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EXCELLENCE FOR SUSTAINABILITY

Research Institute of Organic Agriculture
Forschungsinstitut für biologischen Landbau
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Goods for European farmers and consumers

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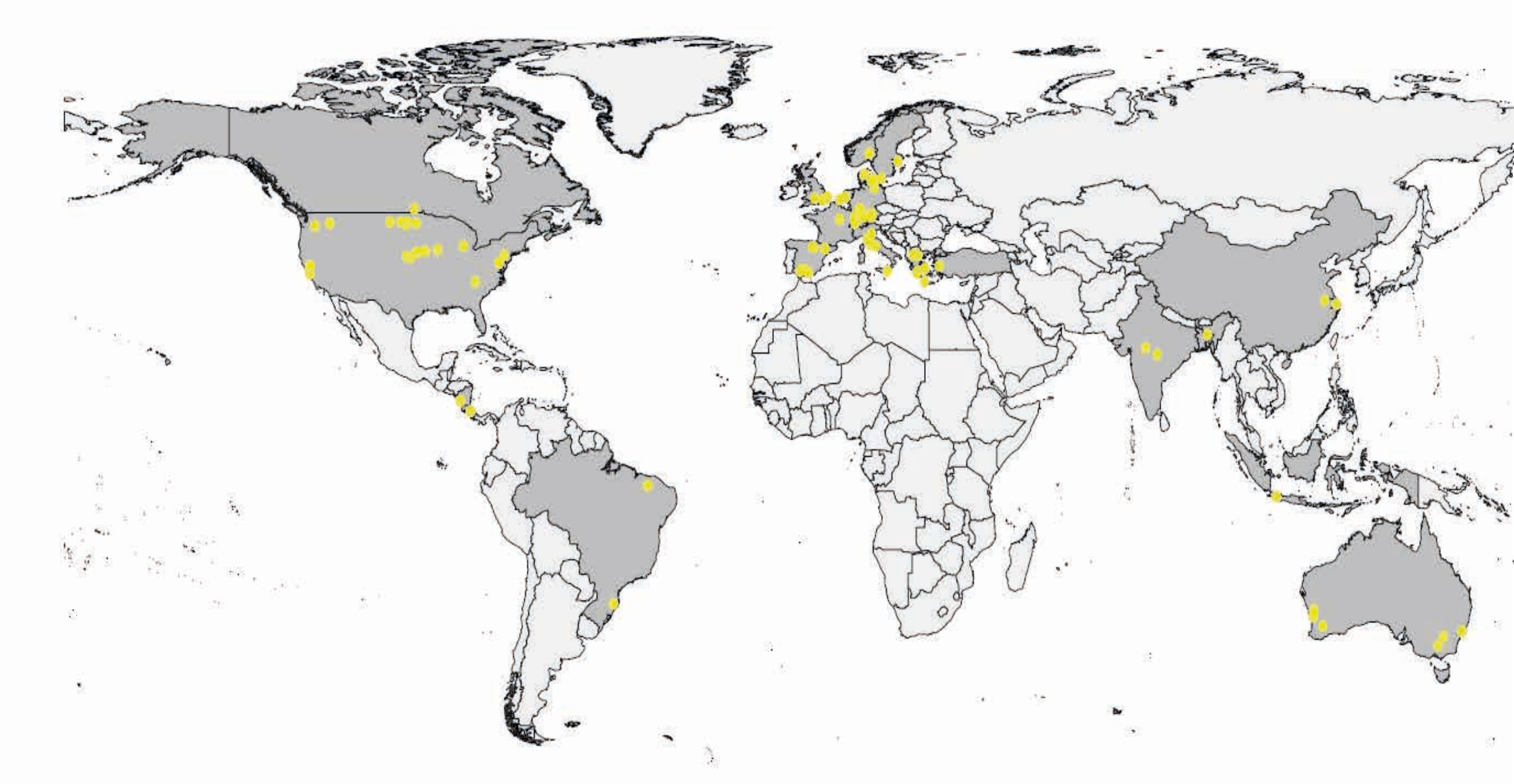
References from field research sites ☞ meta-analyses

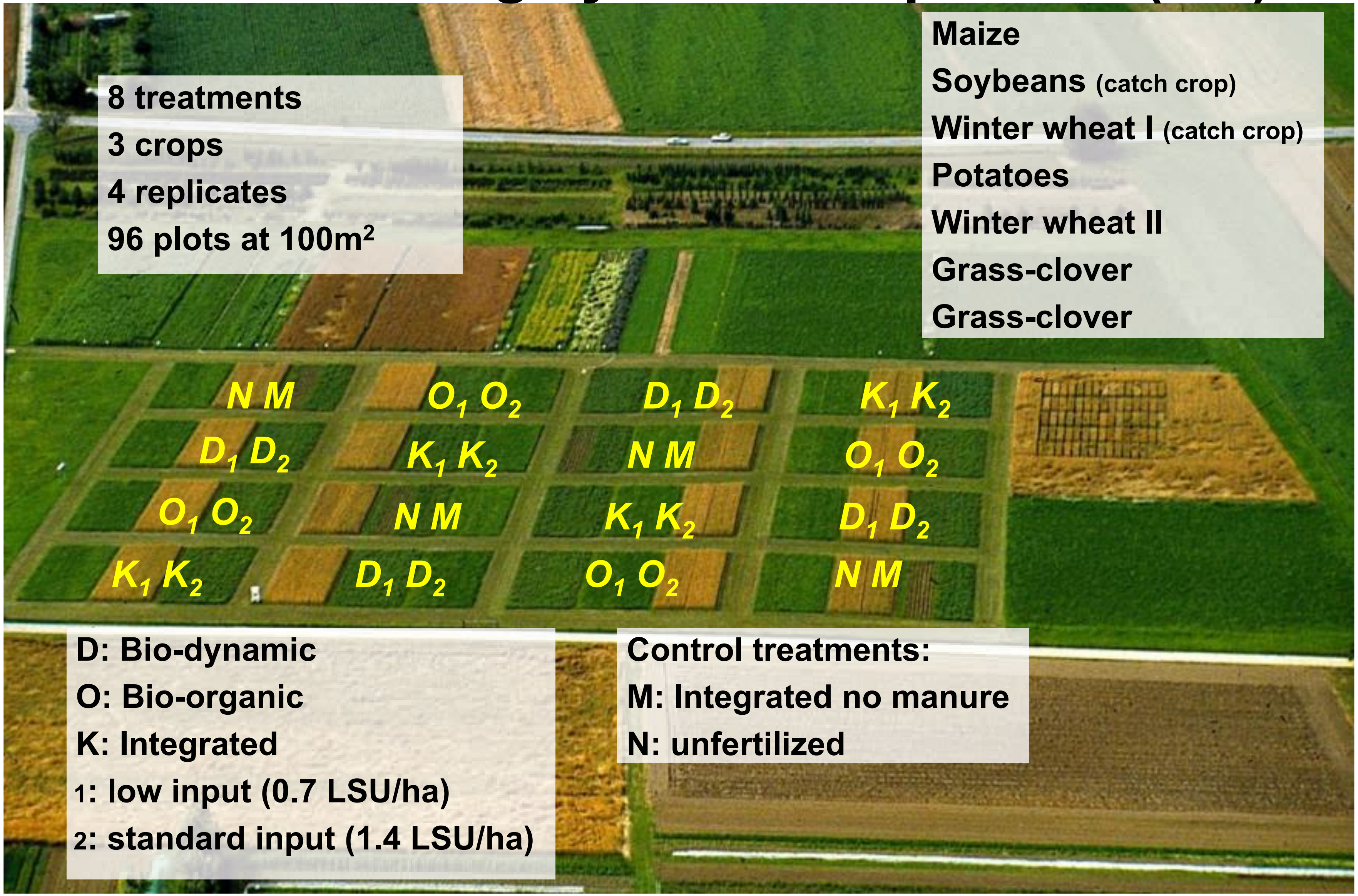


Gattinger et al., 2012 (FiBL)
www.pnas.org/cgi/doi/10.1073/pnas.1209429109


The Rodale Institute
Farming Systems Trial
Pennsylvania, USA

Long-term Agronomic Experiments since 1978

The DOK farming system comparison (CH)



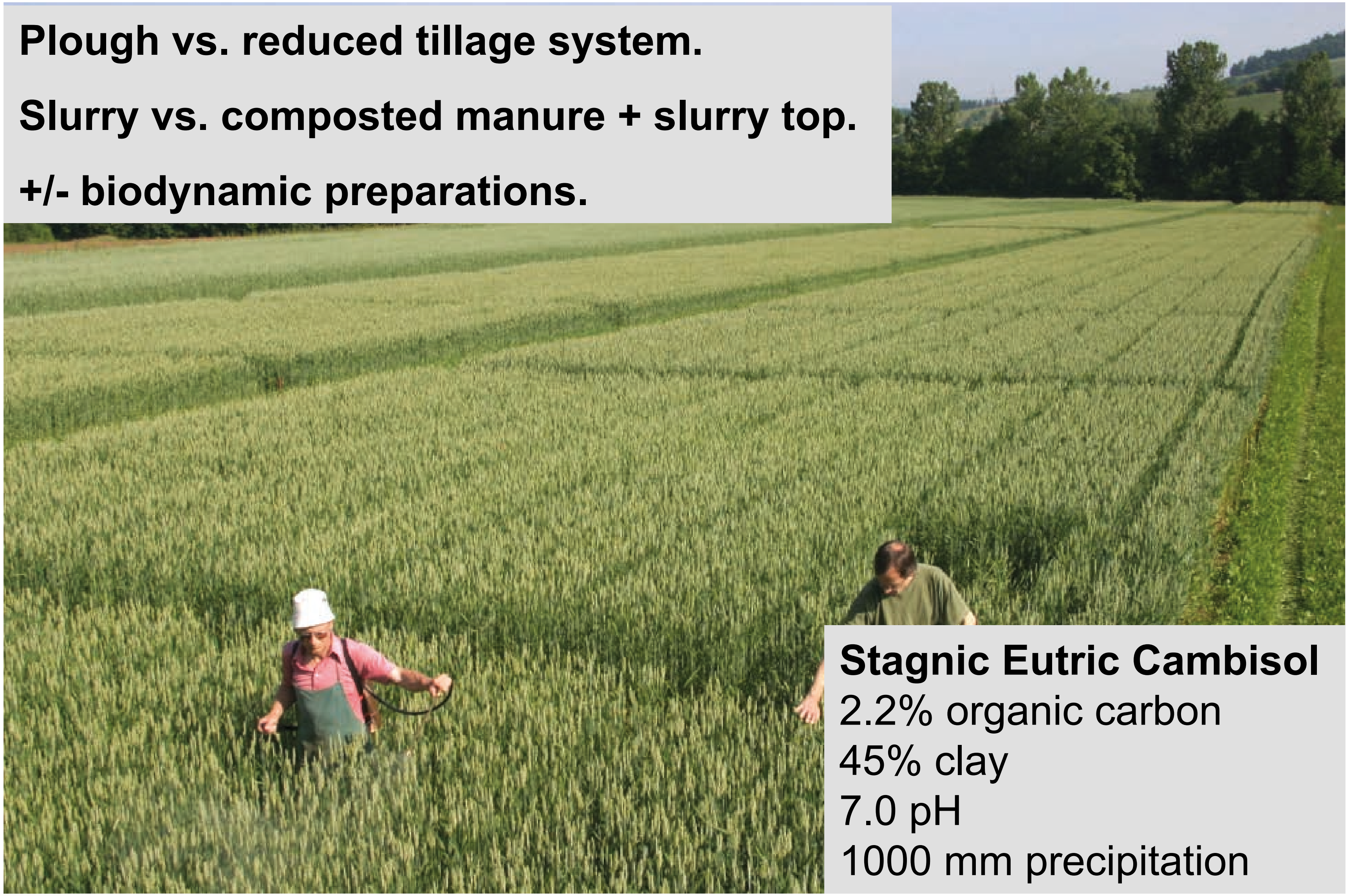
Mäder, Fliessbach, …., Niggli (2002), Science 296

Frick soil tillage field experiment (since 2002)

Plough vs. reduced tillage system.

Slurry vs. composted manure + slurry top.

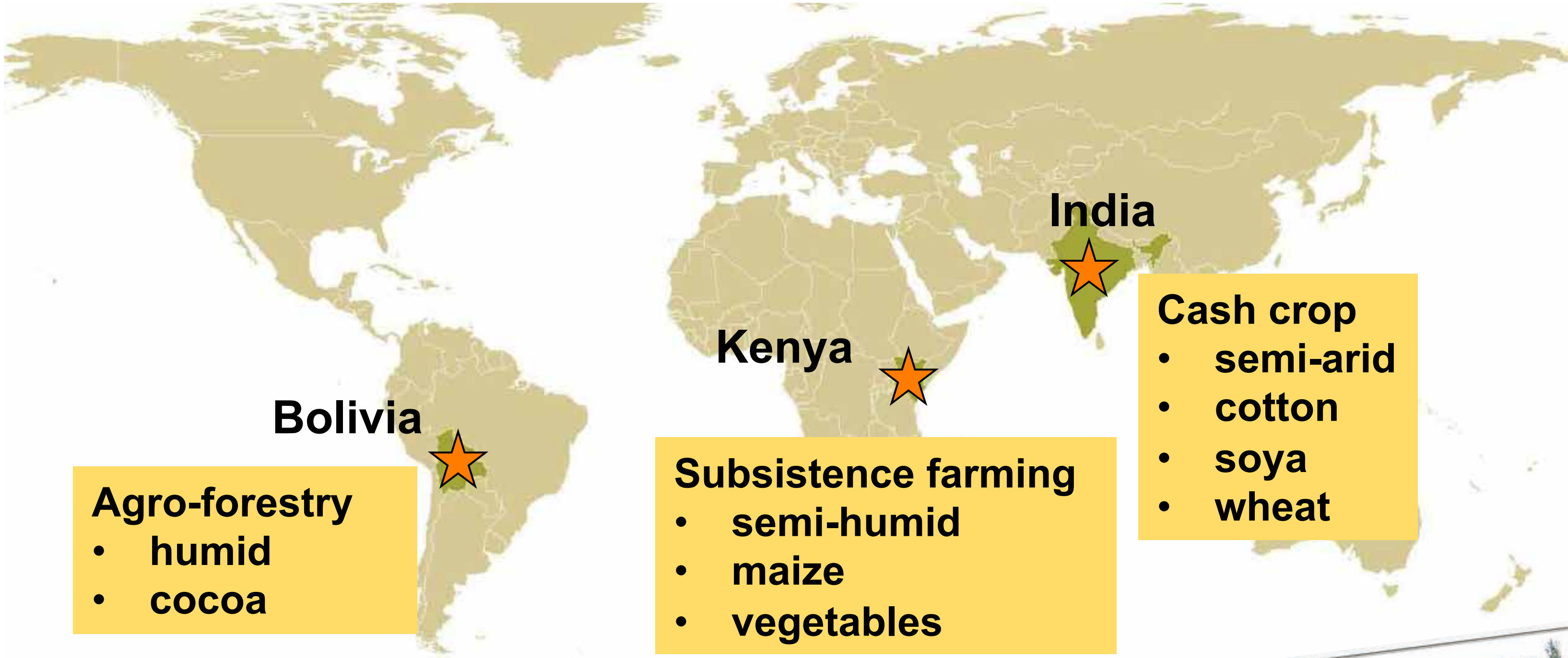
+/- biodynamic preparations.



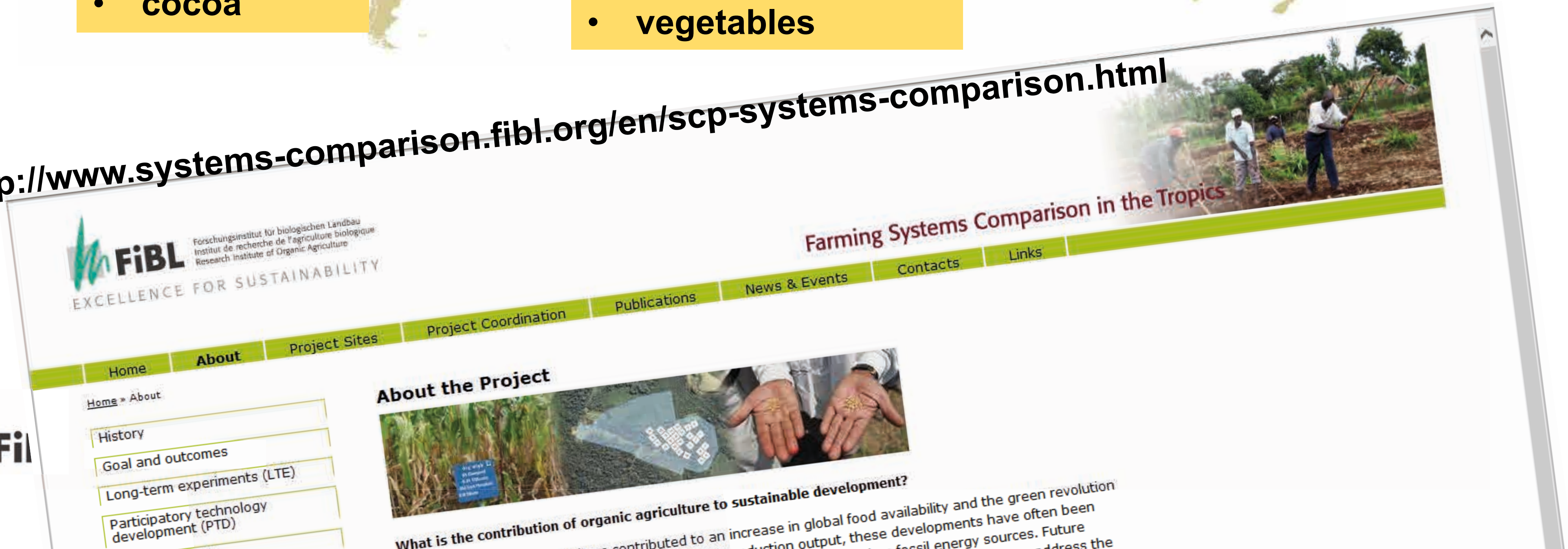
Stagnic Eutric Cambisol
2.2% organic carbon
45% clay
7.0 pH
1000 mm precipitation

Berner et al., 2008, Soil & Tillage Research

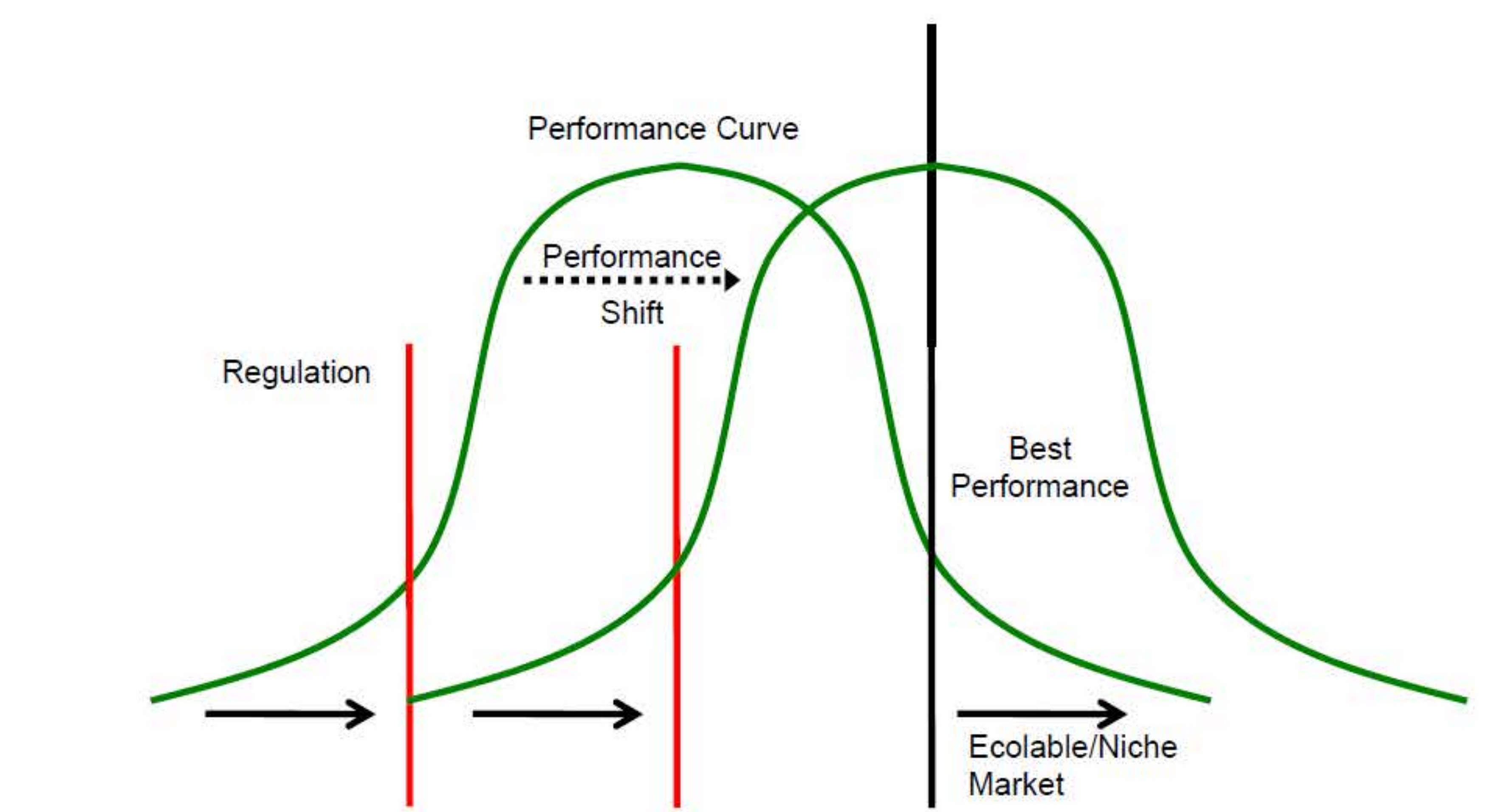
Long-term farming systems comparisons (since 2007)



http://www.systems-comparison.fibl.org/en/scp-systems-comparison.html



How certification is supposed to work

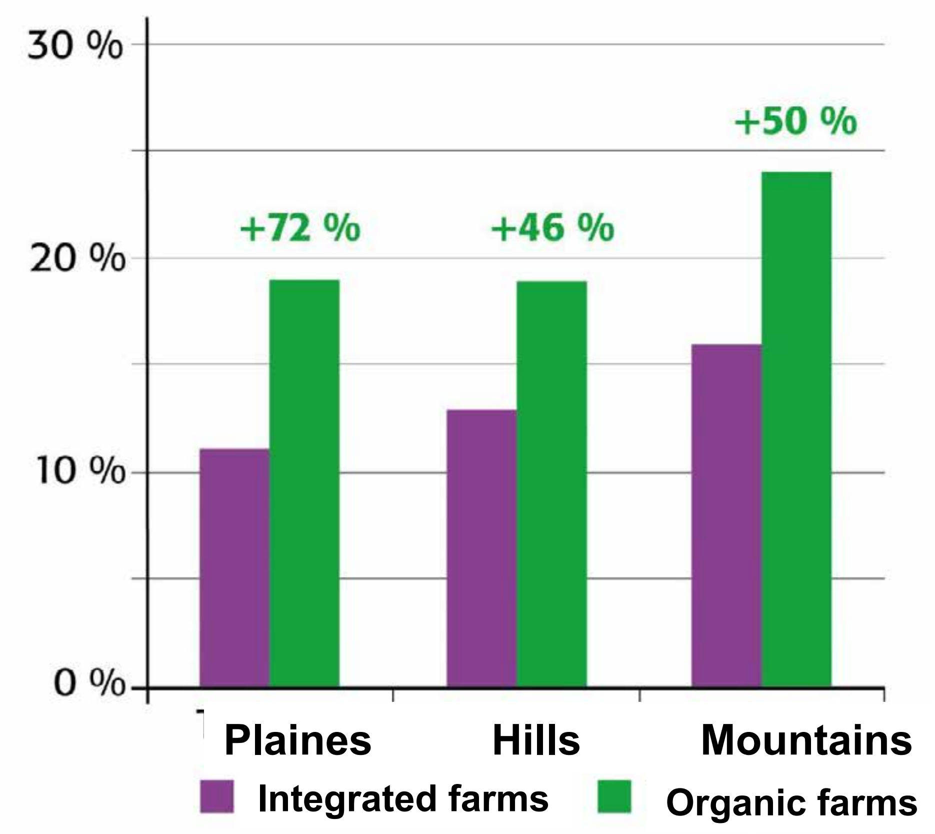


FiBL www.fibl.org

Source: Roscher, 2007
http://www.wwf.de/fileadmin/fm-wwf/pdf_neu/Bella_Roscher_WWF_Sojaseminar.pdf
[Retrieved: 15.10.2010]

Also a question of individual commitment

Organic farmers in Switzerland have higher proportions of semi-natural land, land for ecological compensation or set-aside land than conventional farms (dataset: 60‘000 farms = 100%)

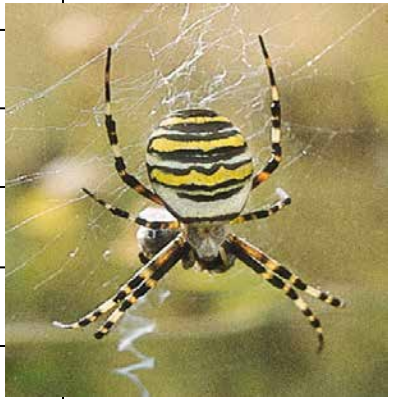


FiBL www.fibl.org

Schader C., Pfiffner L., Schlatter C., Stolze M. (2008). **Agrarforschung** 15(10), 506-511

Biodiversity on organic farms* (global literature review of comparison studies)

Taxon	Positive	Negative	No difference
Birds	7		2
Mammals	2		
Butterflies	1		1
Spiders	7		3
Earthworms	7	2	4
Beetles	13	5	3
Other arthropods	7	1	2
Plants	13		2
Soil microbes	9		8
Total	**66**	**8**	**25**

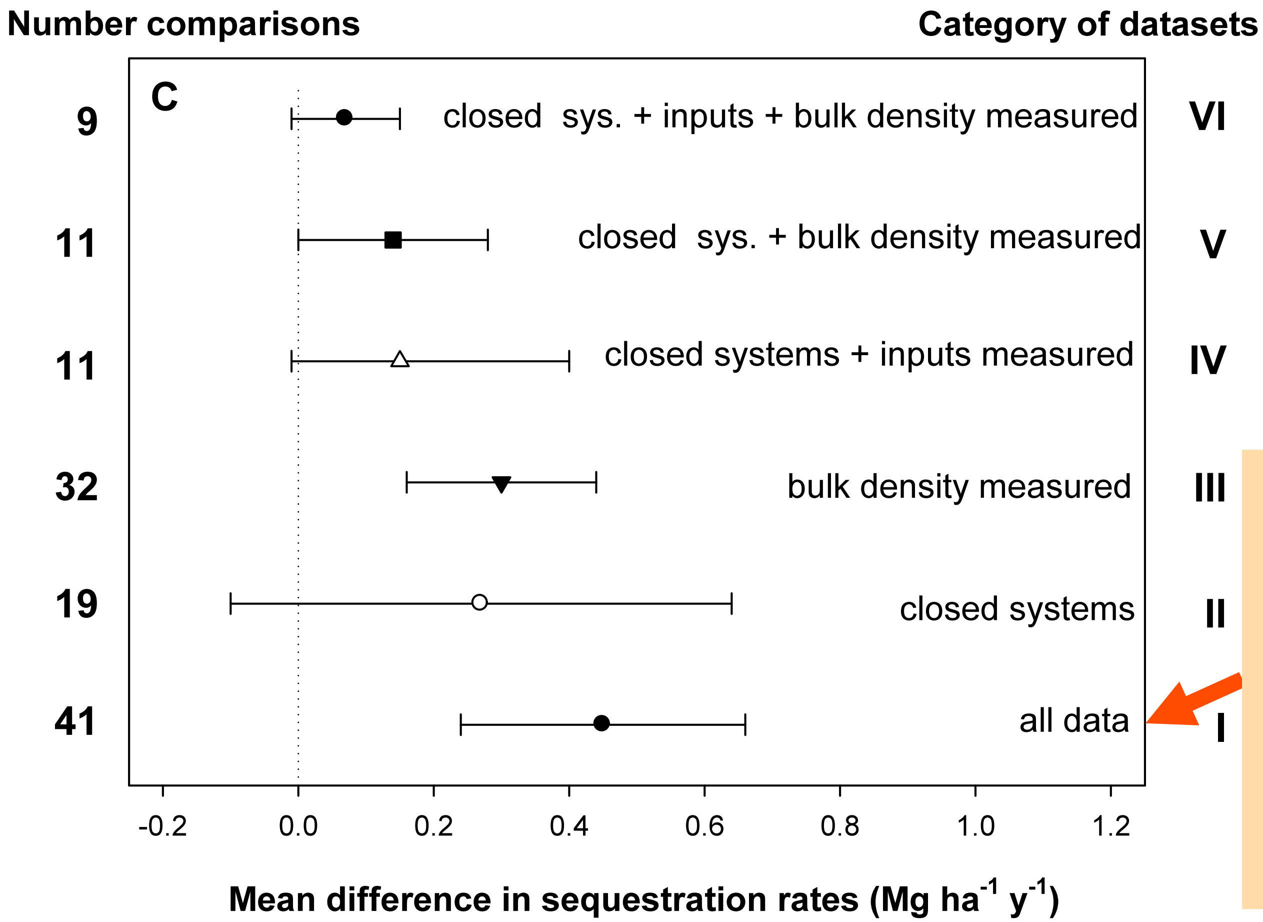


FiBL www.fibl.org

* Scales: Plots, fields, farms, landscape

Hole *et al.*, 2005. Biological Conservation 122, 113-130

Meta-analyses of 74 field trials world-wide: <u>sequestration rate</u> (Mg ha^{-1} $year^{-1}$) and C stocks



Organic fields sequester 450 kg more atmospheric carbon per year than conventional ones.

Mean difference in carbon stocks: 3.5 tons C per hectare

Gattinger et al., 2012 (FiBL)
www.pnas.org/cgi/doi/10.1073/pnas.1209429109

Less N_2O from organically managed soils

	N_2O emissions per acreage (kg N_2O-N ha^{-1} a^{-1})					GWP[d] N_2O emissions per acreage (kg CO_2-eq. ha^{-1} a^{-1})				
land-use	MD[a]	CI[b]	p	studies	comp.[c]	MD[a]	CI[b]	p	studies	comp.[c]
all (annual)[f]	-1.04	0.41	0.00	12	70	-486	191	0.00	12	70
arable	-1.01	0.42	0.00	11	67	-472	195	0.00	11	67
grassland	-2.42	5.16	0.36	2	3	-1133	2416	0.36	2	3
rice-paddies	-1.39	2.22	0.22	1	3	-650	1038	0.22	1	3
overall[g]	-1.03	0.32	0.00	18	98	-482	150	0.00	18	98

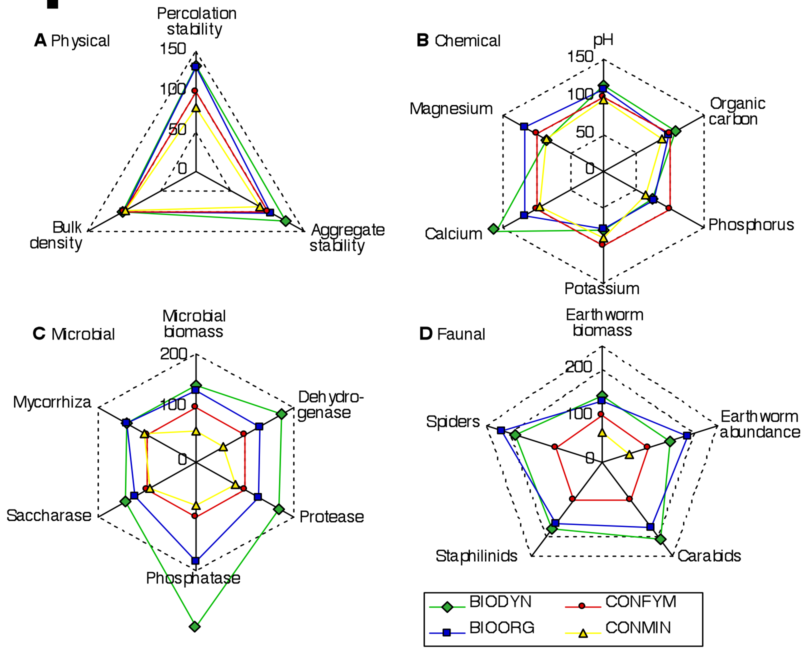
Mean difference for all studies
0.5 t ha^{-1} yr^{-1} less CO_2 eq.
as nitrous oxide.

Cut-off point: - 17 % yields

FiBL www.fibl.org

Skinner, C., Gattinger, A., Müller, A., Mäder, P., Fliessbach, A., Stolze, M., Ruser, R. and Niggli, U. (2014) Science of the Total Environment, pp. 553-563 DOI information: 10.1016/j.scitotenv.2013.08.098

Soil properties in the DOC experiment (year 24)



Mäder, Fliessbach, Niggli (2002), Science 296

Organic = good adaptation to climate change due to higher soil carbon levels

- Increased **aggregate stability** (Gerhardt, 1997; Siegrist et al., 1998; Brown et al., 2000; Mäder *et al.*, 2002; Pulleman et al., 2003; Williams & Petticrew, 2009).
- Increased **water holding capacity**, higher **water content in soil** (Brown et al., 2000; Lotter et al., 2003; Pimentel et al., 2005)
- Improved **infiltration rate** of water (Lotter et al., 2003; Pimentel et al., 2005; Zeiger & Fohrer, 2009).

DOK/Conventio-nal: mineral fertiliser: ➔

DOK/Bio-dynamic with composted manure: ➔➔

Yields: state-of-the-art of literature

- Temperate zones: The ratio between organic and conventional yields (intensive farms) is between 0.75 and 0.8.
  - Seufert, V.; N. Ramankutty and J.A. Foley 2012: Comparing the yields of organic and conventional agriculture. Nature 485, 229-232. doi:10.1038/nature11069.
  - De Ponti, T.; B. Rijk and M.K. van Ittersum 2012: The crop yield gap between organic and conventional agriculture. Agricultural Systems 108, pages 1-9. Elsevier.

- Proof of concept: The DOK trial running in permanence in Switzerland since 1977: Ratio of yields of several seven year crop rotations: 0.83 organic/conventional.
  - Mäder, P.; A. Fließbach; D. Dubois; L. Gunst; P. Fried and U. Niggli 2002: Soil fertility and biodiversity in organic farming. Science 296, 1694-1697.

Yields: state-of-the-art of literature

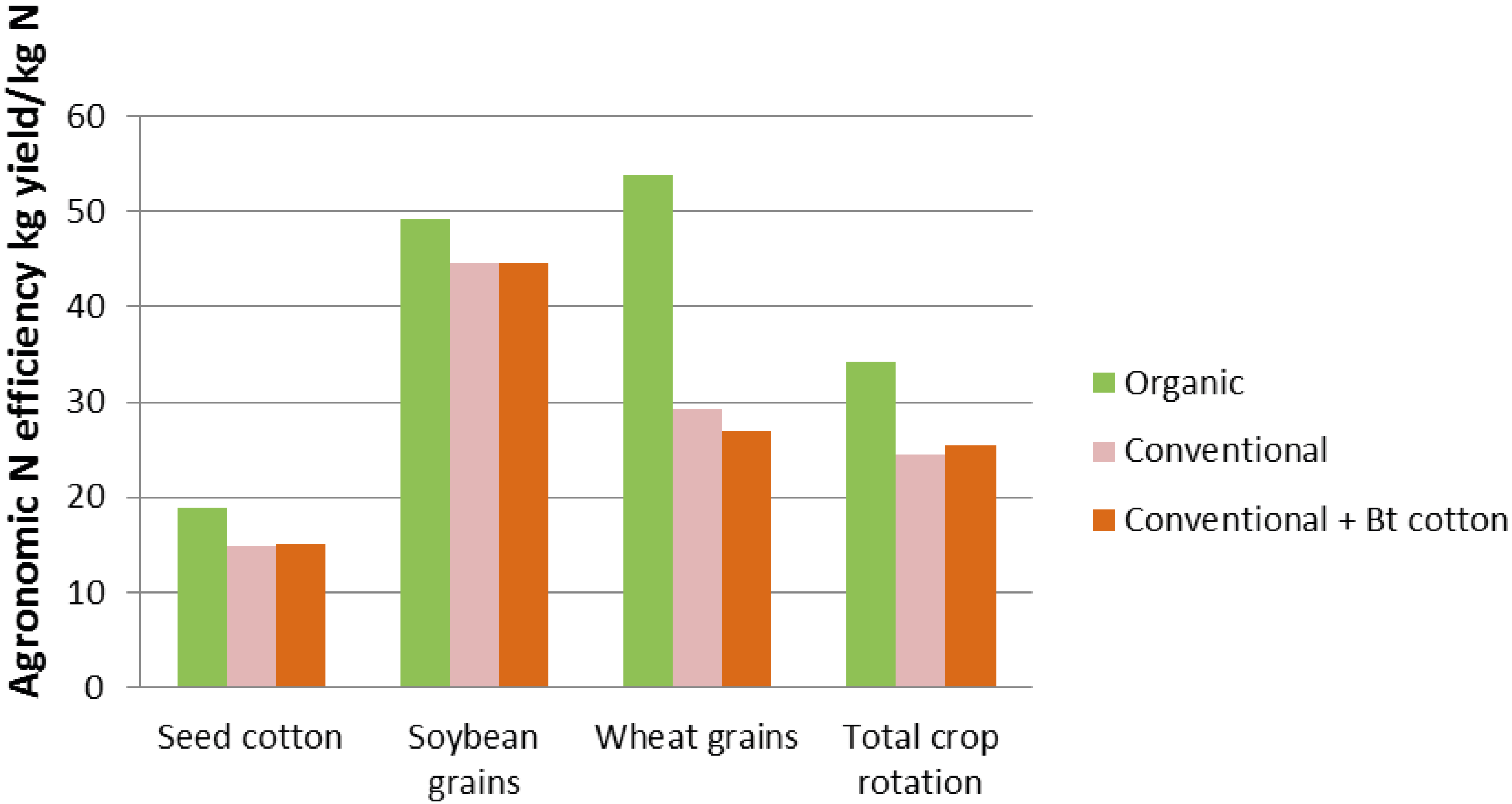
- Sub-Saharan Africa: The ratio between organic and traditional yields is 2.16 in favor of organic.
  - UNCTAD and UNEP (2008). 'Organic Agriculture and Food Security in Africa', New York, Geneva, United Nations Conference on Trade and Development, United Nations Environment Programme.
- An older meta-analyses of global data: the average yield ratio “organic/conventional” was slightly <1.0 for studies in the developed world and >1.0 for studies in the developing world.
  - Badgley, C., Moghtader, J., Quinterio, E., Zakem, E., Chappell, M.J., Avilés-Vázquez, K., Samulon, A. and Perfecto, I. (2006). 'Organic agriculture and the global food supply'. Renewable Agriculture and Food Systems 22: 2, pp. 86-108.

DOK trial in CH, since 1977: Organic yields 83 %, excellent input/output ratio

	Parameter	Unit	Organic farming	Integrated farming (IP) with FYM	Organic in % of IP
Input	Nutrient input	kg N_{total} ha^{-1} yr^{-1}	101	157	64 %
		kg N_{min} ha^{-1} yr^{-1}	34	112	30 %
		kg P ha^{-1} yr^{-1}	25	40	62 %
		kg K ha^{-1} yr^{-1}	162	254	64 %
	Pesticides applied	kg ha^{-1} yr^{-1}	1.5	42	4 %
	Fuel use	L ha^{-1} yr^{-1}	808	924	87 %
Output	Total yield output for 28 years	%	83	100	83 %
	Soil microbial biomass as „output“	tons ha^{-1}	40	24	167 %

Mäder, Fliessbach,..., Niggli (2002), Science 296

Long-term field trial Madhya Pradesh State (Nimar Valley), semi-arid, 800 mm rainfall



Having a clear strategy for innovation

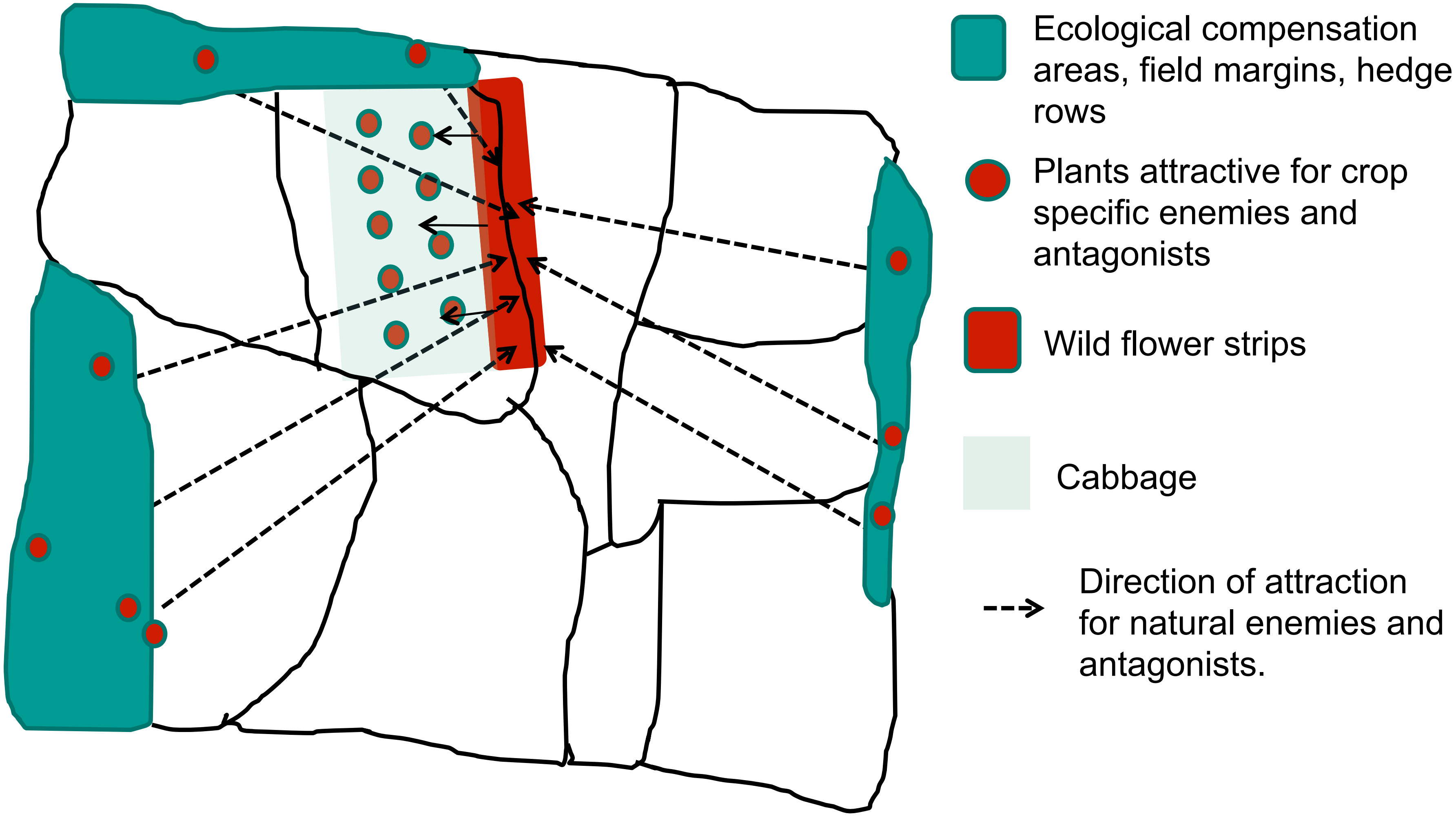
- We need more innovation, otherwise organic farming will become irrelevant.
- The approach taken by the organic movement towards innovation is controversial:
  - For some innovations like bio-control, ICT, precision farming, robots, food processing technology, food storage and packaging, food logistic, glasshouse production, a **technology-affine** approach is taken.

  - Whilst in many cases, technology is seen as a diametric opposite to traditional farmer knowledge.

Having a clear strategy for innovation

- Organic farming should better adopt the full pathway to innovation (and be leading at critically assessing technologies case by case).
- Hierarchy of innovation to be consequently adopted in organic agriculture: Traditional farmer knowledge ➔ farmer driven innovation (on-farm and action research; social and product innovation) ➔ eco-functional innovation ➔ scientific, technical and technological innovation.

Habitat management in cabbage



Luka, H., Balmer, O., Pfiffner, L., Eggenschwiler, L. & Jacot, K. (2011): Einführung von agronomisch und ökologisch wirkungsvollen Nützlingsblühstreifen in der Kulturlandschaft. Dossier Nützlingsblühstreifen, Forschungsinstitut für biologischen Landbau (FiBL) Frick & Forschungsanstalt Agroscope Reckenholz-Tänikon ART, 20 pp.

Functional diversity

Companion plants increase life span, fecundity and mobility of parasitoids

Iberis amara

Centaurea cyanus

Diadegma semiclausum

Companion plants serve as food sources within the crop to enhance longevity and oviposition of parasitoids

Parasitoids: from 2 day survival in cabbage (mono) to 20 days in cabbage + cornflower

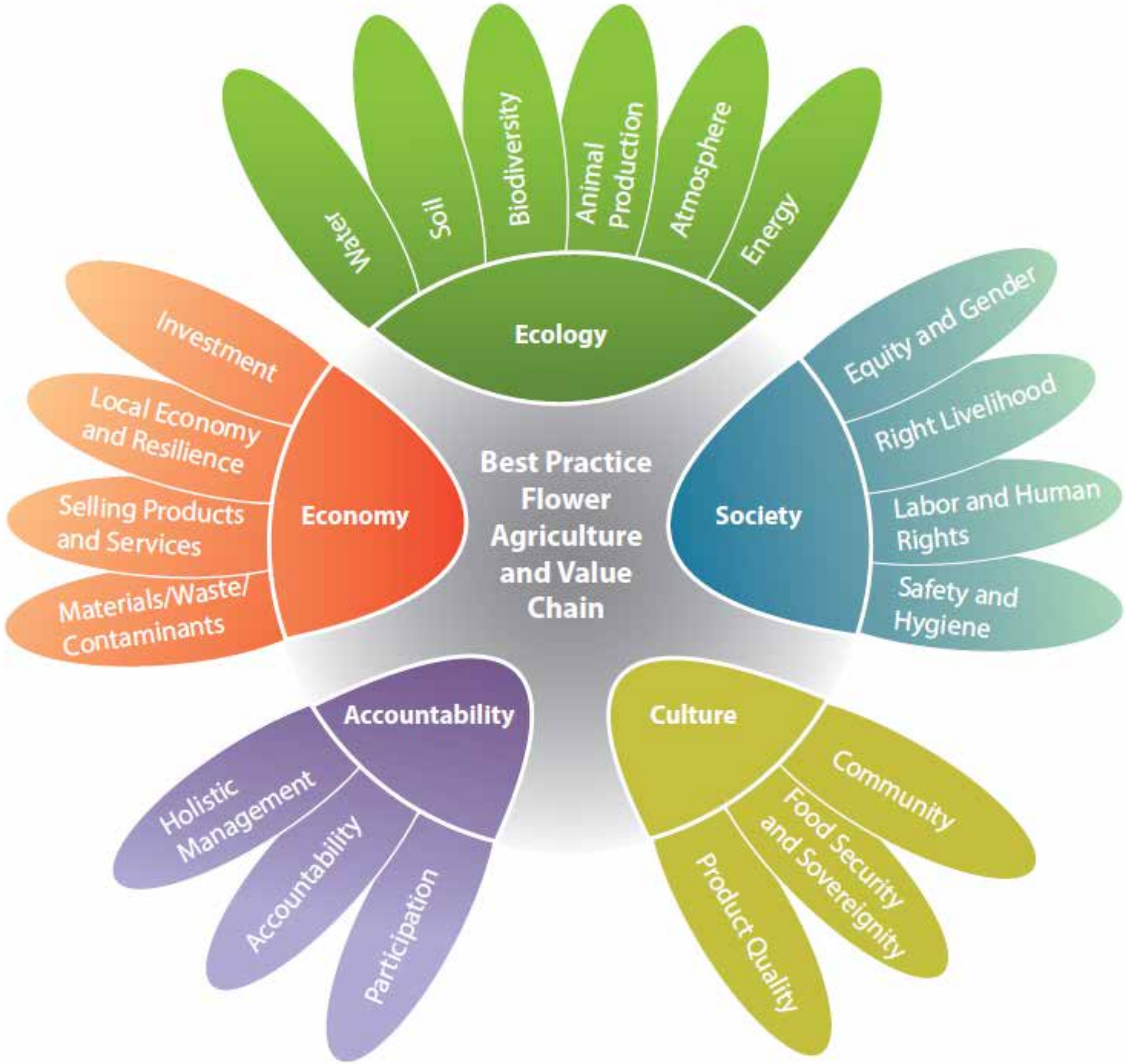
Céline Géneau, 2008


Reduced
tillage
Mouldboard
plough

Abundance and biomass of earthworms (g/m²)

Treatment	All		Juvenile		Cocons
	Weight	Number	Weight	Number	Number
Plough	56.1	156.5	11.2	103.8	21
Reduced	83.3	261.8	18.8	187.0	113
Red/Plough	+48%	+67%	+68%	+80%	+438%


IFOAM: Best practice (SOAAN)



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Conclusions

› Overwelming evidence for being good at delivering public goods at a reasonable level of productivity.

› How to upscale and mainstream organic farming?*

› Discussion about a clearer strategy towards innovation.

› Best organic practice will become important.

* Reasons for niche position:

- Lack of information of consumers?
- Big Business opposed?
- Lack of research (less than 1 % of research spending)?
- Too expensive?
- True cost accounting not applied?