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A functional ecology approach to co-design crop mixtures

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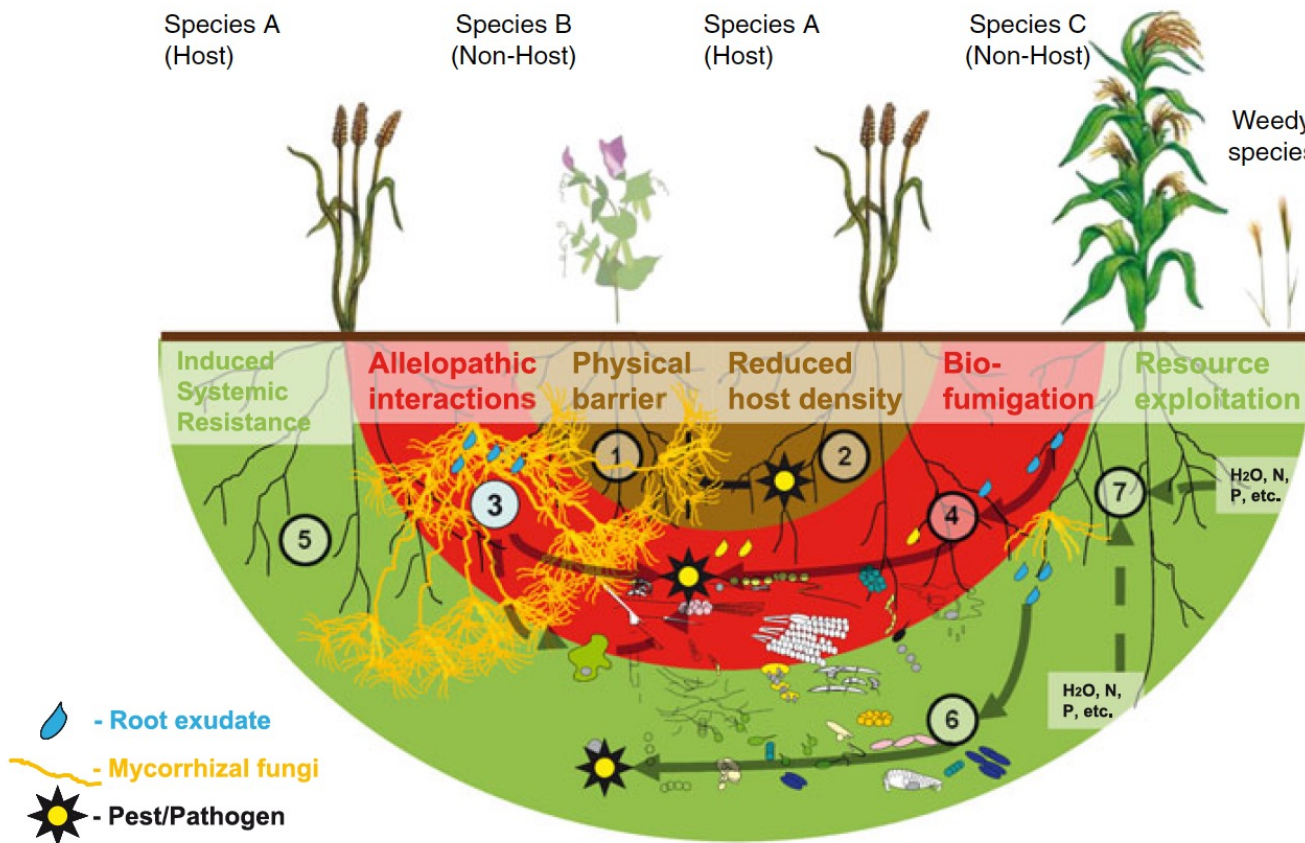
June 02 and 03, 2022 – Towards Pesticide Free Agriculture

A functional ecology approach to co-design crop mixtures

Malick OUATTARA, Raphaël PAUT, Muriel VALANTIN-
MORISON, Safia MEDIENE



Why to promote a biodiversity-based agriculture ?



Ehrmann and Ritz, 2014

- To increase ecological, biochemical and physical processes involved in plants natural defence mechanisms
- But, many combinations between species are possible (Verret *et al.*, 2020)
- And little is known about how to mix species (and varieties) to provide ecosystem services

Need to produce knowledge and tools to help design crop mixtures

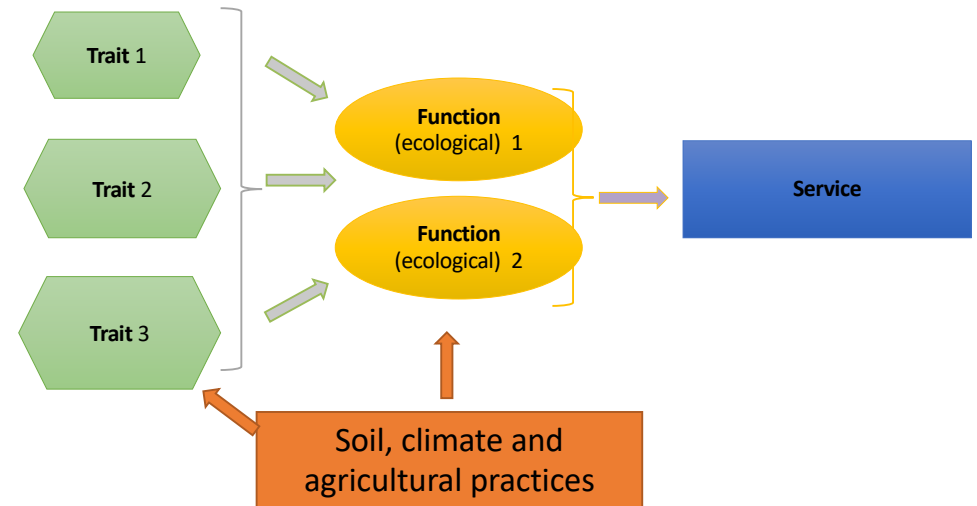


Empirical Knowledge

Scientific Knowledge



Functional Ecology

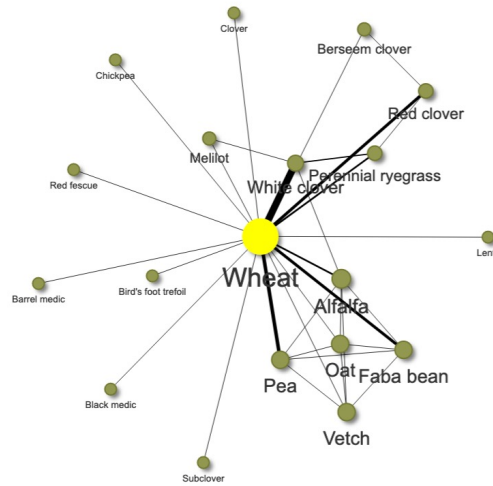


Classification of species mixtures according to their capacity to provide the expected services in the local production context

First outputs of the EcosystemMIX prototype

Online interactive database on crop mixtures: <https://umr-agronomie.shinyapps.io/EcoSystemmix/>

Crop mixture network
here, for the service:
« weed regulation » and
the crop « wheat »

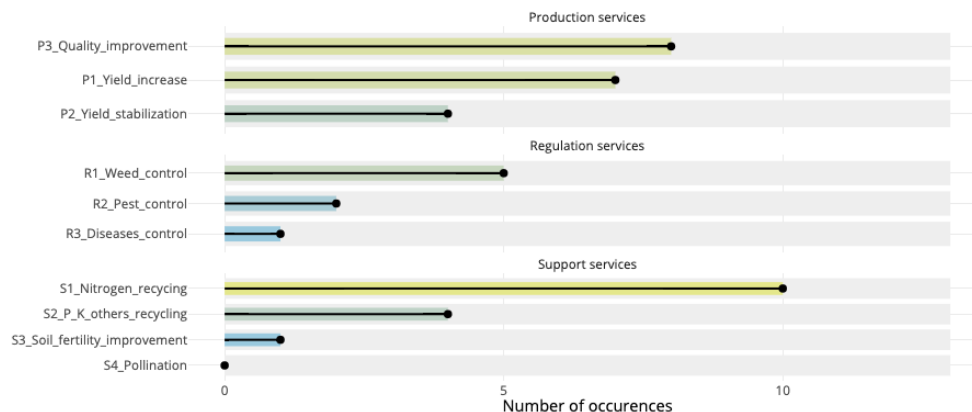


Ajouter nombres d'espèces ou de mélanges de la database

General overview

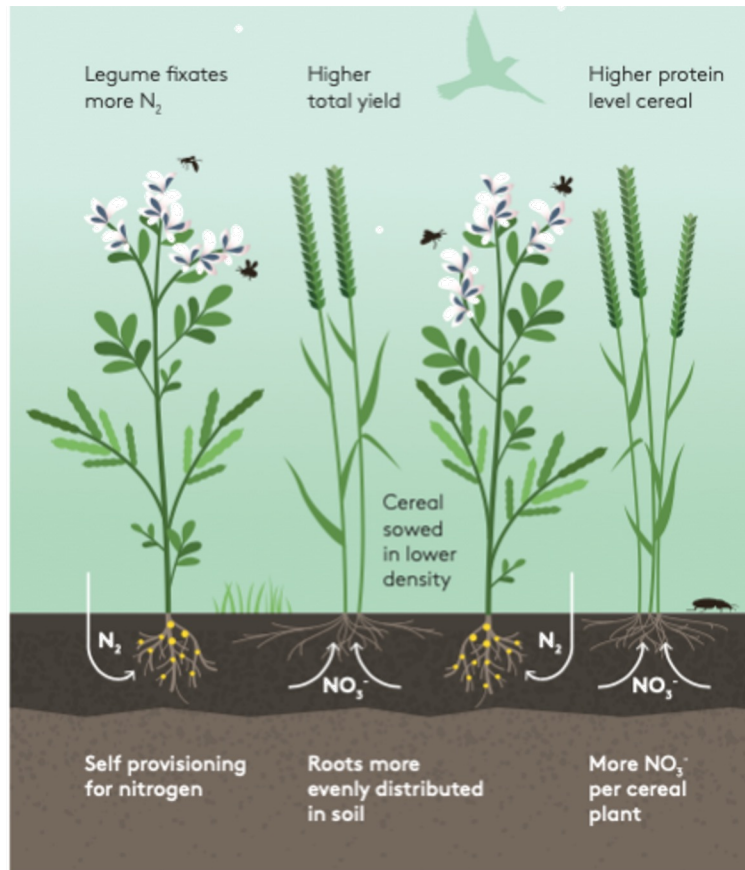
	P1_Yield_increase	P2_Yield_stabilization	P3_Quality_improvement	R1_Weed_control	R2_Pest_control	R3_Diseases_control	S1_Nitrogen_recycling	S2_P_K_others_recycling	S3_Soil_fertility_improvement	S4_Pollination
Barley-Buckwheat	1									1
Barley-Clover-Pea				1						
Barley-Faba bean	2	1	1	1	1			1	1	
Barley-Grass pea				1	1					
Barley-Lentil	1				1					
Barley-Maize						1				1
Barley-Oilseed rape										
Barley-Oilseed rape-Pea										
Barley-Pea	7	1	2	3				7	6	
Barley-Perennial ryegrass					1					
Perennial ryegrass-White clover					2					
Barley-Red clover										
Barley-White clover								1	1	1 1

ID card of a crop mixture (ex: wheat/pea)



Pault et al., 2021

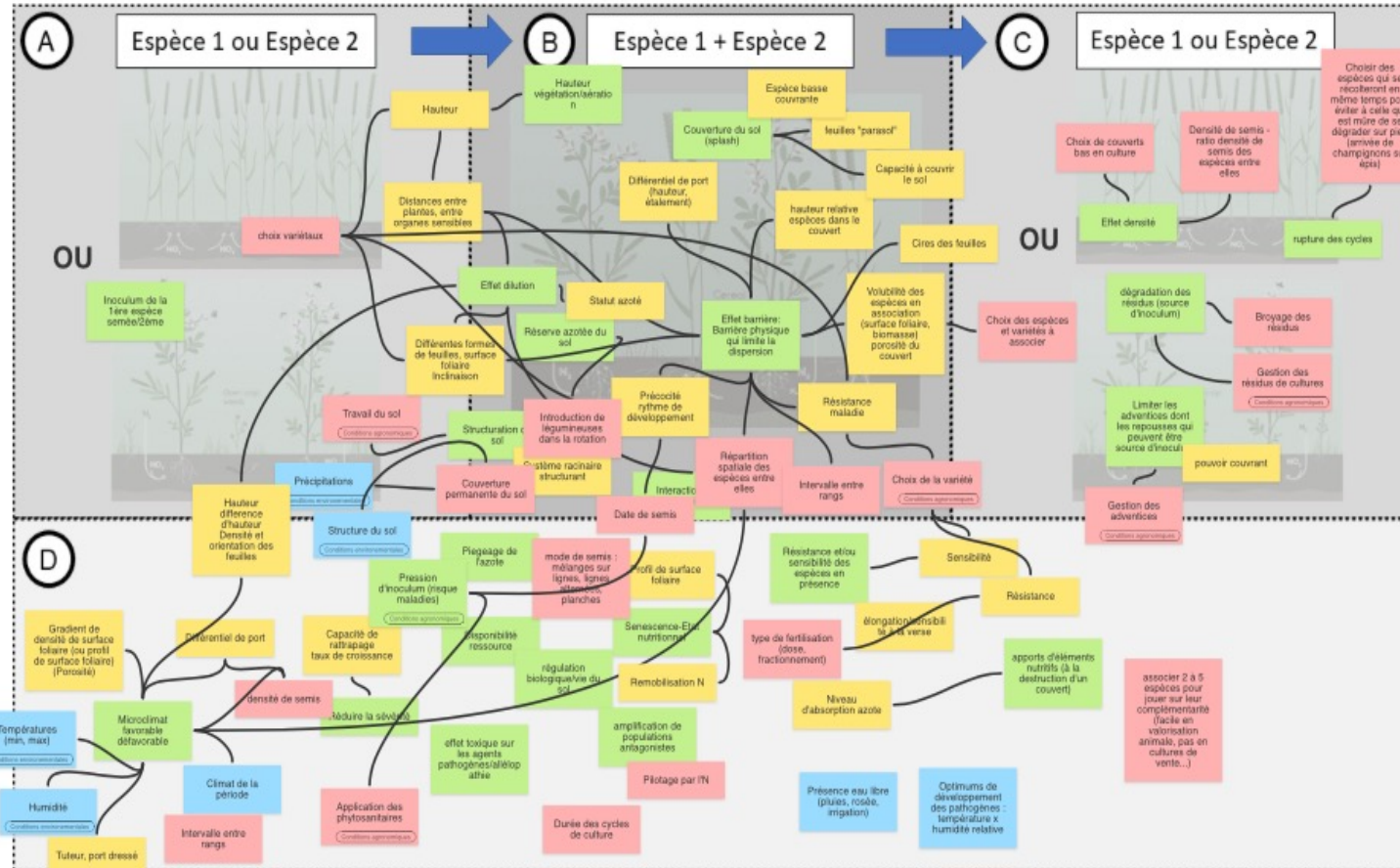
Generic and functional representation of crop mixtures



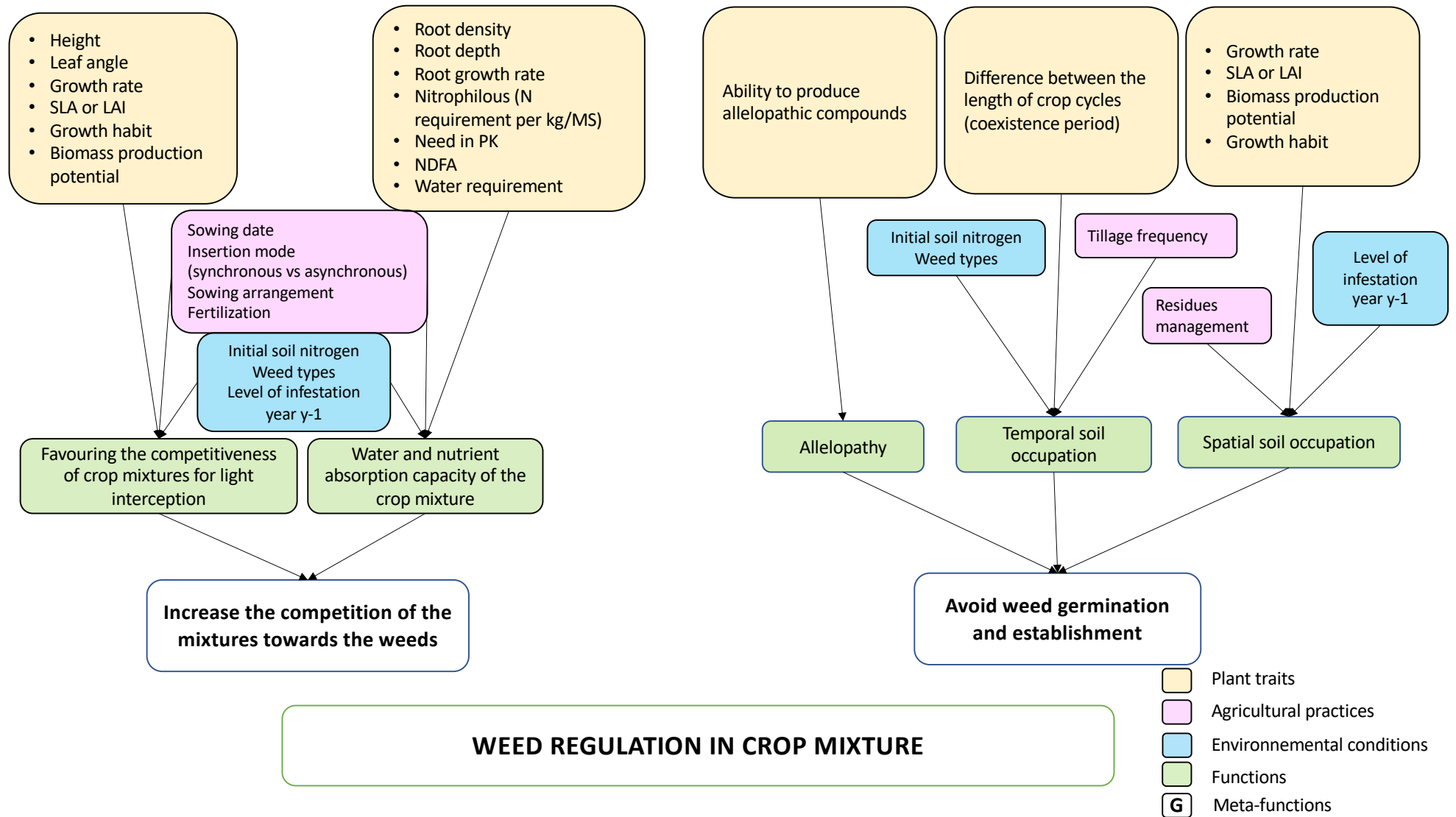
- › Workshops with practitioners and scientists to share knowledge on plant mixtures
- › 5 ecosystem services:
 - › Nitrogen recycling
 - › Weed regulation
 - › Pest regulation
 - › Disease regulation
 - › Production provisioning

Simultaneous cultivation of 2 or more species in the same plot during a significant period of their cycle (Willey, 1979)

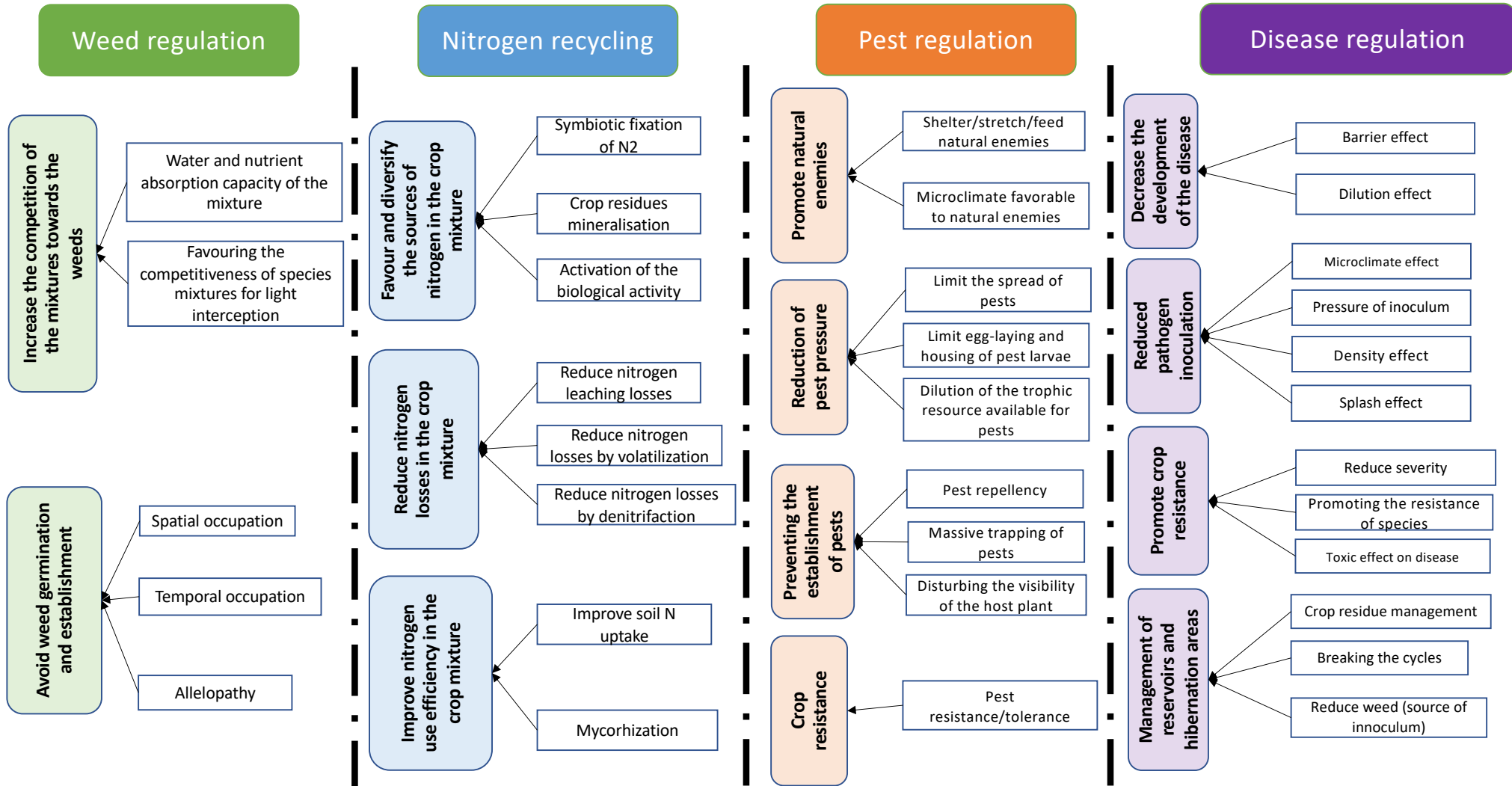
Output of a workshop



Generic and functional representation of crop mixtures

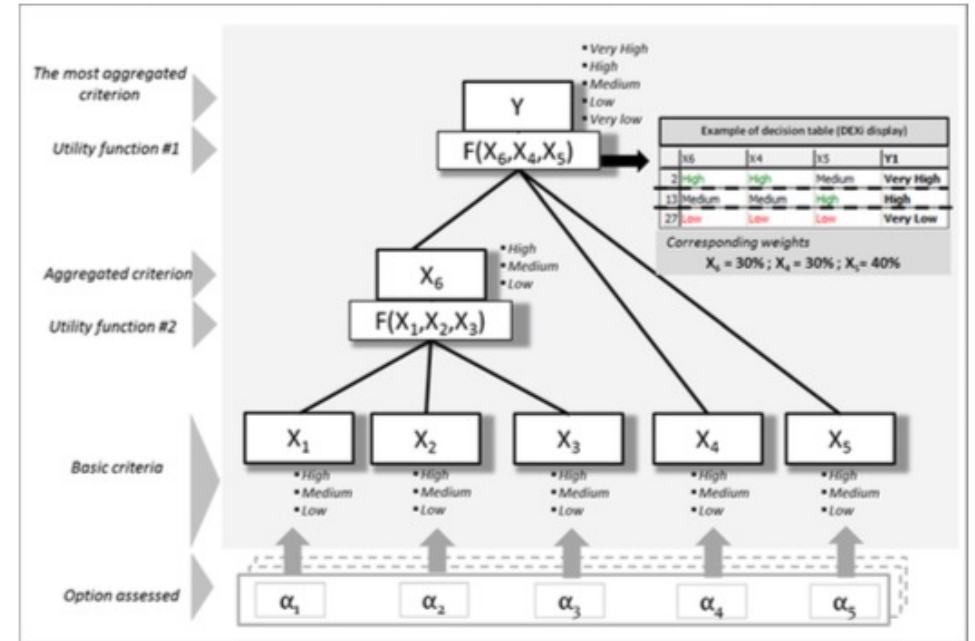


Main functions involved in 4 ecosystem services



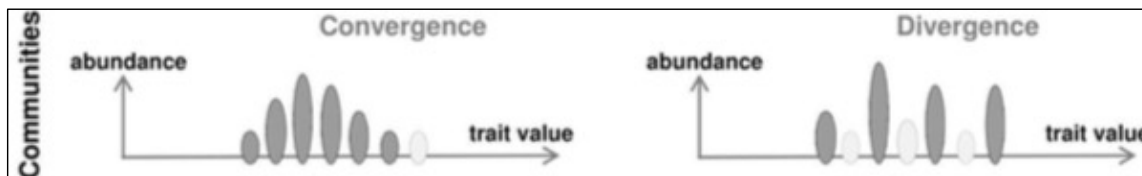
Next steps

- Validate and quantify the functional relationships Traits/Functions/Service
- Qualitative hierarchical multi-attribute model (ex. Dexi)
- Knowledge elicitation (workshops, interviews, surveys)
- Litterature / Database/experiment



Craheix et al., 2015

- Assembly rules of traits in crop mixtures



in Loranger 2015, from de Bello et al., 2013

Thank you for your attention!

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