

Assessment of the environmental and economic performance of agroforestry along a European gradient

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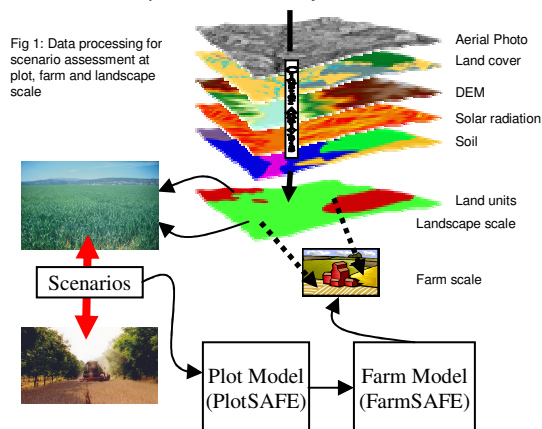
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Agroforestry – the combination of agricultural land use with trees – has been proposed as an alternative land-use system in Europe for a decade now, in order to mitigate environmental problems of intensive agricultural production and to diversify the income of farmers. In the European research project “Silvo-arable agroforestry for Europe” (www.montpellier.inra.fr/safe) we investigated whether this potential is real and to what extent agroforestry can contribute to resolve land-use problems in European rural landscapes. We randomly selected 19 arable landscapes of 4x4 km along a gradient from Spain over France to the Netherlands.

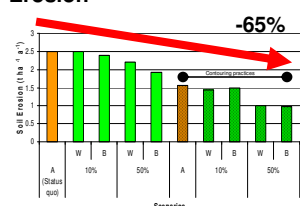
Environmental assessment

Digital maps of land cover, soil properties, exposition and slope were derived for each landscape and combined with daily climatic data. Through a cluster analysis the landscapes were subdivided into areas of different potential productivity, at the same time representing areas of different productivity of hypothetical farms (Fig. 1).

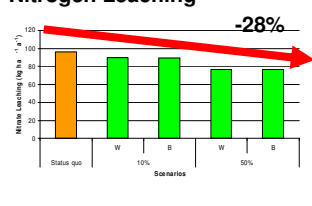
A biophysical model driven by light and water availability was conceived and applied in each landscape in order to assess the productivity of arable agriculture (baseline scenario) and compare it with the implementation of agroforestry with 50 or 113 trees ha⁻¹, in 10 or 50% of the farm in the worst or best land. For all scenarios, environmental effects (erosion, nitrogen leaching, carbon sequestration, landscape diversity) were assessed with additional algorithms.



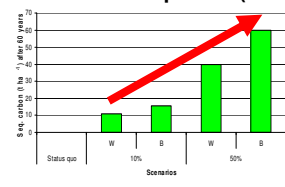
Erosion



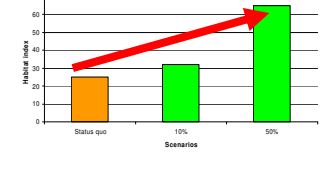
Nitrogen Leaching



Carbon Sequestration



Landscape Biodiversity



Economic assessment

Farm economic data were compiled from local, national and international statistical sources. Profitability was evaluated with a farm economic model linked to the biophysical model. Scenarios included several levels of payment schemes.

European scale

At European scale, potential productive tree growth distribution maps were developed for the five tree species studied (*Juglans* hybr., *Prunus avium* L., *Populus* spp., *Quercus ilex* L. and *Pinus pinea* L.) and environmental datasets were intersected with European arable land to produce “Target Areas” map for agroforestry implementation (Fig. 2).

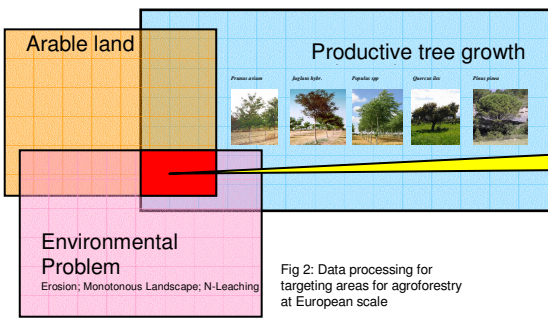
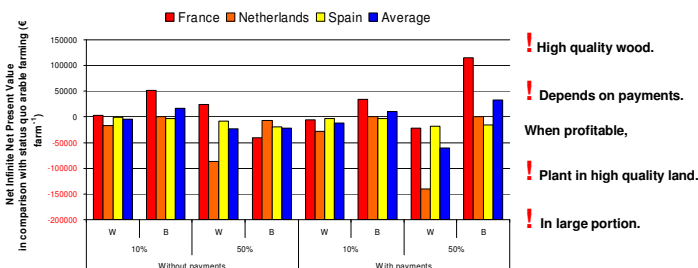
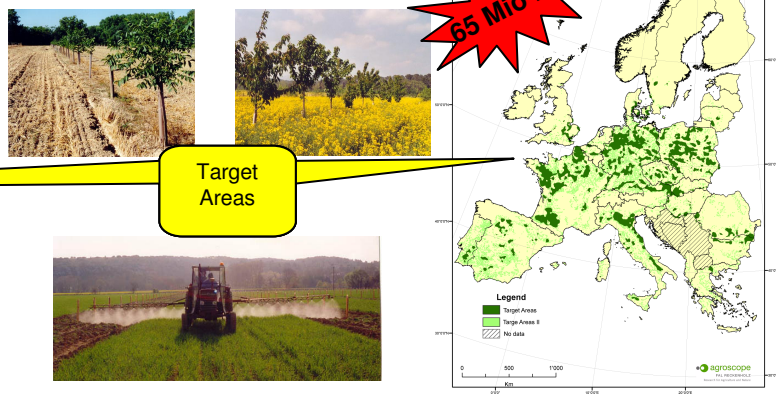


Fig 2: Data processing for targeting areas for agroforestry at European scale



Conclusions

Agroforestry can reduce erosion in average of 65% (up to 80%), reduce nitrogen leaching by up to 28 % and more than duplicate (up to quintuple) landscape diversity in the landscapes under examination. It can be profitable in the temperate zone provided high quality timber is produced and provided the subsidy schemes allow for agroforestry as a land-use system. This can have considerable implications at the European scale. On 65 Mio ha (40 % of the European arable land) the desired environmental effects could be achieved by implementing agroforestry.

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