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Agroecology in sustainability transitions: concepts

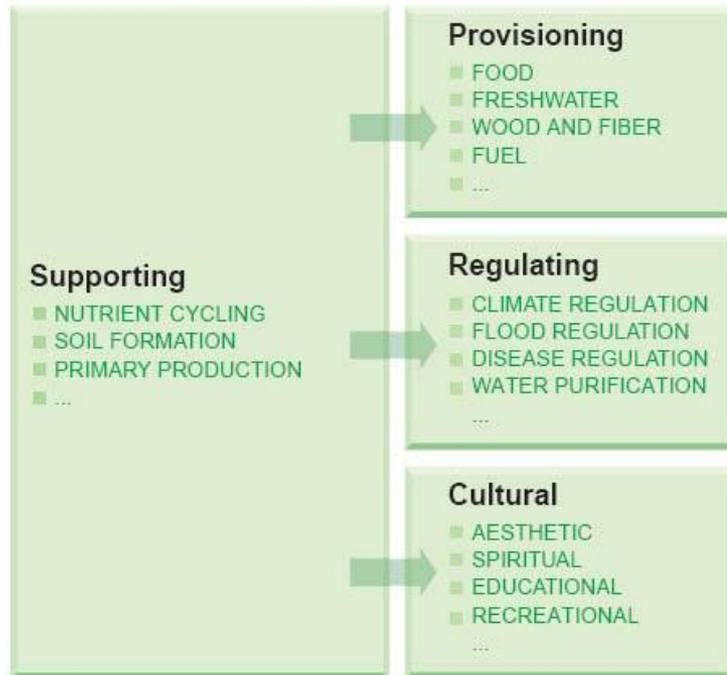
06-05-2020 / Christian Huyghe



Sustainability transition

Maximisation of ecosystem services

ECOSYSTEM SERVICES



Millennium Ecosystem Assessment (2005)

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

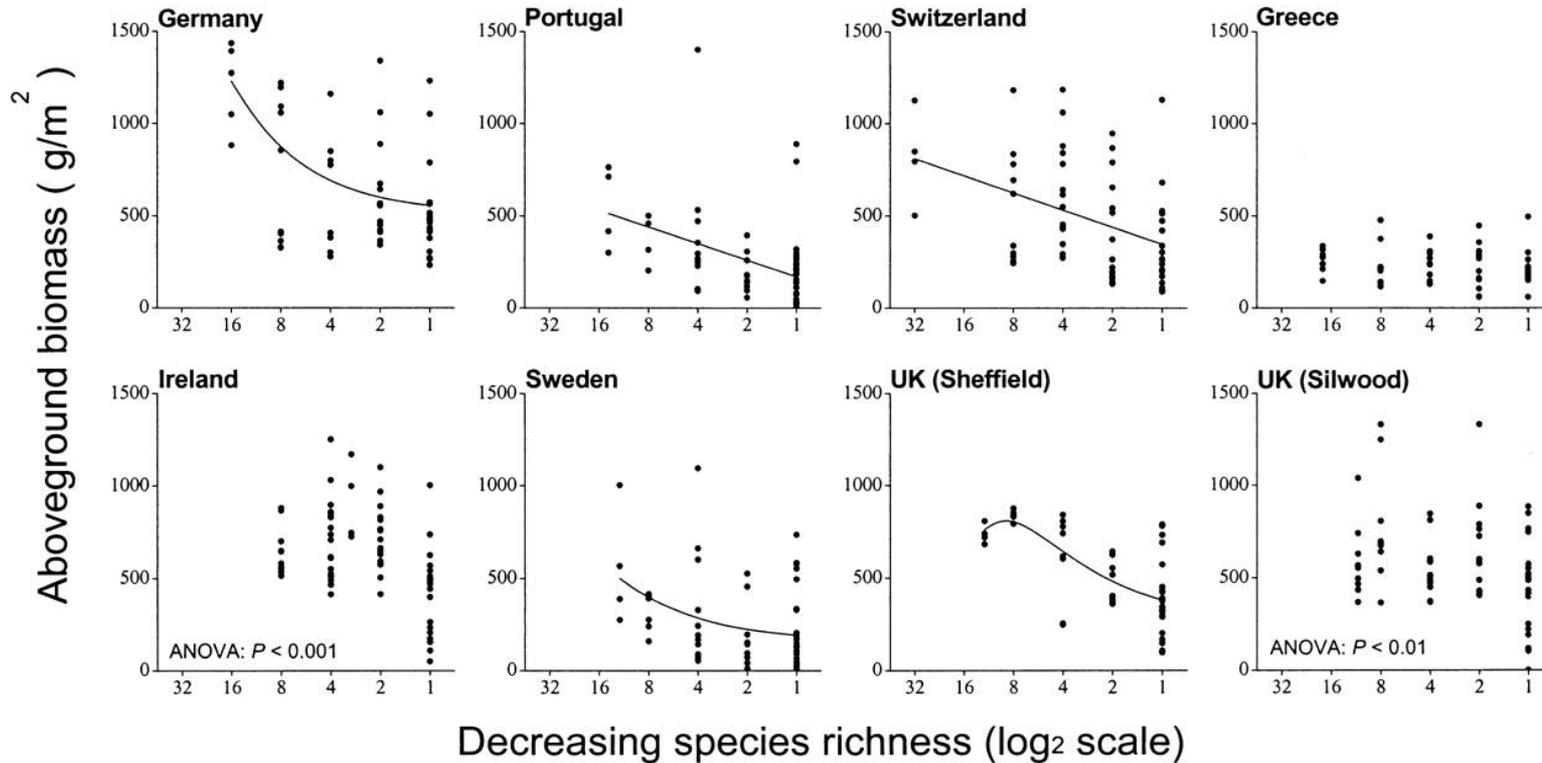
- Food security
- Climate change : how to adapt, to mitigate and to reduce GHG emissions
- Restoring biodiversity
- Restoring quality of air and water





Sustainability transition

Maximisation of ecosystem services: provisioning



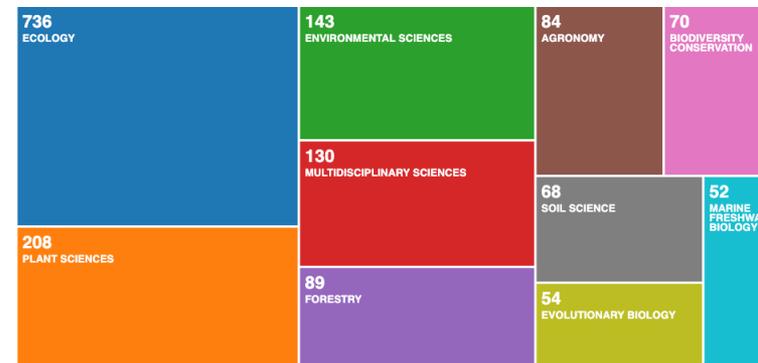
A seminal paper by Hector et al (1999) showing that in many situations, an increasing number of species and of functional groups leads to an increasing biomass production in grasslands

Science, 286, 1123-1127

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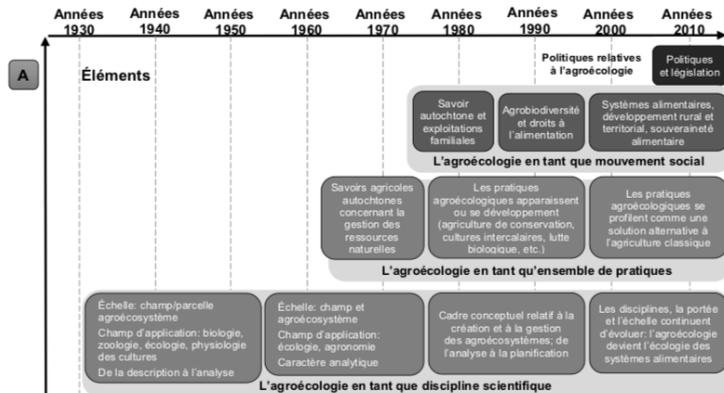
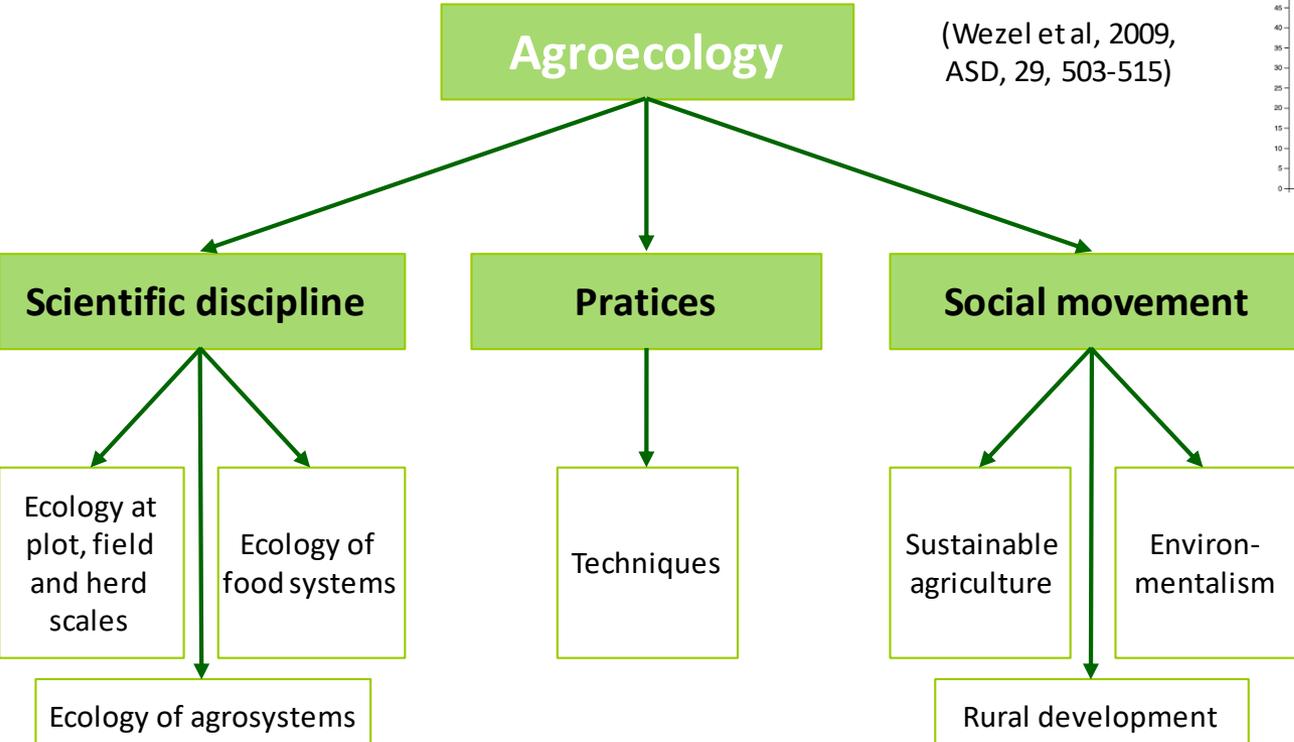
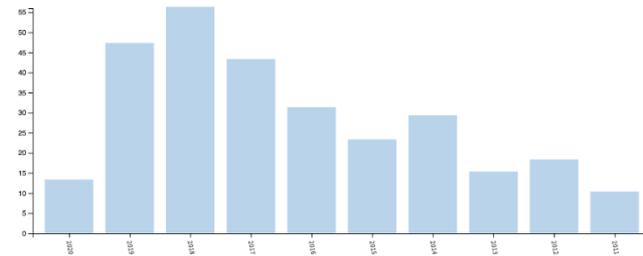
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➤ Agroecology concept: one word, several meanings

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

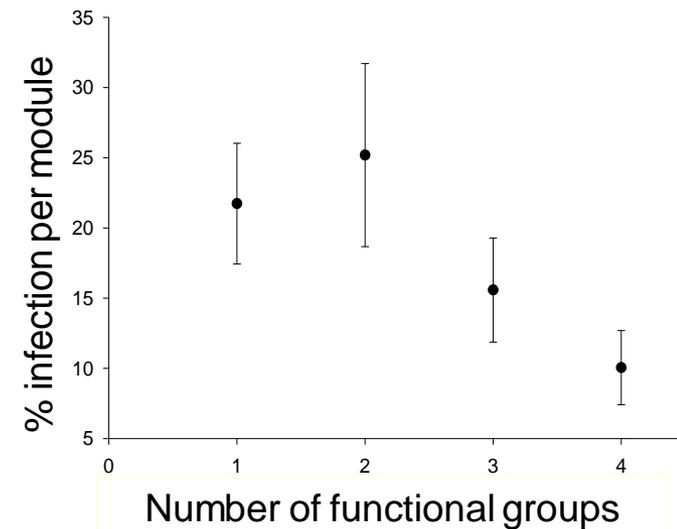
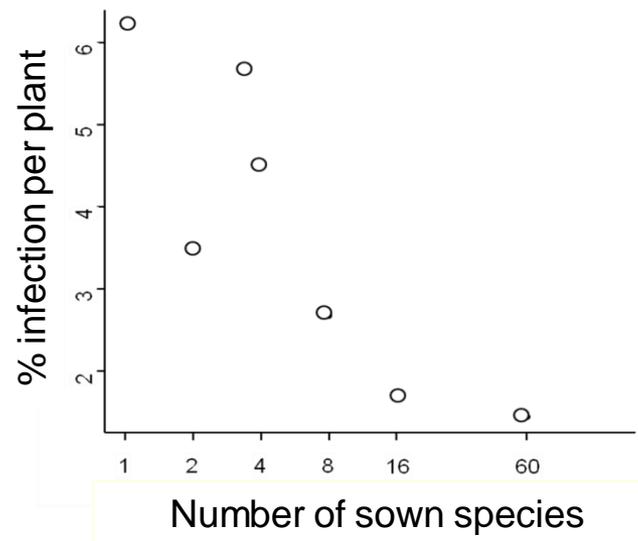


➤ Agroecology concept: what are the underlying hypotheses?

« Increasing functional biodiversity leads to increasing biological regulations »

Which biological regulations?

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



➤ Agroecology concept: what are the underlying hypotheses?

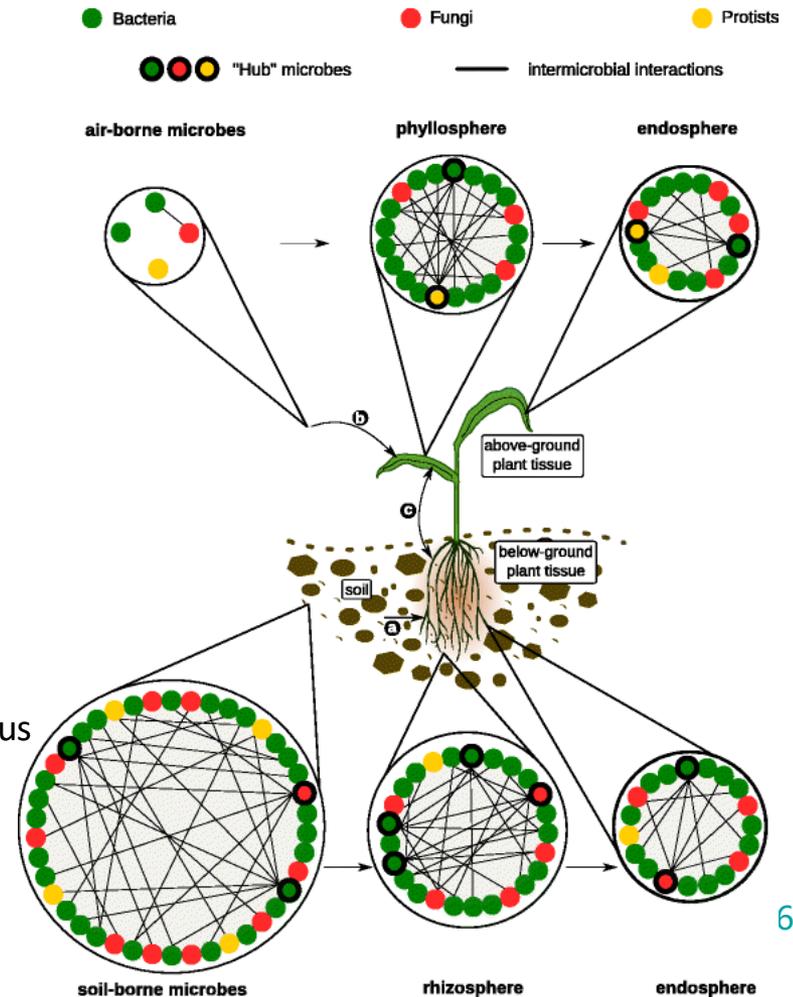
« Increasing functional biodiversity leads to increasing biological regulations »

At what scale?

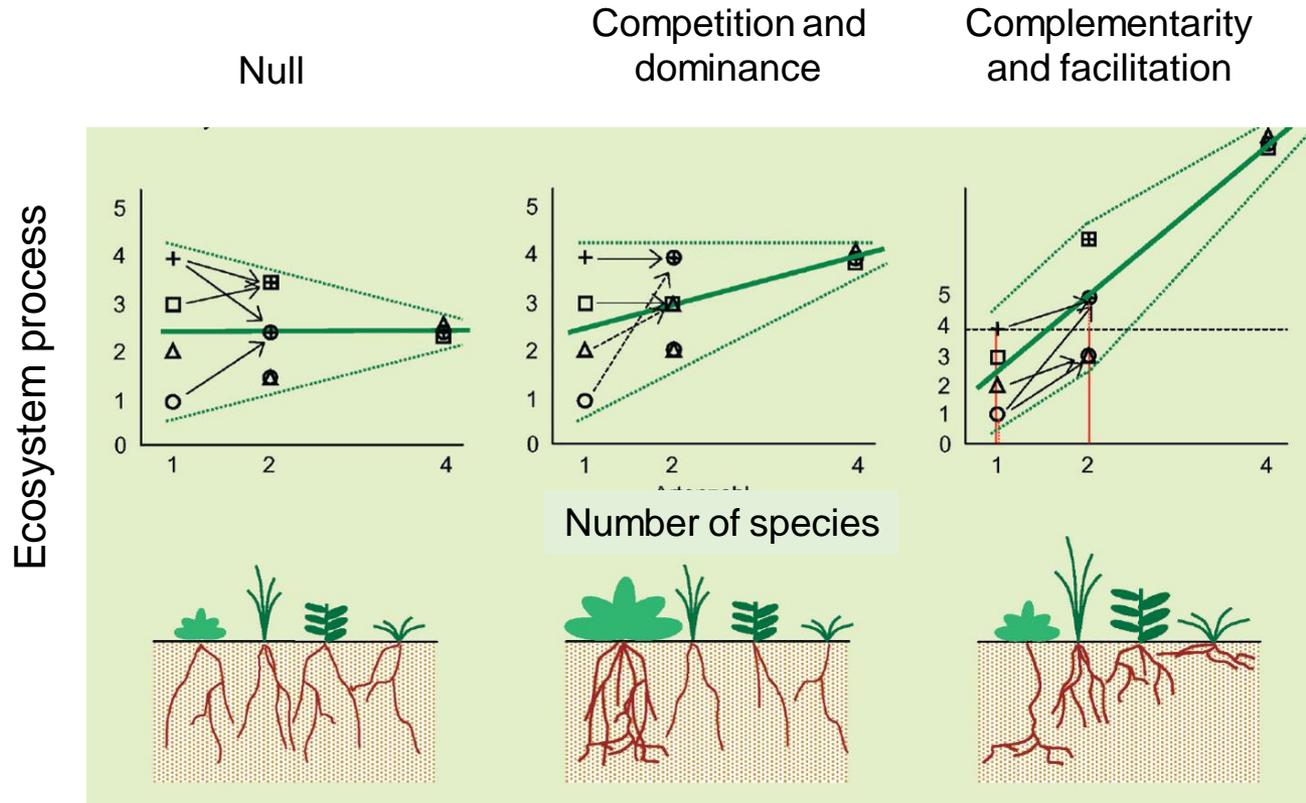
- Plant - plant interactions
- Plant - herbivore interactions
- Interactions among animals
- Plant – microorganisms interaction
 - The understanding of the role of microbiom fits very well with the concept of agroecology
 - Horizontal transmission
 - Links between microbioms of plants, soils, animals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

Representation of microbial networks in the various plant compartments.

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



➤ 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



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➤ 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

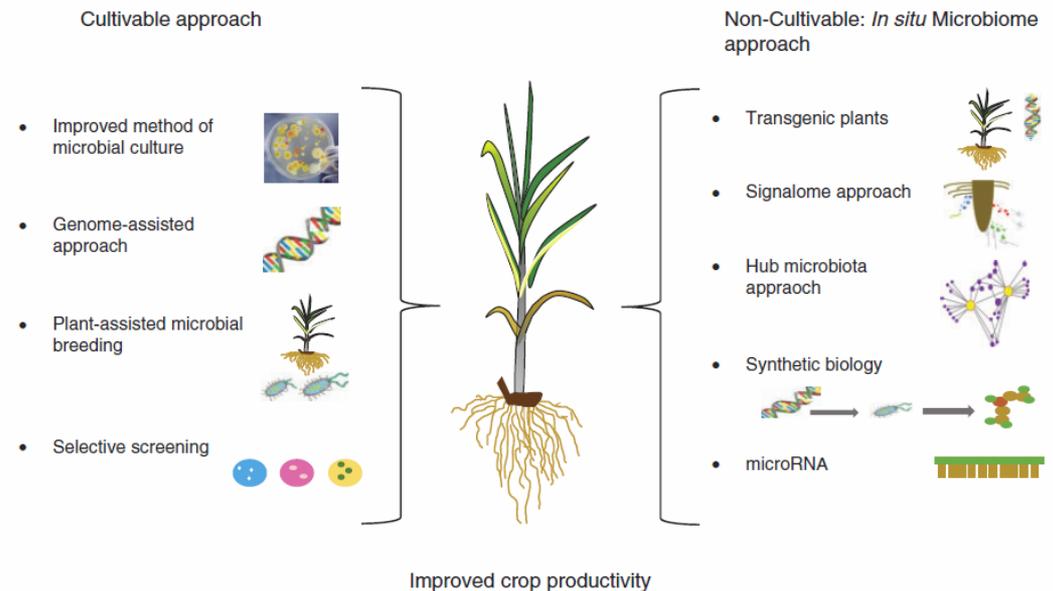


➤ Agroecology concept: New challenges for research – some examples

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



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➤ 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



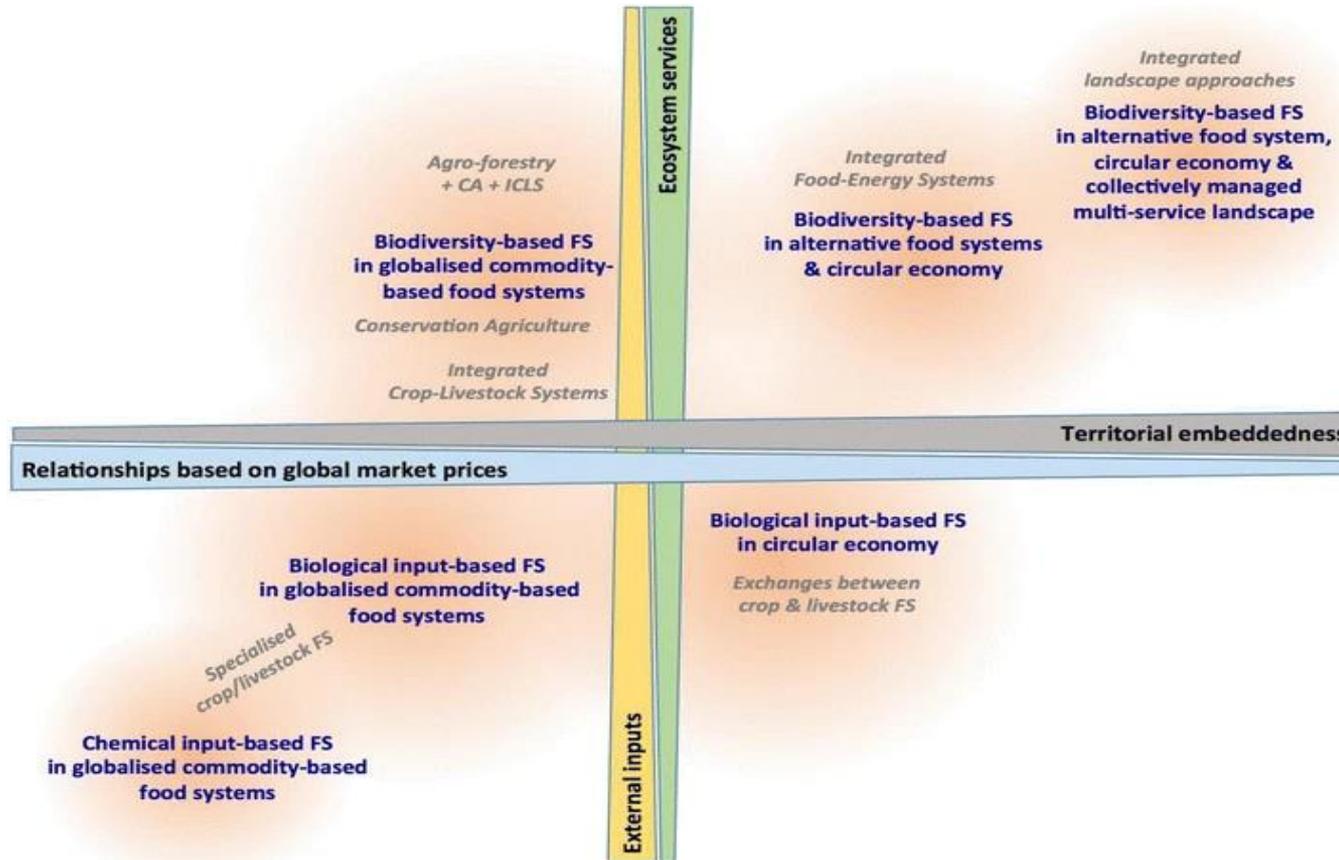
➤ Agroecology concept: New challenges for research – some examples

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).

