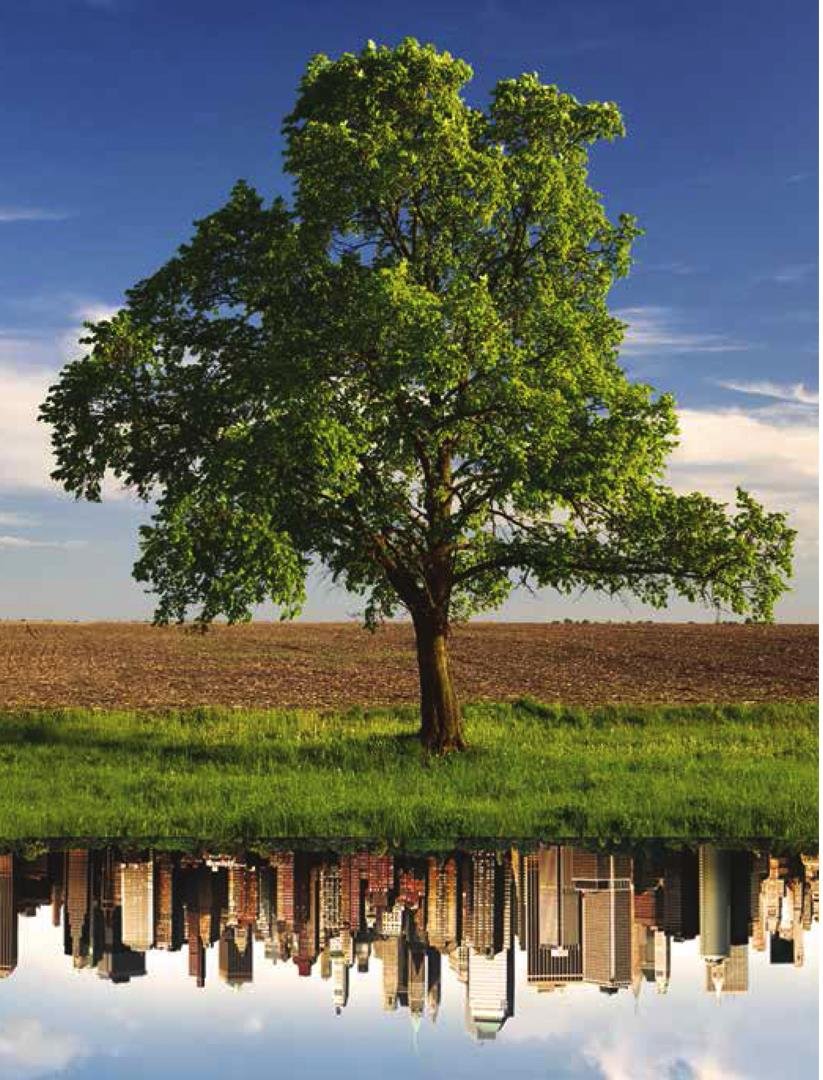


METROPOLI AGRICOLE

The contribution of agroecology to sustainable food systems in metropolitan areas

The role of agroecology in designing sustainable food systems: the experience of the peri-urban rural area of Gallecs (Barcelona, Catalonia)

F. Xavier Sans Serra

Universitat de Barcelona (ES) & Agroecology Europe

The world agriculture is not sustainable

- Doesn't work; shows dramatic signs of imminent failure

~ Soil erosion and soil fertility problems
~ Environmental pollution
~ Decrease water resources and of drinking water
~ Loss of cultivated and natural biodiversity
~ Increase of healthy problems

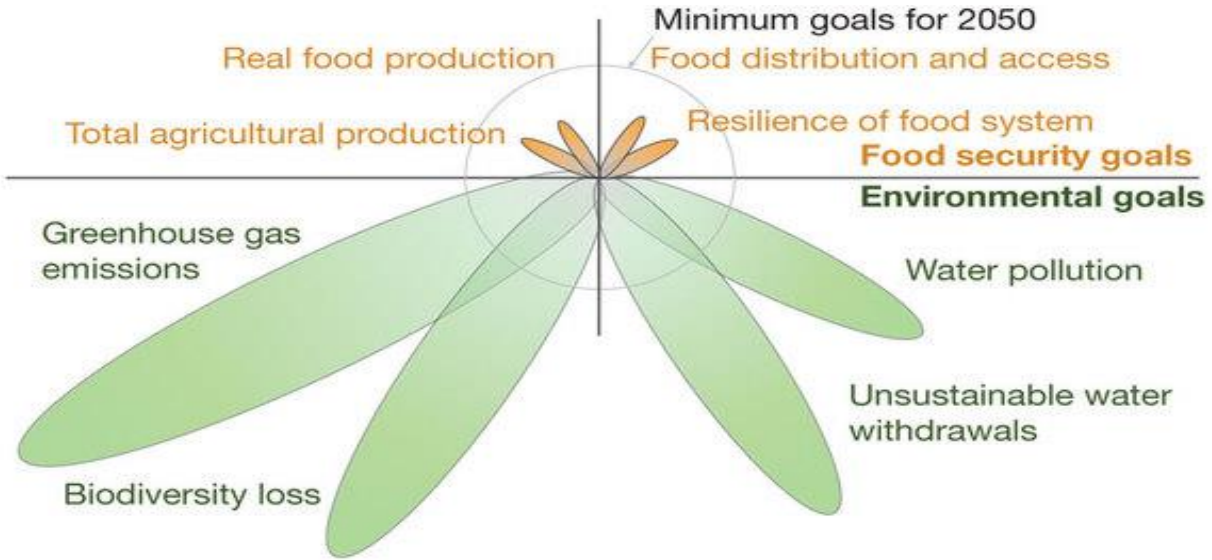
~ Increase of dependence on external inputs
~ Decrease of energy efficiency

~ Decrease in the percentage of resources generated by agrarian activity that arrive to the farmer
~ Increase of poverty and hunger (poverty-poor countries inequality)
~ Decrease of rural population
~ Loss of cultural diversity

- Promote the imbalance between rich and poor countries (first-third world)

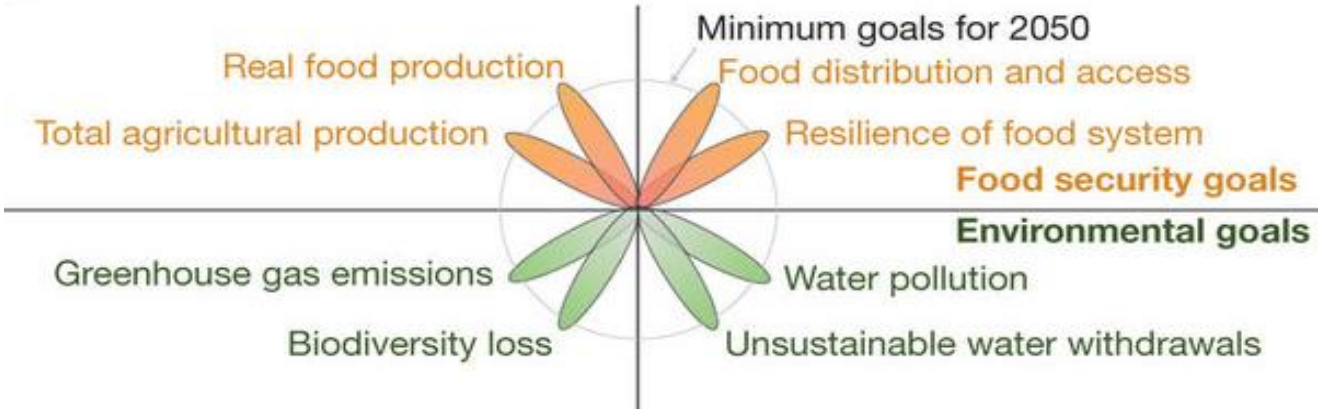
~ Changes associated with the onset of the superpowers in the world development (Brazil, Russia, India, China -BRIC countries-

Qualitative assessment of how current agricultural systems may be measured against the criteria compared to goals for 2050



Source: J. A. Foley et al. 2011. Nature 478: 337-342

Hypothetical situation in which we meet the food security and environmental sustainability goals by 2050

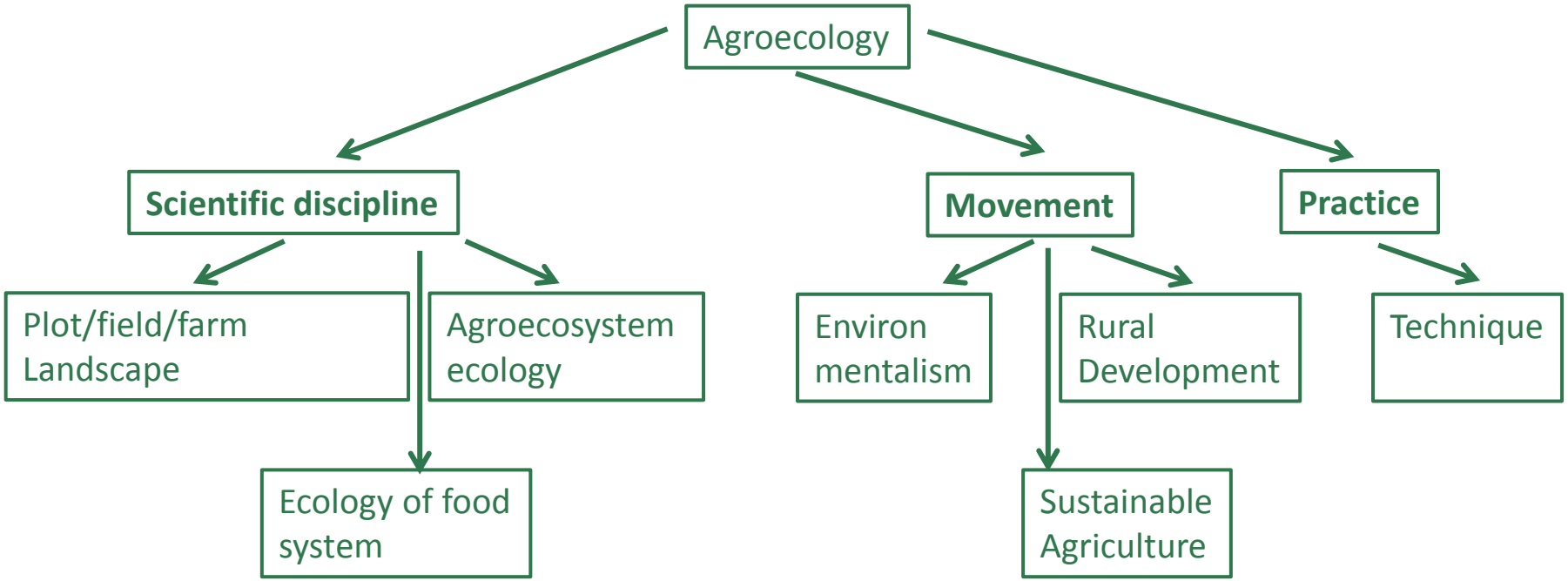


Source: J. A. Foley et al. 2011. Nature 478: 337-342

Some important works in the history of agroecology

1939 H. Hanson	Ecology in agriculture
1956 G. Azzi	Agricultural ecology
1973 D.H. Janzen	Tropical agroecosystems
1974 J.L. Harper	The need for a focus on agroecosystems
1978 S. Gliessman	Memorias del seminario regional sobre agricultura agrícola tradicional
1983 M.A. Altieri	Agroecology
1984 G. Douglas	Agricultural sustainability in a changing world order
1990 N. Lampkin	Organic farming
1995 M.A. Altieri	Agroecology: the science of sustainable agriculture (3rd edition)
1997 S. Gliessman	Agroecology: ecological processes in sustainable agriculture
2004 Clements and Shrestha (eds)	New dimensions in agroecology
2007 Gliessman	Agroecology: the ecology of sustainable food systems

Agroecology



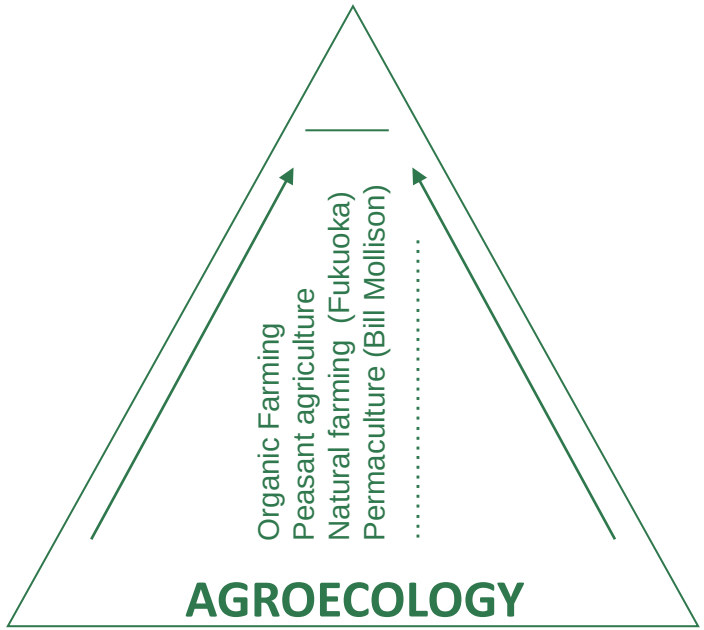
Source: Wezel al. Agron. Sustain. Dev. 29: 503-515

Agroecology

Criterion

Sustainability

Strategies



Discipline

AGROECOLOGY

Agroecological transition

- A complex process that must be articulate at different scales and in several dimensions of sustainability

- Plot / farm scale
- Local society scale (i.e. municipality)
- Greater society scale (i.e. region)
- Interaction of different spatial scales

- Agronomic-technical dimension
- Ecological dimension
- Economic dimension
- Social dimension
- Cultural dimension

§ Sustainability requires addressing all dimensions!

Agroecological transition

Agronomic–technical dimension
- Yield stability
- Organic matter balance
- Nutrients balance

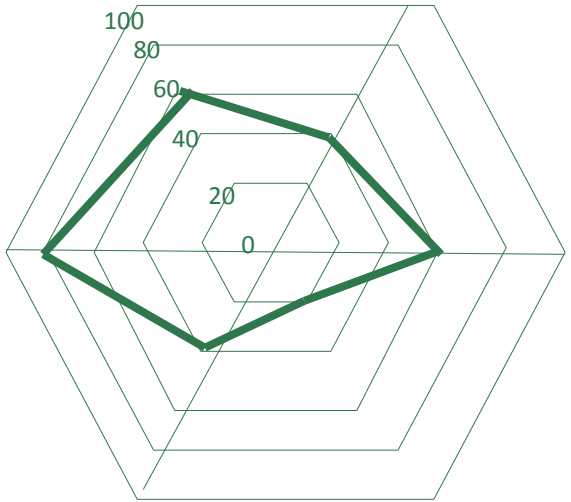
Economic dimension
- Investments
- Economic resilience
- Local economy
- Sale of products and services
- Materials/contaminants/waste

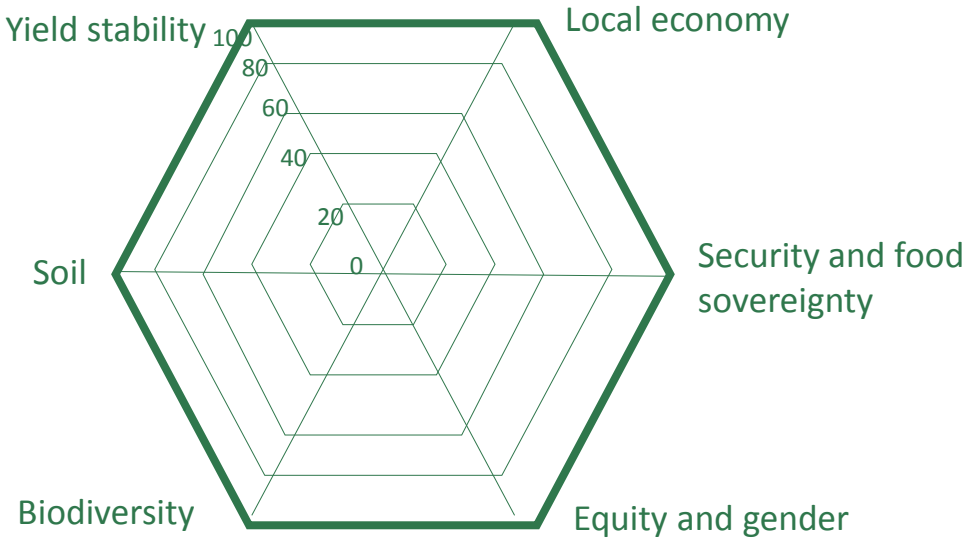
Social dimension
- Equity and gender
- Right to food
- Labour and human rights
- Safety and hygiene

Cultural dimension
- Personal growth and community development
- Security and food sovereignty
- Quality products

Ecological dimension
- Water
- Soil
- Biodiversity
- Livestock production
- Energy

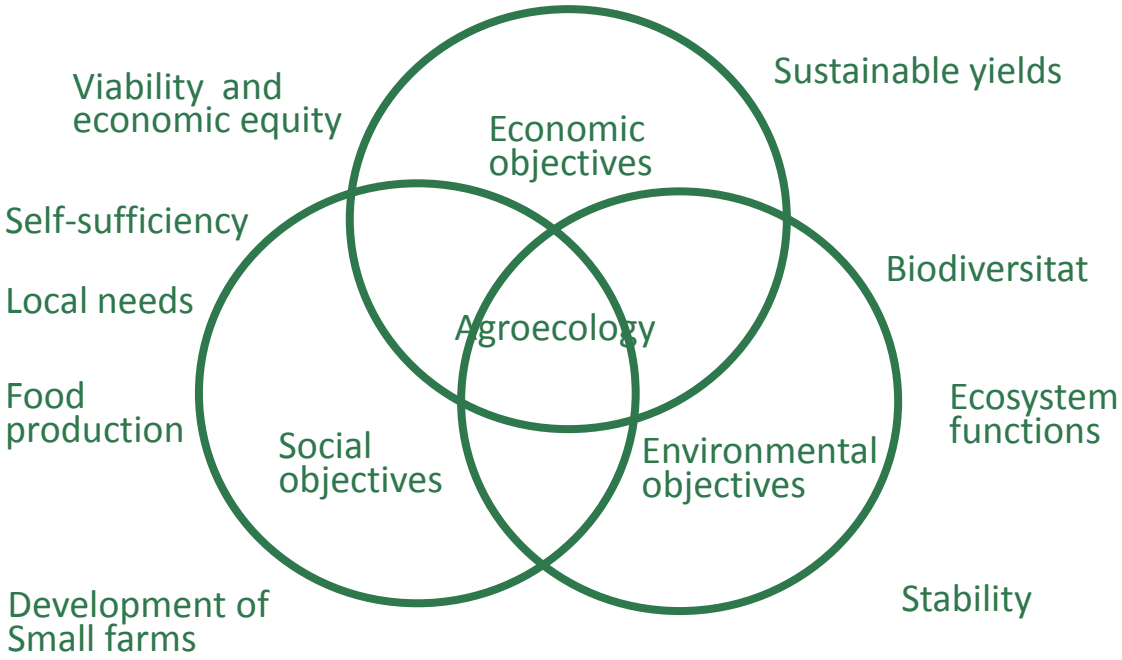
Agroecological transition





Improvements in systems design lead to sustainability

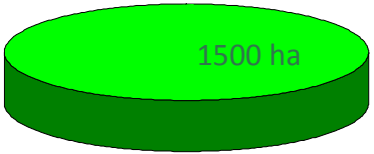
Agroecological transition



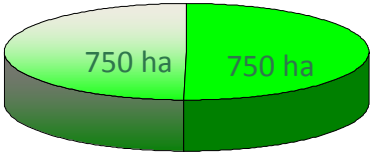
The peri-urban rural area of Gallecs: overview

Area expropriated to build a city of 130.000 inhabitants

Expropriation 1973



Protection 2005



Area definitively protected, classified as non-building land

Industrial and residential area

The peri-urban rural area of Gallecs: overview

- Plays a fundamental role in the land planning
- Fosters landscape, with important environmental and ecological values
- Humanizes the surrounding of the city
- Acts as a green lung
- Offers the opportunity to design a sustainable model of development based on agroecology
- Offers a space for leisure, education, research that can favour the multifunctional role of agriculture

The peri-urban rural area of Gallecs: overview

Since 2005 Gallecs is a protected peri-urban agricultural area

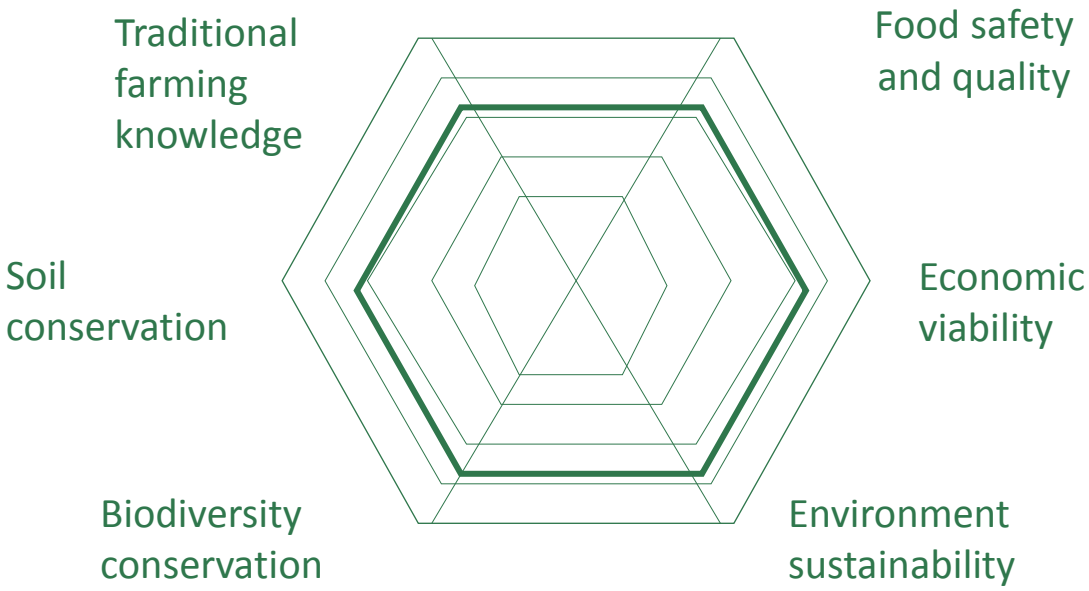
Treats

- Social and town-planning pressure that put at risk the continuity of the activities and the traditional agricultural economies

Opportunities

- The proximity of a consumer market (local market)
- The increasing responsiveness of consumers toward quality (organic farming) and food safety (traceability)
- The social demand of new activities like leisure, environmental education and agro-tourism

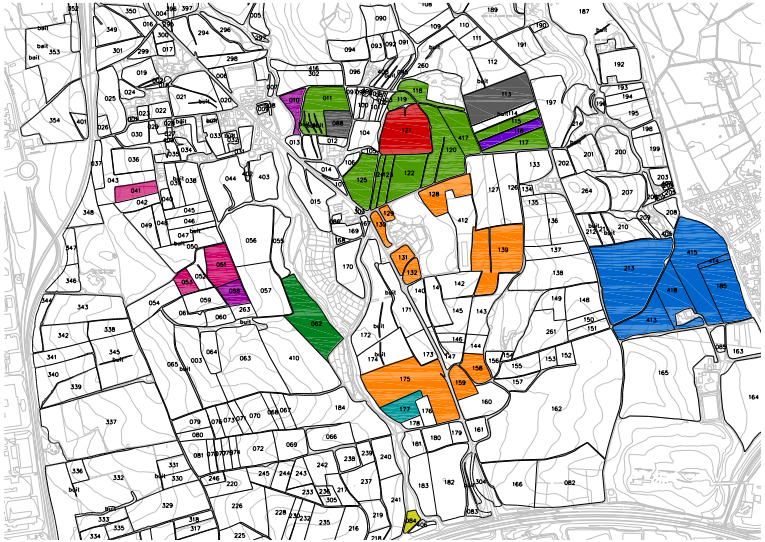
Developing a new agricultural model



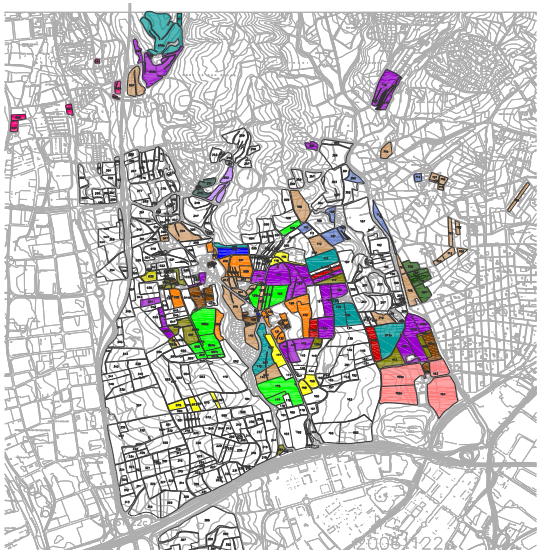
Networking with different stakeholders (participatory process)

Peri-urban area with high environmental values where agroecology and organic farming begins to open way into the rural activities

2005-2006 (11 farmers, 9 different crops, 63.4 ha)



2012-2013 (18 farmers, 16 different crops, 202 ha)
2016-2017 (18 farmers, 16 different crops, 210 ha)



Monitoring the agro-ecological transition

Twenty one pilot fields (41.07 ha)

Crops
(every year)

Crop diversity
Crop rotation
Crop establishment
Crop yield
Profitability
Pests and pathogens
Sowing time
Seed origin
Fertilisation
Soil disturbance
Weed control
Stubble management

Weed communities
(every year)

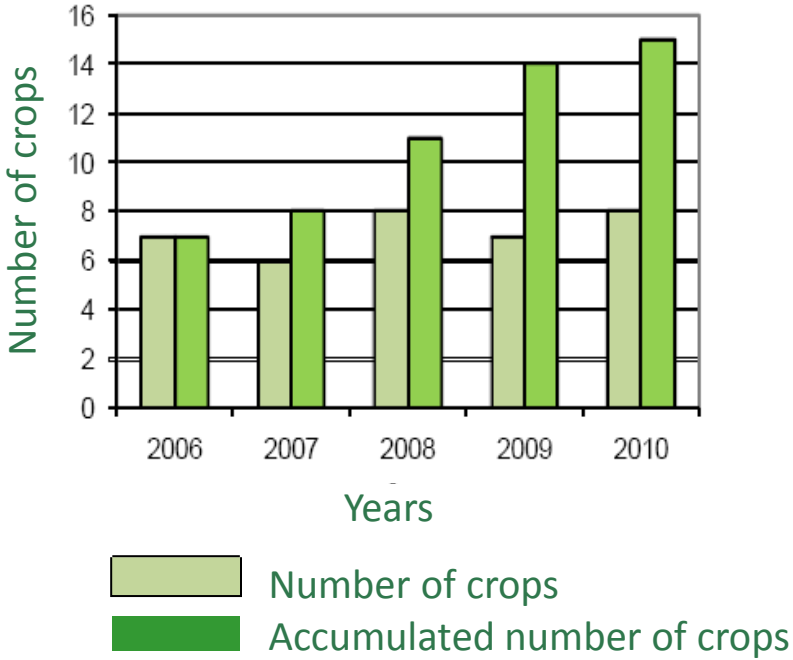
Species composition
Species richness
Diversity
Species frequency
Species cover
Species density

Soils
(2005, 2010 and 2016)

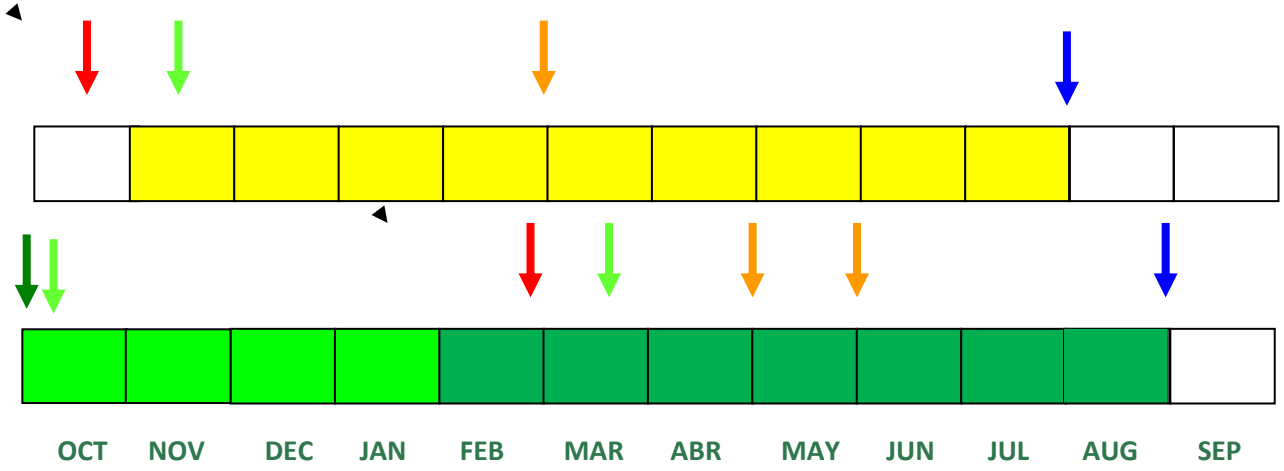
C_{org}
N_{total}
P (ppm)
K (ppm)
C/N
CEC

Crop diversity

Recovery of local and traditional crop varieties



Crop rotation



Cereals (winter wheat –ancient varieties- barley, spelt –ancient varieties-, rye, oat)

Legumes (chickpea, lentils)

Cover crop

Disc harrow

Ploughing

Weed control

Harvest

Sowing

Crop rotation

espelta, *Triticum spelta*

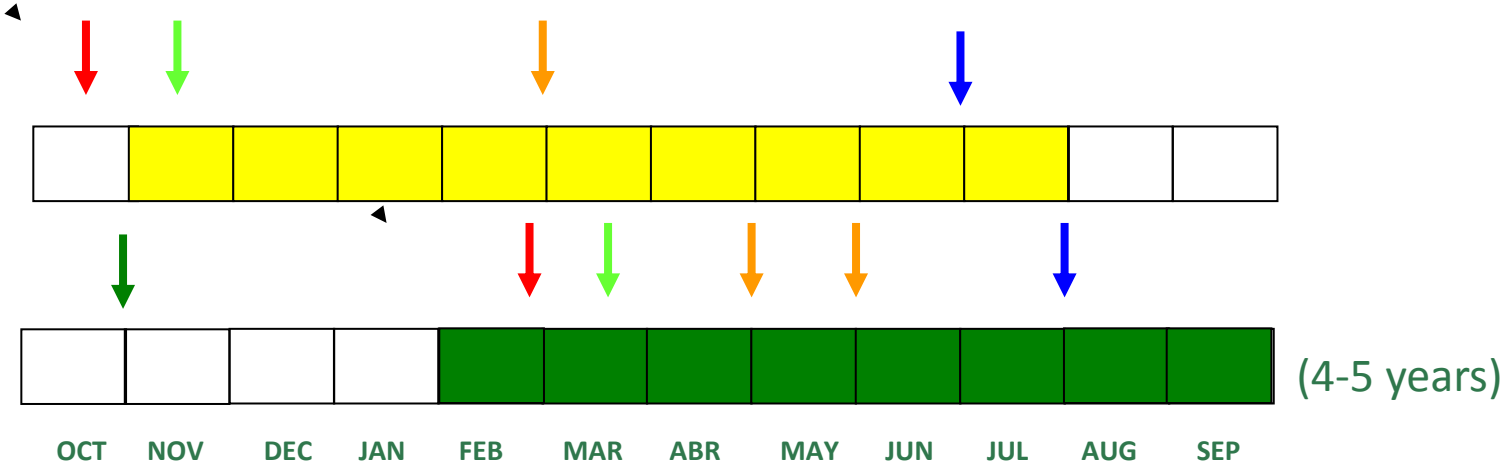
kamut, *Triticum turgidum*

Crop rotation

cigró menut, *Cicer arietinum*

llentia pardina, *Lens culinaris*

Crop rotation



Cereals (winter wheat –ancient varieties- barley, spelt –ancient varieties-, rye, oat)

Perennial legume (alfalfa)

Bare soil

Disc harrow

Ploughing

Weed control

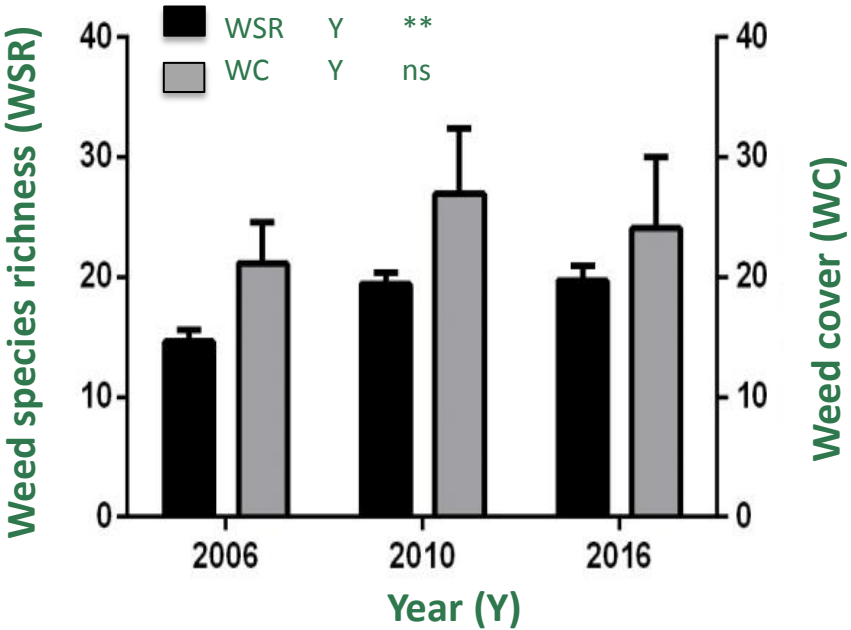
Harvest

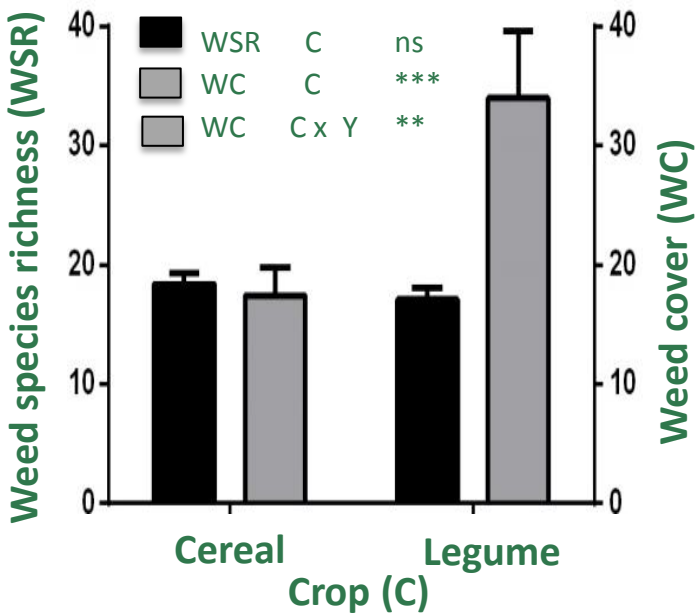
Sowing

Crop rotation

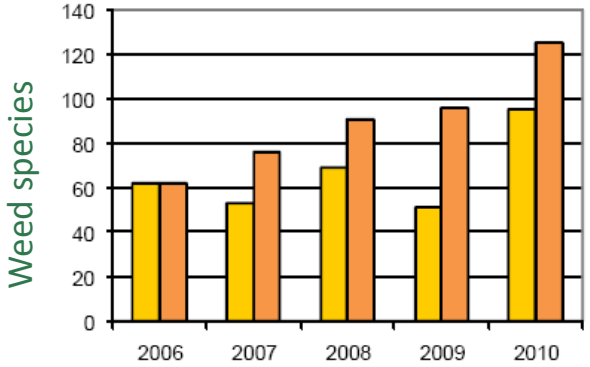
Plant biodiversity - Weeds

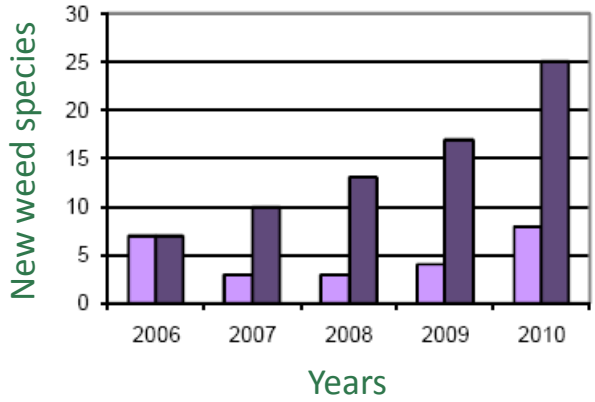
Plant biodiversity - Weeds

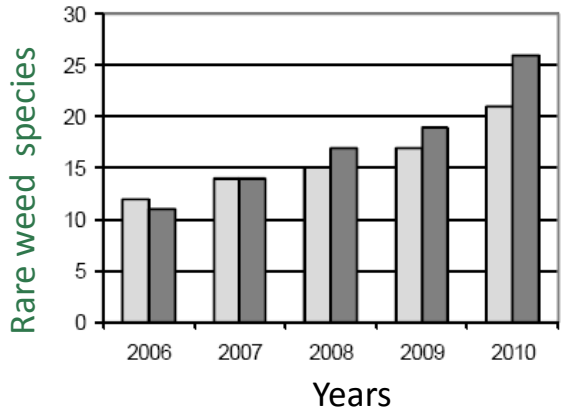




Plant biodiversity - Weeds

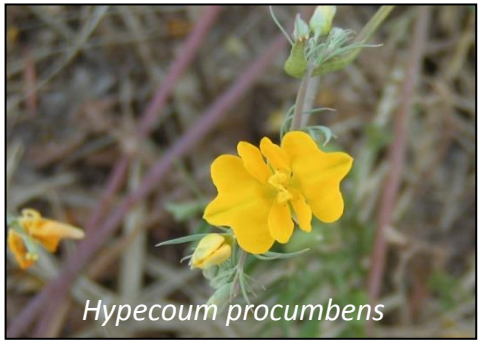


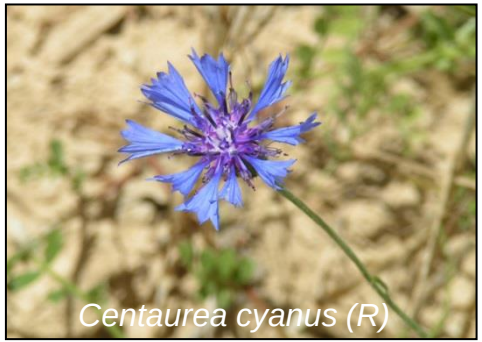




- Weed species number year^{-1}
- Accumulated weed species number
- New weed species year^{-1}
- Accumulated new weed species
- Accumulated cereal weed species
- Accumulated rare weed species

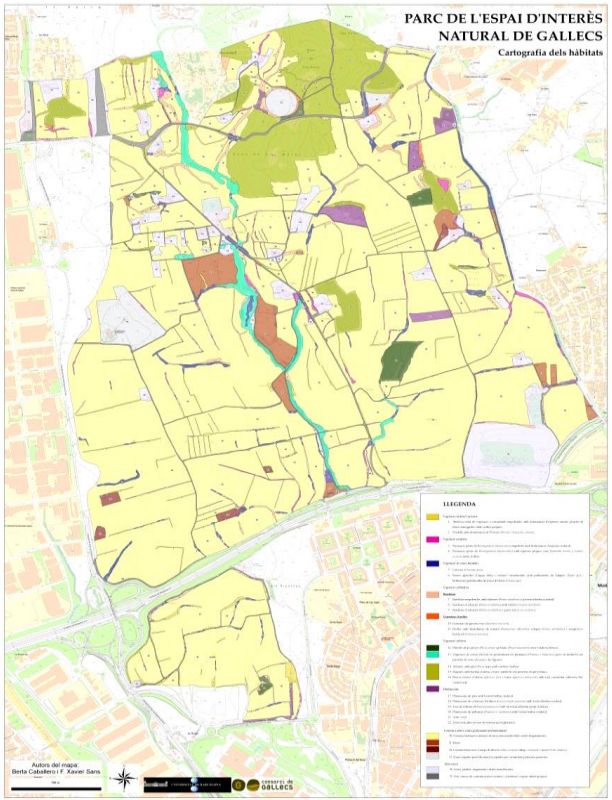
Plant biodiversity - Weeds





Rare species (R) and very rare (RR) in Catalonia *(Bolòs et al., 2005)*

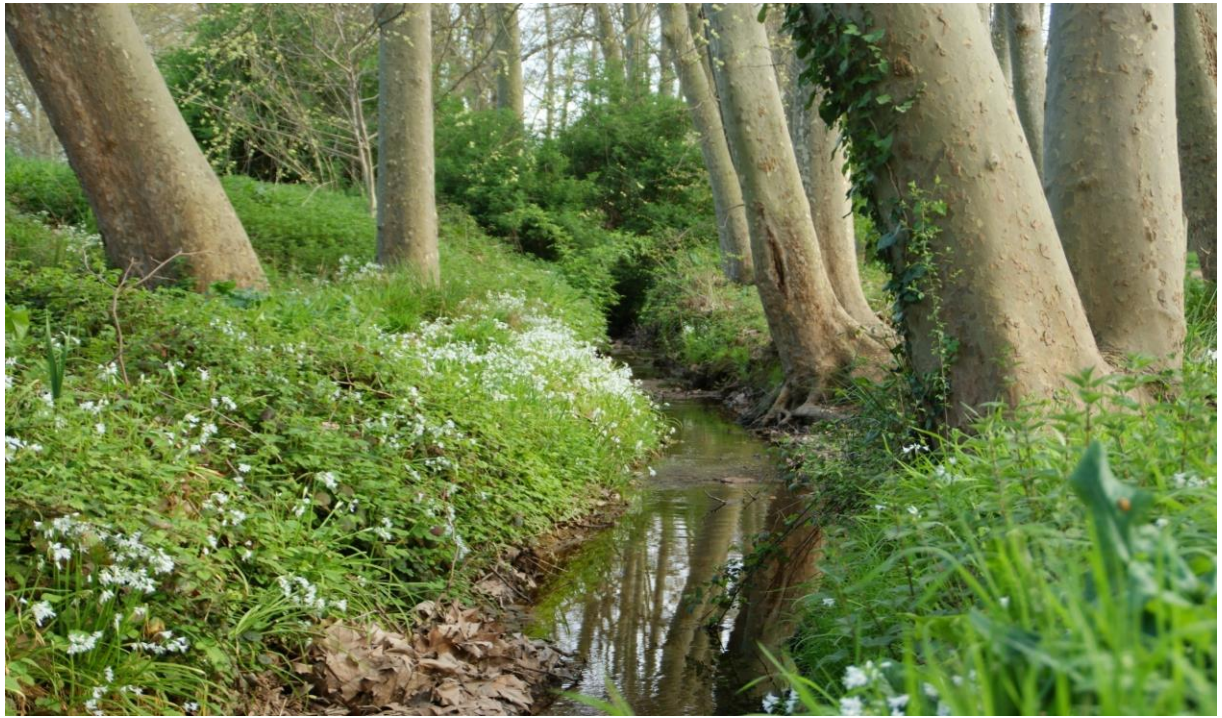
Biodiversity - Conservation of field margins



Biodiversity – Farmland birds

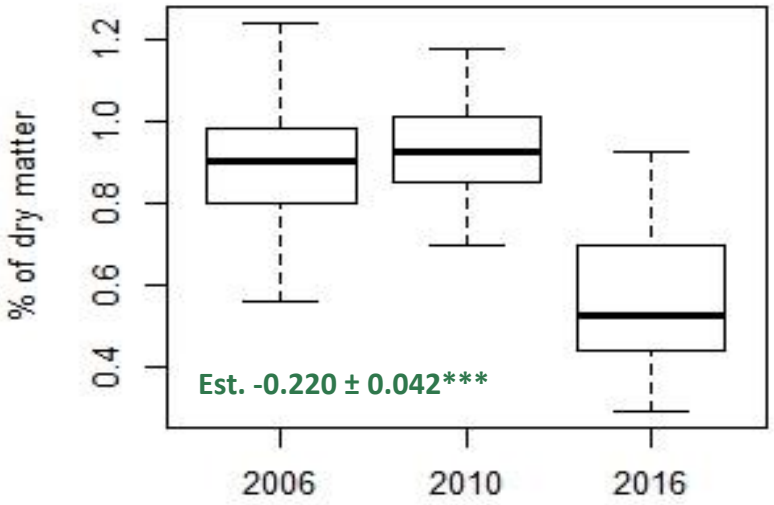
Red partridge, *Alectoris rufa*

Environment conservation



Soils

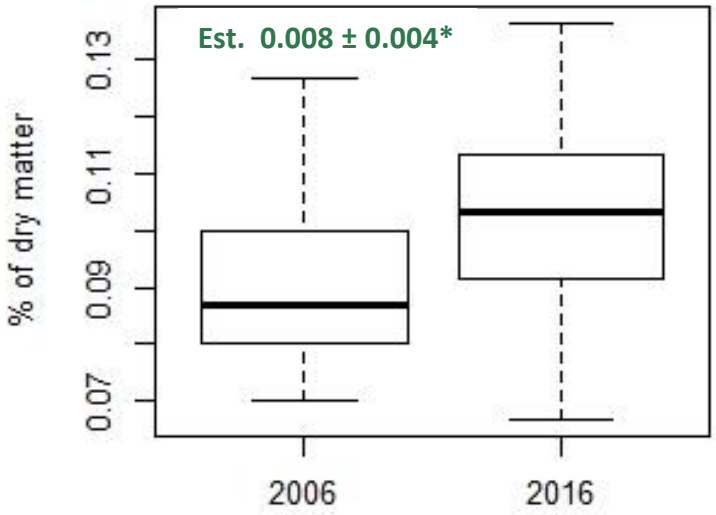
Organic Carbon content



2005 - 2010	Carbon content				
	Estimate ± un SE			IR	
Intercept	0.906	±	0.020	1.000	*
Initial carbon content	0.075	±	0.026	0.947	*
Average fertilisation (kg ha^{-1} any^{-1})	0.055	±	0.024	0.888	*
Proportion Vitalor K application	0.052	±	0.022	0.835	*
Proportion alfalfa sown	0.102	±	0.047	0.827	*
Proportion soil inversion tillage	0.022	±	0.011	0.519	*
Average months of bare ground	0.066	±	0.031	0.754	*

Soils

Nitrogen content



2005 - 2016	Nitrogen content				
	Estimate ± un SE			IR	
Intercept	0.107	±	0.004	1.000	*
Initial nitrogen content	0.009	±	0.003	0.929	*
Initial potassium content	0.006	±	0.003	0.703	*
Average weed production (% cover)	-0.005	±	0.002	0.629	*
Proportion Vitalor K application	0.009	±	0.004	0.560	*
Proportion of stubble burial	0.008	±	0.003	0.890	*

Economic profitability

Economic balance for each farmer

Crop	Expenses	Revenues	Gross Margin
Alfalfa (1,25 ha)	531,97	620,57	88,60
Winter wheat (1,49 ha)	672,23	946,96	274,73
Bitter vetch (4,6 ha)	1213,76	2467,96	1254,20
Spelt (20,5 ha)	1013,96	2495,49	1481,51
Green manure (2,89 ha)	506,96	927,70	421,30
Barley (3,52 ha)	1656,96	2840,54	1183,58
Triticale (3,49 ha)	1231,01	2934,89	1693,88
Total (19,25 ha)	6820,31	13224,10	6397,80

Triticale					
Field	Yields	Premiums	Expenses	Revenues	Gross Margin
068	237,72	136,39	157,45	374,11	216,66
073	399,80	229,39	264,81	629,19	364,38
079	480,84	275,89	318,49	756,73	438,24
302	740,17	424,68	490,26	1164,01	674,60
Total			1231,01	2924,89	1693,88

Economic viability

Generational renewal and the incorporation of young people into the area

Local organic food fairs and organic food shop

Gallecs and Slow Food

- Food community
- Bastion of the white kidney bean (mongeta del ganxet
- Organic school canteens
- Recovery of local and traditional crop varieties

Participatory research

Within the framework of the Tilman-Org project, in 2011 the Research Group “Ecology of Agroecosystems” set up the Gallecs trial, one of the first factorial experiments intended to be a long-term implemented in Spain to test the effects of reduced tillage, fertilisation and green manures in organic arable crops

Participatory research

Within the framework of the project SoilVeg, several experiment have been established aiming to study the introduction of the Agro-ecological Service Crops before vegetable cash crops to provide or enhance ecological services, thus promoting the whole soil-plant system equilibrium.

Concluding remarks

After 10 years, the agroecology model of the PERI-URBAN RURAL AREA OF GALLECS,

~ Increases farmers income
~ Conserves natural resources
~ Contributes to the reduction of biodiversity losses
~ Produces food in relation to the local needs (local market)
~ it is a recreational area for urban people
~ it is an area for education
~ it is an area for research

Thank you for attention

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