Research Institute of Organic Agriculture FiBL
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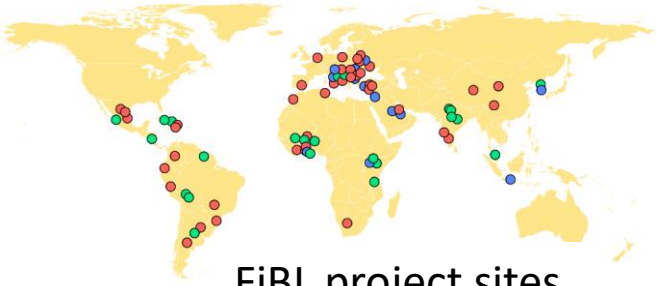


FiBL project sites

Can agriculture as practiced today deliver for the future?

Urs Niggli

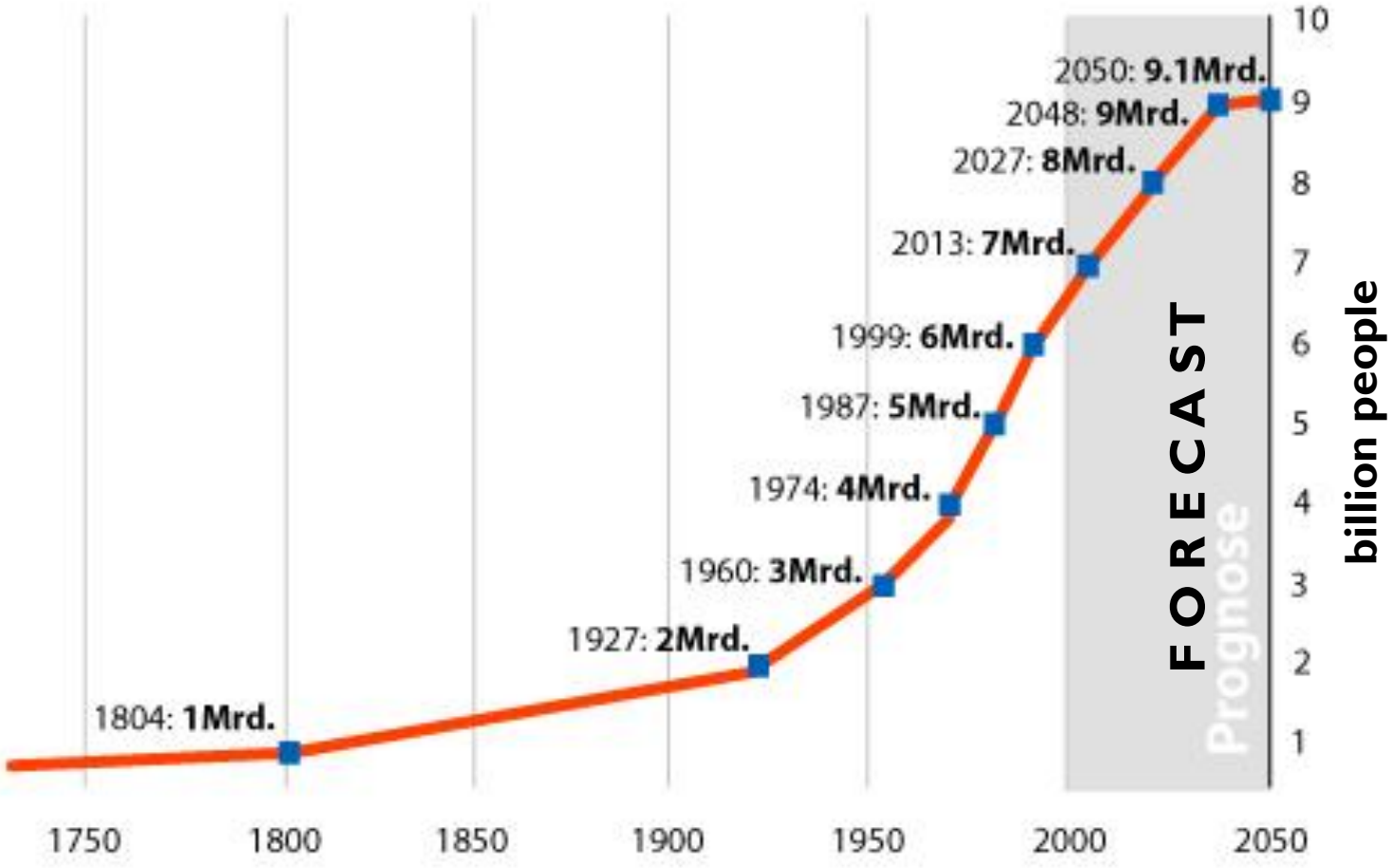
FiBL institutes

ABIM Congress Basel, 21st of October, 2019

About

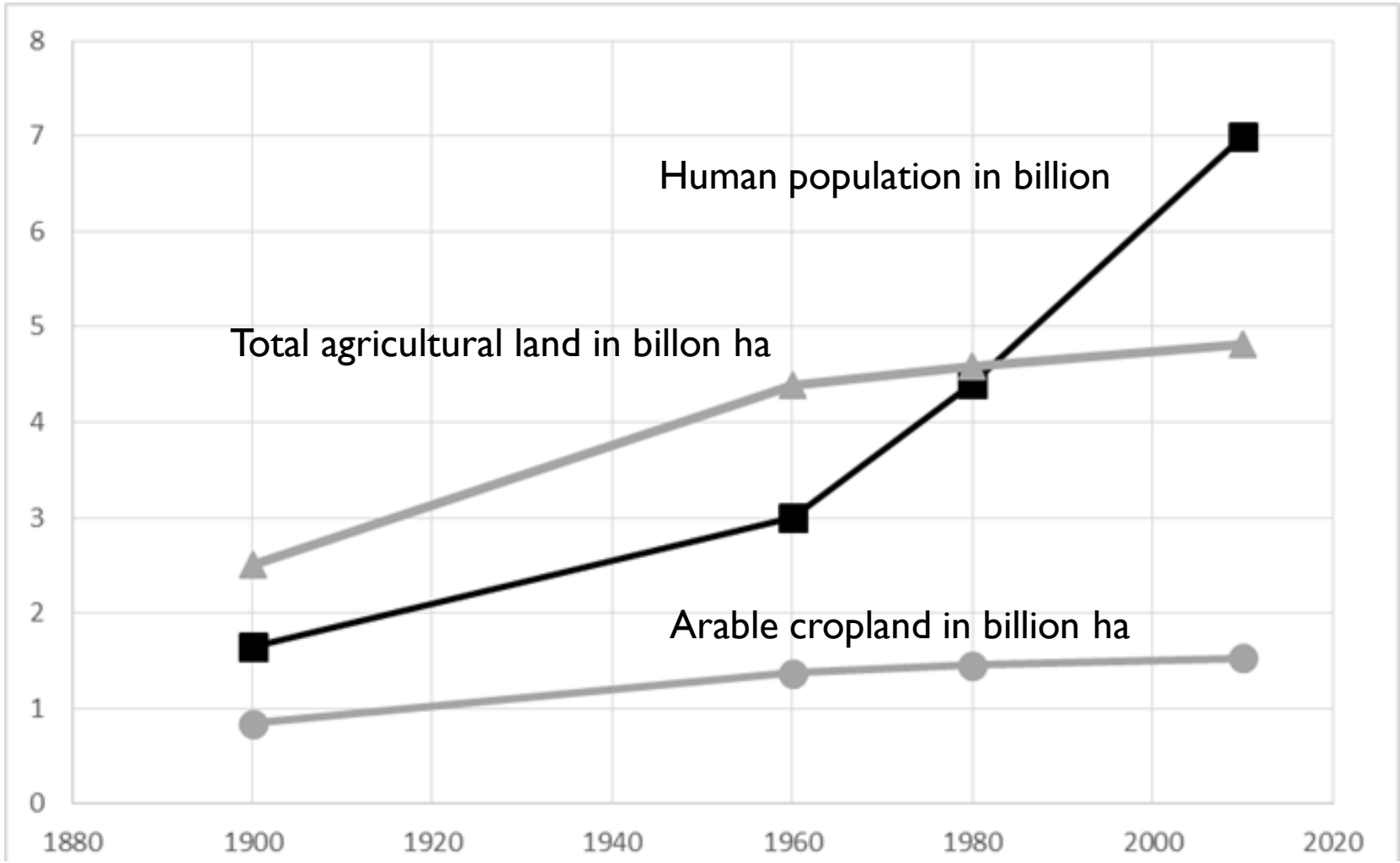
- Business as usual is not an option ….
- What do consumers want?
- Redesign of farming systems.
- Consequences for the industry.
- Societal and policy implications

The productivist concept of the role of agriculture



Quelle: UNO, World Population Prospects (2004)

Decoupling of population growth from the natural resource soil

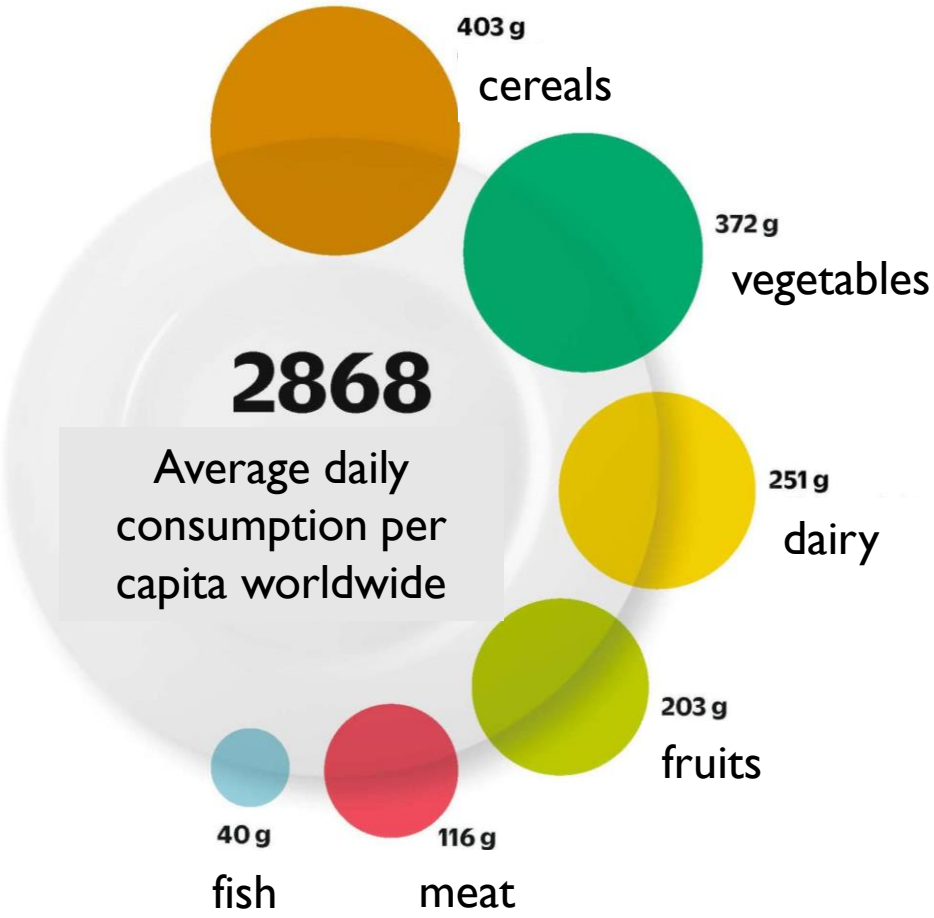


… and increased both livestock production and food wastage

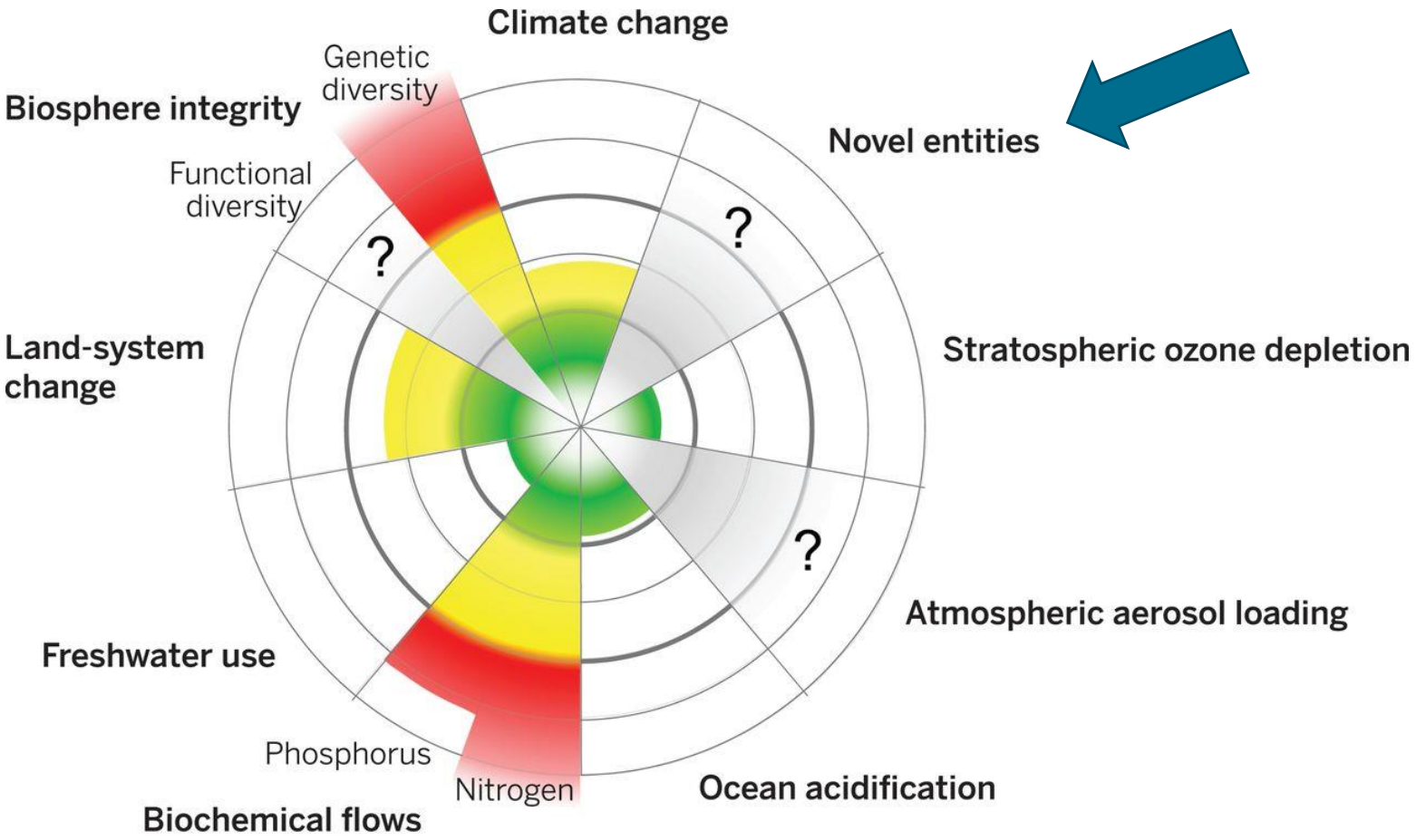
Scientists and farmers have been very successful!

Production → **Consumption**

4600 kcal per day and
per capita worldwide



The planetary boundaries



Will Steffen et al: *Planetary boundaries: Guiding human development on a changing planet.* In: Science. (2015), doi:10.1126/science.1259855.

Citizens have already made up their minds

RESEARCH ARTICLE

More than 75 percent decline over 27 years in total flying insect biomass in protected areas

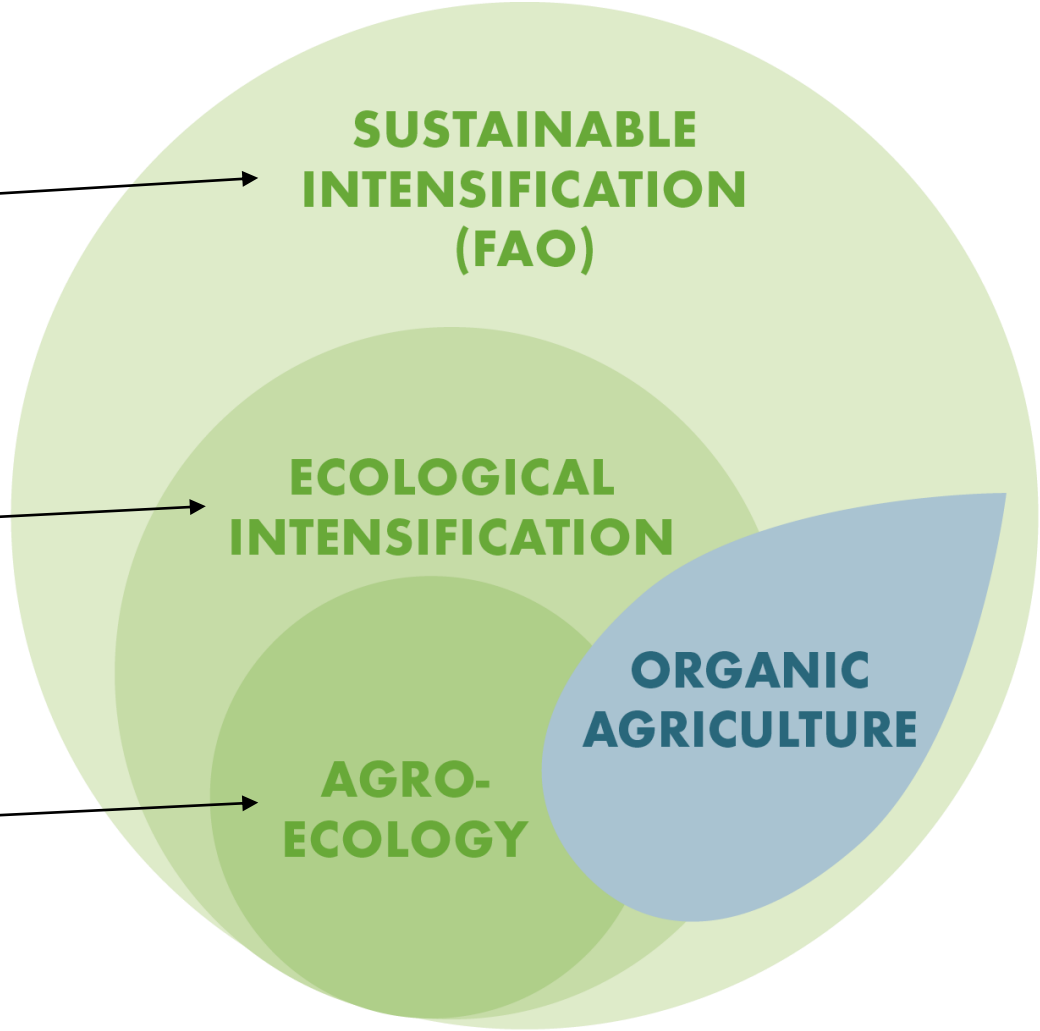
Caspar A. Hallmann[1]*, Martin Sorg[2], Eelke Jongejans[1], Henk Siepel[1], Nick Hofland[1], Heinz Schwan[2], Werner Stenmans[2], Andreas Müller[2], Hubert Sumser[2], Thomas Hörren[2], Dave Goulson[3], Hans de Kroon[1]

A paradigm shift towards making food production more sustainable

Less polluting inputs
Less inefficiency
("more from less")

More production with improved ecosystem services (soil fertility, diversity etc.)

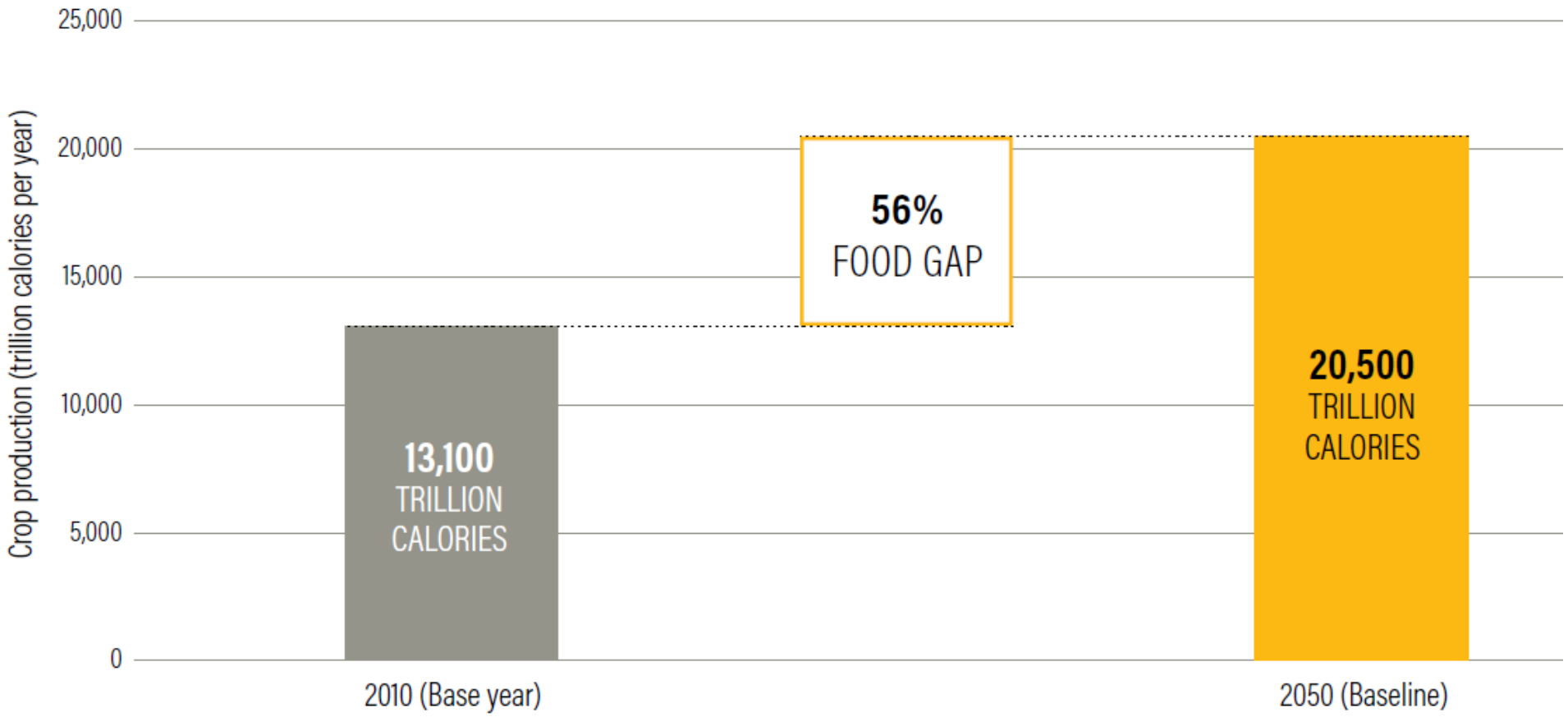
Consequent system approach incl. social community integration



Circles:

- The greener the lower the ecological footprint
- The bigger the more yield

Food demand in the scenario “business as usual” (FAO)



Note: Includes all crops intended for direct human consumption, animal feed, industrial uses, seeds, and biofuels.
Source: WRI analysis based on FAO (2017a); UNDESA (2017); and Alexandratos and Bruinsma (2012).

Different approaches to sustainability

Improved technologies like minimum/ no tillage or GMO crops.

Integrated Production (IP, IPM).

Low Input Agriculture (LIA) or Precision Farming.

Low External Input Sustainable Agriculture (LEISA).

Organic Farming.

Organic Farming & reduced tillage.

Organic (successional) agroforestry systems.

Ecological or eco-functional intensification

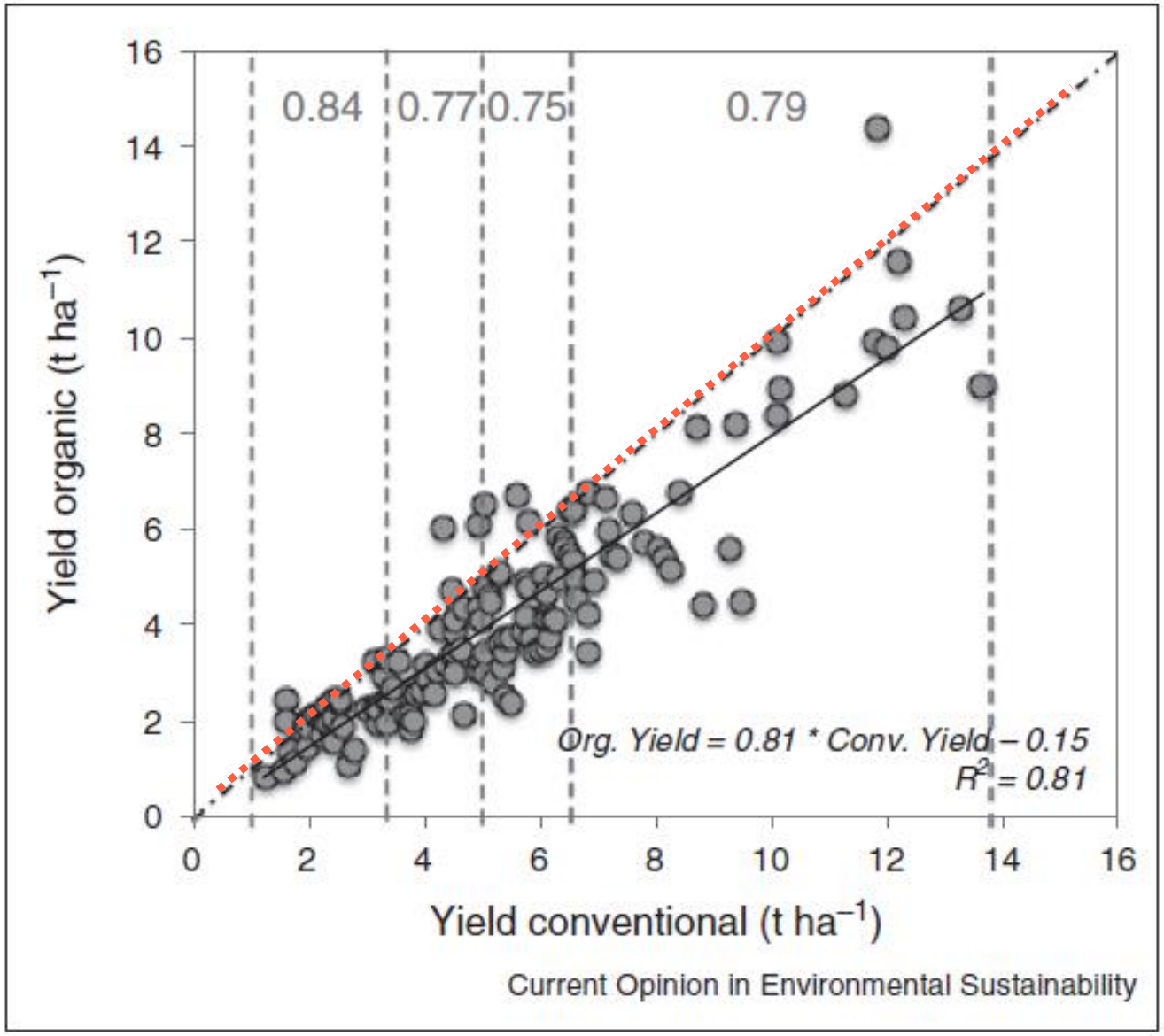
"While sustainable intensification is generally loosely defined, so that almost any model or technology can be labeled under it, ecological intensification proposes landscape approaches that make smart use of the natural functionalities that ecosystems offer. The aim is to design multifunctional agroecosystems that are both sustained by nature and sustainable in their nature."
(Tittonell, 2014)

Productivity in terms of yields is a challenge for organic and agroecological practices

Causes:

- lower nitrogen supply
- lower phosphor supply
- plant protection
- weed control

Niggli et al. (2016)
State of the art research results and best practices. OKnet Arable.



Tittonell, 2014

Productivity losses caused by harmful organisms (diseases, pest and weeds)

Global yield losses due to failure to take crop protection measures are estimated and modelled to be between **17 and 40** % (Savary et al., 2019).

Photo FiBL

Agroecology/Organic farming and SDGs

Initiative of INRA and JKI (and other state research centres)

Towards chemical pesticide-free agriculture:

- Redesign production systems
- Secure use of biocontrol
- Precision farming/digitalisation
- Coordinated long term surveys
- More fundamental research (e.g. phytobiome, plant immunity, populations dynamics).
- Relationship pesticides and human health.
- Plant protection in the societal context.
- Turn policies and regulations.

A need for the redesign of farming systems

Strip and contour farming

Redesign of farms and crop rotation towards higher system integration with precision farming (GPS, sensors, cameras, databases on soil quality, robots etc.).

Example shown is a 3000 hectare organic farm in Argentina owned by the Thompkins family.

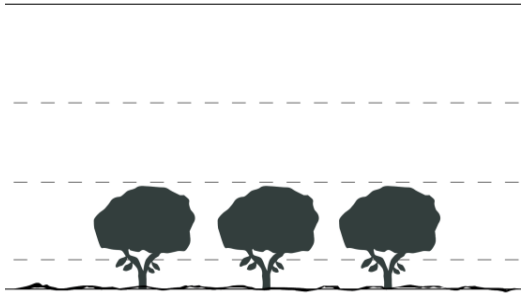
E.g. digitalisation*: Clever use of novel technologies versus *dummies*

* true for any novel technologies

Monocropping systems

Cocoa production systems, Rio Alto Beni, Amazonian watershed, Bolivia (FiBL projet)

Monocultures



Organic
Conventional

Agroforestry systems

Organic
Conventional

Successional agroforestry systems

Organic
(no external input)

Moniliophtora perniciosa
"Witches' Broom Disease"

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Digitalisation

Example with *Trichogramma* polyphagous wasps (endo-parasitoids) against European corn borer (*Ostrinia nubilalis*), applied by drones (see right) instead of by hand (see below).

Sustainable farming systems and land use change

more arable land in %

Muller, A., Schader, C., El-Hage Scialabba, N., Hecht, J., Isensee, A., Erb, K.-H., Smith, P., Klocke, K., Leiber, F., Stolze, M. and Niggli, U., 2017, Strategies for feeding the world more sustainably with organic agriculture, **Nature** Communications October/2017.

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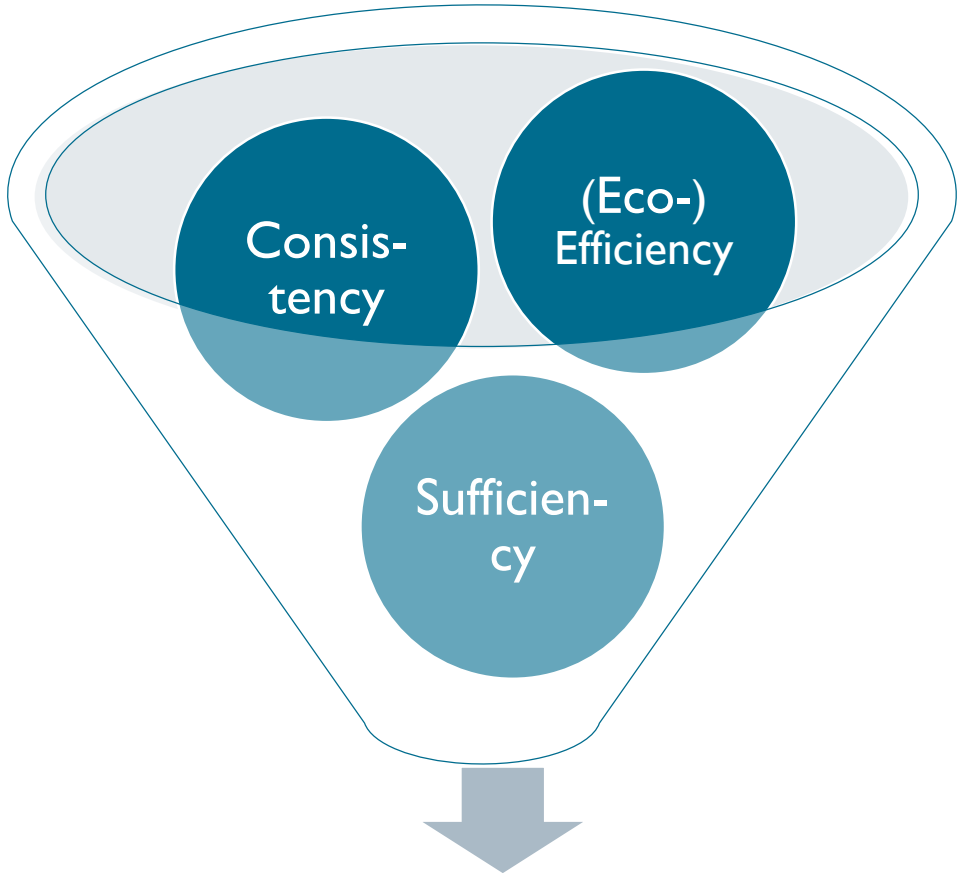
% Wastage reduction	% reduction in food-competing feed	Climate change impact on yields: zero — % organic 0	20	40	60	80	100	medium — % organic 0	20	40	60	80	100	high — % organic 0	20	40	60	80	100
0	0	0	5	10	17	25	33	21	26	33	40	47	57	46	50	54	58	64	71
	50	-16	-12	-8	-4	2	8	2	7	10	16	22	27	25	26	29	32	35	40
	100	-26	-24	-20	-16	-12	-8	-9	-6	-3	1	5	9	12	13	14	15	17	20
25	0	-6	-1	5	10	18	26	14	20	25	32	40	48	39	42	45	50	56	61
	50	-22	-18	-13	-8	-4	-2	4	0	5	9	14	21	18	20	22	25	27	32
	100	-30	-27	-25	-21	-17	-13	-14	-11	-8	-5	-1	4	6	7	8	8	10	13
50	0	-11	-7	-1	5	11	20	8	13	18	25	32	40	30	34	38	42	47	53
	50	-25	-23	-19	-14	-9	-4	-9	-6	-2	3	8	14	10	12	15	17	21	25
	100	-35	-32	-29	-25	-22	-18	-19	-17	-13	-10	-7	-3	-1	0	1	3	4	7

A sustainable economy is defined by 3 narratives:



Sustainable Food Systems

(Eco-)Efficiency:
More output with less input and less environmental footprint

Consistency:
Adaptation to territorial, cultural and socio-economic context, resilience, anthropogenic and natural flow of material compatible, cradle-to-cradle.

Sufficiency:
Reduction of consumption and waste, temperance, avoidance of rebound effects

What can be learnt?

- Biocontrol and botanicals are imminent parts of the future agriculture.
- Innovation has been insufficiently funded, publicly and privately.
- System redesign with higher complexity is an excellent context for biocontrol and botanicals
- Trade-offs between "feeding the world" and "safeguard the planetary boundaries" require an extension of the sustainability narratives (efficiency, consistency and sufficiency).h