

Transformative change in agriculture is urgently needed

Two proposed ways forward

(which in practice are not very different, and also benefit each other)

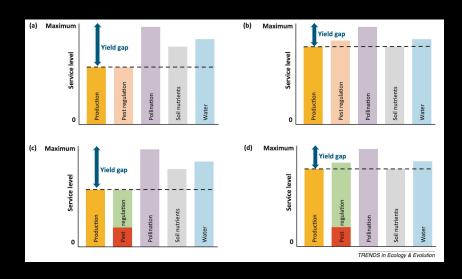
Diversified farming systems

Bring back agricultural diversity that was lost due to intensification



Ecological intensification

Increase crop production through ecological processes replacing conv. intensification





Field & farm level diversification: intercropping







Study focus	Number of studies	Effect of strip intercropping		
		Positive	Neutral	Negative
Biodiversity	11	8	2	1
Pest control	12	5	7	0
Biodiversity and pest control	12	12	0	0
Biodiversity, pest control and yield	21	19	2	0

One practice with great potential: strip intercropping!

Systematic review of 56 peer-reviewed studies

- Major but undervalued practice of farmland diversification
- Increases biodiversity, pest control and yield alike in 90% of the studies
- Pest densities reduced up to 75% and predator diversity increased by 50%
- Yield benefits potentially compromised by higher labor costs

BUT:

64% of all studies conducted in Asia (3% Europe) and few in large conventional systems → Potential ??

(a) Wheat Biological pest control (b) Oilseed rape biological pest control Pollen beetle larvae density Wheat aphid density Monoculture strips strips Parasitism of pollen beetle larvae Parasitism of wheat aphid Insecticide-free Insecticide-free strips strips

Alarcón-Segura et al. (in review)

Strip intercropping compared to monocultures

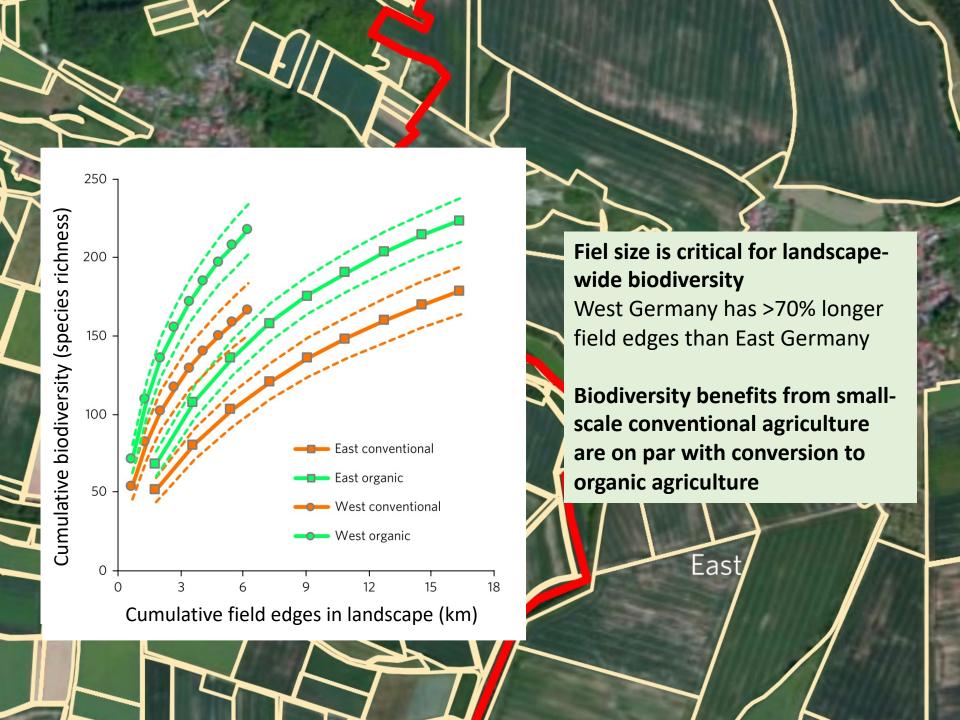
- 50% less aphids
- 20% less pollen beetle larvae
- 15% higher aphid parasitism
- Pollen beetle parasitism unaffected
- No effects of insecticide application
- Spiders benefit from wheat, carabid beetles more abundant and diverse in oilseed rape
- Strip intercropping benefits both groups

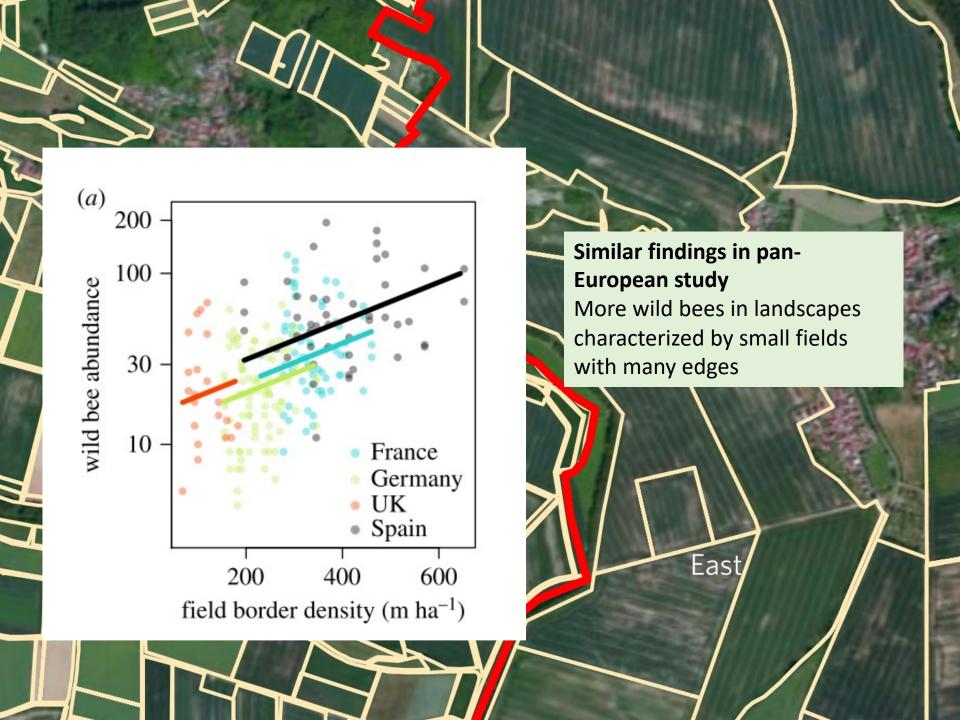
Even large strips adapted to existing conventional machinery enhance biodiversity and biocontrol in intensive cropping systems



Potentials of digitalization & automatization for field and farm level diversification !!?







Ecological intensification of agricultural production: example of pest regulation

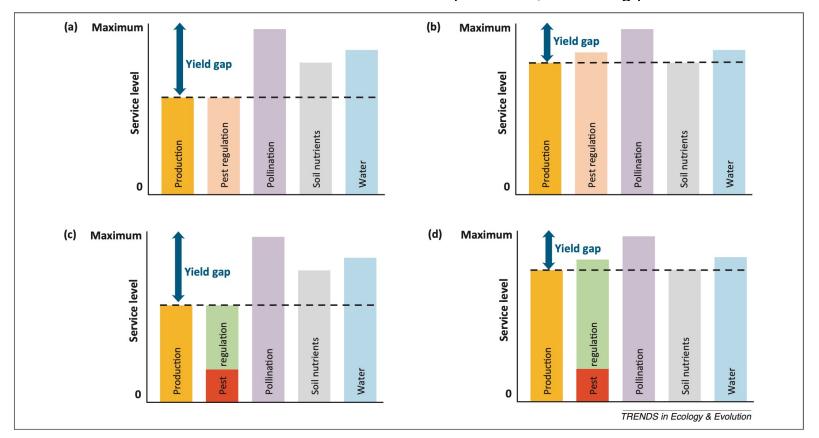
Bommarco et al. 2013, Trends in Ecology & Evolution

(a) Yield gap

Resulting from lack of pest regulation

(b) Conventional intensification

Pest regulation boosted by anthropogenic inputs = pesticides, increasing production



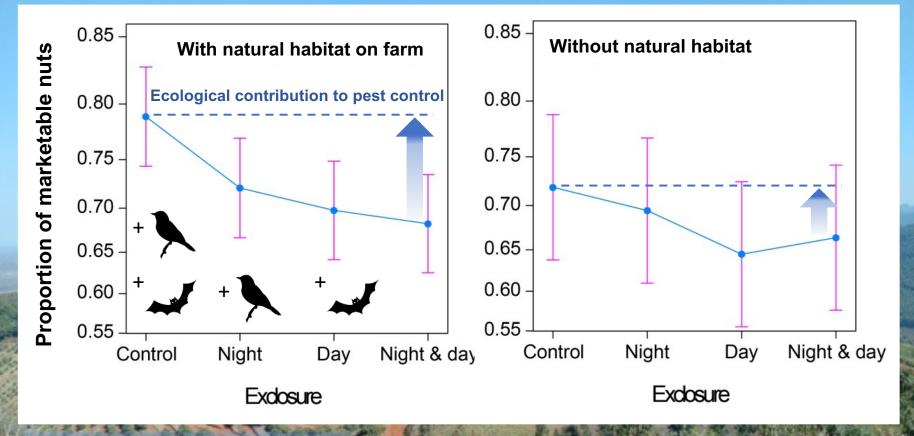
(c) Ecological replacement

Pest regulation partly provided by biodiversity (green bar), but overall similar to (a)

(d) Ecological intensification

Pest regulation boosted by biodiversity (green bar) rather than by anthropogenic inputs (red bar), increasing production







Great importance of biocontrol and of natural habitat

- No bats & birds ≙ 13% more crop loss
- Higher nut damage in simple landscapes with big monocultures

Linden et al. 2019 Journal of Applied Ecology

 Natural habitat on farm and landscape scale increases bat activity and biocontrol
Weier et al. 2018 Biological Conservation

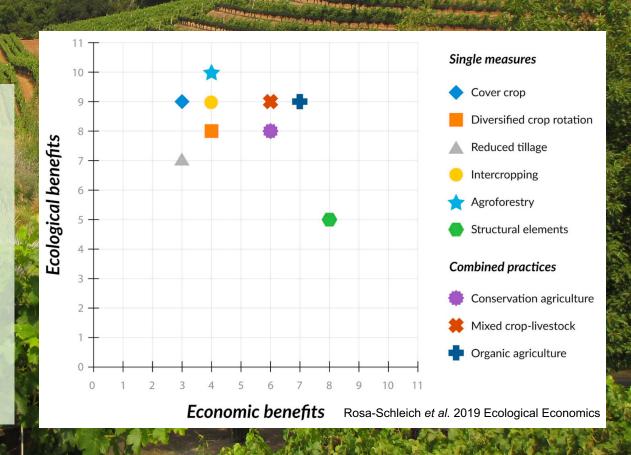




Towards truly regenerative agricultural systems by combining multiple practices

Synthesis of > 10,000 studies on agricultural diversification

- Ecological and economic benefits
- Single and combined practices
- Combined diversification practices deliver greatest benefits at farm level



Traditional approach with biodiversity conservation segregated from agriculture Integrated Semi-natural diversified habitat landscapes Cropland heterogeneity **Small** fields Crop **Agricultural** diversity diversification & ecological intensification