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Federal Department of Economic Affairs,
Education and Research EAER
Agroscope

Agro-ecosystem: Complexity and biodiversity at various scales and its importance for the agricultural production system

Felix Herzog



Paris, 29.04.2015



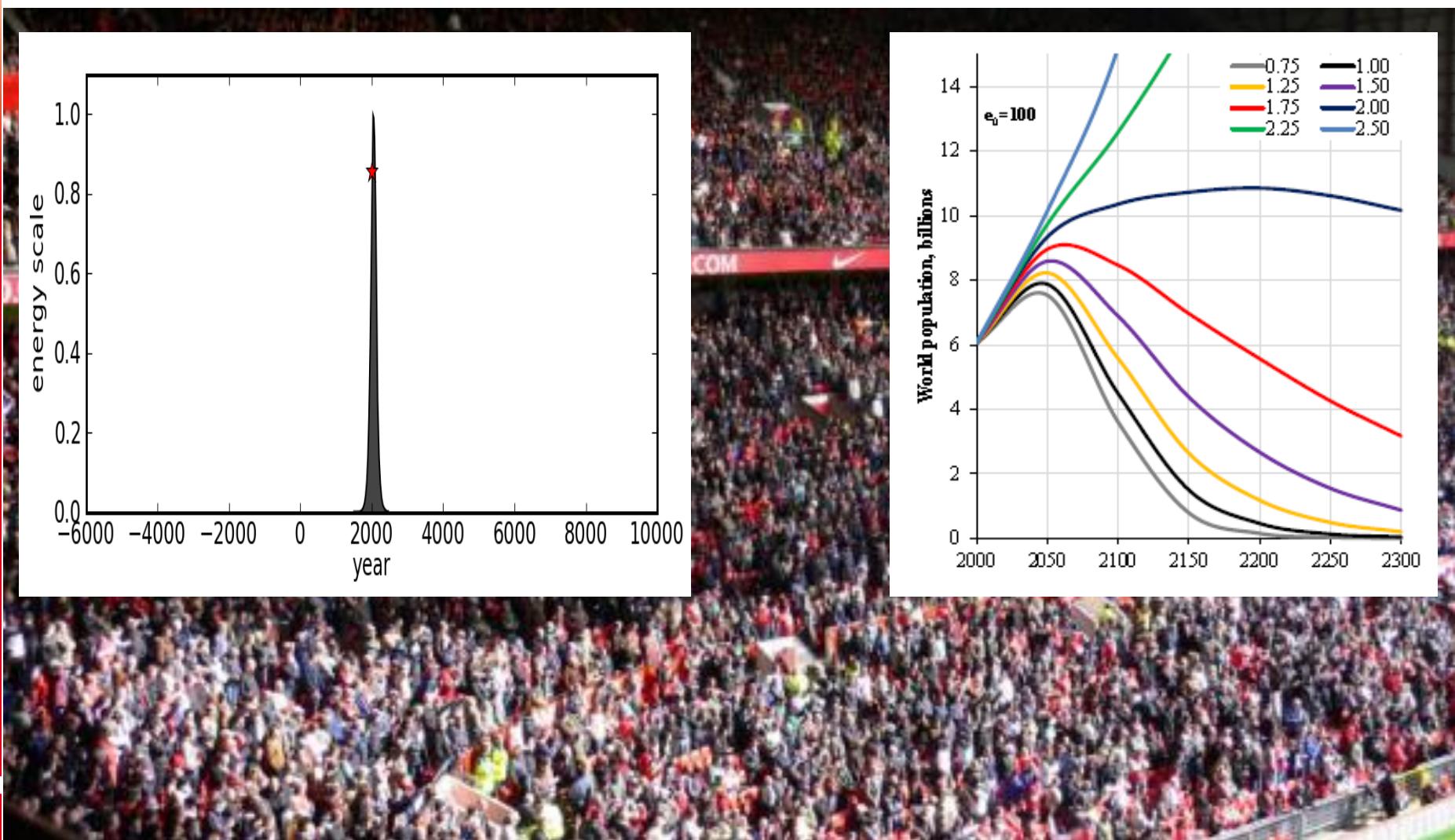


T1: To what extent can biodiversity better support agro-ecosystems / agricultural production systems in terms of multi-functionality and outcomes in a global change context?

T2: Which policies and governance systems can promote the emergence and support of agro-ecosystems / agricultural production systems benefiting from and beneficial to biodiversity and ecosystem services?



The „big picture“: Peak oil – peak child



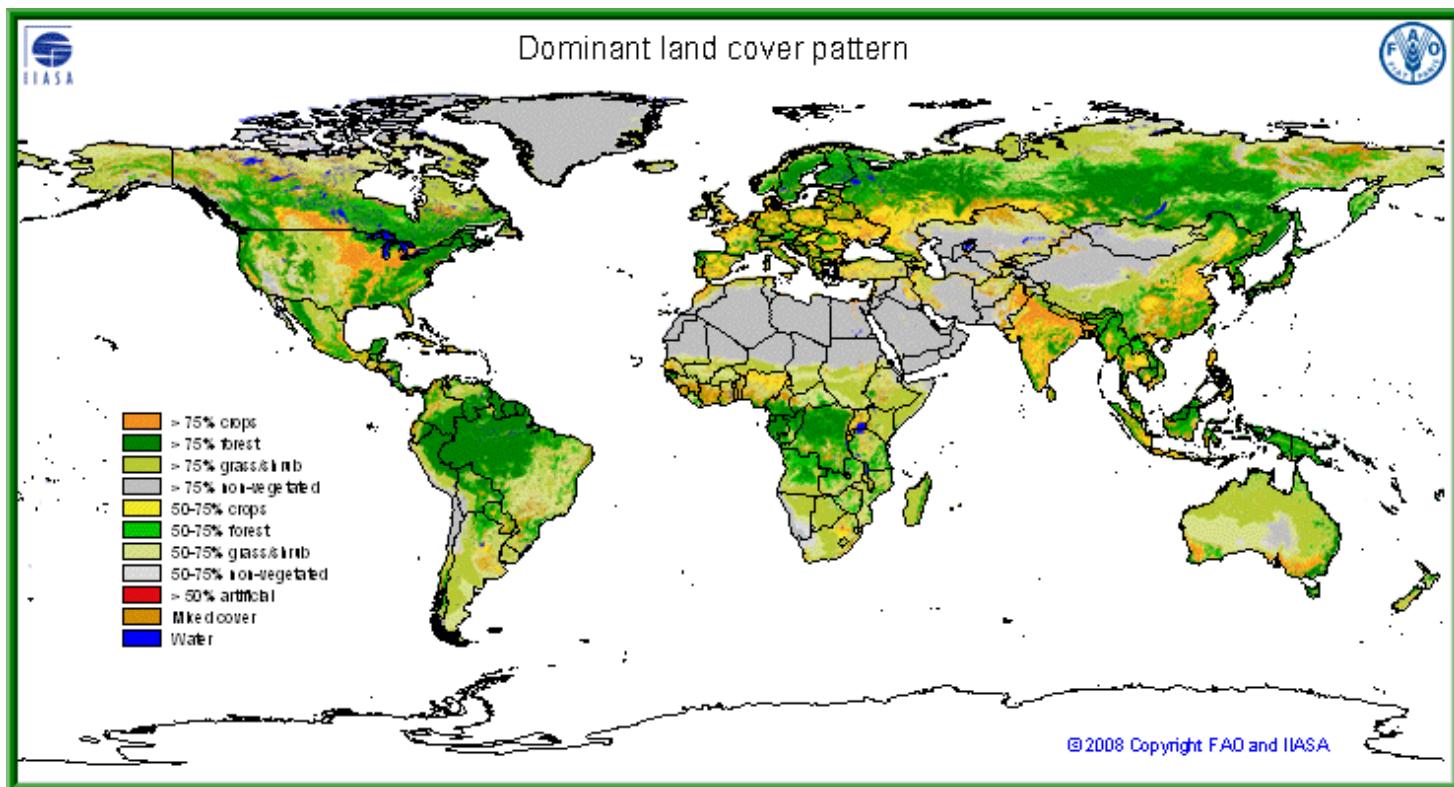


→ Produce more with less



+ climate
change

48 mio. sqkm (1/3 of Global land area)





2013 – 14 Joint Call



BASIL: Landscape-scale biodiversity and the balancing of provisioning, regulating and supporting **ecosystem services**

Eco-serve: Sustainable provisioning of multiple **ecosystem services** in agricultural **landscapes**

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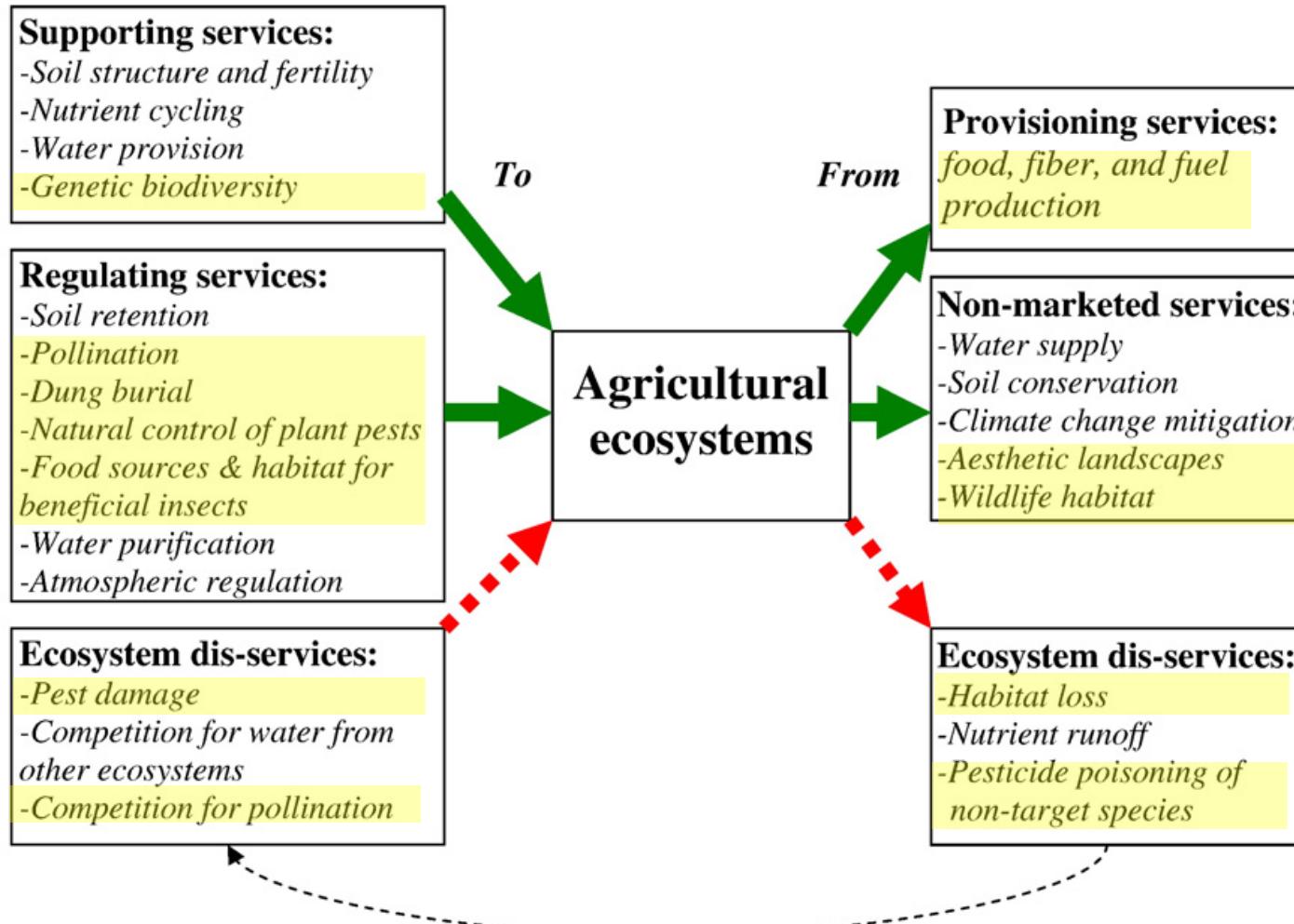
CP³: Civil-Public-Private-Partnerships and collaborative governance approaches for policy innovation to enhance biodiversity and **ecosystem services** delivery in agricultural **landscapes**

BEEHOPE: Honeybee Conservation centres in Western Europe: an innovative strategy using sustainable beekeeping to reduce honeybee decline.



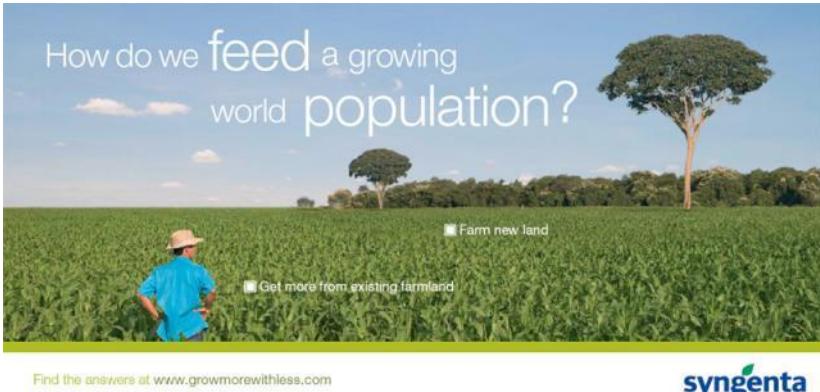
Ecosystem services and dis-services to agriculture

Wei Zhang^{a,*}, Taylor H. Ricketts^b, Claire Kremen^c, Karen Carney^d, Scott M. Swinton^a





Agro-industrial approach



How do we feed a growing world population?

Farm new land
Get more from existing farmland

Find the answers at www.growmorewithless.com

syngenta

This advertisement for Syngenta promotes the agro-industrial approach by suggesting two ways to increase food production: farming new land and getting more from existing farmland. It features a farmer in a field under a blue sky with a large tree in the background.

Adapt the environment to the crop

Agro-ecological approach

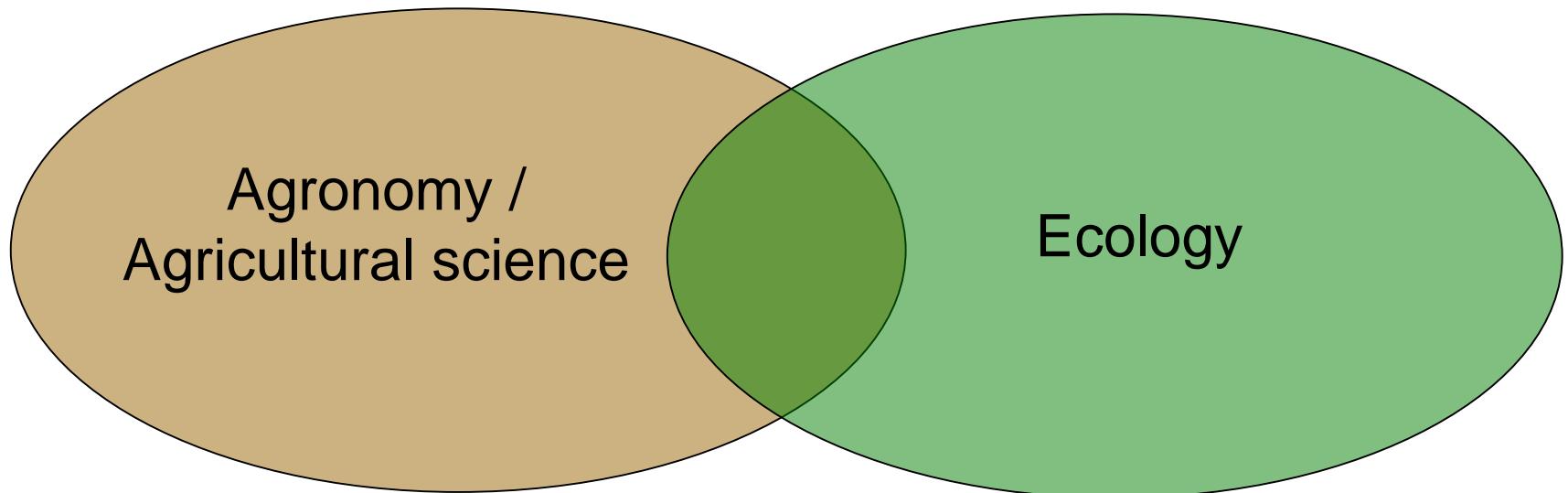


Adapt the cropping system to the environment



What is agro-ecology?

„... the effort to mimic ecological processes in agriculture“

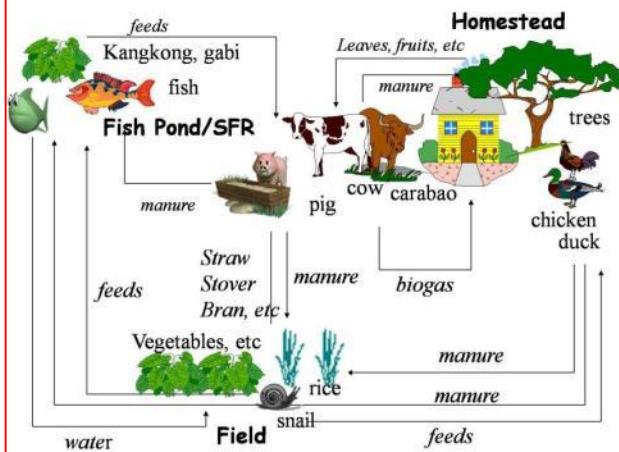




Plot



Farm

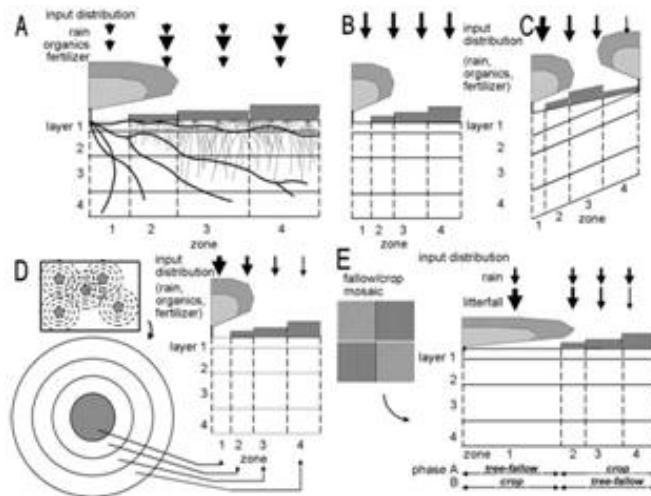
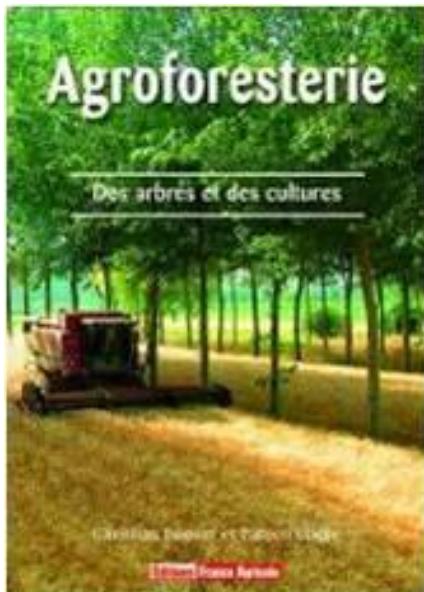


– Landscape



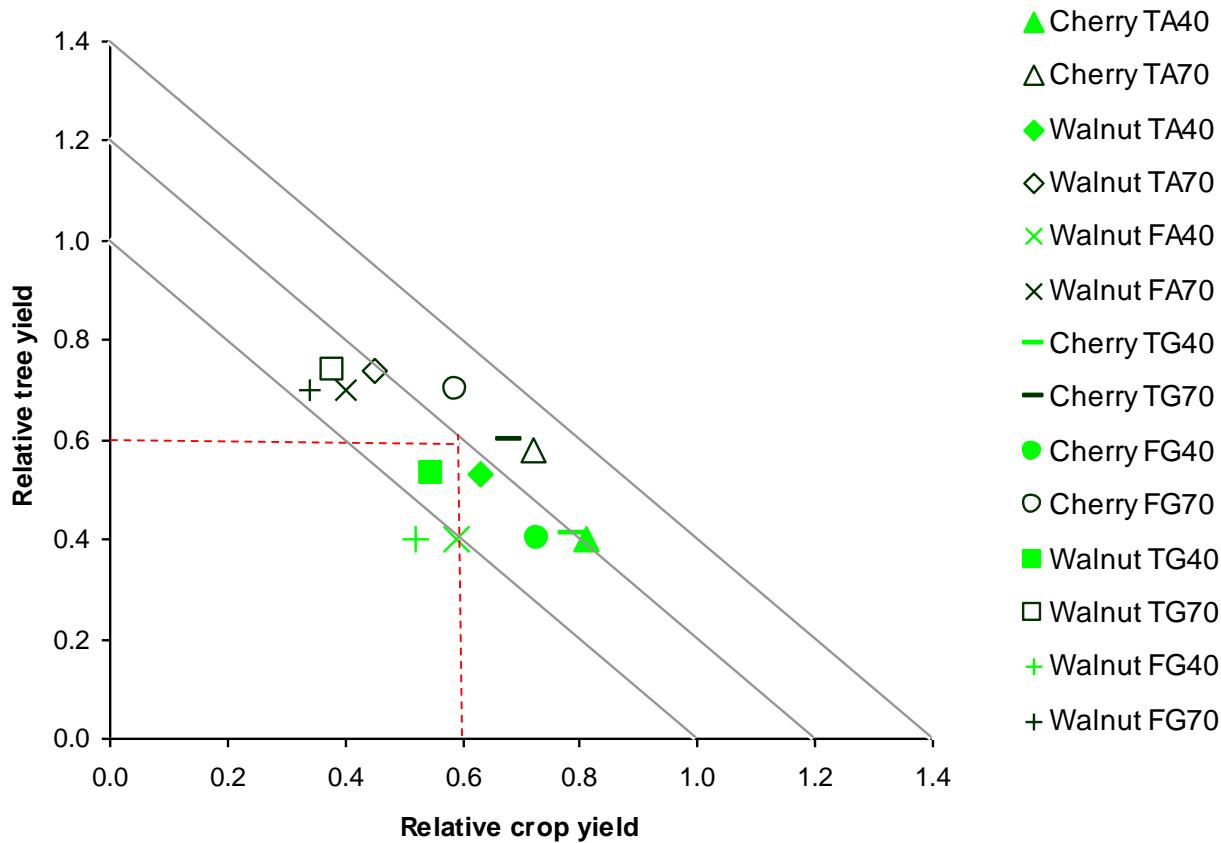


Plot level intensification: Efficient resource capture



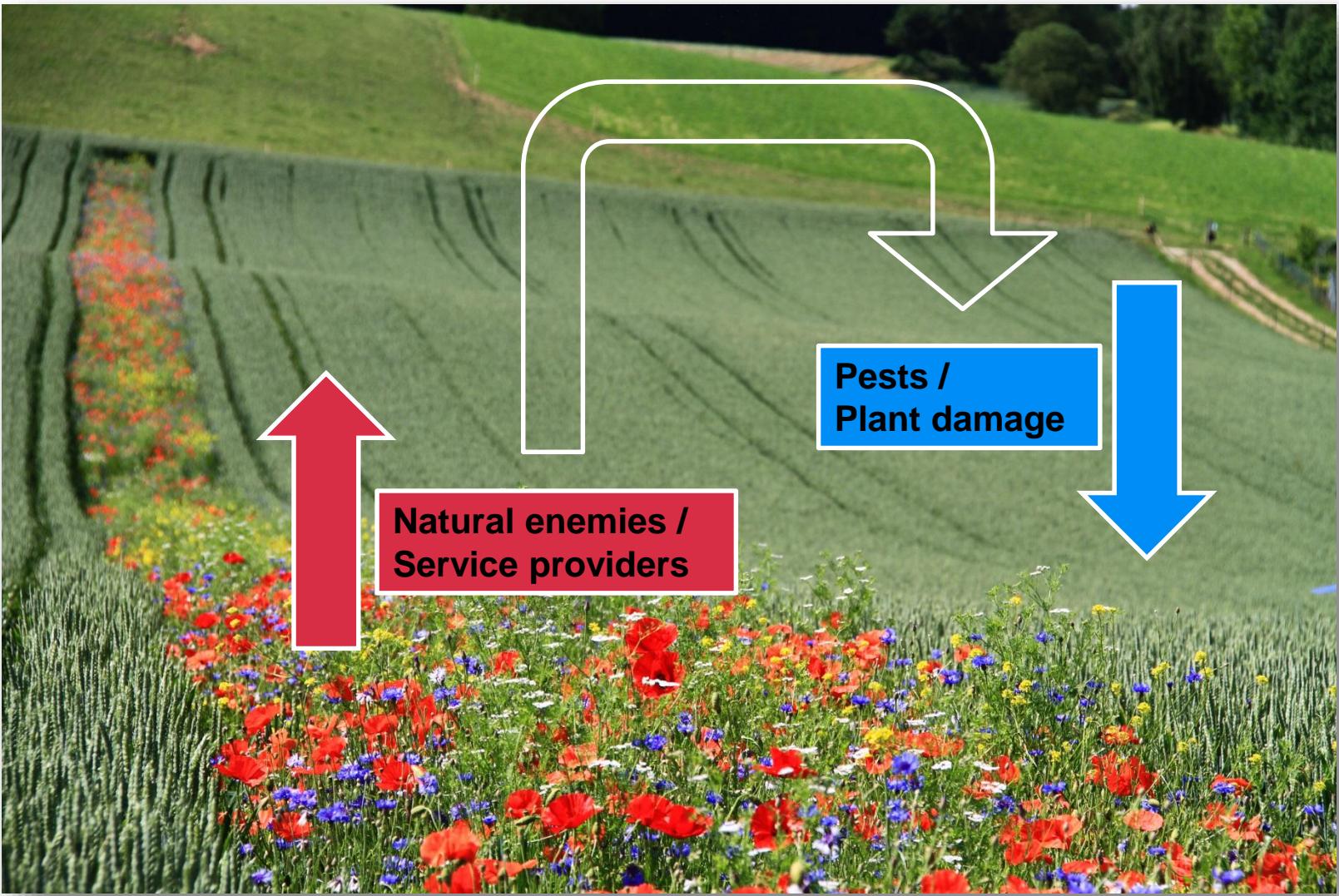


Plot level intensification: Agroforestry LER > 1





Flower strips for pest control





Significant reduction of cereal leaf beetles in wheat

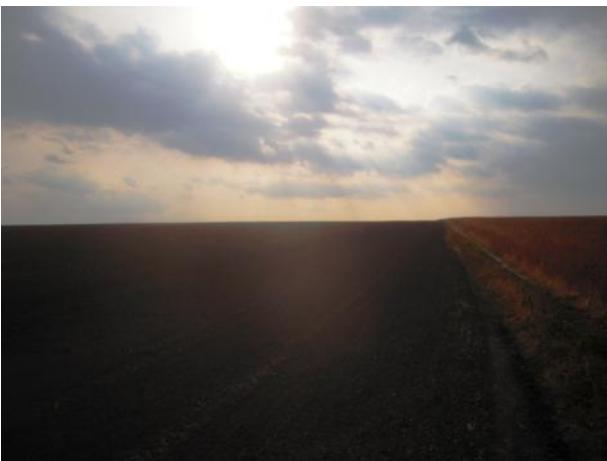
Oulema melanopus L.:



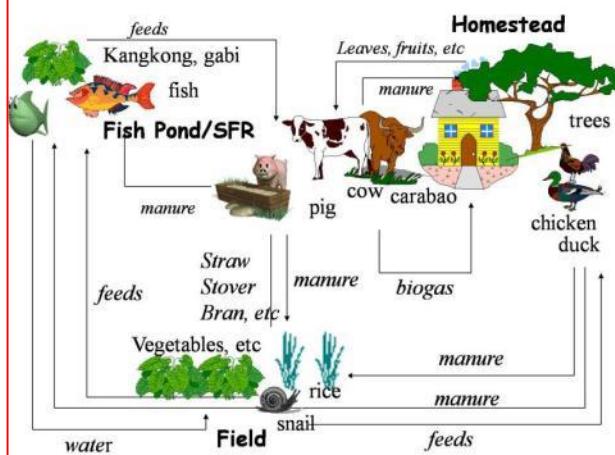
- Larvae feed on leaves of cereals
- Major cereal crop pest in Europe (spreading in N-America)



Plot



Farm

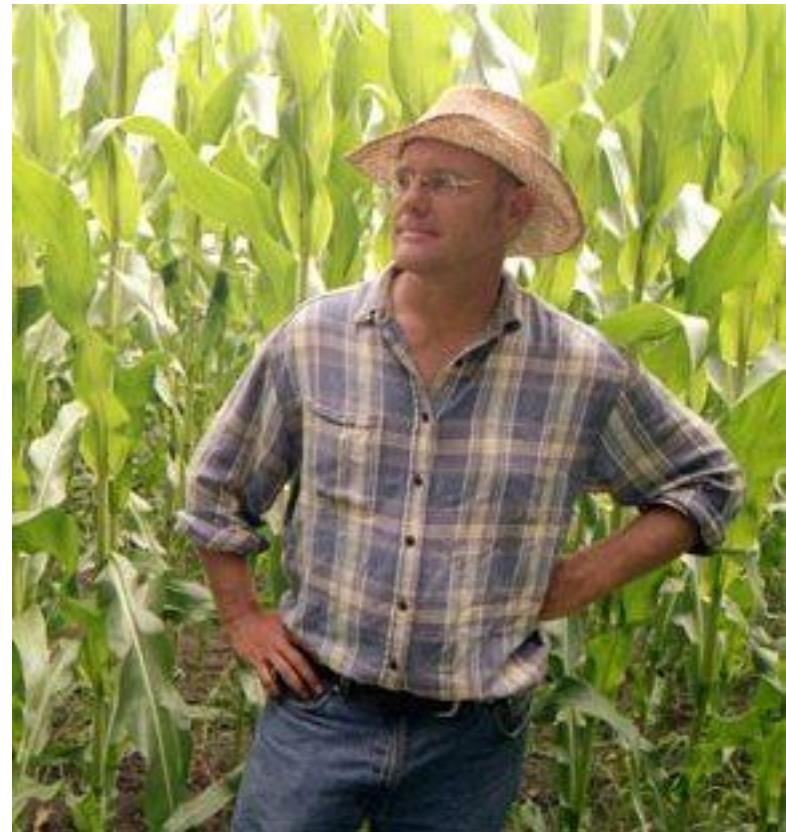
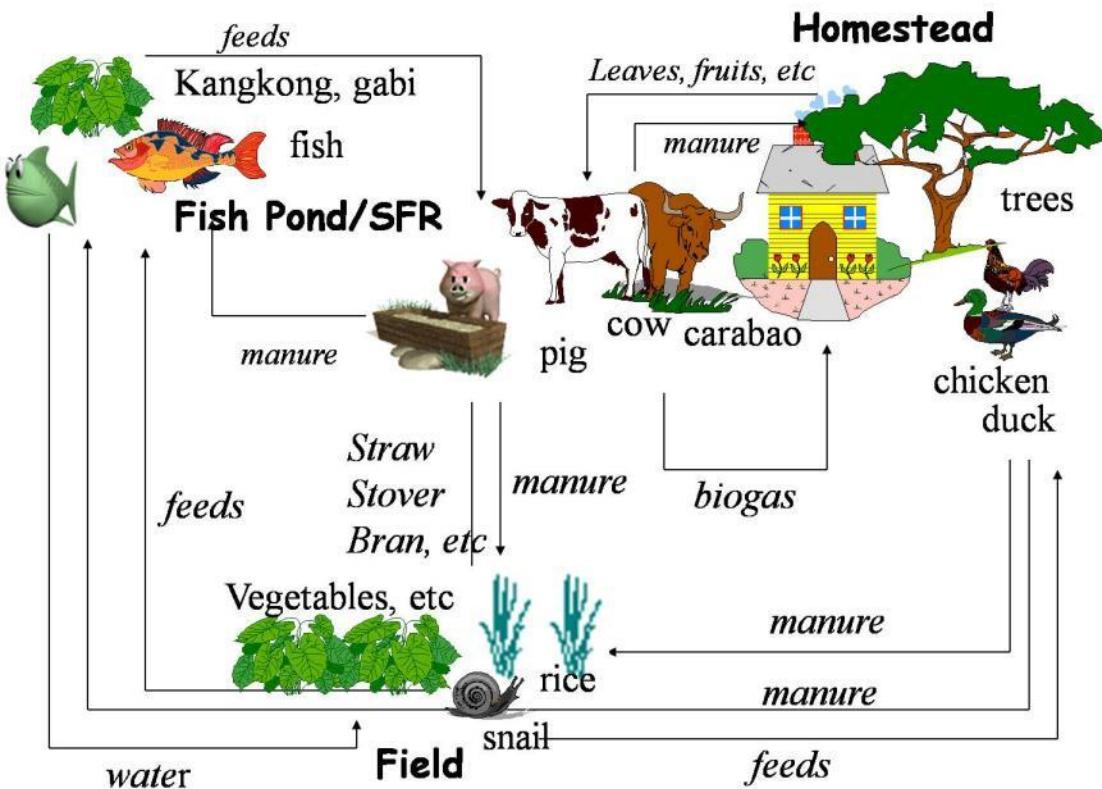


– Landscape





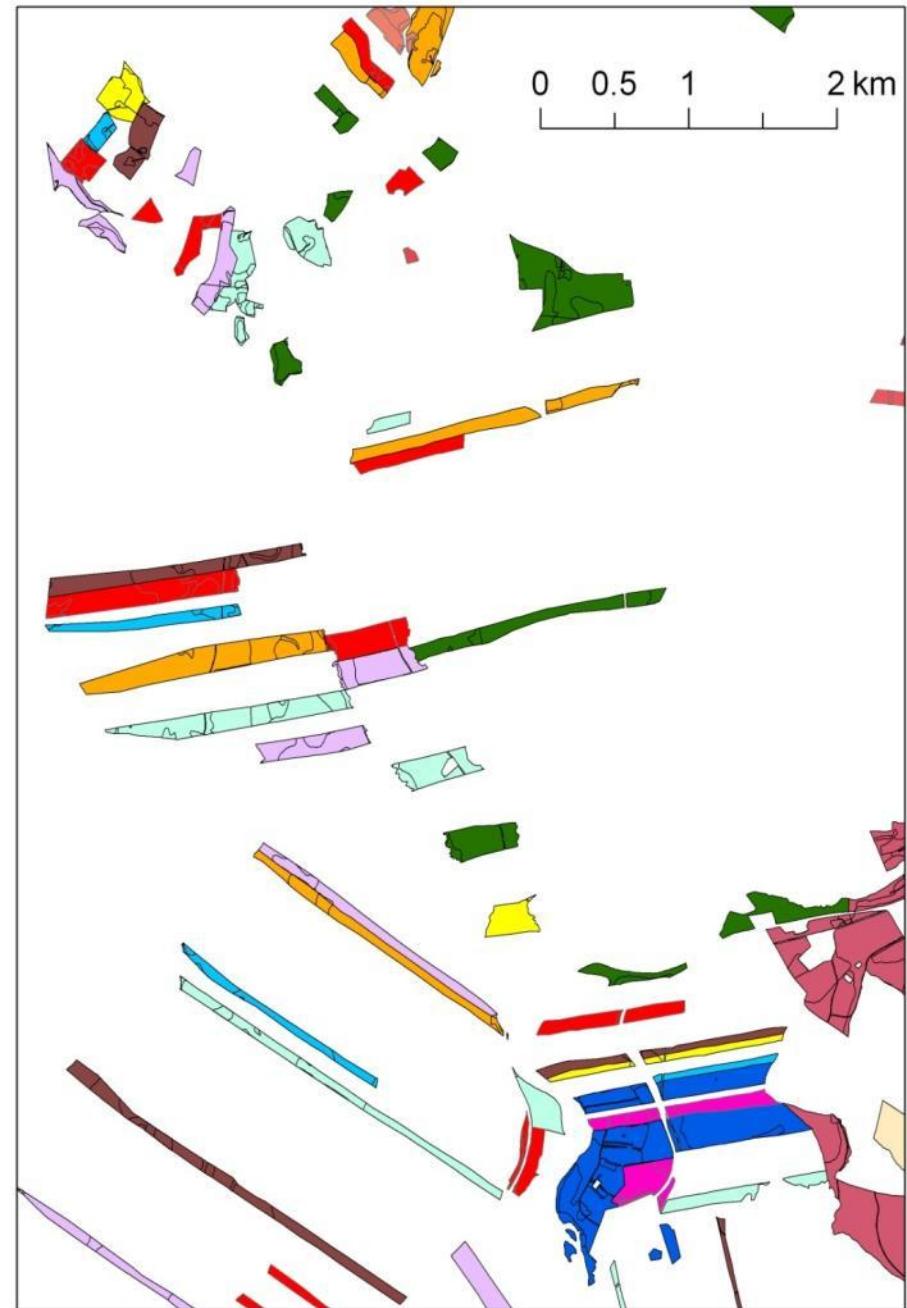
Farming enterprise: Major decision making unit!





Farms are often spatially disaggregated

Farm management units in Norway



© Fjellstad



Farms are often spatially disaggregated

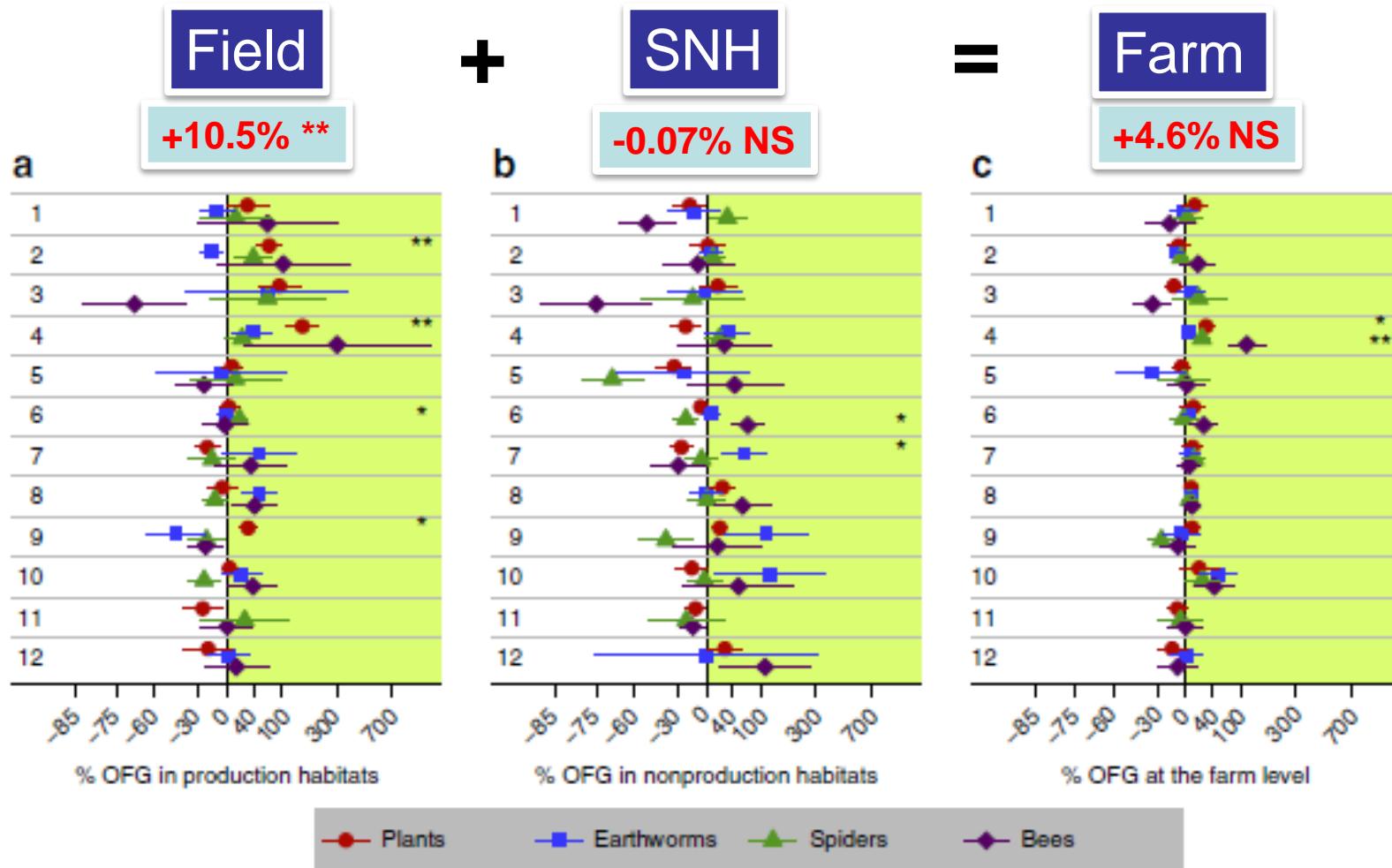
Olive farm in Spain



© G. Moreno



Gains to species diversity in organically farmed fields are not propagated at the farm level



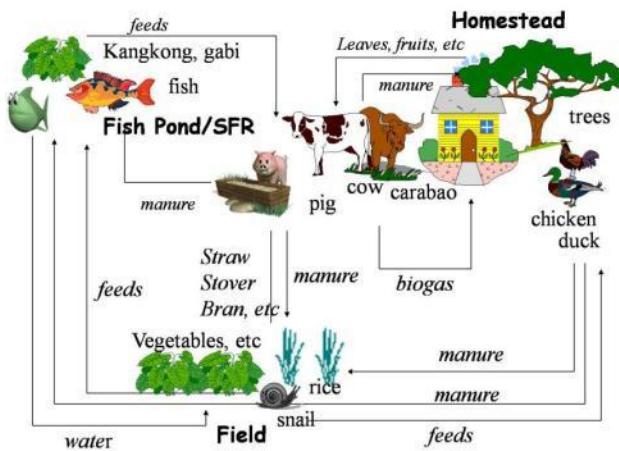
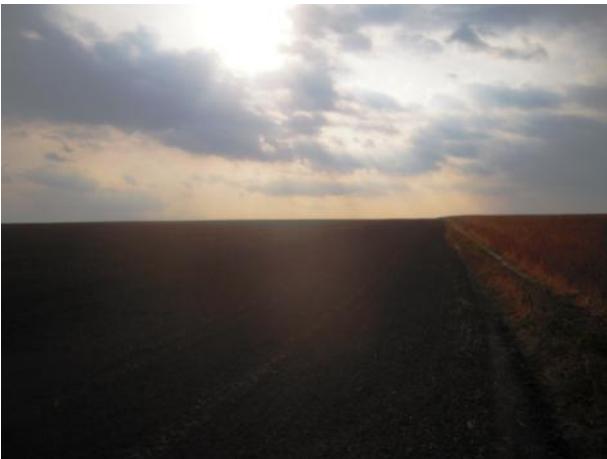


Plot

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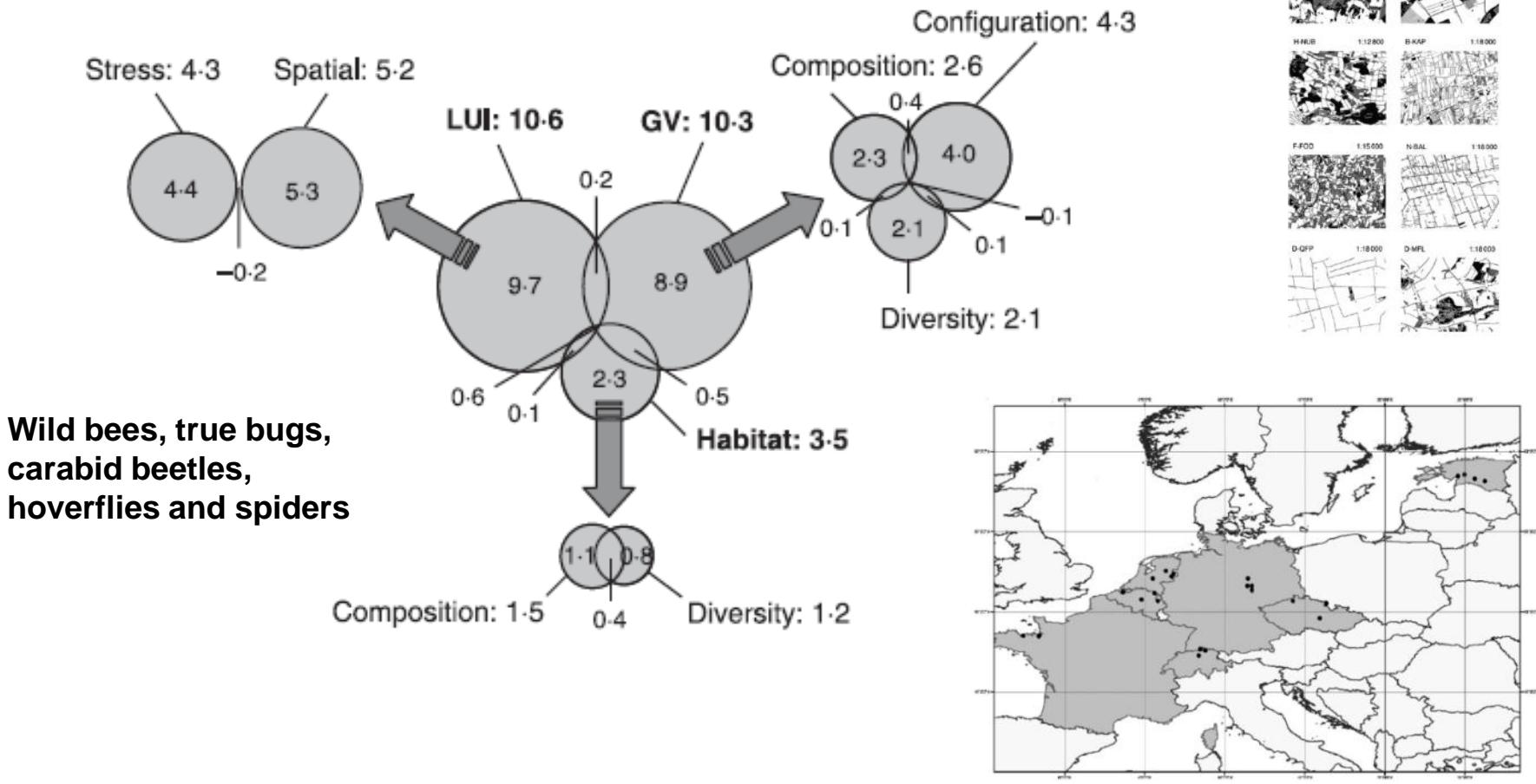
Farm

— Landscape





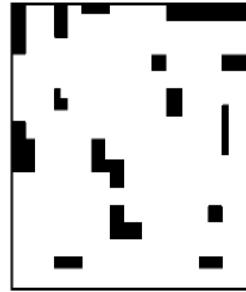
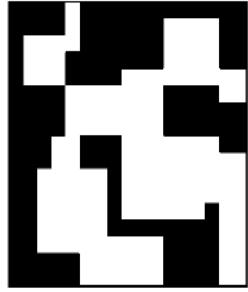
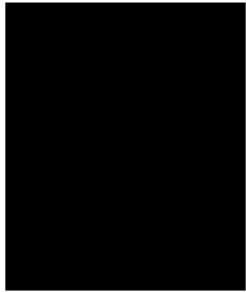
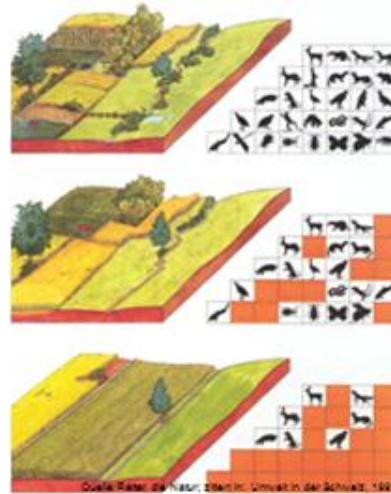
Landscape level Landscape context explains arthropod communities





Landscape fragmentation

Landscape composition (habitat amount)



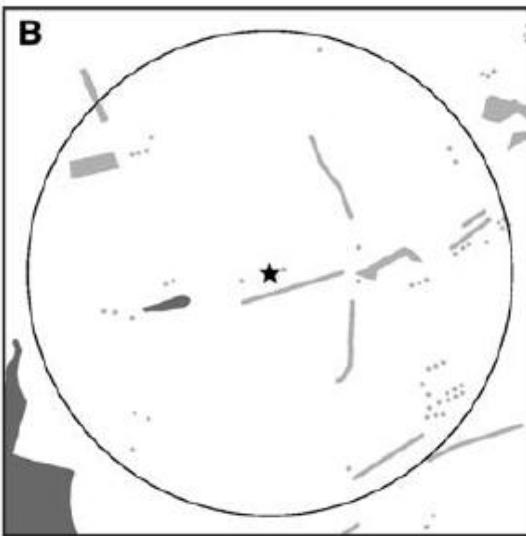
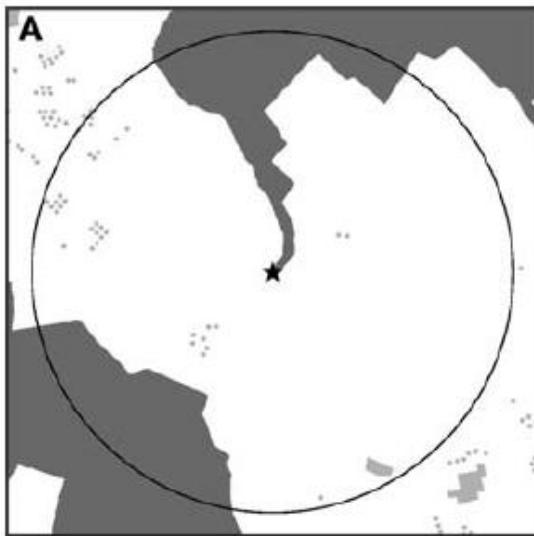
Landscape configuration (connectedness)

→ Usually not differentiated



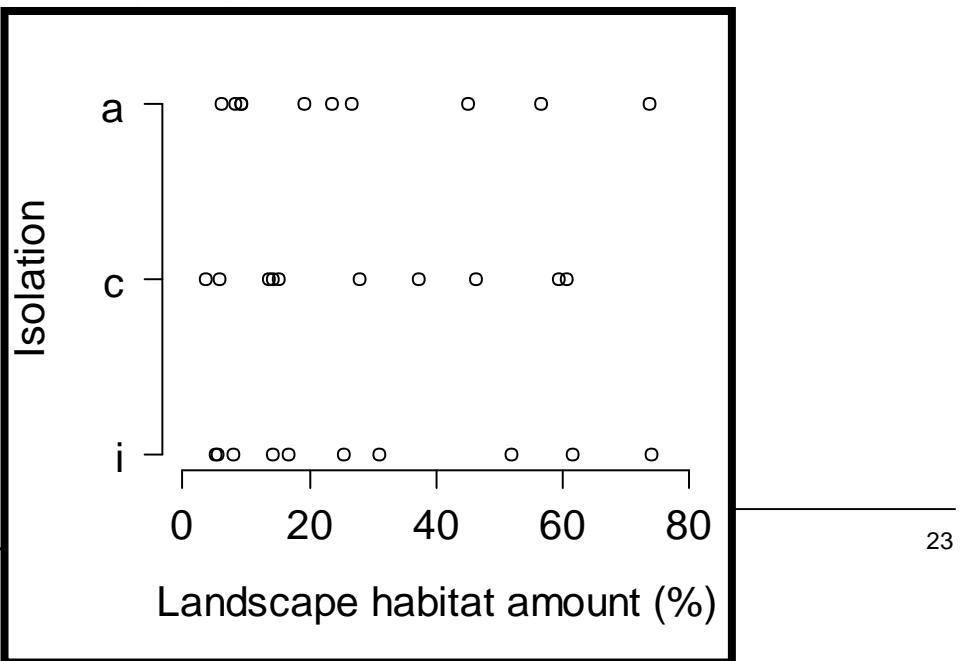
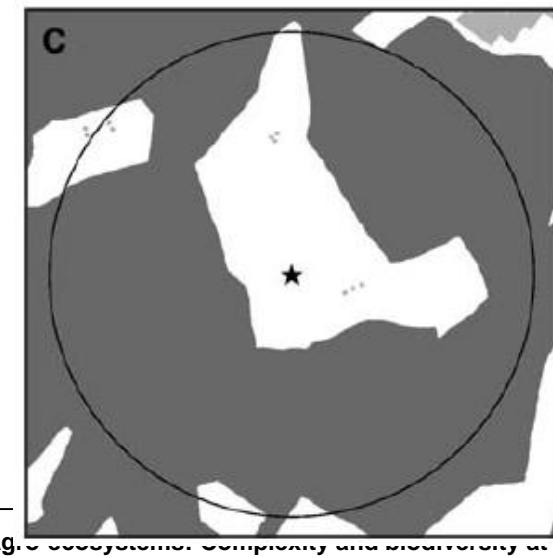
Cherry tree landscape experiment

Adjacent



Connected

Isolated



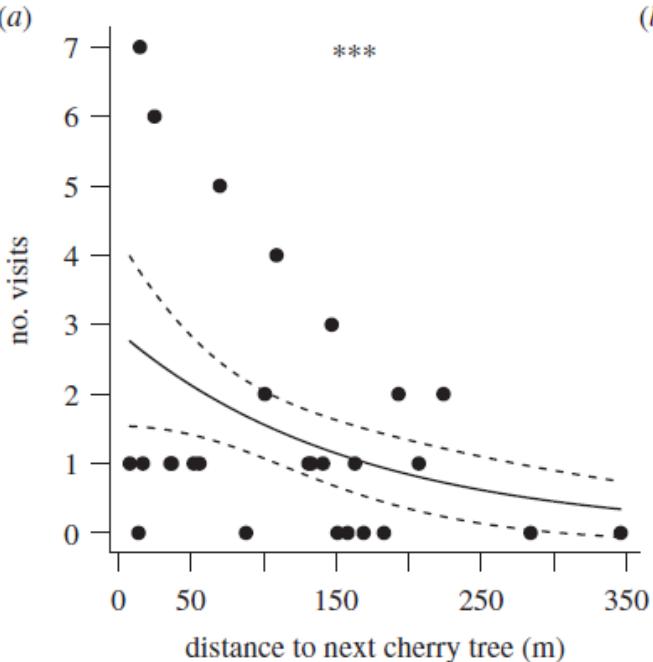






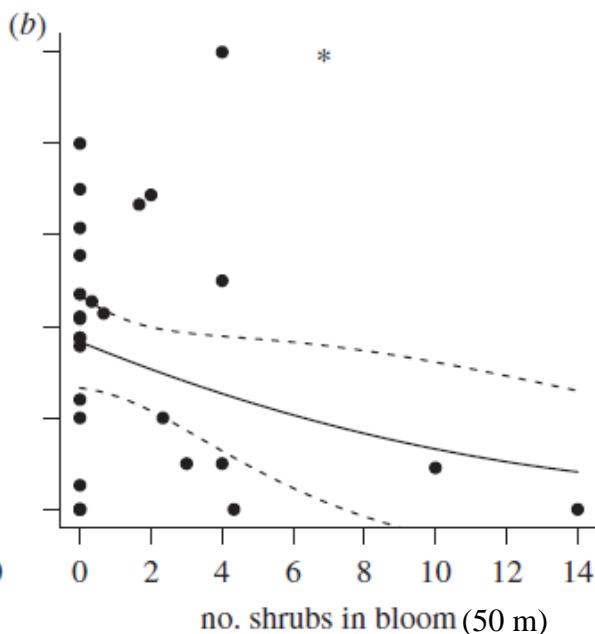
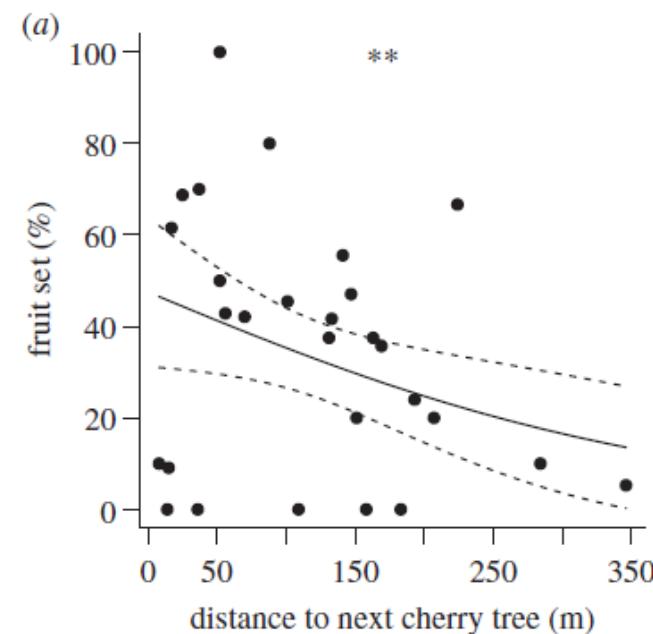
Isolation

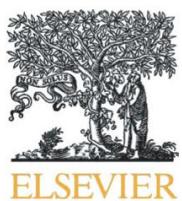
N° of flower visits



Habitat amount

Fruit set (%)





Ecosystem services and dis-services to agriculture

Supporting services:

- Soil structure and fertility
- Nutrient cycling
- Water provision
- Genetic biodiversity

Regulating services:

- Soil retention
- Pollination
- Dung burial
- Natural control of plant pests
- Food sources & habitat for beneficial insects
- Water purification
- Atmospheric regulation

Ecosystem dis-services:

- Pest damage
- Competition for water from other ecosystems
- Competition for pollination

To

From

Agricultural ecosystems

Provisioning services:

- food, fiber, and fuel production

Non-marketed services:

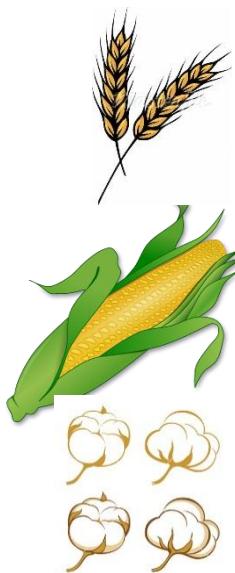
- Water supply
- Soil conservation
- Climate change mitigation
- Aesthetic landscapes
- Wildlife habitat

Ecosystem dis-services:

- Habitat loss
- Nutrient runoff
- Pesticide poisoning of non-target species



Neglecting dis-services: «Major weakness of ES approach» (Lele et al. 2013)



Period	Yield (kg/ha)	Actual loss [%]			Total
		Weeds	Animal pests	Diseases	
Wheat					
1964/65 ¹	1250	9·8	5·0	9·1	23·9
1988–90 ²	2409	12·3	9·3	12·4	34·0
2001–03	2691	7·7	7·9	12·6	28·2
Maize					
1964/65 ¹	2010	13·0	12·4	9·4	34·8
1988–90 ²	3467	13·1	14·5	10·8	38·3
2001–03	4380	10·5	9·6	11·2	31·2
Cotton					
1964/65 ¹	1029	4·5	11·0	9·1	24·6
1988–90 ²	1583	11·8	15·4	10·5	37·7
2001–03	1702	8·6	12·3	7·9	28·8

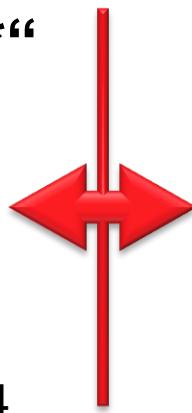


Neglecting dis-services: «Major weakness of ES approach» (Lele et al. 2013)

„ecosystem* AND service“
16'786 REFs

- 13 also «dis-service»

ISI WoS 2005 - 2014



„crop* AND diseas*“
67'125 REFs

„crop* AND pest*“
53'523 REFs



biodiversa

Collaborative research

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Collaborative research

- Interdisciplinary and International
- Transaction costs ...
... but added value!





Thank you for your attention



Agroscope good food, healthy environment