Agroforestry fact sheet

Agroforestry is the mixture of trees and crops in cultivated parcels. It was a traditional system in both tropical and temperate countries before agriculture intensification during the last century. Very recent results show that it may be a key option for the future of modern agriculture, including in temperate countries.




10 years ago, agroforestry was still ignored by farmers, foresters, policy makers of developed countries. But times have changed. Agroforestry is an utmost example of **ecological intensification** : it increases land productivity and offers at the same time many environmental services. A French national scheme for planting half a million hectares of agroforestry during the next 25 years was based on results obtained by INRA, Montpellier.

A walnut – wheat agroforestry plot at the Restinclières farm, tree pruning time (left)

Monitoring water sap flow through tap roots and superficial roots to document the hydraulic lift on walnut agroforestry trees (right)

Increase of productivity with agroforestry

The mix of trees and crops is the fundamental principle of agroforestry. INRA researchers showed that the production from one hectare of a walnut/wheat mix is the same as for 1.4 hectares with trees and crops separated. This is a **40% increase in productivity**, far better than any other innovation introduced by agronomists in the recent past. This is achieved with an optimal 50 to 100 trees/hectare density, and an appropriate management of the system (tree line orientation, tree pruning regime, winter crops). Agroforestry trees grow very fast, faster than trees in forest plantations.

Rightly associated and appropriately managed, trees and annual crops establish a synergy in the use of the vital resources of light, water and soil nutrients. Several mechanisms allow this to happen which have to do with the plasticity of trees and crops to adapt to new environmental conditions. For example, by having to compete with winter crops, the tree naturally lays down deeper roots, that extend beneath the upper layers of the soil from which the crops draw their nutrients. This enables the trees to draw on water and nutrients that escape the roots of the crops. Each tree also grows more quickly than it would in an exclusively forestry plot as the trees are no longer competing with an immediate neighbour. Finally, the trees actively help the crops by sheltering them from wind, violent rain or scorching sun, and this could be an advantage in the context of climatic change.

Some environmental services of agroforestry systems

Excavation of a walnut tree to document its coarse root architecture in agroforestry (left).

Mechanical soil coring to 4m depth to document fine root dynamics (right)

- Control of nitrate leaching

  The deep rooting pattern of agroforestry trees allows them to capture nitrates that leach below the rooting zone of the crops. This help to protect water tables against nitrate pollution.
- Additional carbon sequestration

  Temperate agroforestry systems store more than 2 T/ha/year of C as compared to conventional agriculture. A significant part of this C is injected in deep horizons of the soil through root turn-over.
- Protection of biodiversity through habitat protection

  Bats, carabs, birds, syrphus flies, endangered flowers, earthworms, the list of wild species that delight in agroforestry plots is updated continuously. Trees bring more than expected in agriculture land, especially in treeless plains. They offer corridors for wild species migrations and move.
- Landscape amenity

  Agroforestry landscapes are open and very appreciated by walkers, riders, hunters. They offer views that are quite different from forest plantations.
- Reduction in the use of timber produced in non-sustainable systems

  High quality timber produced in agroforestry may release the pressure on tropical forests.
- Micro-climate in the context of global warming

  Global warming has local effects on agriculture, including water and heat stresses on crops and animals. Partial shade provided by trees may help mitigate such stressful events.

The benefits of agroforestry for farmers

Demonstrations carried out by INRA have shown that this tree-crop mix is compatible with the mechanical means currently used, provided the rows of trees stand between 15 and 40 metres apart, and that the trees are pruned properly and rationally. Economic analyses have established that a farm that plant 25% of its land area with high quality timber agroforestry (service, pear, cherry, maple, walnut, etc.) will finally **double its annual income** with the selling of the trees. The recommendation is to plant species with a high added value which yield wood that is in great demand on the market. In European terms agroforestry was introduced in the Common Agricultural Policy in 2007.

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Reference : Dupraz C. and Liagre F. 2008. Agroforesterie, des arbres et des cultures. Editions France-Agricole, Paris, 413 pp.

agroforestry systems examples