

AGROFORESTRY IN THE MIDI-PYRENEES REGION

Synthesis report edited by *Arbre & Paysage 32* ("Tree & Landscape in Gers")

Because agriculture must take new challenges up : Produce and Preserve.

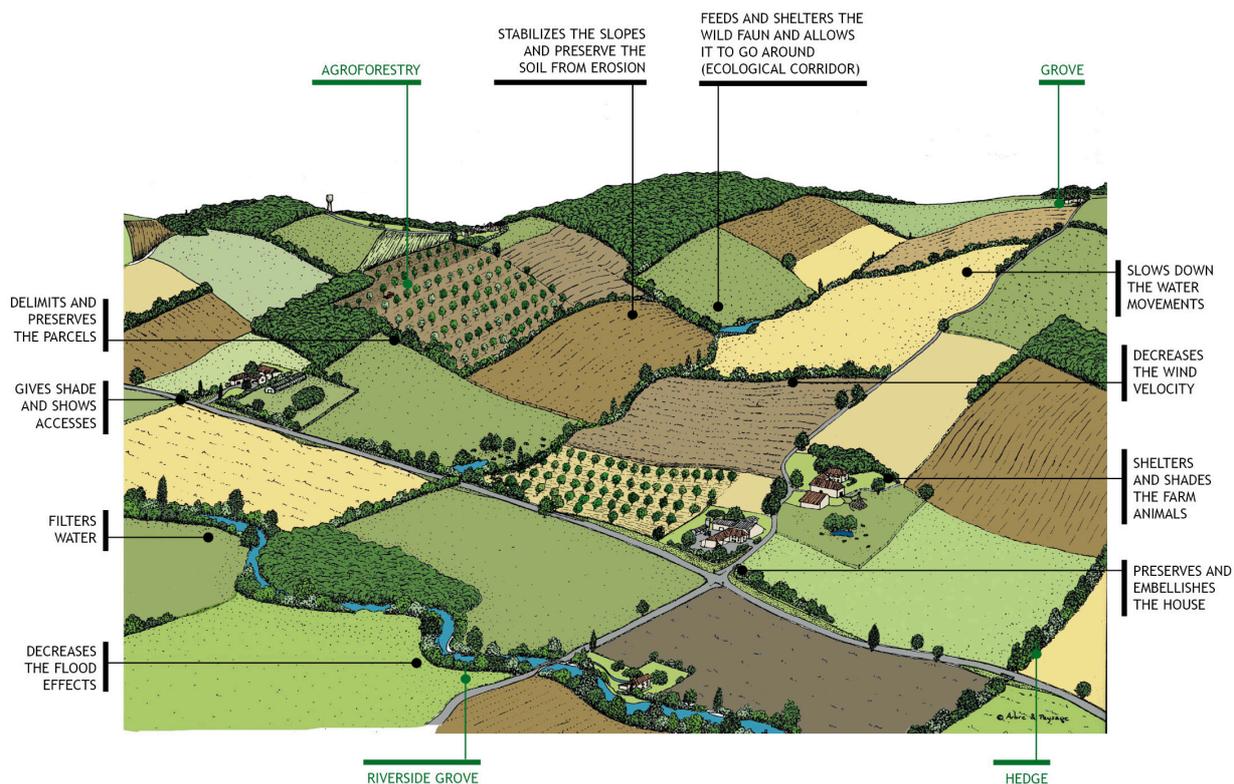
Because it will soon be necessary to find alternatives to the fossil energies and to agricultural inputs, more and more expensive.

Because research results in agroforestry are very encouraging, it becomes more than ever relevant to give back to the field tree the role it deserves, at the very heart of the cultivated areas.

Agroforestry, today recognized and supported at the European and national levels through the French Rural Development Program (FRDP), appears as a relevant and audacious answer to the agro-economical, agro-ecological and agro-technical stakes of a modern and deliberately sustainable agriculture.

Logics that fit together

WATER – SOIL – BIODIVERSITY – CLIMATE - LANDSCAPES



The challenges to be taken up by agriculture are clearly defined in the FRDP :

- Consolidate the incomes while preserving the natural resources
- Improve the environment consideration in the economic activities and increase the environment quality
- Go with the rural economy diversification and life quality
- Preserve and increase the territories diversity value.

Be a water purifier and regulator, a soil preserver and soil quality improving factor, a carbon fixer, a climatic absorber, protective for crops and cattle, an essential link for biodiversity, a biomass producer, a landscape diversity and quality factor, etc.

Be a protection, production, environment setup, and embellishment tool. The transversality property gives the tree the ability to bring, both to the farmer and the collectivity, a large number of technical answers.

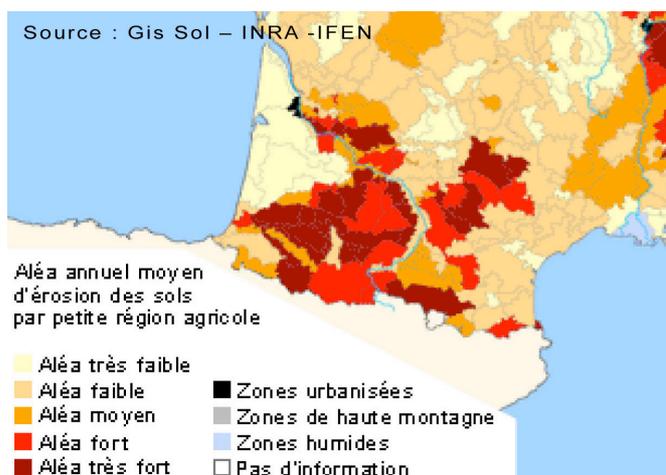
It also allows to satisfy the new political frames and the present and succeeding expectations: eco-conditionality of the agricultural grants (introduction of the « topographic particularities preservation » norm), areas submitted to environmental constraints, 4th nitrate actions program, setting up of a « Green and Blue Frame » and of a « farm certification », etc.)

A regional context favorable to agroforestry

Extending to 2,5 million hectares arable lands, that is 56% of its surface, the Midi-Pyrénées region is the first agricultural region in France. Dating back from its mixed farming and poly-cattle breeding tradition and thanks to its territories diversity, the Midi-Pyrénées region presents a scale of contexts favourable to the agroforestry development, especially in the areas of large scale crops and of cattle breeding.

The Midi-Pyrénées region is among the territories where the ground erosion is the most hazardous in France.

Beyond forestry planting, which occupies 30% of the region surface, it is of first importance to keep favouring a balanced and diffused distribution of the tree on the whole territory.



Mean erosion hazard per small agricultural region
very weak to very strong hazard - urban, mountain, humid

The first successful « modern » agroforestry experiences

Convinced by the agroforestry template relevance, *Arbre & Paysage 32*, in a financial partnership with the Midi-Pyrénées Regional and the Gers Departmental Councils, started an agroforestry experimental program in 2007. In total, more than 200 ha have been planted in the whole Département, essentially in large scale cultivations but also in poultry and pig courses and in wine growing. After three years, the track record is more than positive. The plantation achievement rates are good and the farmers have well integrated the trees in their practices. They will be technically accompanied for three years and will progressively learn how to shape the trees and to manage in the best way the trees – crops synergies. During these three years, we also tested different biodegradable mulching (corn starch , chipped wood RCW, straw), protection systems against the cervidæ favouring tree sheath, grassed path around the tree foot, etc.





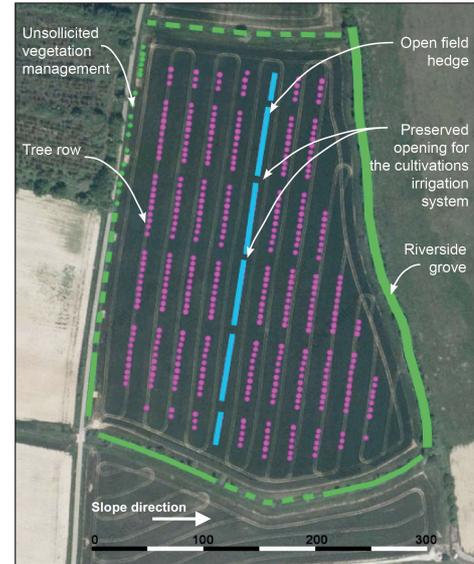
Agroforestry as we developed it in the Gers Département, could be described as « second generation » for it is intended to be as integrating as possible.

It is no longer mono-species plantations but association of local wild and forest species.

Along with this setting up, the surrounding vegetal formations are integrated : work on natural regeneration on the parcel border, management plan for hedges and riverside groves, hedge plantation where there is nothing, tadpoles restoration.

The grassed paths along the tree lines are sowed and will naturally evolve toward an optimum and relevant mixture.

Coming out of the trees' coppicing or the tadpoles restoration, the branches see their value increased as energy timber or are chipped locally and used as mulch (RCW).



Development perspectives

We deal with plural agroforesteries, for the aspects that it includes are various and it will be possible to vary them according to the different practices and contexts in the Midi-Pyrénées region large scale crops and forage production, farming and breeding of poultry, pigs, sheep, bovine, wine growing, etc.



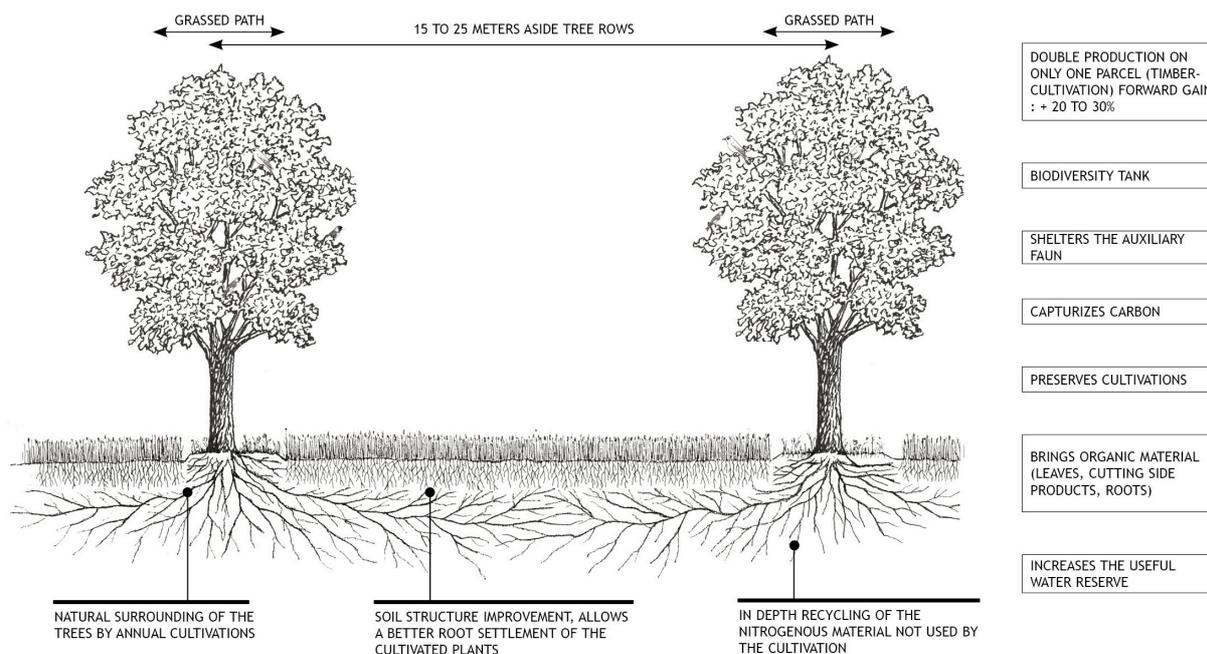
Reconcile Tree and Agriculture, Economy and Ecology

RESEARCH ACHIEVEMENTS

A WINNING SOLUTION

A correctly designed and correctly driven agroforestry parcel gives a higher productivity than one where trees and crops are separately grown. The advantage of this synergy has been demonstrated in different research programs, for more than ten years.

The biodiversity increase, the soil improvement and the climatic effects, mainly due to the trees, improve the parcel potential.



ECONOMIC YIELDS / HIGHER PRODUCTION WITHIN THE SAME PARCEL

Increase one's parcel profitability

Comparing agroforestry to a plantation with trees on a side and crops on the other, **the biomass product is from 10 to 60 % higher.**

In the density range of 40 to 80 trees per ha, **the profitability is, at least, at the level of a non-tree agriculture.** It has been demonstrated as able to be **increased by 30%.**

The benefits may be more sizeable and fast to be perceived. As a matter of fact, these computations don't take into account neither the tree contributions to the agricultural production (inputs reduction and cultivations preservation against the climatic hazards) nor the **value of the possible other products** (energy timber, chipped wood RCW, fruits, forage).

Dealing with 25 to 50 meters aside tree rows, **it is possible to cultivate till the trees cutting down,** with a moderate reduction of the agricultural production.

Raising a savings fund

The agroforestry farmer mainly grows high value timber species, such as the walnut, the wild cherry, the service tree, the sorb tree, the peer tree, ...

Investing in the timber, the farmer builds today a capital that will constitute, tomorrow, his pension and that of his children. The matter is not to convert the whole of his farm in agroforestry but 10 to 20 % of his Useful Agricultural Surface (UAS).

Considering that trees occupy 10% of an agroforestry parcel surface, converting 10% of his UAS leads to, at the beginning, less than 1% loss in his incomes. From the date when the farmer begins getting income from the timber, INRA assesses an up to doubling farm incomes increase.

Increasing the production quality

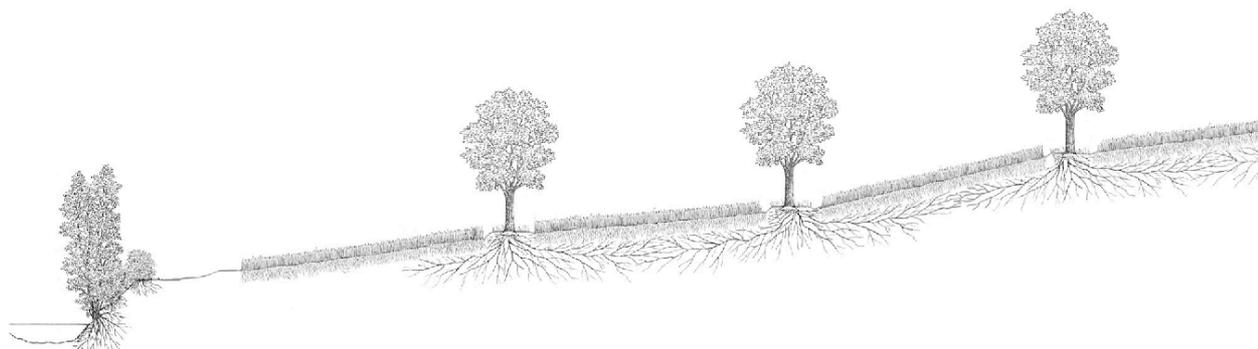
The experiences leaded by INRA tend to show that agroforestry cereals benefit of **higher protein levels** than mono-species cereals. Trees on an agroforestry parcel also benefit to **the animals' well-being**, which may result in an increasing living mass, a lesser mortality, and a lower food waste. Agroforestry aims to the **inputs reduction** thanks to a « natural » soil improvement and to an integrated cultivation preservation (auxiliary faun in the spot core).

Concerning the timber production, the balance is also positive. One can state a **higher trunk diameter increase and a better timber quality** (regular growth). The trees take advantage of a low plantation density and absorb part of the fertilizers not used by the cultivations.

ENVIRONMENTAL AND AGRONOMICS YIELDS

Even if it is difficult, today, to dissociate economy and ecological impacts, the agroforestry settings contribute to better preserve the natural resources : inputs reduction (fertilizers and plant-care products), water purification and regulation, soil improvement and preservation, carbon fixing, positive micro-climatic effects and rural landscape quality.

Regulate the water flows



INRA in Montpellier observed that **agroforestry trees roots go deeper** than forest trees ones.

This characteristic root system is favoured by largely inserting winter cultivations in the turnover, which, by taking resources in surface before the opening of bud, force the trees to colonize the deeper strata to get their needs.

If winter cultivations are not possible, mechanical operations can be recommended to control the surface roots (surrounding).

This characteristic of the agroforestry trees root system has several interesting consequences :

Better anchoring and capacity for a deeper soil prospection :

- ⇒ Consequence : a **better resistance to the climatic excesses** (dryness, wind),
- ⇒ Consequence : **lesser competition against the cultivation** for water but also for the mineral elements. Besides, one speaks of "nutrients pump" about the fact that nutriment elements **come up** from deep strata along the root system.

Additional taking of water from the ground by the trees, leading to dryer deep grounds at the end of summer.

- ⇒ Consequence : **increased capacity to stock autumn and winter rains**

Example : 100 mm under 12 year old walnuts in Restinclières (Hérault), 200 mm under 12 year old poplars in Vézénobres (Gard)

⇒ Consequence : **summer nitrogen mineralization reduced** by the soil drying.

Even more, one must add the **trees summit effect** which, because of the generated micro-climate, also contributes to **reduce the cultivations climatic demand** by reducing the evapo-transpiration and contributes to **slow the nitrogen mineralization down** before the autumn rains.

Control water quality

The agroforestry systems can also contribute to **limit the diffused pollutions by raising a security snare under the cultivations**. This mechanism is yet more efficient because the root systems are distinct and superposed. About all, this concerns the nitrates which leach vertically and a part of which may be intercepted and well used by the trees for their biomass production. Concerning phosphorus and the plant-care products molecules, which move more by run-off, it will be, about all, the grassed paths and the hedges integrated to the agroforestry system which will contribute to limit their diffusion by fixing and degrade them.

Master the floods expansion streams

The temporary water stocking during the major flood peaks is an efficient solution to preserve the downstream inhabitants.

The agroforestry parcels act as combs for stream obstructions and as stream slowing down.

This is why setting them up in the major water stream beds is a good solution to continue cultivating these soils, while preserving them from violent floods.

Improve the soils quality and struggle against erosion.

On an agroforestry parcel, the leaf and thin roots decomposition **enriches the soil with organic material, stimulating the detritivorous and saproxylic organisms** which play an essential role in the fertility preservation process. Moreover, this capacity to fix more carbon presents several advantages for cultivated fields, such as a **higher availability in nutriment elements, a better water retention and a better resistance to erosion**.

Agroforestry trees roots are able to draw nutriment elements from deep and mineral soil strata.

Trees play the role of true **"nutriments pump"** for the associated cultivations benefit.

Facing erosion, the agroforestry systems action is twofold. They act as combs by retaining the suspended elements in runoff waters. By slowing water stream down along the slopes, they limit the downstream erosive power.

Carbon fixing

Because of its capacity to capture carbon and therefore limit the greenhouse gases, agroforestry is mentioned in the Kyoto protocol articles 3.3 and 3.4. The carbon is fixed on one side in the tree wood but also in the organic matter integrated in the soil, coming out of the annual leaf and dead roots degradation. The tree root settling injects in the soil deep strata a significant carbon quantity, thus contributing to its fertility.

Reduce the climatic stress shocks

The windbreak effect : when exposed to wind, the cultivations get dry, leaves and fruits may fall or be damaged. Wind also raises the cereal leaning hazard and disturbs the plant fertilization.

By limiting the climatic stresses, the windbreak effect from the hedges included in the agroforestry systems is benefic whatever the cultivations. According to the wind importance, it leads to a yield increase varying between 5 and 30 % in large scale cultivations and market gardening. This benefit is clearly higher in orchards, specially for apple and peer trees, the production of which may double only thanks to the climatic preservation.

The sunshade effect: under the tree shadow, the cattle's struggle against the summer hot weather is easier. The animals grazing more, the milk yields and the meat production increase. Under the tree shadow, the females calve in a very quiet situation. The result is a lesser animal birth mortality.

The tree shadow is especially useful for open-air poultry farming. The poultry colonize more easily the total parcel if trees are uniformly planted. It leads to poultry disease and mortality reduction, food diversification, lesser food waste and higher living mass.

Save biodiversity ... and make it useful

It is important that biological environments be interconnected so that faun and flora can move to insure the species reproduction and regulation. Creating biological corridors between the groves, the cultivated lands, the riverside groves, the meadows, the forest clumps, the agroforestry parcels and the wild space hedges are precious to sustain the cultivated spots ecological equilibria.

On an agroforestry parcel, because the trees are inside the parcel, the cultivation auxiliaries' action is more important and precocious. Earthworms, birds, bats, ladybugs, predatory carabids, pollinating insects, parasitoids... find refuge in the trees or in the foot grassed path to feed, reproduce or spend winter. All this biodiversity can lead to the pesticide use reduction by naturally controlling the cultivation devastator's population.

Thanks to the variety of plants coming into flower at shifted periods, the agroforestry systems present to the precious pollinators nectar and pollinic resources all the year-long.

The latters can in turn pollinate the cultivations but also produce honey from the melliferous plants (hawthorn, oak, lime, willow, medlar trees, wild maple ...).

Main bibliographic references :

Works by the Christian Dupraz's team - INRA Montpellier and the bibliographic works by Agroof Développement.

