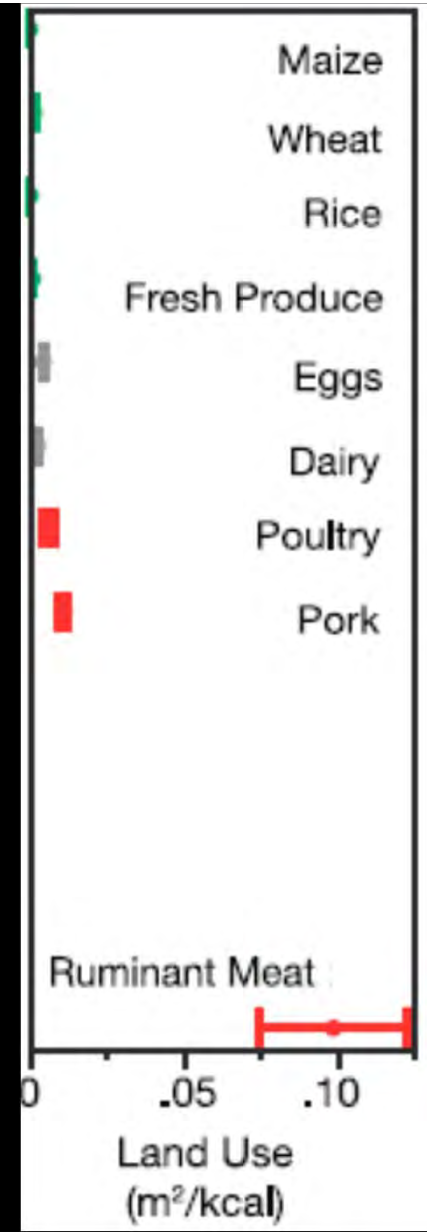
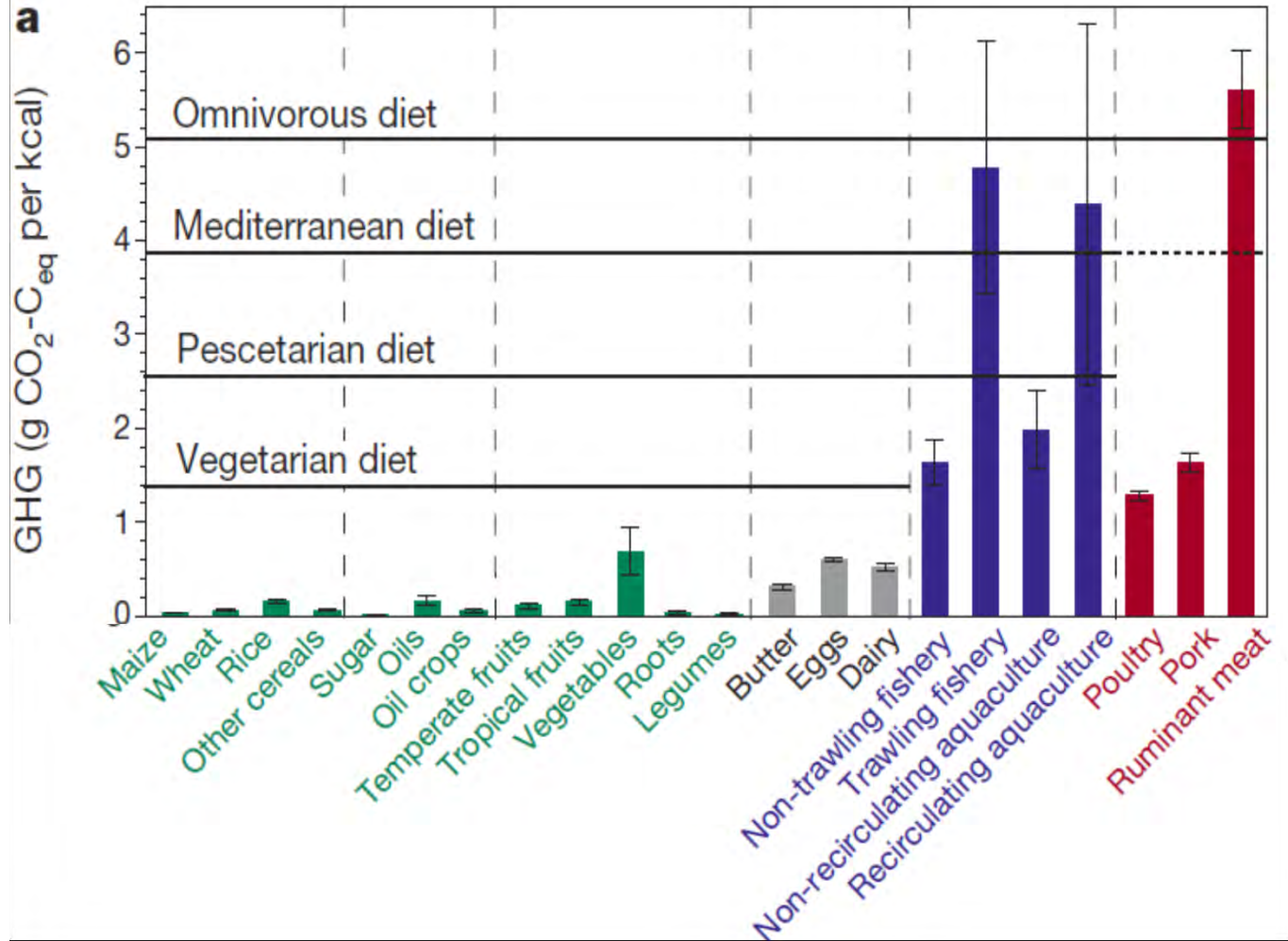


protein supply

g protein per cap per day

● livestock products
● plant products





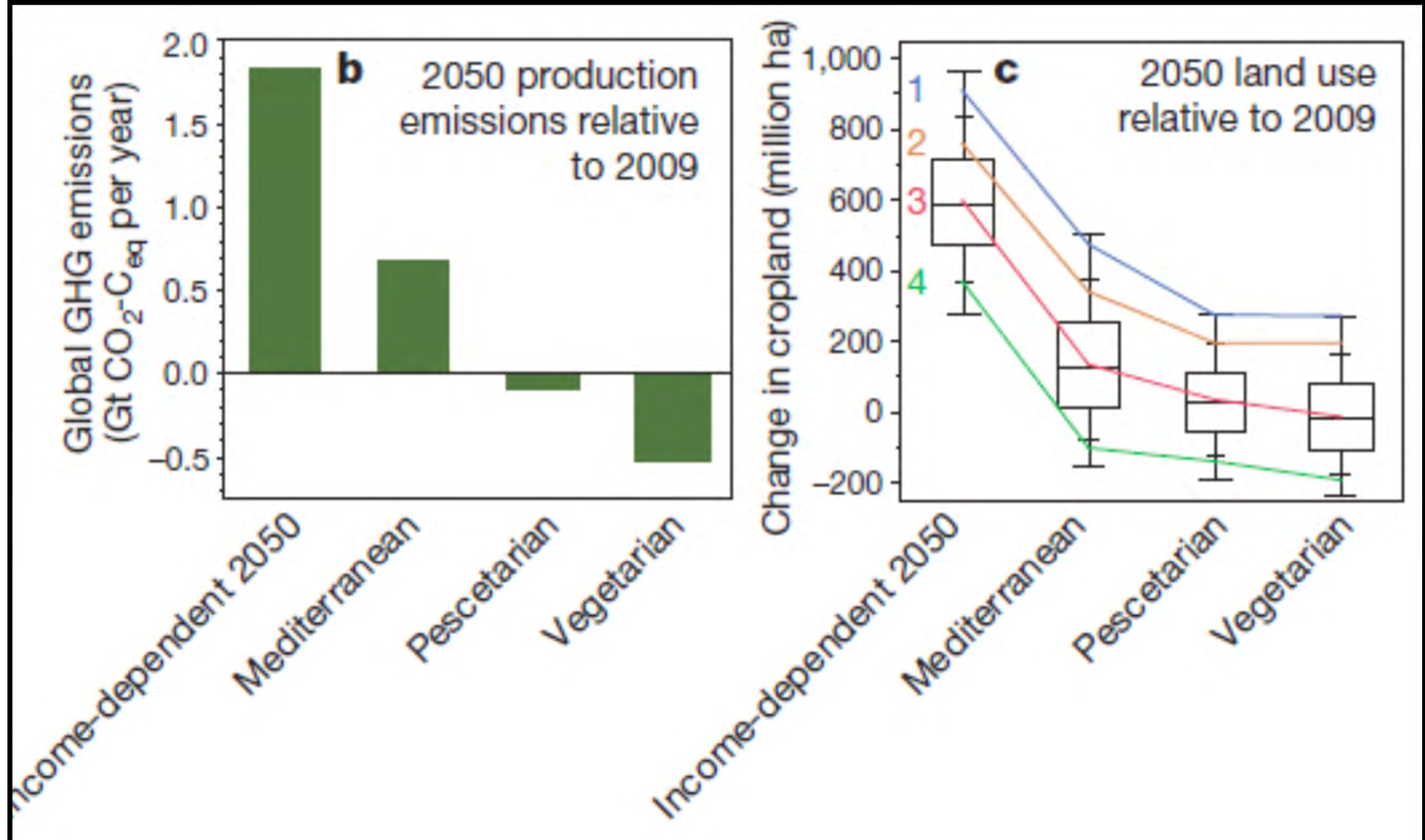
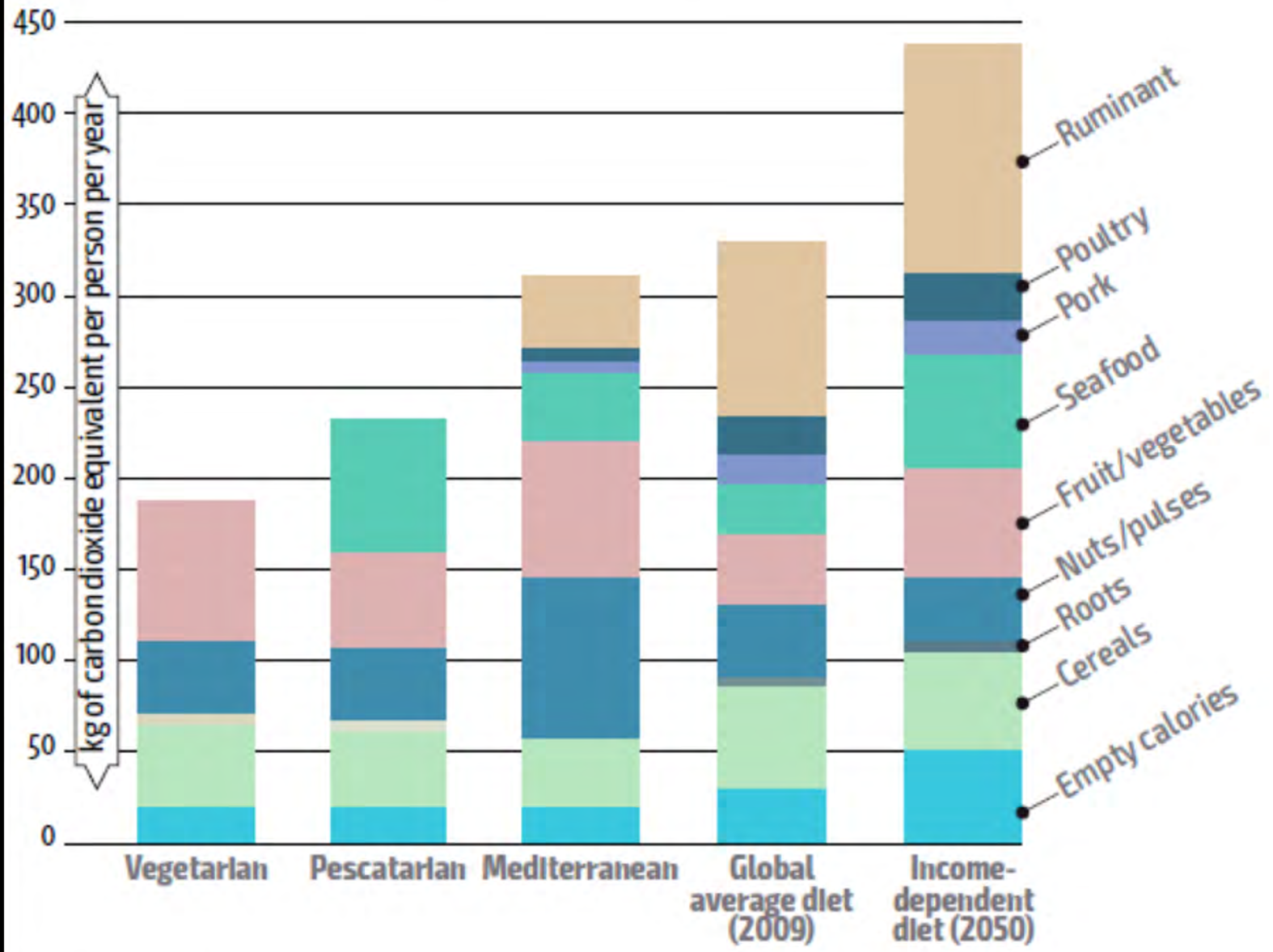
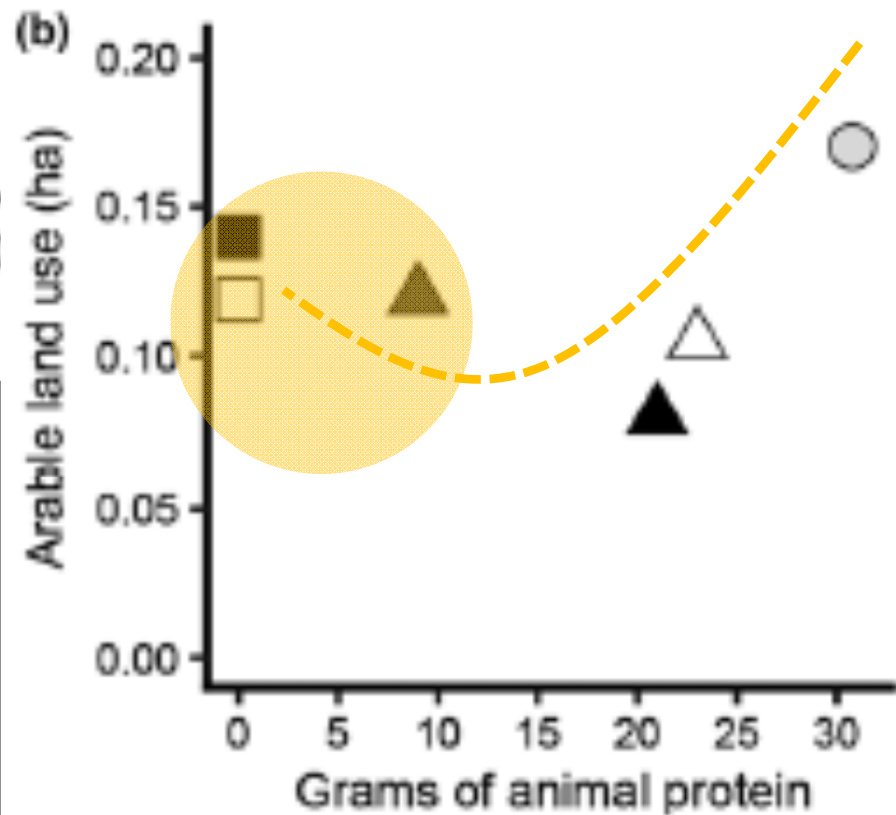
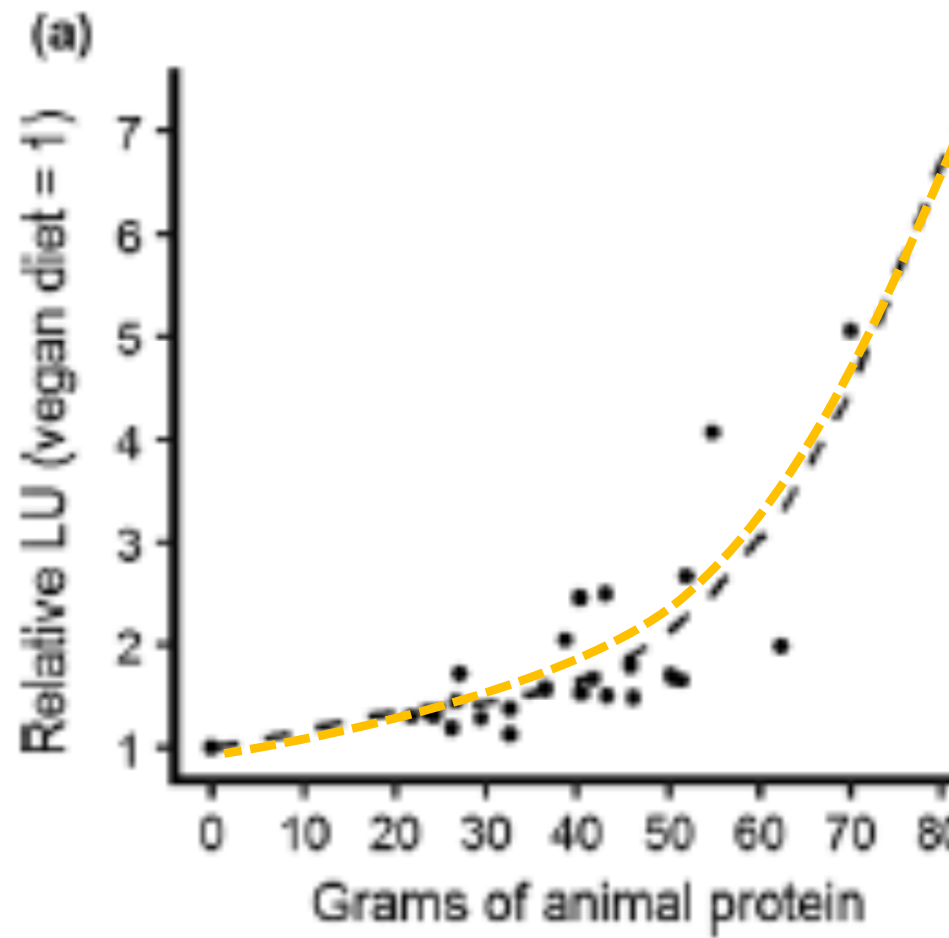


Figure 9.3 Greenhouse gas emissions by diet type



Source: IFPRI, 2015.

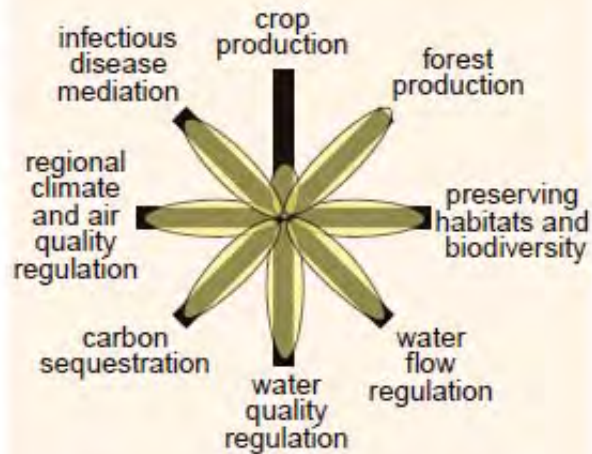


Wie kann die biologische Landwirtschaft zu nachhaltigen Ernährungssystemen beitragen?

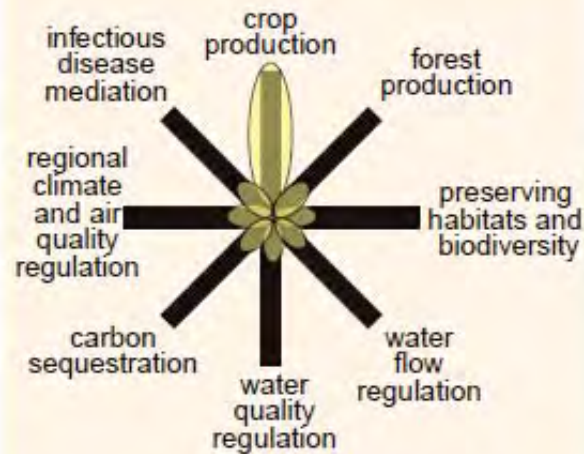
Wie messen wir Nachhaltigkeit?

- pro Kilogramm Produkt?
- pro Hektare?
- in Totalwerten?

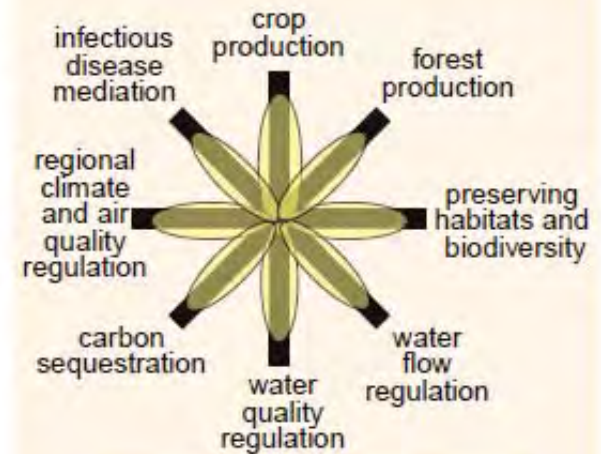
Schmutz-Schutz-/ Share-Spare-Debatte



natural ecosystem



intensive cropland



cropland with restored ecosystem services



Courtesy of R. Hobbs

Fischer et al. 2008

Ist die Frage, ob Bio die Welt ernähren kann überhaupt eine relevante und interessante Frage?

Nachhaltige Ernährungssysteme, nachhaltige Landwirtschaft, Biolandbau – worum geht es eigentlich?

- Was ist nachhaltige Landwirtschaft?
- Welche Rolle spielt “Natürlichkeit” in nachhaltiger Landwirtschaft?
- Was ist ein landwirtschaftlicher Betrieb?

Picture: idyllic orchard

Picture: Chickens on pasture

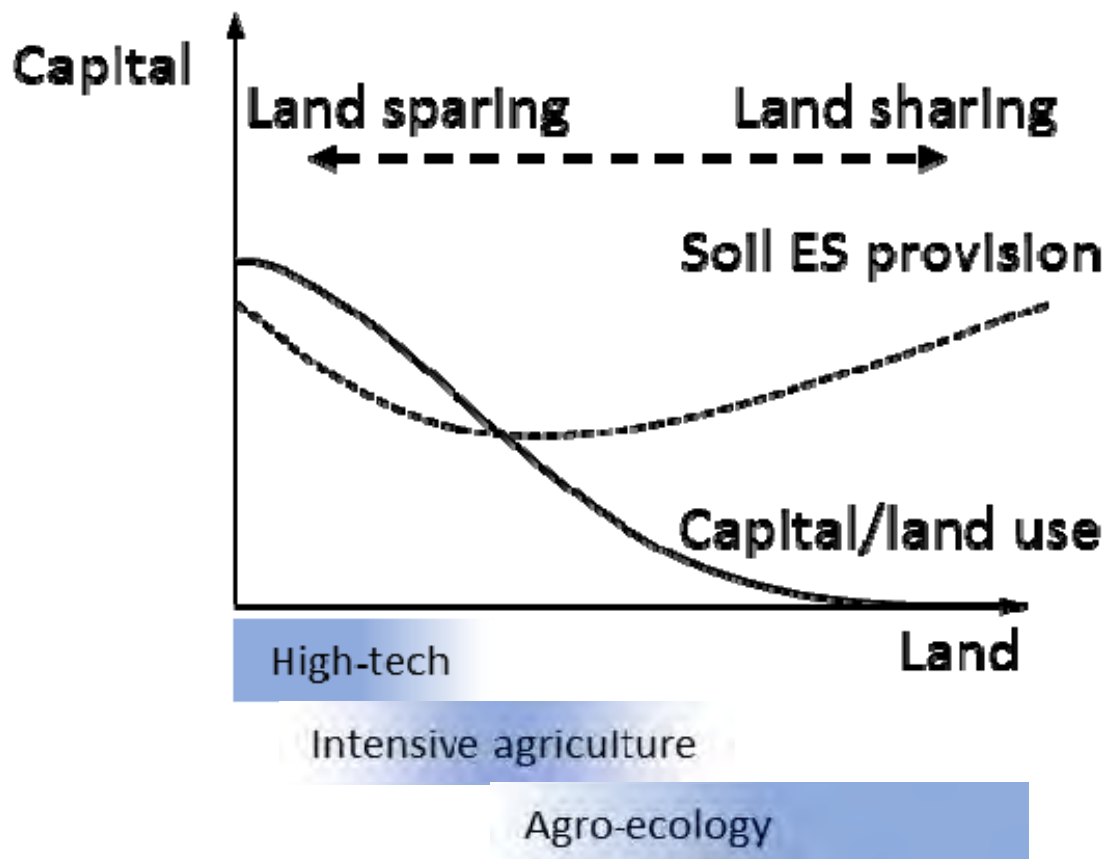
Picture: intensive orchard

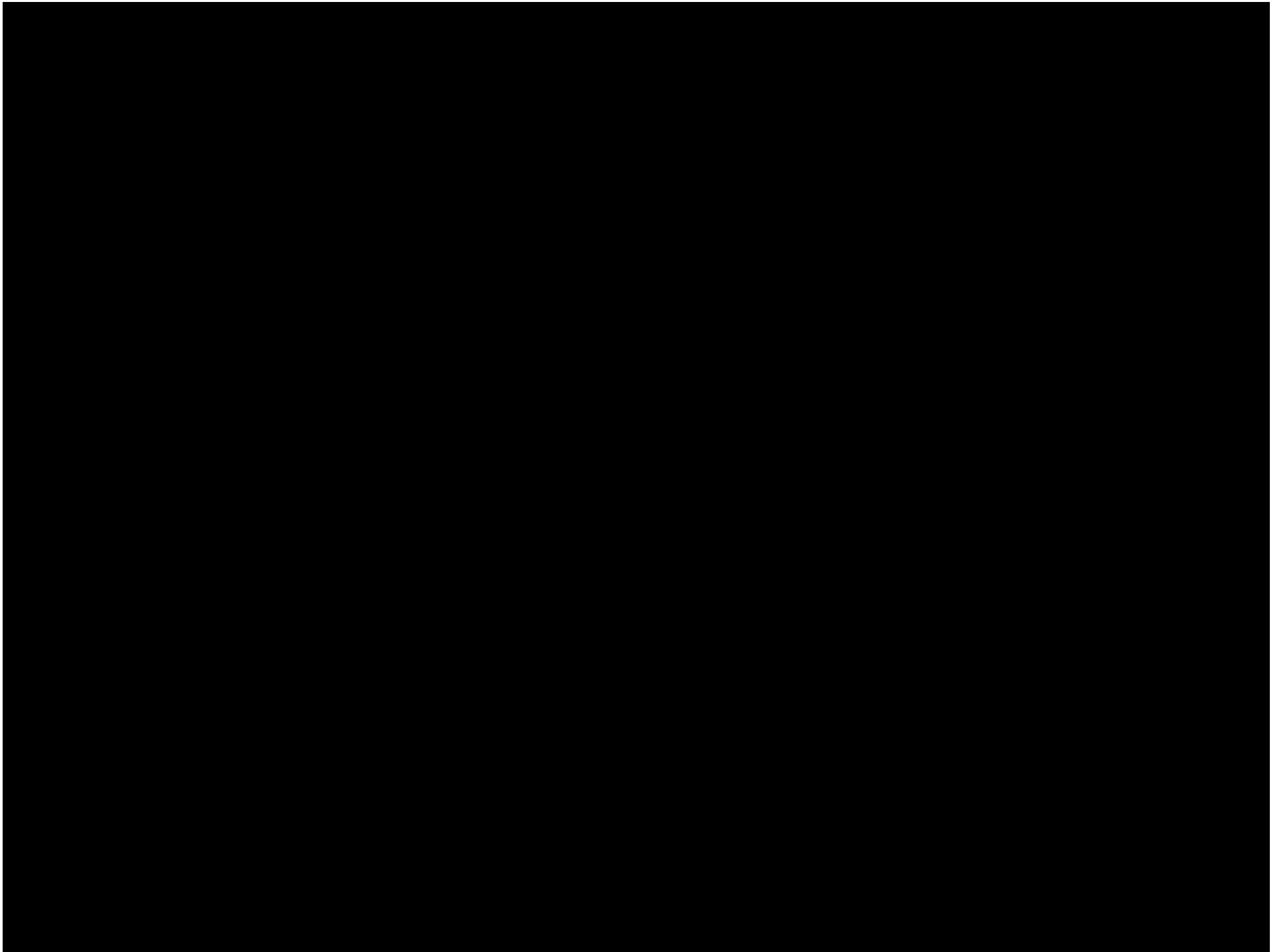
Picture: battery chickens

Picture: vertical farming

Picture: artificial meat

Natürlichkeit





Grobsteuerung

Politikinstrumente

- N-Steuer auf Mineraldüngern und importierten Futtermitteln
- CO₂-Steuer auf fossilen Energien
- Strengere Regulierung der Pflanzenschutzmittel

Mehr Bio

kein Allheilmittel aber
eine Vision

Was heisst nachhaltig?

- Pro ha; pro Kilo; total;
- Share-Spare

Was müssen wir

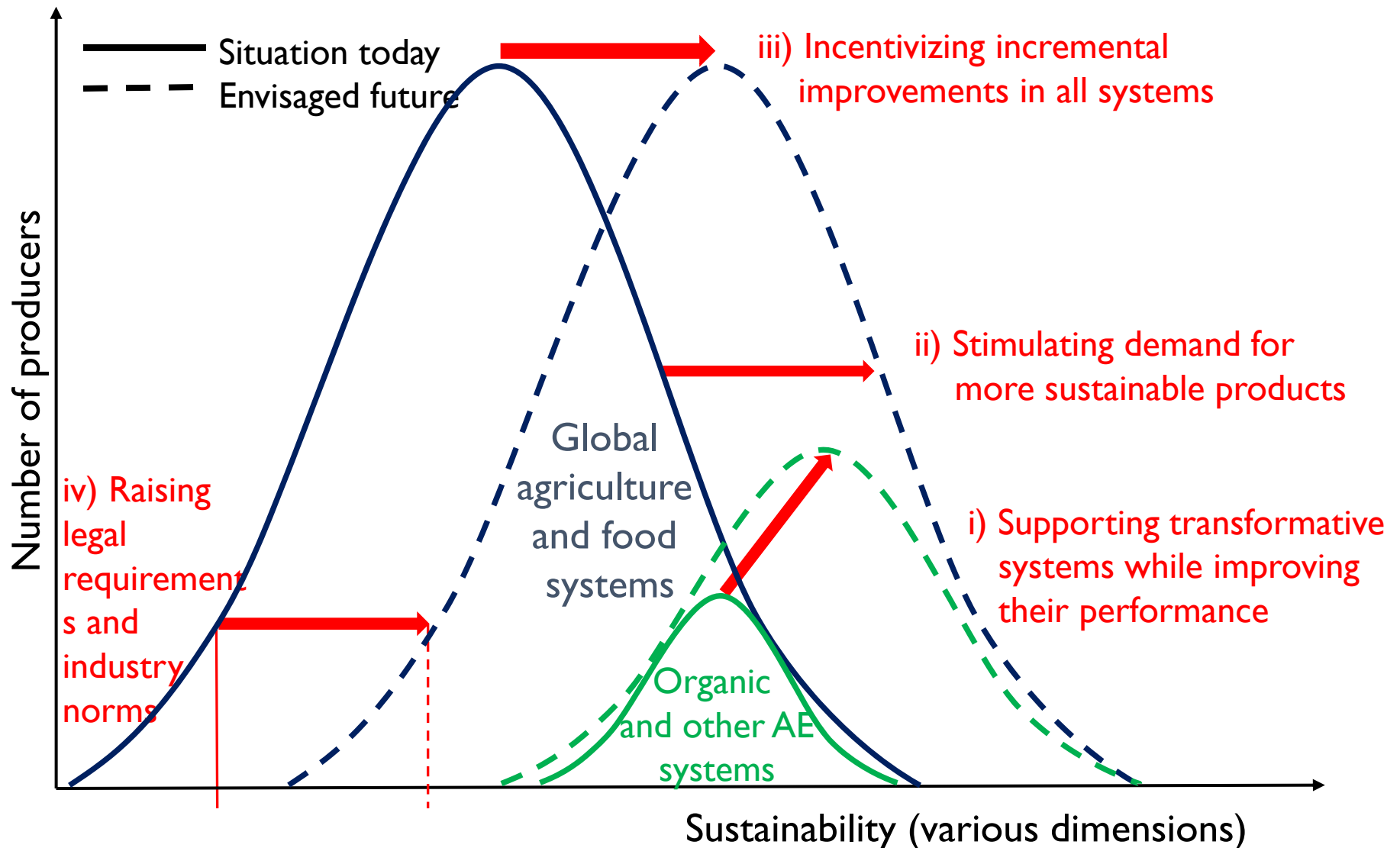
produzieren?

Weniger Kraftfutter
und Futtermais

Weniger tierische Produkte

Weniger Abfall

Policy levers to drive sustainability in food systems



Vorsicht bei

- Der Diskussion von **Klima vs. anderen Nachhaltigkeitsaspekten** in der Landwirtschaft
 - **CO₂-Zertifikaten** und anderen Klimapolitikinstrumenten aus dem Energiebereich
 - **Zielkonflikten** zwischen verschiedenen Nachhaltigkeitsaspekten (z.B. Dominanz der Ertragslücke)

Nachhaltige Landwirtschaft kann nicht diskutiert werden ohne Konsum und Verarbeitung zentral zu berücksichtigen.

Effizienz

Konsistenz

Suffizienz