Agroforestry the European way. State of the art and challenges

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Trees and Agriculture: a change of paradigm

Trees inside parcels
Trees around parcels
Around parcels
Inside parcels
On-farm research
1990-2010
What did we learn?
Agroforestry is not a mixture of agriculture and forestry: it’s a new farming system.
Traditional agroforestry practices are valuable

But modern schemes better adapted to present-day agriculture are feasible.
Agroforestry is deep-rooted in European agriculture
Agroforestry offers innovative solutions to modern challenges of rural development

Farm income, Rural employment, Biodiversity, Soil protection, Water protection, C sequestration
But the key finding is:
Agroforestry makes money

Compatible with modern machinery

Requires time and capability to invest for the next generation: help needed!
To mix or not to mix: trees and crops/animals...
Agroforestry 0.8 ha
Mixture Separation

Forest 0.6 ha

Land Equivalent Ratio (LER) (LER) (Mead and Willey, 1980)

LER = 1.4 ha

Agriculture 0.8 ha

Forest 0.6 ha

Agriculture 0.8 ha

Land Equivalent Ratio (LER) (Mead and Willey, 1980)
Land Equivalent Ratio

1.2 to 1.6

Poplars-winter cereals
14 years
A 1.4 LER means that a 100 ha agroforestry farm produces as much crop and tree products as a conventional 140 ha farm where trees and crops are separated.

Part of a new green revolution

Increased efficiency of natural production factors (light, water, natural nitrogen)
Root profiles of 14 year old walnut trees (Novembre 2009)

Pure walnut grove

Walnut wheat Agroforestry
Research for action: guidelines for improved AF systems
Environmental services of agroforestry
Landscaping, positive image of farming with nature
Adaptation to Climate Change
CROPS IN AGROFORESTRY SYSTEMS ARE PROTECTED AGAINST CLIMATE CHANGE HAZARDS
Improving water infiltration

Increase of soil porosity, terracing, increase in soil organic matter pools...
Floods mitigation

Hedge impact on soil water

Under study
Resilience to stormy events

About 300 million trees were felled in France, approximately 3% of the national total (photo courtesy AFP).
Mitigation of Climate Change: Carbon storage
1 to 2 T C/ha/year with 50-100 trees/ha

More than most other options for C sequestration in European agriculture

Sequestration in the soil: under study
Protection against fire hazards
Soil protection
Deep roots ecosystem services
Reduction of Nitrogen transfers to water bodies

Site: Restinclières, Prades Le Lez, France

Average nitrate leaching
(kg.ha^{-1}.an^{-1})

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<thead>
<tr>
<th>Category</th>
<th>Nitrate Leaching (kg.ha^{-1}.an^{-1})</th>
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<tr>
<td>Agroforestry</td>
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Under study
Biodiversity protection
Habitat fragmentation reduction
Towards reducing the use of pesticides in agroforestry?

Under study, hypothetical
Biological control of wheat aphids in agroforestry
Biological control of vineyards mites in agroforestry

The pest: *Eotetranychus carpini*

A predator: *Kampimodromus aberrans*
Habitat ratio: a new tool for the conditionality of the future Common Agricultural Policy?

Field trees in the future CAP

Habitat ratio = proportion of the farm area under the beneficial influence of trees and natural habitats
Towards reducing the use of fertilizers in agroforestry?

To be studied, hypothetical
Profitability

This 60 year old walnut grove (156 trees/ha) is valued at 120 000 euros of timber per hectare
Research is still in the making....
To be explored...

- Ecophysiology of shaded crops
- Microclimatology of heterogeneous stands
- Identification of tree and crop ideaotypes adapted to agroforestry
- Sélection of shade varieties for all major crops
- Sélection of deep-rooted trees
- Modelling tree-crop interactions
- Biological control of pests in agroforestry plots
- Nutrients cycling in treed agrosystems
Pending: Virtual experiments

- 11 m x 9 m
  - 100 stems/ha

- 7 m x 7 m
  - 200 tiges/ha
  - (forest control)

- 11 m x 5 m
  - 180 stems/ha

- 19 m x 11 m
  - 50 stems/ha

- 19 m x 19 m
  - 30 stems/ha
Pending: System optimisation assisted by modelling

Tree line orientation
North-South / East-West

Pruning height: 10 m versus 6 m

Tree density
133 trees.ha⁻¹
64 trees.ha⁻¹
Pending: Designing enhanced and innovative agroforestry systems

Biomass production in agroforestry

Various tree managements
Expect progresses

Adopt to...

product AND protect

A tribute to European pioneer farmers...
Merci