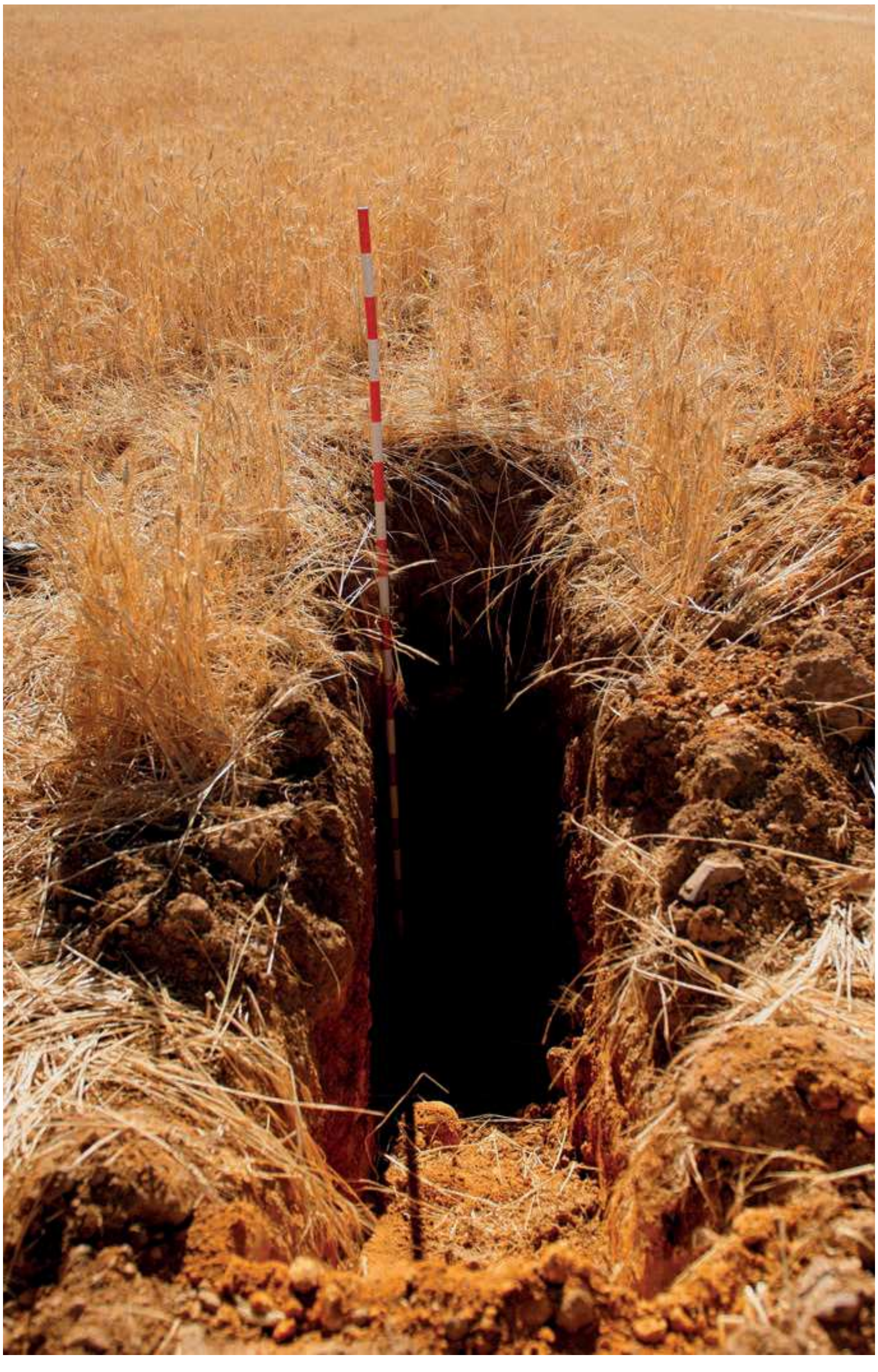
Putting agroforestry to the test

LIFE has co-funded projects showing how agroforestry theories can be put into practice, using cover crops and other techniques that contribute to climate change adaptation strategies.



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Agroforestry involves growing trees or shrubs in and around crops or pastureland. It has been shown to increase biodiversity, reduce erosion, slow water run-off and enhance productivity and resilience. It is therefore a potential tool in the farmer's climate change adaptation toolbox.

Sustainable agroforestry in semi-arid Spain

Under the leadership of the University of Valladolid, between 2012 and 2017, the LIFE project OPERATION CO_2 sought to evaluate the feasibility of increasing carbon sequestration in Europe through sustainable forestry and agroforestry management actions.

The agroforestry part of the project took place on two pilot plots of 25 ha. One was located at Ayoó de Vidriales in Castille and Leon, the other at San Mateo de Gállego in Aragon. "The chosen areas share diverse environmental issues such as soil compaction, erosion, drought, fire risk and desertification," notes technical manager Salvador Hernández Navarro, of the University of Valladolid.

The communally-owned Ayoó de Vidriales fields had been left uncultivated for over 15 years, leading to soil degradation and increasing the risk of wildfires. The land in San Mateo de Gállego, part of the semi-arid Los Monegros area, "has typically grown low-yield cereals on a biannual rotation cycle of wheat and barley, followed by a year of fallow land," he says.

The OPERATION CO_2 project team drew up agroforestry plans for the pilot sites. These were "based on the specific characteristics of the designated areas and a variety of species was selected to cover a wide range of uses, for example, wood, biomass, fruit

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trees, aromatic herbs, border protection and annual crops, amongst others," explains Professor Hernández.

Trees and crops were treated with mycorrhizal fungi, which increase root capacity and allow the plant to adapt better to periods of drought. Each plot was sub-divided into three zones, in order to compare the effects of different mycorrhizal treatments: 100% treatment; 50% treatment; and no treatment (control zone).

In the first year of the project, soil was decompacted by means of vertical ploughing, crops were sown on cultivation ridges, and the soil was injected with a product based on mycorrhizal spores, beneficial bacteria and humus. In the second year, the project planted approximately 3 000 trees and bushes according to the agreed agroforestry plan. Species planted included sweet chestnut (*Castanea sativa*), almond (*Prunus dulcis*), maritime pine (*Pinus pinaster*), and cork oak (*Quercus suber*).

In order to encourage the growth of mushrooms and truffles with commercial value, "some of the trees were inoculated with ectomycorrhizas, for example, cork oaks with *Pisolithus tinctorius*," says Professor Hernández.

"Cereal and/or legume crops were sown between the forestry rows, in order to sustainably manage the soil. The use of mouldboard ploughs was strictly avoided along with any tilling that could damage the mycelium of the mycorrhizae," he explains.

What were the results?

To assess the impact of the agroforestry trials, the project measured indicators of biomass, carbon content and biodiversity, annual yield, tree survival rates and the effect of mycorrhizal treatments.

Results showed that annual crop yields were significantly higher in the plots with the higher percentages of mycorrhizal treatment. For instance, in 2015, the barley yield at San Mateo in the zone with 100% treatment was nearly double that of the control zone. More and deeper crop roots also improved the soil's water retention capacity. Survival rates of trees varied from 79-97%, depending on the species, with, for instance, almost all almond trees surviving in Ayoó de Vidriales.

Injecting trees with ectomycorrhizas encouraged the spread of alternative crops with a high added value. Lactarius (milkcap) and Boletus (penny bun) mushrooms were found below trees in Ayoó de Vidriales, while truffles were present next to holm and kermes oaks in San Mateo de Gállego.

Levels of species richness and species abundance increased significantly thanks to the project's actions. "At San Mateo de Gállego, the increase of biodiversity on the LIFE project plot in respect of surrounding plots was spectacular," says Professor Hernández. The agroforestry systems also increased resistance to pests and diseases. Phytosanitary control is being substituted for biological control thanks to the increase in auxiliary fauna. Predators and parasites of insect crop pests, specifically aphids, live on the cover crops and help keep these pests under control. This directly benefited the landowner who reported a reduction in input costs and time spent treating the land.

Carbon analysis of the project's agricultural parcels suggests that implementing agroforestry will enable these areas to serve as a long-term carbon sink. In particular, in the previously abandoned fields of Ayoó de Vidriales, a 30.5% decrease in soil carbon was avoided.

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Website: http://operacionco2.com/

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