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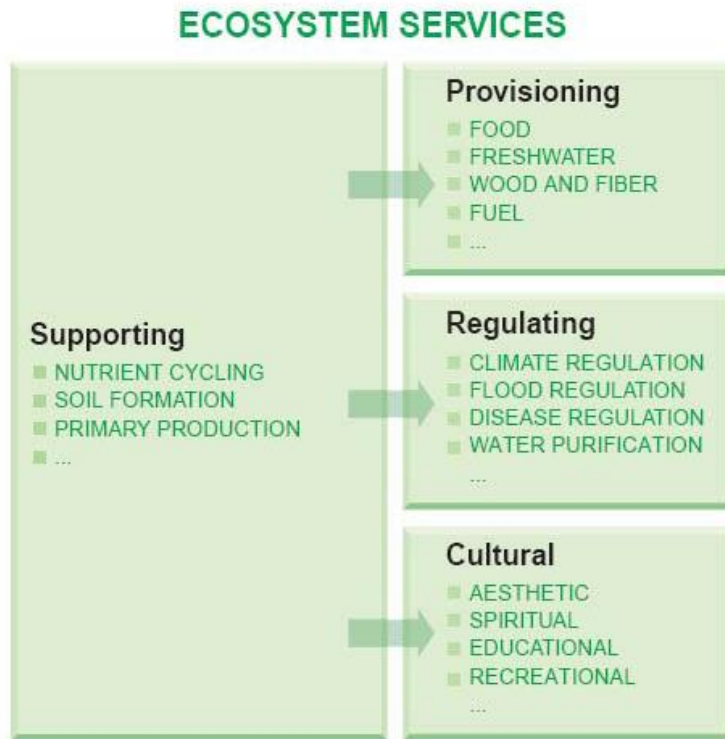
# Agroecology in sustainability transitions: concepts

06-05-2020 / Christian Huyghe



# Sustainability transition

Maximisation of ecosystem services



Millenium Ecosystem Assessment (2005)

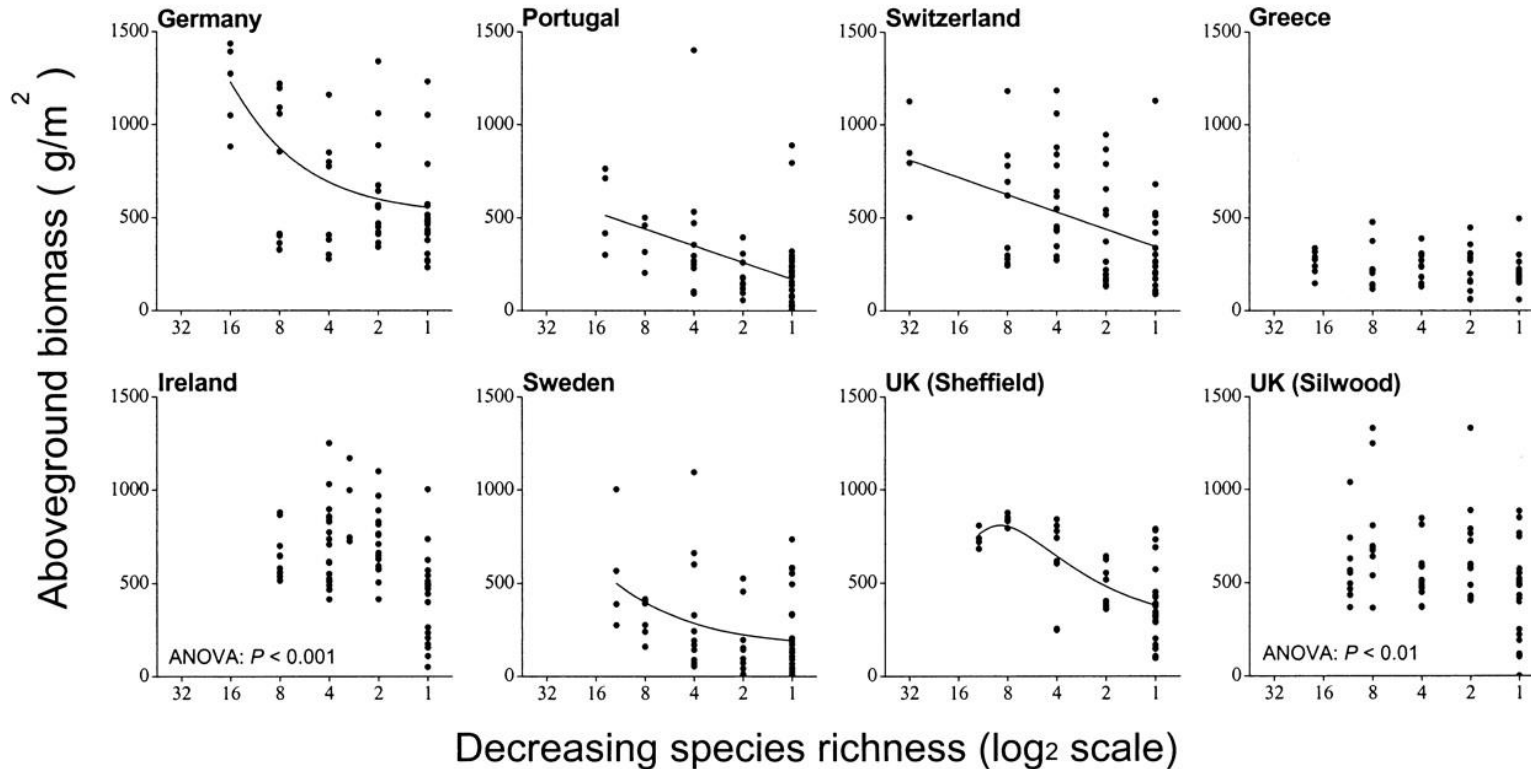
A need to meet the global challenges (HLPE, 2019)

- Food security
- Climate change : how to adapt, to mitigate and to reduce GHG emissions
- Restoring biodiversity
- Restoring quality of air and water



# Sustainability transition

Maximisation of ecosystem services: provisioning



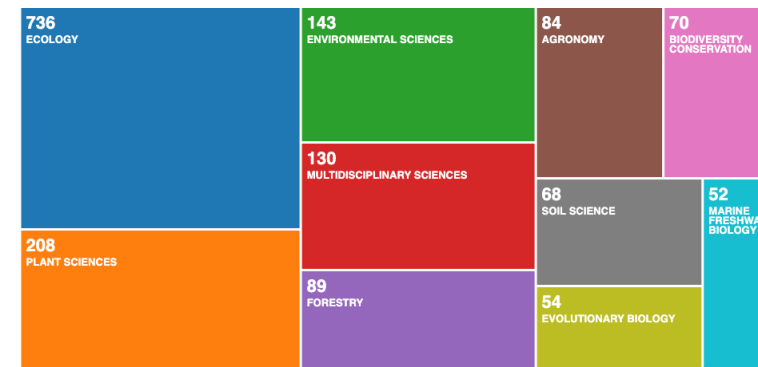
A seminal paper by Hector et al (1999) showing that in many situations, an increasing number of species and of functional groups leads to an increasing biomass production in grasslands

*Science*, 286, 1123-1127

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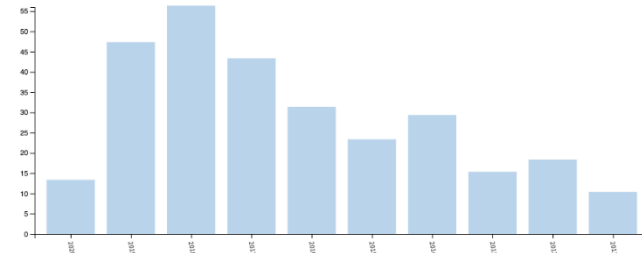
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# ➤ Agroecology concept: one word, several meanings

(Wezel et al, 2009, ASD, 29, 503-515)



## Agroecology

### Scientific discipline

Ecology at plot, field and herd scales

Ecology of food systems

Ecology of agrosystems

### Pratiques

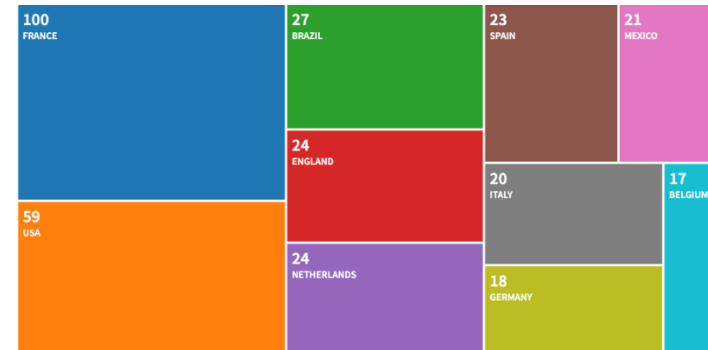
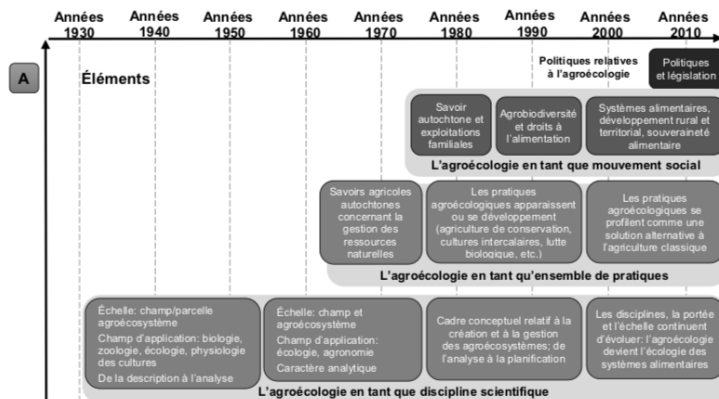
Techniques

### Social movement

Sustainable agriculture

Environmentalism

Rural development

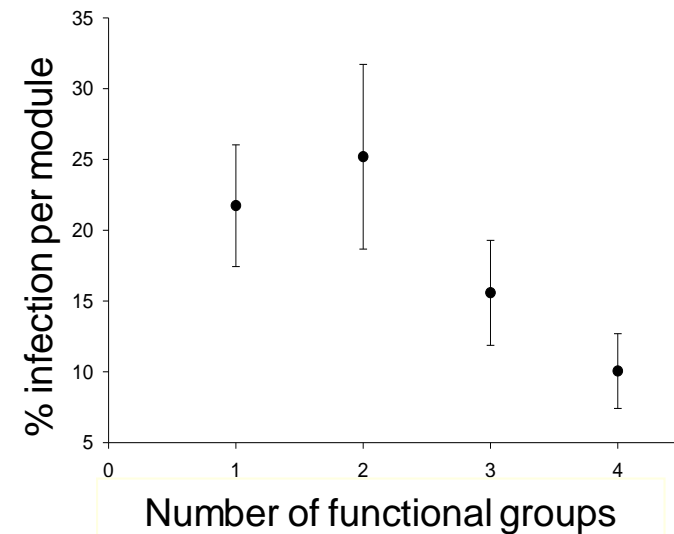
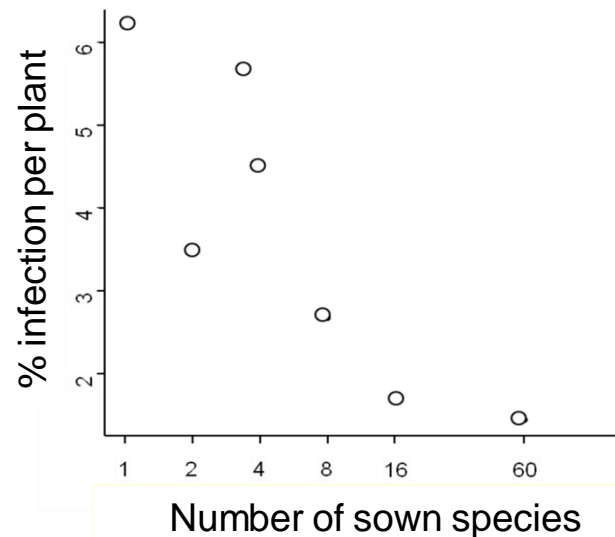


# ➤ Agroecology concept: what are the underlying hypotheses?

« Increasing functional biodiversity leads to increasing biological regulations »

Which biological regulations?

- Supporting services: nitrogen cycle
- Regulating services: controlling pests and diseases



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Example from Iena experiment

# ➤ Agroecology concept: what are the underlying hypotheses?

« Increasing functional biodiversity leads to increasing biological regulations »

At what scale?

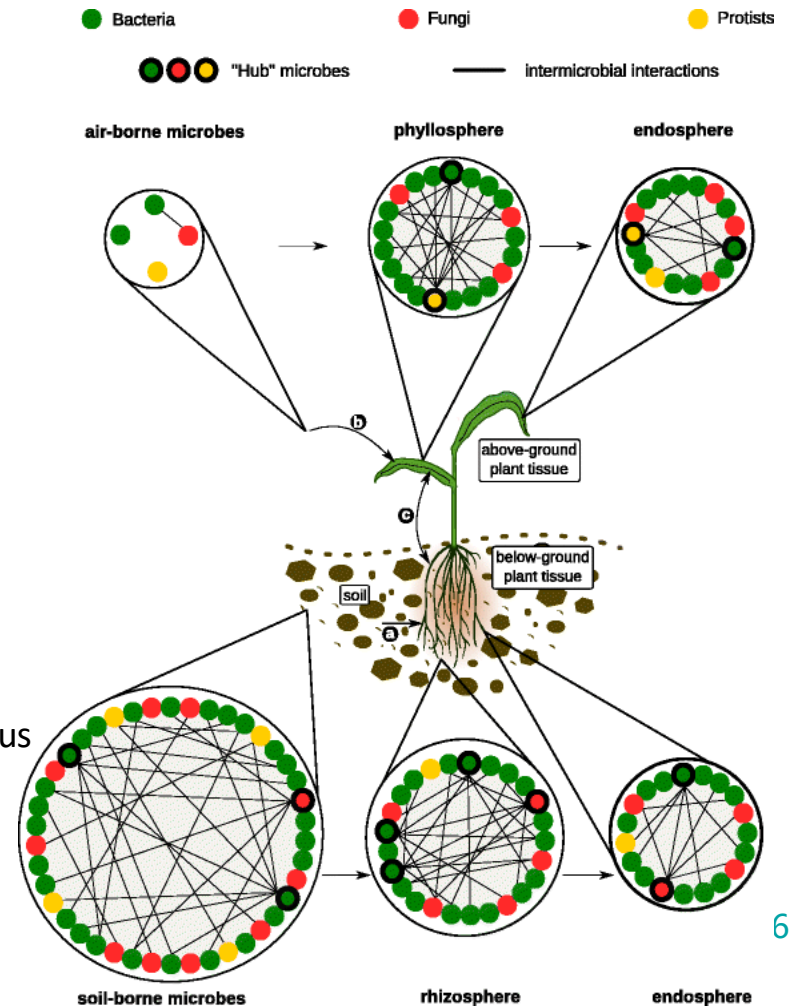
- Plant - plant interactions
- Plant - herbivore interactions
- Interactions among animals
- Plant – microorganisms interaction
  - The understanding of the role of microbiom fits very well with the concept of agroecology
  - Horizontal transmission
  - Links between microbioms of plants, soils, animals and humans

Representation of microbial networks in the various plant compartments.

*From Hassani et al, 2018, Microbiome 6, Art 58*

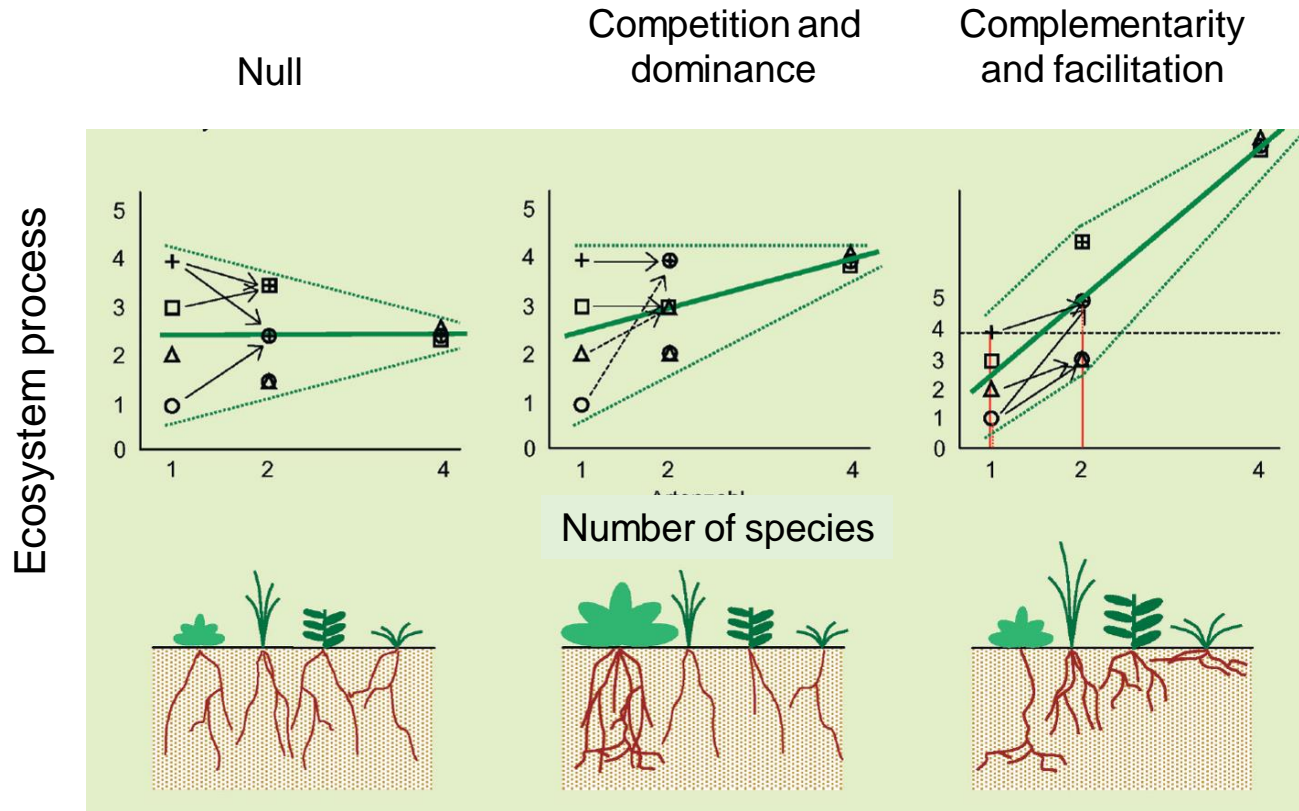
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# ➤ Agroecology concept: what are the underlying mechanisms?



In the concept of agroecology, a major importance is given to complementarity and facilitation

This opens fully new prospects for reconsidering the production systems

- Mixtures of species
- Companion species
- Relay cropping
  - 2 crops a year
  - Overlapping growing seasons

# ➤ Agroecology concept: what are the underlying mechanisms?

## The chemical ecology

- The behavior of an insect is largely determined by its odor environment: content in volatile organic compounds
  - Sexual confusion (pheromons)
  - Detection of host plants (kairomons)
    - Tagetes and protection against aphids and flies in gardens
    - Mixtures of rapeseed and annual legumes to control *Psylliodes chrysocephalus*
- The concept of olfactory landscape



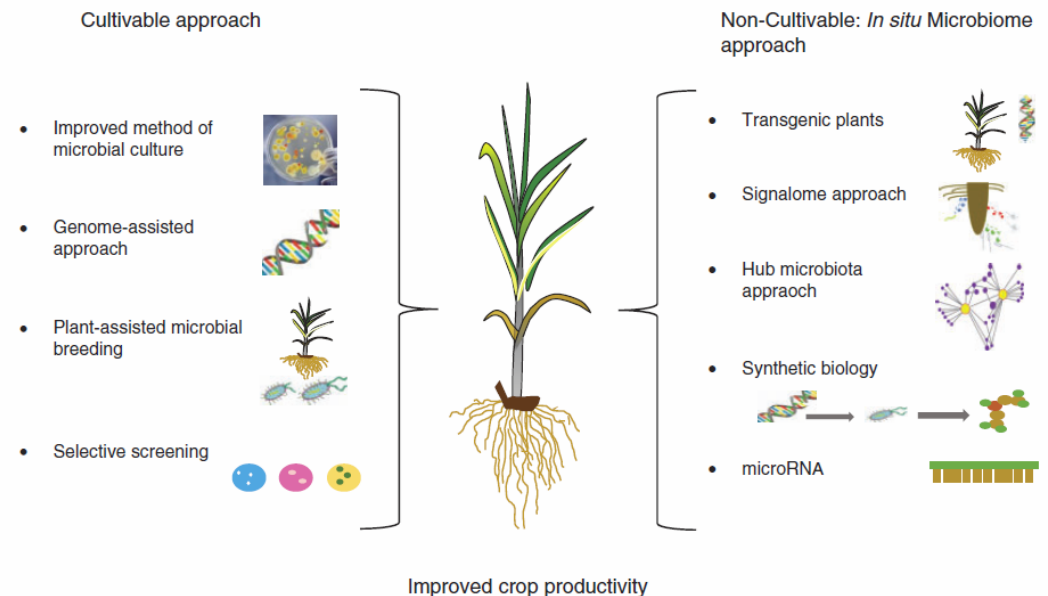


# ➤ Agroecology concept: New challenges for research – some examples

## In plant genetics

- Breeding new species (companion crops) and for new traits (ability to grow in mixtures)
- Search for new alleles
  - Question for the role of genome editing (Lotz et al, 2020, Outlook on agriculture)
- Co-breeding with microbiom ?

Singh BK et al. 2018, Microbiology Australia 39, 17-23



# ➤ Agroecology concept: New challenges for research – some examples

## In crop protection

- Based upon biological regulations, what role for prophylaxy?
- Biocontrol
  - Macroorganisms and conservation biology
  - Microorganisms: what can be learnt from microbiom
  - Pheromons and kairomons
  - Natural substances
- Agroecology is clearly a key lever for a chemical pesticide-free agriculture



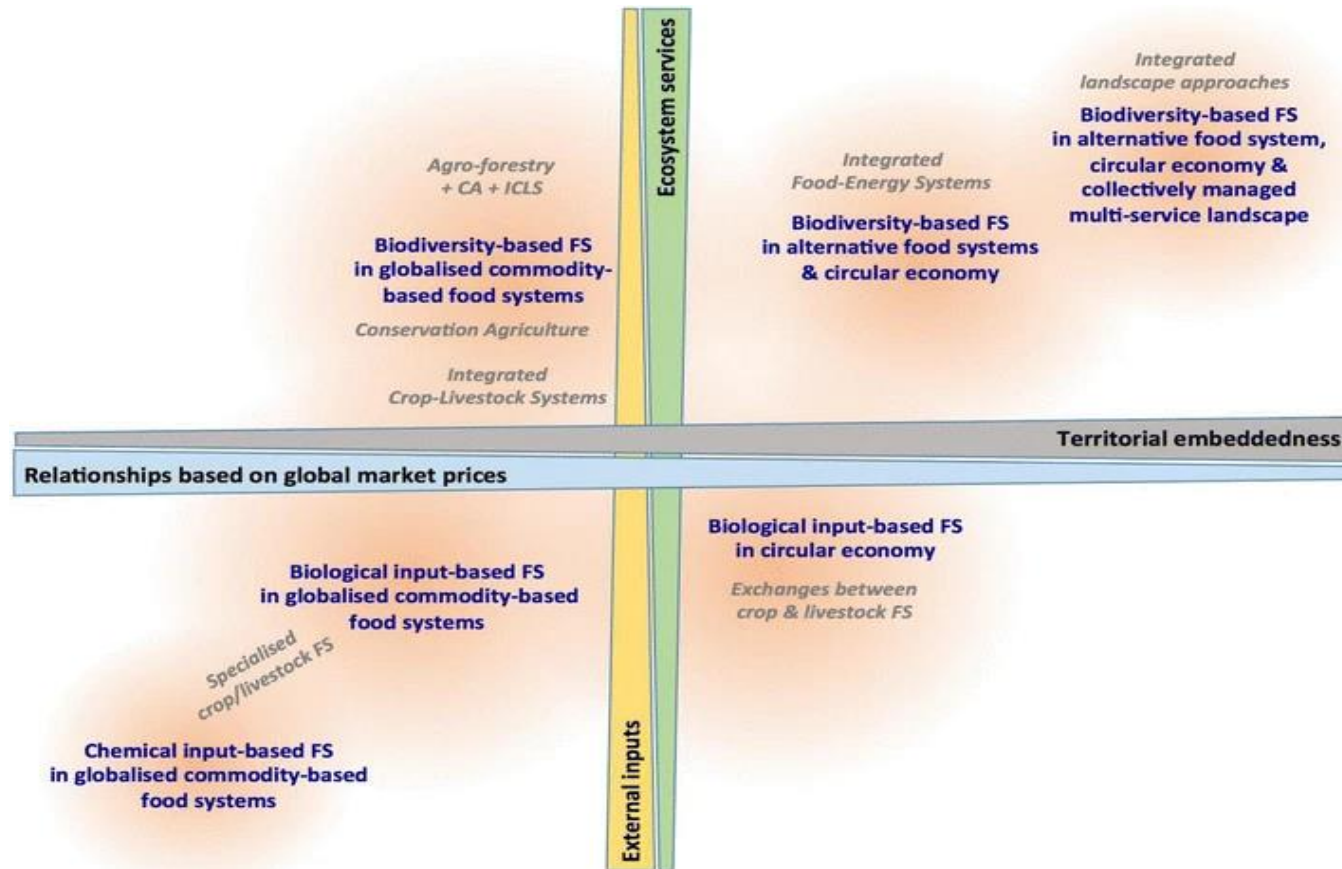
# ➤ Agroecology concept: New challenges for research – some examples

## In human and social sciences

- What are the conditions to foster the transitions to agroecology-based production and food systems? The underlying values
  - AgroecologyNow
  - Anderson et al, 2020 (Agroecology and Sustainable Food System 44, 561-565)
- The conditions for transition in the production systems
  - Adoption and changes in the advisory systems
  - Agroecology and maximisation of the dependency to local conditions



# ➤ Agroecology and food system transitions



Agri-food models according to the degree of ecosystem services vs external inputs (Y-axis) and the relationships with socio-economic contexts (global market prices vs territorial embeddedness- (X-axis).