LIFE agro for adapt

Co-funded by the European Union



LIFE AgroForAdapt (2021-2026)

Agroforestry systems for the adaptation to climate change of Mediterranean agricultural and forest landscapes

LIFE20 CCA/ES/001682

Layman's Report

Context

The Mediterranean basin is one of the most vulnerable "hotspots" or critical points to climate change worldwide. In this scenario of rising temperatures, increasingly erratic precipitation regimes, and changes in the frequency and intensity of extreme events, the management of our agricultural and forest lands requires urgent adaptation measures.

The main processes that have shaped the rural landscape of Mediterranean Europe since the mid-20th century are, on the one hand, agricultural intensification and, on the other, rural abandonment. In flat areas, a progressive grouping of crop fields was promoted to create increasingly large and simplified plots, mainly dedicated to monocultures. One of the consequences was the loss of 70% of hedgerows in France between 1962-99 and 50% in Catalonia between 1957-81. More than 90% of combined orchard-crop systems were also lost in France and Spain between the 1960s and 1990s.



Examples of agricultural simplification: Left: crops reach practically to the riverbank, and the riparian forest has been greatly degraded or has disappeared. Right: a "sea of grain," a landscape completely devoid of trees.

Some consequences of this simplification are:

Economic vulnerability: heavy dependence on external inputs (agrochemicals, energy, and fuel), the need for increasingly large and expensive machinery, and exposure to the fluctuations of single-product markets. This progressively reduces profitability, causing the disappearance of family-run farms and making it difficult for new generations to take over.

Environmental and climate vulnerability: the progressive loss of soil fertility and biodiversity reduces the ecosystem's ability to withstand extreme weather events, increasing its vulnerability to pests and diseases. The abandonment of forest areas leads to excessive vegetation density, increasing their vulnerability to drought, health issues, and wildfires.

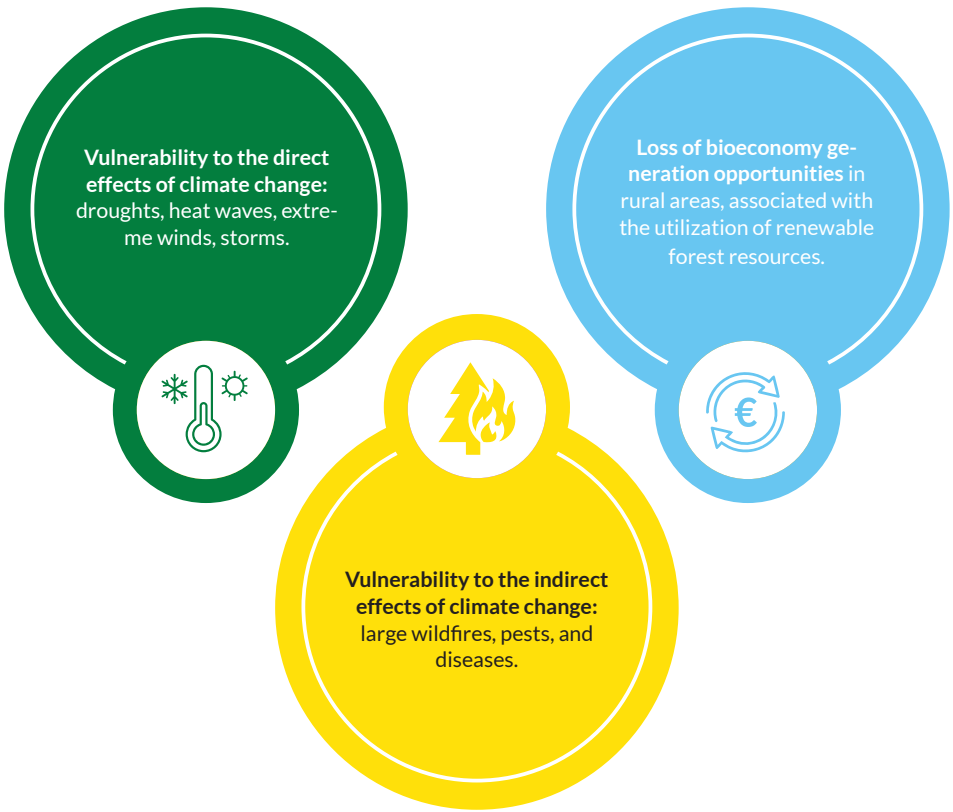
Pollution: The contamination of waterways by nitrates and other agrochemicals is a major environmental problem in predominantly agricultural areas.



Forest spontaneously occupying former agricultural terraces.

On the other hand, over the past sixty years, the abandonment of agriculture and livestock farming in Spain, mainly in mid-mountain areas, has led to an increase of more than seven million hectares of forest area, that is, an increase of two-thirds compared to the forest area in the 1950s. Of the current 28.5 million hectares of forest, the majority are abandoned: in Spain, only 15% of the increment in timber growing stock is harvested each year, not considering the Cantabrian coast.

The resulting continuous forest mass, often with excessive density, is exposed to growing problems:



Agroforestry systems: ancient solutions to present and future challenges

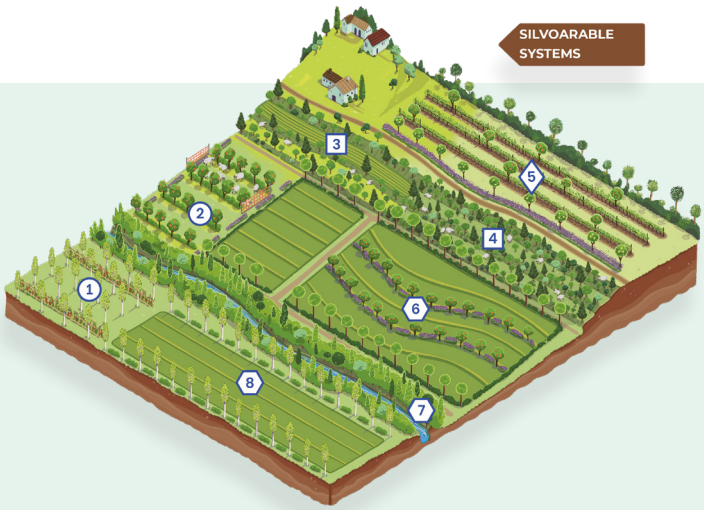
The economic, social, and environmental limitations of the prevailing agricultural and forestry model have led to the emergence of land-use trends that seek to restore the viability of family farms. This rethinking involves a better understanding of agricultural and forest ecosystems to seek a more efficient use of locally available resources and thus increase the economic, social, and environmental sustainability of the farms. This process includes incorporating recent advances in the understanding of soil functioning, microbiology, ecology, physiology, or genetics, but also the consideration and updating of traditional practices, including what we now call agroforestry systems.



Traditional agroforestry landscape (Lleida, Spain).

> *We define agroforestry as the practice of deliberately combining woody vegetation (trees or shrubs) with agricultural and/or livestock systems to generate benefits from their ecological and economic interactions, where:*
> *- At least 5% of the system's area is occupied by canopies of woody vegetation when it reaches full development.*
> *- At least one-third of the area is occupied by the agricultural and/or livestock component.*

Two of the main types of agroforestry systems in the Mediterranean context are **silvoarable** systems (a combination of woody vegetation with crops) and **silvopastoral** systems (a combination of a woody component—trees and/or shrubs—with livestock or pastoral production). In both cases, the starting situation can be land with a prior agricultural use (where the woody component is added) or a woody system (plantation or forest) where the agricultural or livestock component is added. The woody component can include fruit trees, grapevines, timber or fodder trees and shrubs, and species that serve an auxiliary function: windbreaks, soil improvement, shelter for beneficial wildlife, etc. The agricultural component could be any crop, herbaceous or woody.

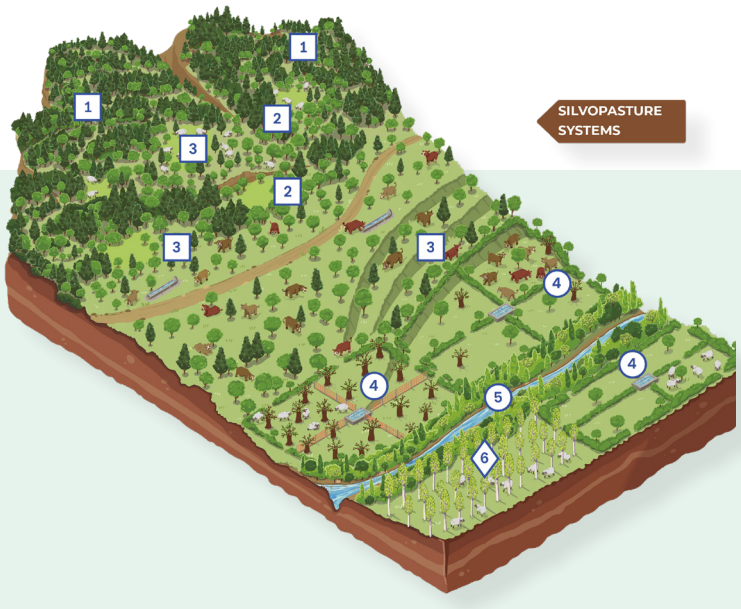


1 / Horticultural and fodder crops between the poplar trees
2 / Herbaceous and woody forage between fruit trees. Woody and herbaceous hedges (complementary flowering species)

3 / Recovery of cultivation and pasture on former terraces. Thinning (reduction of tree density) on slopes
4 / Heavy thinning of old terraces. Thinning (reduction of tree density) on slopes

5 / Woody (shrubs, trees, aromatic plants) and herbaceous hedges (complementary flowering species). Cover crops. Fruit trees scattered in the vineyard rows

6 / Rows of fruit trees and aromatic plants following key-line design (hydrological design). Woody hedgerows (shrubs, trees)
7 / Restoration of the riparian forest
8 / Woody hedgerows (shrubs, trees)



1 / Thinned forest
2 / Recovery of open spaces
3 / Heavily thinned forest / wooded pastureland

4 / Diversification of grazing land with forage shrubs and trees (pollards or not). Creation of pastoral enclosures for rational grazing
5 / Restoration of the riparian forest

6 / Pasture between rows of trees

Silvoarable systems

The design of a silvoarable system seeks to optimize the allocation of space between woody and agricultural components to maximize complementarity in the use of light, water, and soil nutrients, as well as positive interactions: microclimate improvement, indirect fertilization, hosting of beneficial fauna...

The complementarity is based on the fact that each component occupies different heights and different depths in the soil, and they are also active (i.e., photosynthesizing) at times of the year that do not always coincide. As a result, light and water are utilized more effectively, increasing infiltration and reducing problems with waterlogging and erosion.

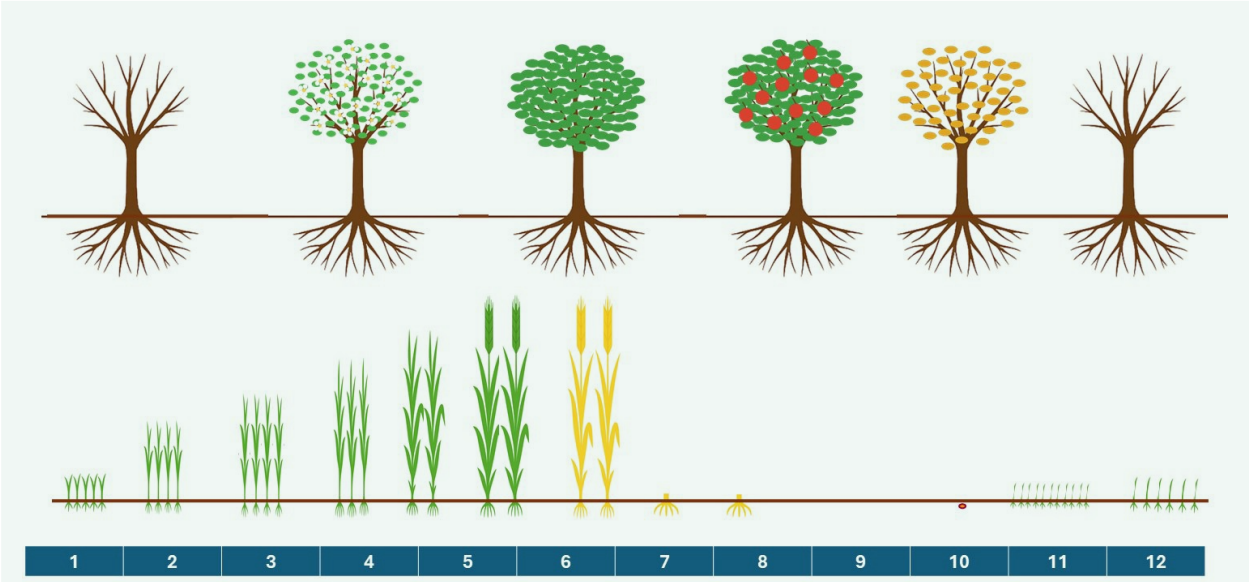


Diagram of the development stages of a winter cereal and a deciduous fruit tree during the different months of the year (numbered from 1 to 12). If they are produced separately, there are long periods of the year when the available resources (water, light) are not utilized. In contrast, if they are combined, it is possible to have at least one of the two components active every day of the year.



Silvoarable system with fruit trees in Charente-Maritime (France).

Interactions are the effects of the woody component on the agricultural one, and vice versa. For example, trees create a microclimate for the crop that is more humid and less exposed to wind and sun, host beneficial fauna, and increase soil organic matter and carbon, although they also cause partial shading. On the other hand, agricultural management allows for regulating competition from adventitious vegetation on the trees.

The main consequences of the processes of complementarity and interaction are higher total productivity (considering both components), diversification of the products obtained, and greater capacity to adapt to climate change. In addition, these systems lead to significant environmental improvements: protection of soil, water quality and biodiversity.

The woody component is mainly arranged along the plot margins or as interplanted rows (alley-cropping).

ADVANTAGES OF SILVOARABLE SYSTEMS

ADVANTAGES COMMON TO ALL SILVOARABLE SYSTEMS

Productive and socio-economic advantages

- Diversification of production (agriculture + other agriculture and/or forestry and/or livestock)
- Higher total productivity per hectare
- High added-value products (social and environmental benefits)
- Heritage land value
- Social perception of ownership role
- New sources of funding: climate credits, beekeeping, landscape improvement, etc.

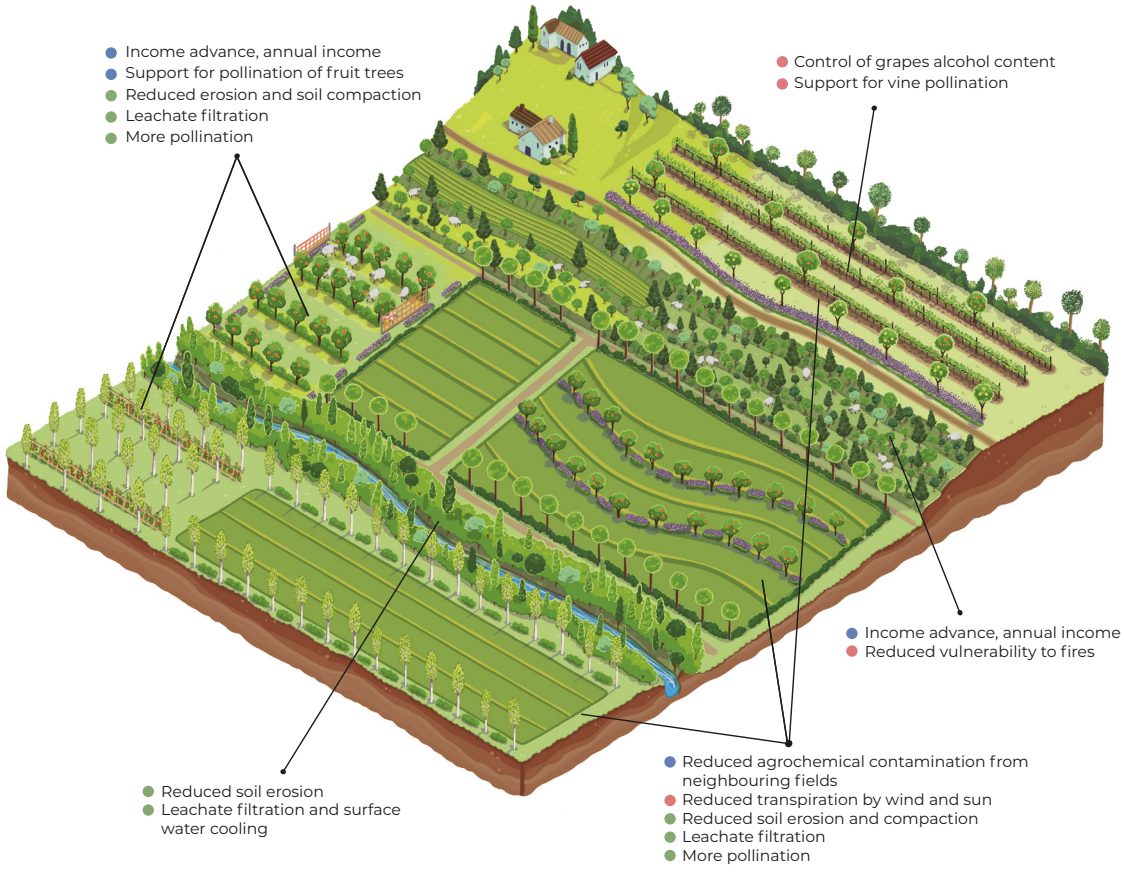
Adaptation to climate change

- Buffered extreme temperatures, less impact in case of drought or storms

Environmental benefits

- More biodiversity (habitat diversification) and better connected
- More carbon sequestration

SPECIFIC ADVANTAGES OF EACH SILVOARABLE SYSTEM



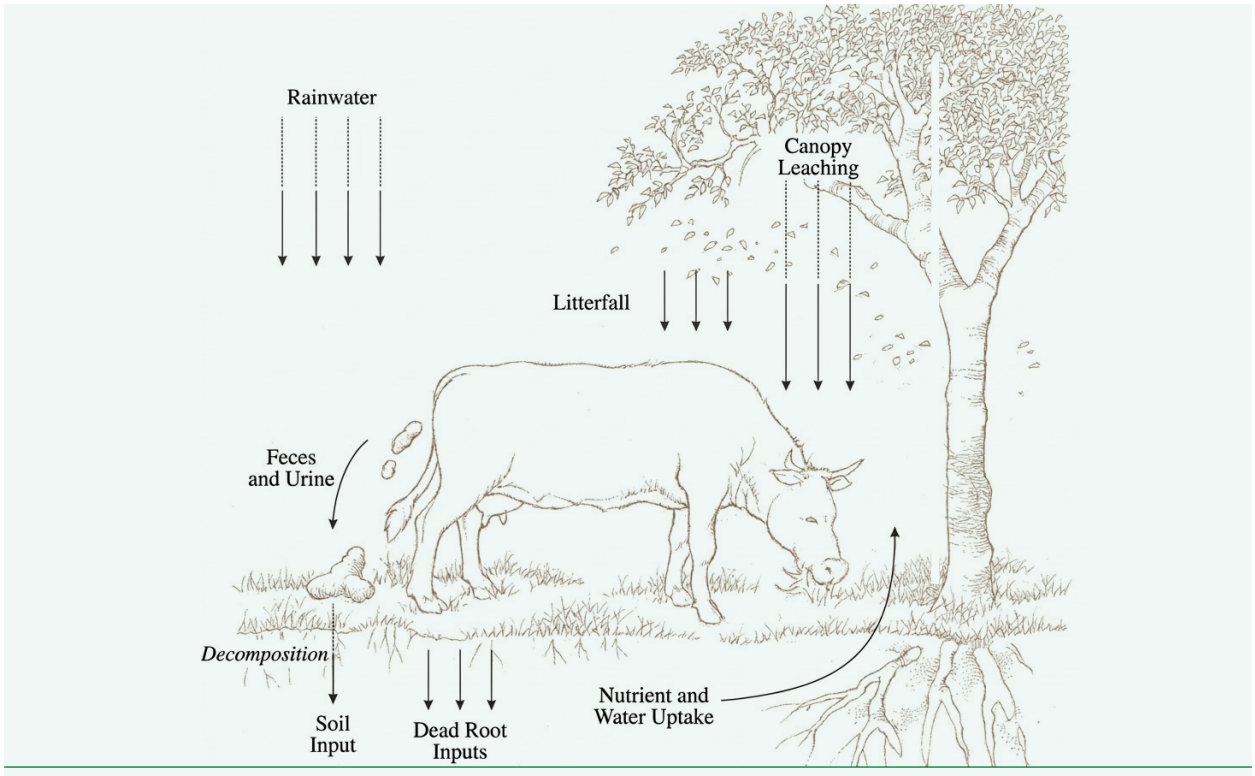
Silvopastoral systems

Similar to silvoarable systems, silvopastoral systems seek to create complementarities and positive interactions between the woody component and the pastoral or livestock component.



A silvopastoral system where selective thinning and shrub clearing has been carried out (Barcelona, Spain).

The main interactions of the trees on the livestock component are the creation of a milder microclimate for the pasture and the animals, which extends the period when the pasture remains green and improves animal welfare. Additionally, the woody component can be a complementary food source, in the form of leaves and tender branches (from forage trees and shrubs) and from fruits (acorns, chestnuts, fruit...). In turn, the animals fertilize the trees with their dung and, in the case of forest silvopastoralism, help limit the growth of shrubs, reducing competition for the trees and maintaining a forest that is less vulnerable to wildfires.



Interactions between the various components of a silvopastoral system.

To turn a forest into a silvopastoral system, it is usually necessary to apply a silvicultural treatment (thinning and shrub clearing) to create conditions for livestock to access, move through, and promote the emergence of herbaceous and woody forages. If the silvopastoral system is established on pastureland, the woody vegetation is commonly added to the perimeter or as grouped (rows or clusters) or scattered individuals, and always with an appropriate protection system for the trees.

ADVANTAGES OF SILVOPASTORAL SYSTEMS

ADVANTAGES COMMON TO ALL SYSTEMS

Productive and socio-economic advantages

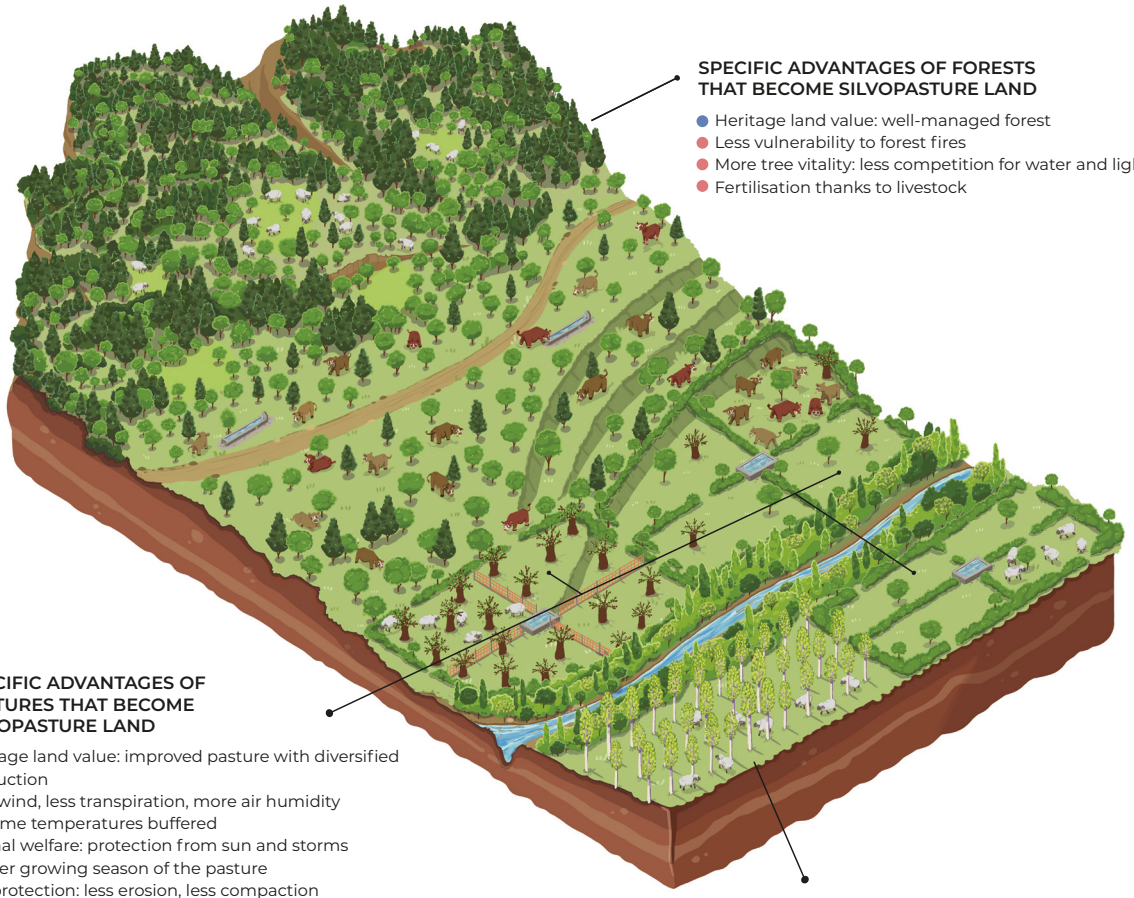
- Diversification of production (livestock and forest products)
- Diversification of fodder resources: grass, green shoots, fruits, acorns, etc.
- Higher total productivity per hectare
- High added value products thanks to social and environmental benefits
- Social perception of ownership role
- New sources of financing: climate credits, beekeeping, landscape improvement, etc.

Adaptation to climate change

- More tolerance to drought and extreme weather events

Environmental advantages

- More biodiversity (habitats diversification) and better connected



SPECIFIC ADVANTAGES OF FORESTS THAT BECOME SILVOPASTURE LAND

- Heritage land value: well-managed forest
- Less vulnerability to forest fires
- More tree vitality: less competition for water and light
- Fertilisation thanks to livestock

SPECIFIC ADVANTAGES OF PASTURES THAT BECOME SILVOPASTURE LAND

- Heritage land value: improved pasture with diversified production
- Less wind, less transpiration, more air humidity
- Extreme temperatures buffered
- Animal welfare: protection from sun and storms
- Longer growing season of the pasture
- Soil protection: less erosion, less compaction
- Water protection: filtering of manure and leachate
- Carbon fixation in woody organs
- Less impact of river floods

SPECIFIC ADVANTAGES OF POPLAR GROVES THAT BECOME SILVOPASTURE LAND

- Fertilisation thanks to the livestock
- Soil protection: less erosion

The LIFE AgroForAdapt project

The **LIFE AgroForAdapt project** (October 2021 – December 2026) aims to promote agroforestry systems as a multifunctional solution that facilitates adaptation to climate change in Mediterranean agricultural and forest landscapes.

Partners

The project includes eight complementary beneficiary entities, coordinated by the Forest Science and Technology Centre of Catalonia (CTFC). It also includes two co-financing entities and the collaboration of other institutions in the working areas: Catalonia and Castile and León in Spain, Occitanie, and Provence-Alpes-Côte d'Azur in France.

CTFC	**Forest Science and Technology Centre of Catalonia:** Research and transfer center
Diputació Barcelona	**Barcelona province council:** Public administration
Diputació de Girona	**Girona province council:** Public administration
AMB Àrea Metropolitana de Barcelona	**Barcelona Metropolitan Area council:** Public administration
Generalitat de Catalunya	**Catalan Department of Agriculture, Livestock, Fishing and Food:** Public administration
fundació emys recerca i conservació del patrimoni natural	**Emys Foundation:** Nature Conservation NGO
agresta	**Agresta S. Coop.:** Forestry and environmental consulting cooperative. Responsible for project implementation in Castile and León
Agroof agroforesterie	**Agroof, SCOP. :** Agroforestry consulting cooperative. Responsible for project implementation in France

Co-financing entities:

Diputació Tarragona	**Tarragona province council:** Public administration
RÉPUBLIQUE FRANÇAISE Liberté Égalité Fraternité / agence de l'eau Rhône Méditerranée Corse	**Rhône-Mediterranean-Corsica Water Agency:** Public administration

Additionally, a project advisory committee composed of 44 people was involved, which contributed to the successful development of the actions through four thematic meetings that addressed the design, management, and monitoring of agroforestry systems; the challenges and opportunities of regulatory and commercial promotion of agroforestry systems; and strategies to boost the visibility and association-building of agroforestry.

Territorial impact of the project

AgroForAdapt has monitored 75 demonstrative silvoarable and silvopastoral systems, and has supported the replication of almost 300 additional agroforestry systems via technical support or direct implementation. In total, work has been carried out on more than 4,000 hectares of agroforestry:

- 38 demonstration silvoarable systems (226 ha) and 99 replication systems (670 ha). These feature a wide variety of agricultural species (grains, aromatic plants, grapevines, forage legumes...) and woody species (stone fruits, nuts, high-quality timber trees, mycorrhizal trees...).

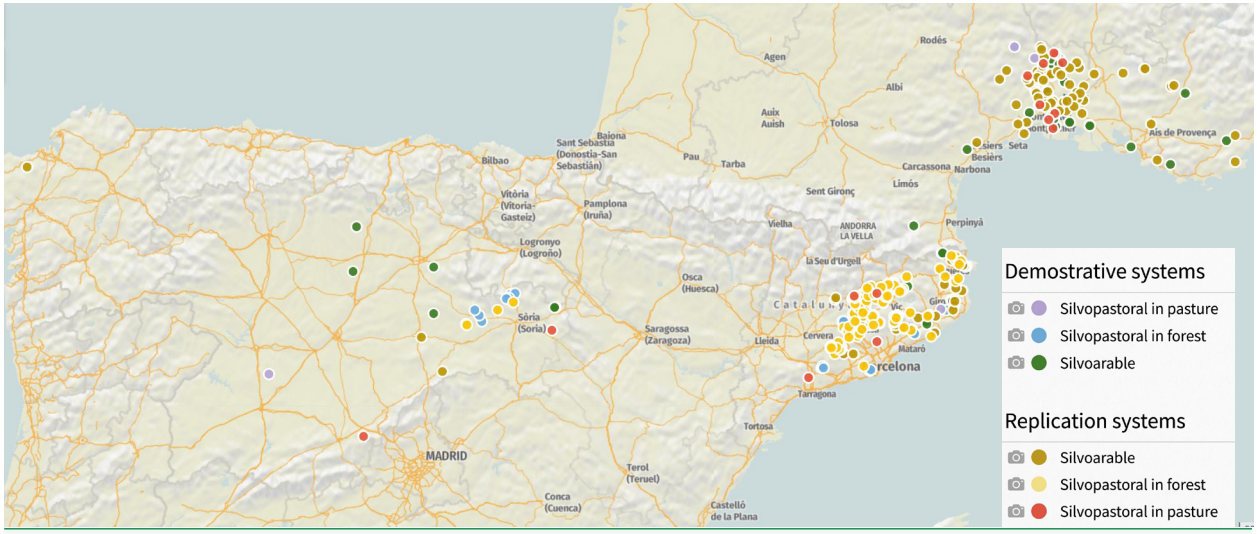


Silvoarable system with truffle oaks combined with aromatic plant cultivation.

- 11 demonstration silvopastoral systems in pastures (144 ha) and 15 replication systems (129 ha).
- 26 demonstration silvopastoral systems in forests (477 ha): composed of 51% pine forests (mainly Scots and Aleppo pines), 22% oak forests, and 27% mixed forests. Additionally, these systems have been replicated in 184 forests covering 2,398 hectares. Approximately 15% of this area has been converted to an open-woodland ("Dehesa-like") through drastic reduction in tree density, while the rest of the area was treated with low intensity thinning, keeping a forest environment.



Thinned and brush cleared forest (Barcelona, Spain).



Viewer of demonstration and replication agroforestry systems of the LIFE AgroForAdapt project. Available here.



Monitoring and results of the AgroForAdapt demonstration silvoarable systems

A detailed assessment was carried out across the 38 demonstration silvoarable systems which are characterised by their great diversity of combinations, as well as different farming and climatic conditions. Fifteen of the systems had already been established before the project, making it possible to assess silvoarable systems at different ages and stages of development.

The assessment compared the performance of crops and trees grown together (agroforestry systems) with the same crops and trees grown separately (monocultures) under the same conditions. The main aspects evaluated were those related to productivity and adaptation to climate change, including crop yield and plant vigour, the effects on farm management (such as mechanisation and input use), the microclimate created by trees (light, air and soil temperature, and humidity), and impacts on soil carbon, and on birds and pollinating insects. Although the demonstration sites were highly diverse and most of them were still relatively young—meaning that interactions between trees and crops were only beginning to develop—some common trends emerged, as described below.



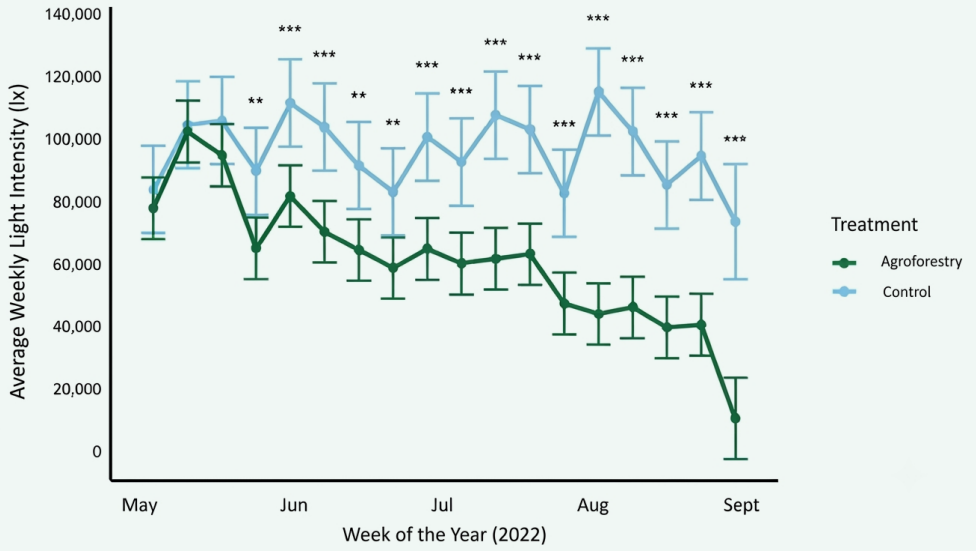
Monitoring station equipped with sensors measuring light, air temperature and humidity, and soil temperature in a silvoarable plot (Barcelona, Spain).

Overview of tree–crop interactions

- No significant effects of crops on tree performance were observed.
- During the first years after tree establishment, no significant positive or negative effects of trees on crops were detected. As a general rule, interactions begin to appear at a distance roughly equivalent to the height of the trees.
- Once interactions become established, they are complex and dynamic. Both positive and negative effects were observed, and these changed over time depending on tree size, the season, and weather conditions. The main trends observed in systems where tree–crop interactions were active are summarised below.

Effects of trees on crop growing conditions

- **Light:** Trees reduce the amount of light reaching the crop. In systems where crops are grown beneath a continuous tree canopy, light availability remains largely unaffected before the trees leaf out. However, once the canopy is fully developed, the trees can intercept up to 75% of incoming light right below the crown.

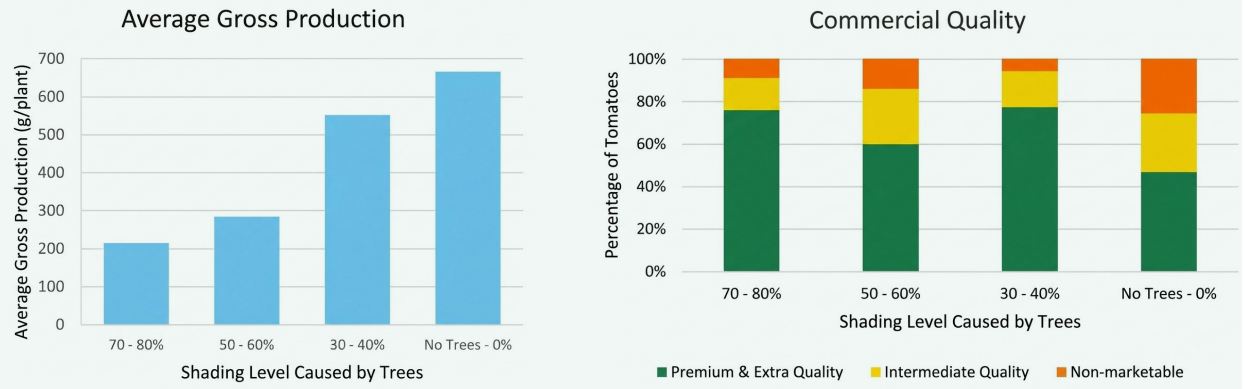


Evolution of light availability from May to September at 1.5 m above ground in a silvoarable system with 12-year-old hybrid walnut full canopy cover (green line) compared with an agricultural monoculture (blue line). Until mid-May, when the trees leaf out, shading is negligible. As the canopy develops over the summer, shading becomes increasingly pronounced. The asterisks indicate that the difference between both treatments is statistically significant. Adapted from Nyi Aung et al. (2026).

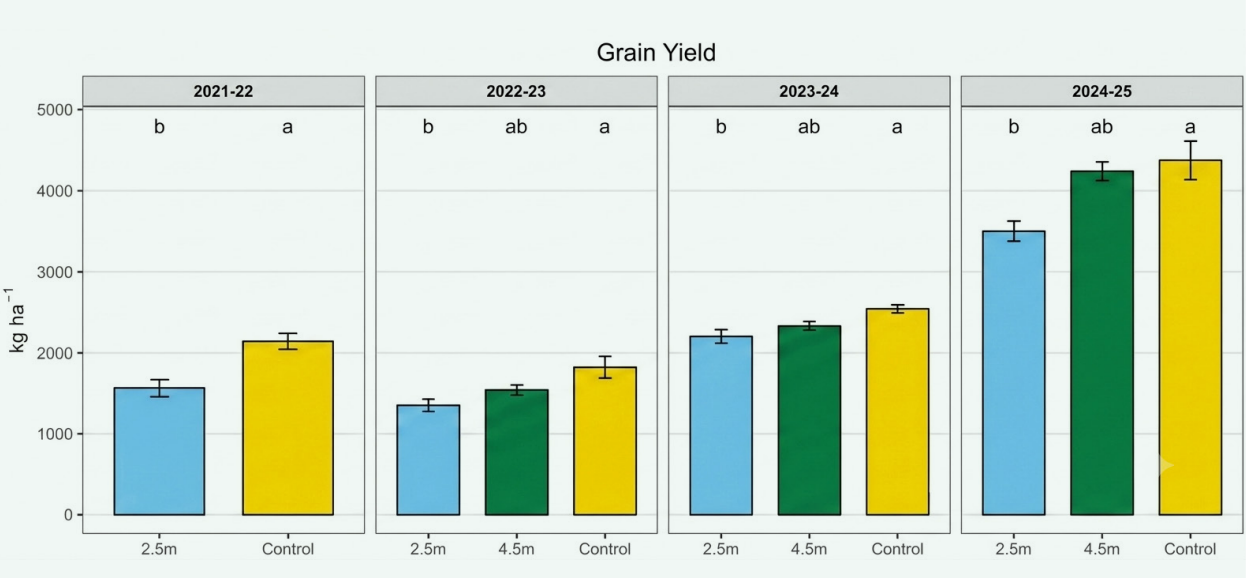
- **Temperature:** trees mitigate the extreme temperatures under which crops grow, both in winter and, in particular, in summer. In a silvoarable system with 6-metre-tall deciduous trees, there is an increase of 1°C in the minimum soil temperature in winter and a reduction of 3°C in the maximum soil temperature in summer, at a distance of 3.5 metres from the trees.
- **Humidity:** no generalised effect of trees on air humidity or soil moisture has been observed. However, a reduction of waterlogging periods has been observed in agroforestry systems.

Productivity results

- **Total productivity:** agroforestry systems show higher total productivity (crop + trees) per hectare than agricultural and tree monocultures.
- **Agricultural outcomes under moderate shade:** generally, there is a neutral or slightly positive effect in unfavourable years (drought, heatwaves), and a neutral or slightly negative effect in favourable years (rainfall well distributed throughout the year). As regards crop quality, an increase is observed in the commercial grade of the vegetables (see graph below), higher protein content in cereals and a lower alcohol content in grapes. In contrast, in the case of sage, no effects have been observed on essential oil concentration.
- **Agricultural outcomes under intense shading:** in general, a decrease in productivity is observed. The quality of some crops may improve (tomatoes), but in other cases a decline in quality is observed (lemon balm).
- **Orientation of the rows:** the effect of shading is more pronounced to the north of the tree rows than to the south of them.



Tomato yield and quality in agroforestry systems with decreasing levels of shade, from left to right: yield is proportional to available light, whilst quality is proportional to shade. The best overall results (high yield, high quality) are achieved with light shade (30-40% canopy cover).



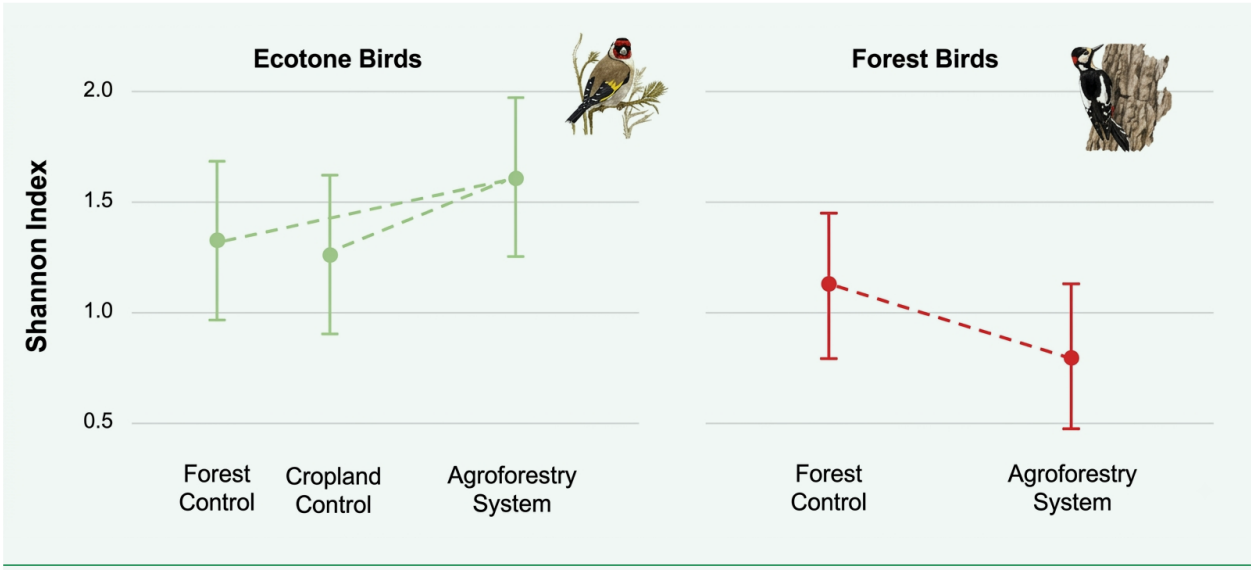
Changes in grain yield for barley (2021–22) and wheat (2022–23 onwards) grown in agroforestry systems at different distances from walnut tree rows (2.5 and 4.5 m) and under monoculture conditions (control). The average tree height is 3 m (2021), 3.5 m (2023) and 5 m (2025). The letters (a, ab, b) indicate the statistical grouping of the treatments.

Effects on agronomic management

- **Managers' perceptions:** the general perception amongst those managing these systems is very favourable: young trees do not pose a problem for crop development or management, although it is essential to adjust the distance between the tree rows so as not to hinder mechanisation. One of the most highly valued factors is the increase in the property value of the plot thanks to the presence of trees.
- **Complexity:** as the systems develop, it is necessary to manage the agricultural component, the tree component and also the interactions between the two. For example, if the shade cast by the trees is considered excessive, it may be necessary to bring forward or intensify pruning. Furthermore, the shade prolongs the crop's growing season, which can be beneficial (more months of vegetable production) or detrimental (uneven crop ripening).
- **Additional services provided by trees:** a lower incidence of pests and diseases has been observed in crops grown in combination with trees, reducing reliance on agrochemicals. In agroforestry systems with horticultural crops, a reduction of up to 50% in irrigation requirements has been observed.
- **Wildlife:** in some cases, an increase in the presence of roe deer and wild boar has been noted, linked to the presence of trees. However, planting lavandin in wooded areas appears to chase wild boar away.

Effects on biodiversity

- **Birds:** in silvoarable systems over 10 years old, there is an increase in the diversity of birds typical of "ecotone" environments (areas where open spaces meet wooded areas), such as passerines (warblers, shrikes, buntings). No effects have been observed on bird groups typical of strictly agricultural or forest environments, nor in younger agroforestry systems.
- **Pollinating insects:** the abundance of honey bees, bumblebees, other wild bees and hoverflies depends more on the total flower availability than on whether the flowers are in woody or herbaceous plants.



Bird species diversity in different monocrop and silvoarable agroforestry systems.

Effects on the soil

- A gradual increase in the soil's organic carbon content has been observed, due to the presence of trees. The increase is particularly marked in the tree row, where the soil is not tilled, but is also detectable in the cultivated agroforestry area. In a 12 years-old walnut-and-cereal agroforestry system, an increase in soil organic carbon of 37% was observed in the tree row, 25% at 2.5 metres from the trees and 13% at 4.5 metres from the trees. The total increase across the plot is 7%, which is a substantial value considering that the trees are still in the first quarter of their lifespan.

Conclusion

Well-designed and well-managed silvoarable systems (with moderate, regulated shading) offer benefits in terms of productivity (higher total productivity, greater stability, and reduced dependence on external inputs), adaptation to climate change, and environmental improvements (biodiversity, soil). The extent of these effects varies over time.

For more details on the results of the demonstration silvoarable systems:
https://agroforadapt.eu/en/publications-agroforadapt/



Monitoring and results of the AgroForAdapt demonstration silvopastoral Systems

To evaluate the performance of demonstration silvopastoral systems, monitoring included the dynamics of ttree and understorey growth and vigour; structural vulnerability to forest fires; effects on the microclimate (light, temperature and air and soil humidity); and diversity of flora and fauna.

To do this, a network of 13 demonstration forests has been established in Soria, Barcelona, Girona and Tarragona (Spain). In each of these, three treatments were applied, adapted to the conditions of the individual forest:



Control: an untreated area within each forest, to enable comparison of its development with the other management treatments.



Light thinning and shrub clearing: selective reduction of tree density and undergrowth, whilst maintaining a forest environment but allowing access for livestock.



Heavy thinning and shrub clearing: a significant reduction in tree density, creating a landscape with medium or low tree density to significantly increase the land's livestock-rearing potential.

View of the demonstration forest at Tarragona (Spain), showing the condition following each treatment.

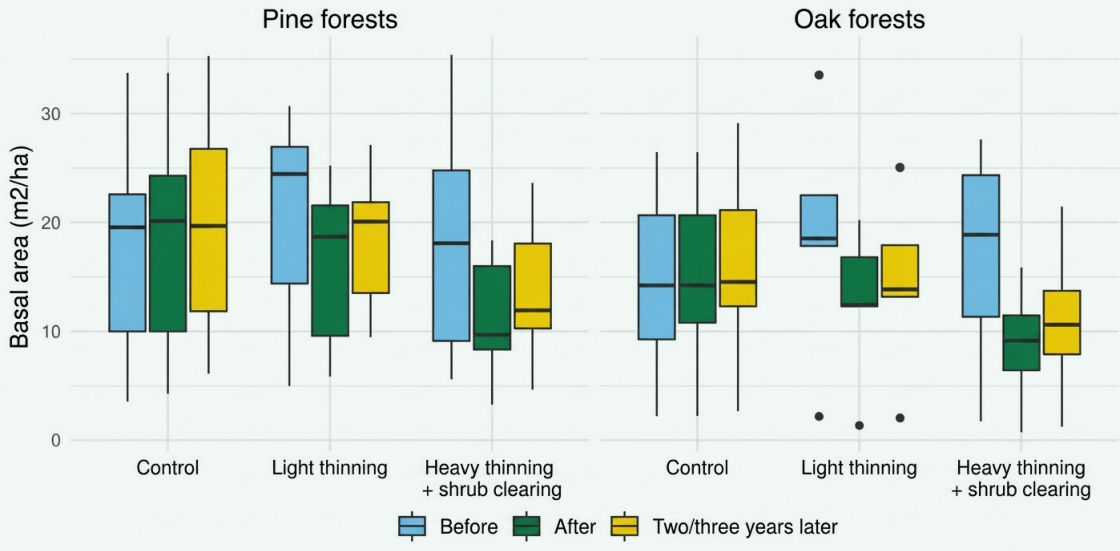
Monitoring of these demonstration forests has been carried out at three stages: before and immediately after the treatments, and at the end of 2025 – that is, two or three growing seasons after the treatments. The monitoring is carried out on permanent inventory plots.



Silvopastoral monitoring plot: in the foreground: a cattle exclusion fence to study the development of the herbaceous layer without it being grazed by livestock; in the background: a monitoring station for light, air humidity and temperature (Barcelona, Spain).

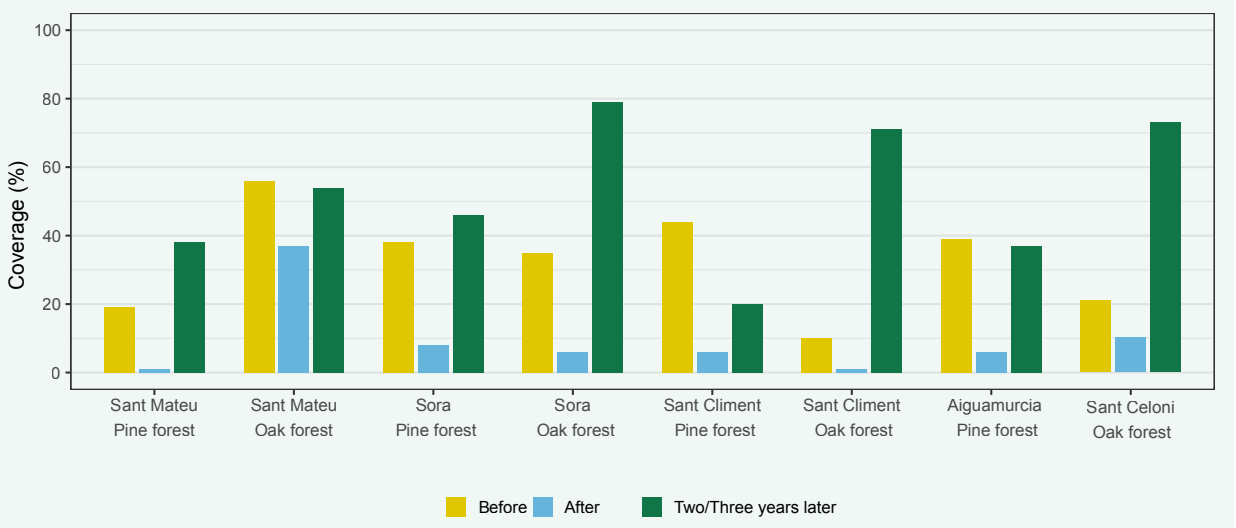
Forest dynamics and vigour

- Greater tree growth in the thinning treatments, thanks to the increased light and water available for each tree retained, compared with the control treatment.

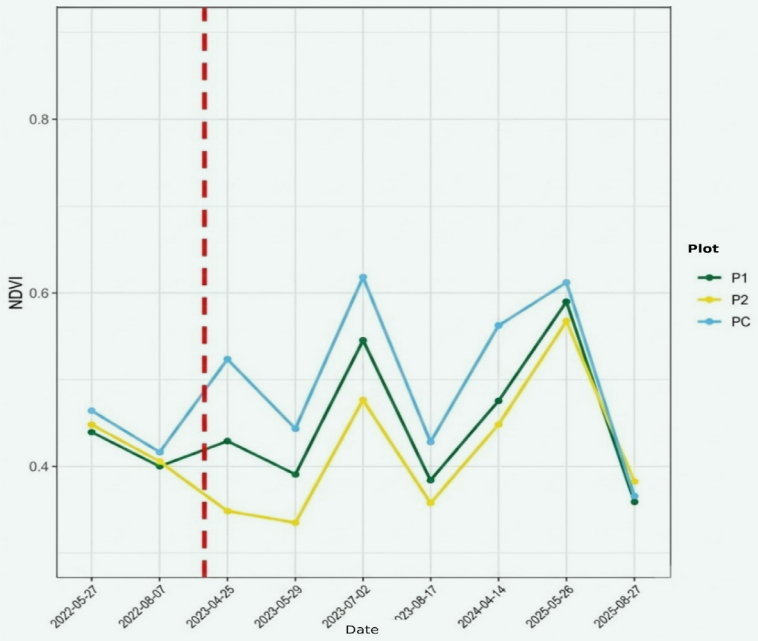


Basal area (m^2/ha) is a measure of how much space tree trunks occupy within a given area. The graph shows this variable broken down by forest stand type before the treatments, immediately after the treatments, and two or three years later. The width of the box plots reflects the variability of the data.

- The development of forage resources (shrubs and grass) of pastoral interest following silvicultural treatments has been influenced by the level of grazing: in general, this has been less intense than anticipated, meaning that these resources have been utilised less effectively than would be desirable.
- Light thinning and heavy thinning treatments significantly reduced the biomass and cover of forage resources of pastoral interest (by 80% and 95% on average, respectively). However, after two or three years, these resources show a degree of recovery which, in most cases, exceeds the initial values, particularly in heavy thinning treatments in oak and holm oak woodlands.
- In the heavy thinned plots, the number of herbaceous species of pastoral interest has tripled.
- Silvicultural treatments cause a decline in total photosynthesis. However, in just two or three years, the vegetation shows rapid recovery, reaching levels similar to those in the untreated area.



Effect of the light thinning treatment on the cover of species (shrubs and herbaceous plants) of pastoral interest in eight demonstration forests in Catalonia. Data are shown before the treatment was applied, immediately afterwards, and two or three years later.

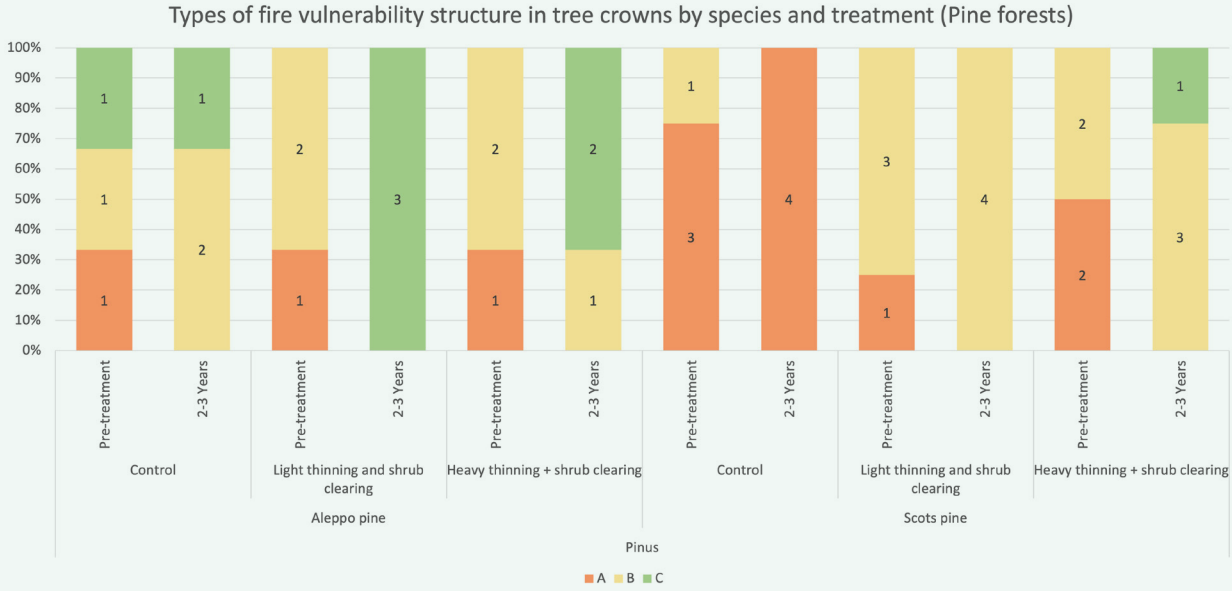


Changes in the NDVI index (vegetative activity) in the inventory plots of the Aiguamúrcia demonstration forest (Tarragona). Initially, the three plots showed similar conditions, but following the intervention (red line), vegetative activity declined as a result of the reduction in tree density, both in the light thinning (P1) and, in particular, in the heavy thinning treatment (P2), compared with the control area (PC). However, within three years, vegetative activity tends to even out across the three treatments, indicating rapid recovery.

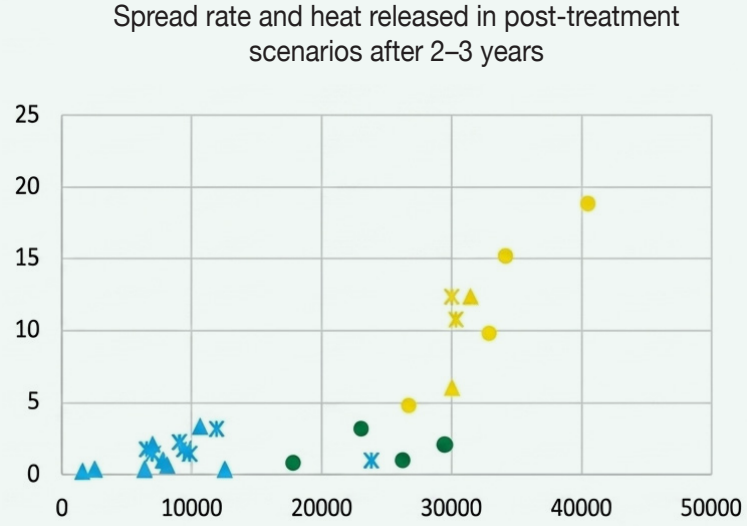
Vulnerability to forest fires

The structural vulnerability of forests to crown fires – which are the most dangerous – was analysed using the TV-FoC methodology. In addition, modelling was carried out using the *Behave* model to assess the effect of treatments on the behaviour of a model fire. The main findings are:

- Light thinning treatments (62% of the plots) and, above all, heavy thinning (82%) result in a reduction in vulnerability to forest fires within 2–3 years after the intervention.
- The improvement is particularly noticeable in pine forests, whilst in holm oak and common oak forests, part of the effect is lost due to the resprouting capacity of these species.
- Untreated areas (Control) exhibit the highest heat intensities and the highest fire spread rates in the event of a fire: 44% of untreated forests would generate crown fires, compared with 22% of treated forests.



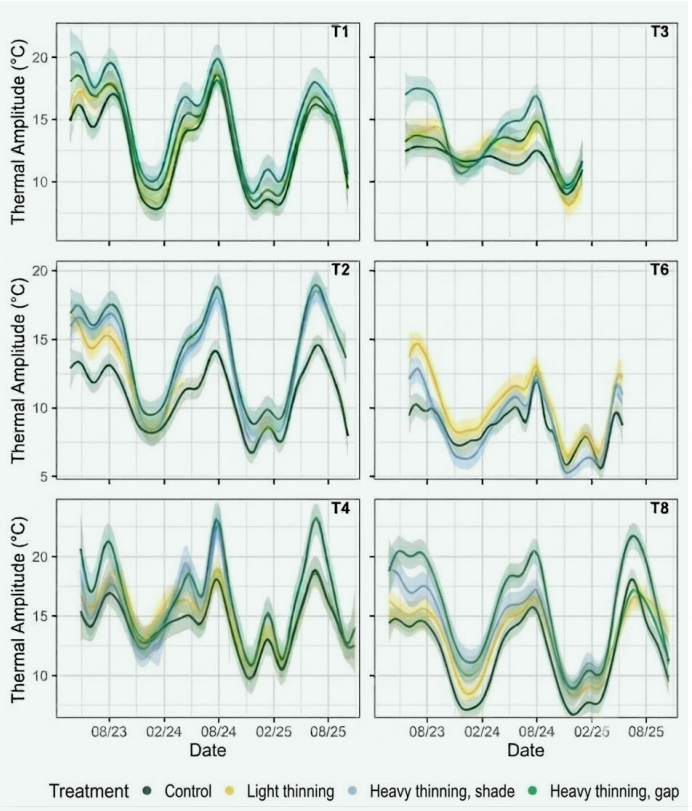
Types of fire vulnerability structure in tree crowns by species and treatment in pine forests. The numbers indicate the number of plots of each vulnerability category.



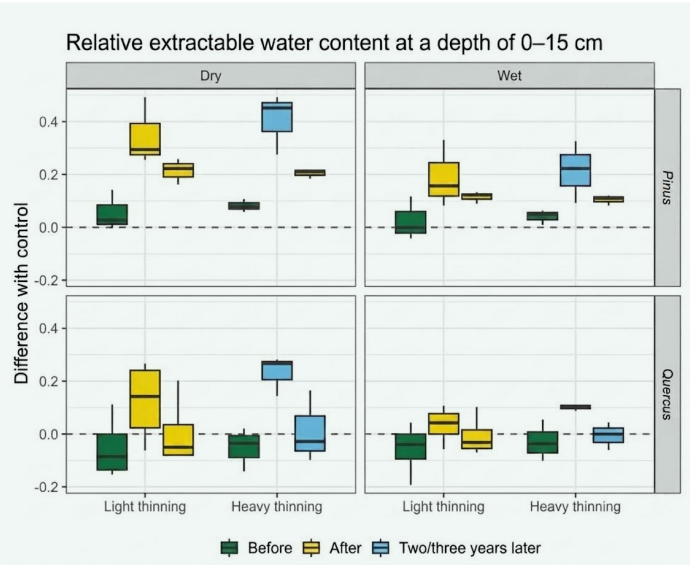
Spread rate (m/min; vertical axis) and heat released (kJ/m2; horizontal axis) by a model fire, 2–3 years after treatment, in control plots (circles), light-thinning plots (triangles) and heavy-thinning plots (crosses). Surface fires (the least severe) are shown in blue, whilst the most severe fires – passive and active crown fires – are shown in green and yellow, respectively.

Microclimate regulation

- Silvicultural treatments make it possible to significantly increase the amount of light reaching the undergrowth: +236% with heavy thinning and shrub clearing (+61% beneath the trees) and +114% with light thinning and shrub clearing.
- Furthermore, silvicultural treatments led to an increase in the water content of the top 15 cm of soil, according to a simulation using the Medfate model. This effect was only temporary in the case of holm oak and oak forests, whilst in pine forests it persisted throughout the 3-year monitoring period.
- However, the loss of tree cover has a negative impact on the microclimate in which the grass grows: in the treated areas, and especially in the heavy thinned zones, there is an increase in extreme summer temperatures and daily temperature fluctuations, while air humidity decreases.
- Overall, the micro-conditions for grass growth have improved thanks to the silvicultural treatments compared with the initial situation (control area), where the lack of light limits its growth. Furthermore, the microclimate created is expected to be more favourable (milder temperatures, higher air humidity) than that expected in a grassland completely devoid of trees.



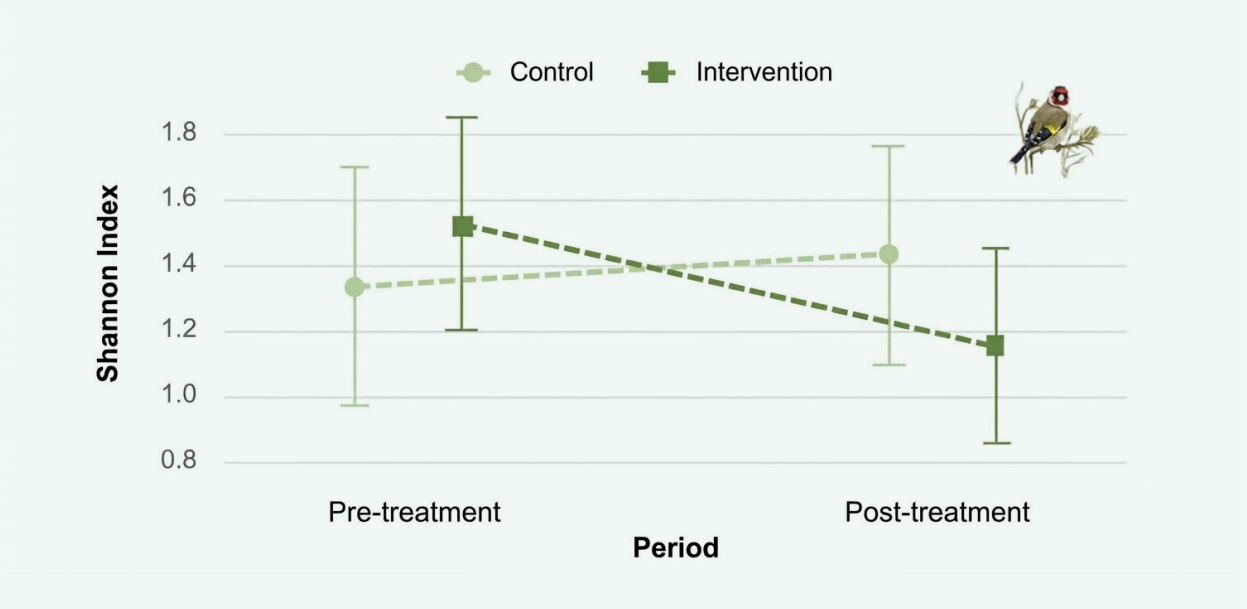
Average daily temperature range recorded in the undergrowth (1.5 m) under different treatments: control, light thinning, and heavy thinning (shade: measurement point under a tree; gap: measurement point in an open area).



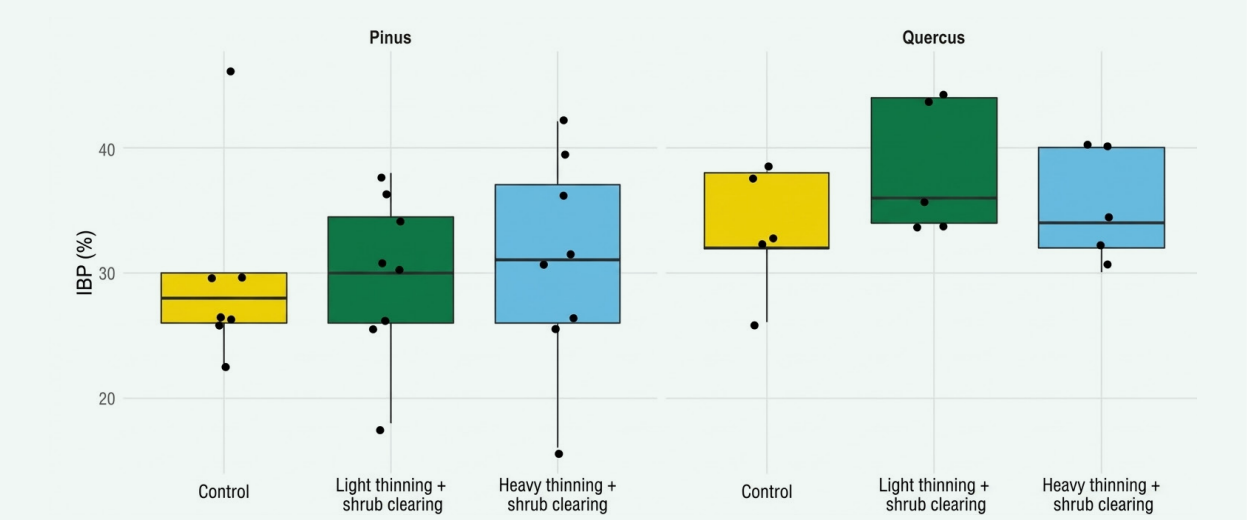
Difference in extractable water content (available to plants) in the top 15 cm of soil in managed forests (light thinned, heavy thinned) compared with control stands, by forest stand type and whether the year was dry or wet. Values above the dotted line indicate an increase in water content compared with the control.

Biodiversity

- The overall effect of silvicultural treatments on biodiversity indicators is barely noticeable, both in terms of plant diversity and biodiversity hosting potential, as estimated using the IBP methodology.
- The only group of birds adversely affected by the treatments has been that of species typical of transitional habitats between open and closed areas, which have shown a decline in the case of the heavy thinning treatment.
- In contrast, an increase in butterfly populations and diversity (particularly those typical of open areas) was observed in several of the treated forests, compared with the control areas.



Shannon diversity index of the bird community typical of mixed habitats in control areas and in heavy thinned systems, before and after the intervention. The points represent the model-estimated means and the vertical bars correspond to the 95% confidence intervals.



Average values of the Potential Biodiversity Index (IBP) 2–3 years after the interventions, depending on the treatment applied (control, light thinning/shrub clearing and heavy thinning/shrub clearing), in pine and holm oak-oak forests. Each point represents a stand.

For further details on the results of the demonstration silvopastoral systems:
https://agroforadapt.eu/en/publications-agroforadapt/

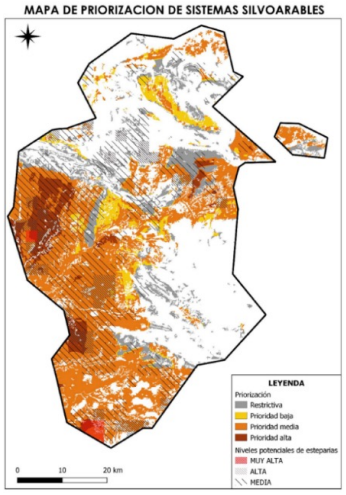
Main project outputs

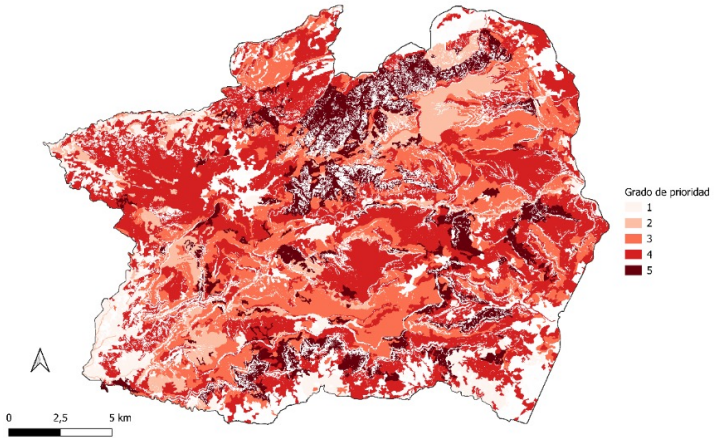
Prioritization tools

Two tools have been created to identify areas where implementing agroforestry systems would be particularly strategic, based on geographic information systems, geostatistics, and expert knowledge.

The PrioSilvAra tool classifies agricultural areas according to their potential to host silvoarable systems and the effect these would have on ecosystem services related to soil (organic carbon), water quality (nitrate vulnerability), and biodiversity (connectivity). A pilot application of this tool has been carried out in the province of Burgos (Spain, with over 7,000 km² of agricultural land), due to its diversity of ecological conditions and its representativeness of inland areas of the Iberian peninsula.

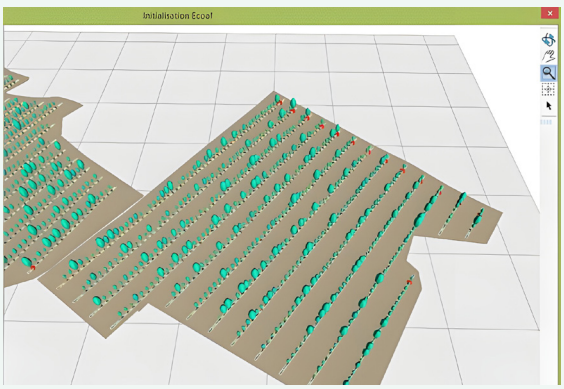
The SilPas tool identifies forest areas where silvopastoral management would be most technically viable (considering various types of livestock) and would also have the greatest impact on reducing vulnerability to wildfires. A pilot test was conducted in the Prades massif (Tarragona, Spain), covering nearly 40,000 hectares. Subsequently, the SilPas portal was developed to identify the most viable areas for silvopastoral management across the whole of Catalonia.





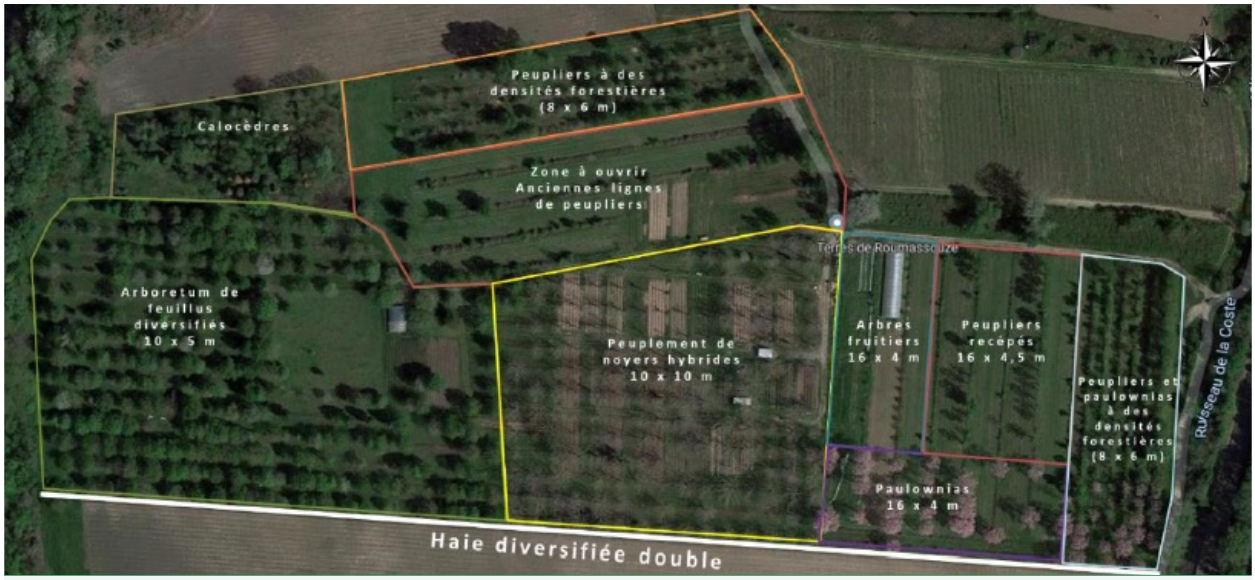
Tools to support the design of agroforestry systems

EcoAF is a digital tool to facilitate the design of silvoarable systems, intended to be useful for technicians, farmers, practitioners and researchers. An update of this tool has been developed within AgroForAdapt, with improvements that make it easier to use, including various starting scenarios and multiple tree layouts.



Comprehensive Agro-Silvo-Pastoral planning models

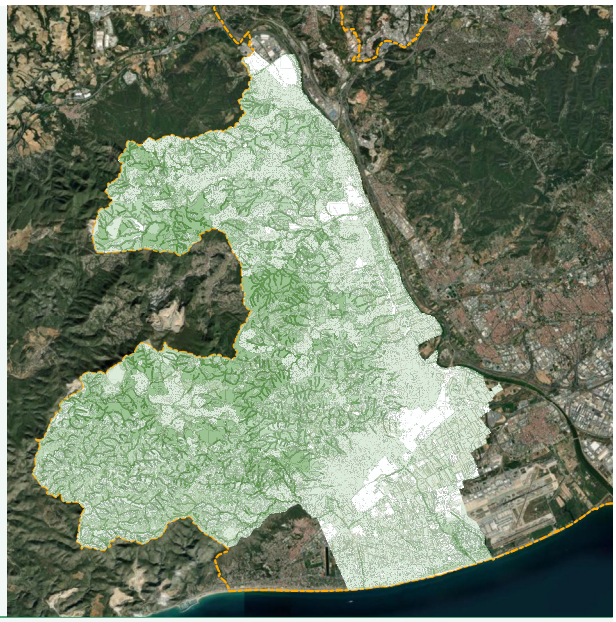
A factor that limits the adoption of agroforestry systems is the lack of planning tools that integrate agricultural, forestry, and pastoral uses together. For this reason, three pilot models of comprehensive agroforestry planning methodologies have been created. Each one is adapted to a planning scale: small-to-medium farm (approximately: 5-50 ha); medium-to-large farm (approximately: 25-500 ha); and municipal or supra-municipal scale (approximately: 1,000 - 50,000 ha).



Roumassouze estate planning (11 ha; Gard, France).



Camps i Armet estate planning (150 ha; Girona, Spain).

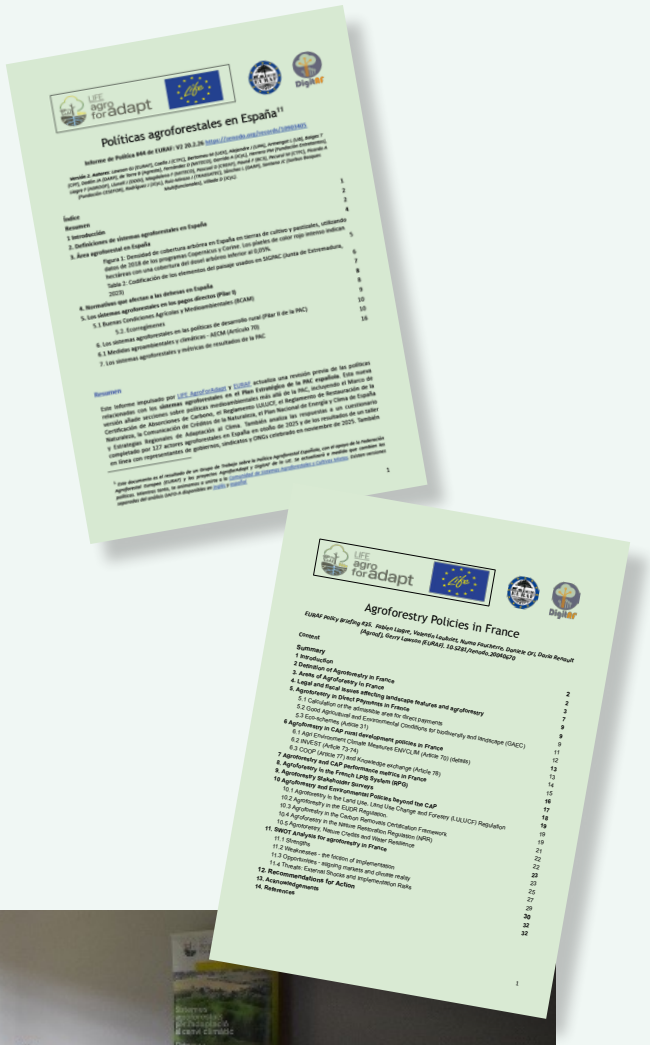


One of the information layers of the agroforestry management plan for the Baix Llobregat Mountains (12,000 ha; Barcelona, Spain).

Analysis of the regulatory and political framework and proposals for improvement

The regulatory and political framework for agroforestry systems is very complex due to the multiple regulations involved and the great diversity of these systems. To facilitate an understanding of this framework, an analysis of the regulatory context has been conducted for both Spain and France, including the main regulations affecting these systems, their articulation in the Common Agricultural Policy (CAP), a SWOT (Strengths, Weaknesses, Opportunities and Threats) and an Action Plan for improving the regulatory framework.

These publications have been prepared with the participation of multiple co-authors in each country. In addition, they incorporate lessons learned on the ground, from conversations with people involved in the project's demonstration systems and participants in the transfer activities, as well as information gathered through surveys and workshops with policy experts.



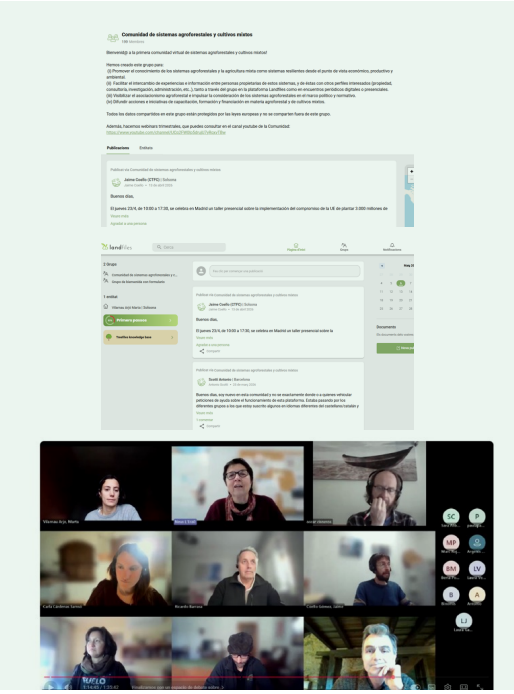


Promoting Associationism in Spain

People interested in agroforestry systems form a dynamic and motivated community, but they are spread out across the territory. To facilitate networking, direct exchange between producers and people in the advisory, research, and administration sectors, as well as with other groups interested in agroecological practices, the Agroforestry Systems Community has been created.

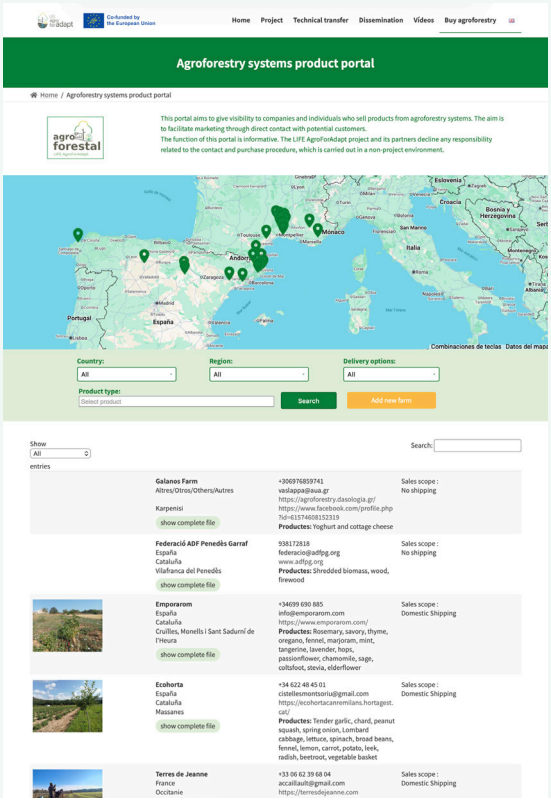
In addition to functioning as a thematic social network with over 200 members and organizing three to four webinars annually, this Community is Spain's representative to the EURAF (European Agroforestry Federation).

Additionally, this Community has been the seed for establishing an Agroforestry Association in Spain, with the goal of promoting agroforestry systems and serving as a meeting point for interested individuals.



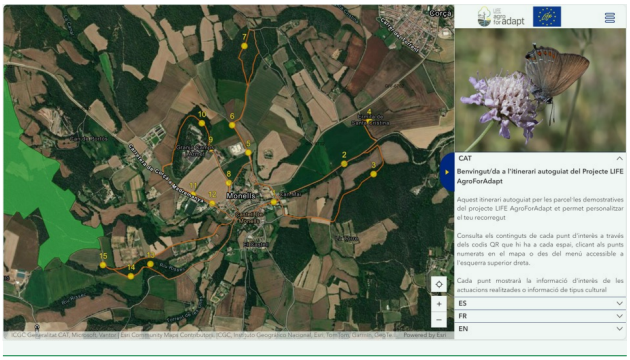
Commercial Promotion

A particular feature of agroforestry systems is the diversification of the products obtained. To give visibility to the people and entities that sell products from agroforestry systems directly, and to make it easier for potential buyers to find them, the Portal of Products from Agroforestry Systems has been created. This portal allows searches by geographic area, product type, and shipping range, and provides descriptive profiles of each farm.



Self-guided tour of the “Camps i Armet” agro-silvo-pastoral farm

The Girona Provincial Council has created a self-guided tour of the Camps i Armet farm, which it owns, located in Girona (Spain). Over 12 km, the route allows visitors to learn firsthand about the concept, design, and objectives of three demonstration agroforestry systems (two silvoarable and one silvopastoral), as well as other features of this 150-hectare demonstration farm. The tour can be done by following the poles with QR codes installed along the route, or by consulting the itinerary’s website. This educational tool is an example of integrating responsible tourism, technical outreach, and new technologies.





Technical Manuals

Design and Management of Silvoarable Systems

The "Manual for the Design and Management of Silvoarable Agroforestry Systems in Mediterranean Conditions" (2026) is a comprehensive guide for professionals and managers on the deliberate integration of woody vegetation with agricultural crops to generate ecological and economic benefits.

Through its seven chapters, the manual details the scientific foundations of spatial and temporal complementarity, offers practical recommendations for the design and maintenance of silvoarable plots, and analyzes the current regulatory framework. Additionally, it includes 11 real-world case studies from Spain and France that demonstrate the technical feasibility and profitability of these systems.



Design and Management of Silvopastoral Systems

The "Manual for the Design and Management of Silvopastoral Systems for Adaptation to Climate Change" (2026) aims to guide landowners and technicians in creating Mediterranean landscapes more resilient to the effects of climate change, specifically through silvopastoral systems, that is, the combination of woody vegetation with livestock systems.

The document focuses on showcasing the diversity, foundations, and criteria for designing and managing silvopastoral systems, and highlights the strategic role of livestock in reducing the vulnerability of forested areas to fire, as well as the potential to diversify feed and increase animal welfare thanks to woody vegetation.



Marketing of products from agroforestry systems

The "Manual for Marketing Products from Agroforestry Systems" is a strategic guide aimed at improving profitability by adding value to high-value-added products (quality foods, high-value wood, medicinal plants...).

It details the technical, economic, and legal conditions for improving profit margins, providing ideas for organizing harvesting and processing. It also explores innovative opportunities related to carbon certification and ecotourism. Finally, it uses tools like the Agroforestry Systems Products Portal to give this sustainable business model commercial visibility.



Biodiversity in Silvoarable Systems

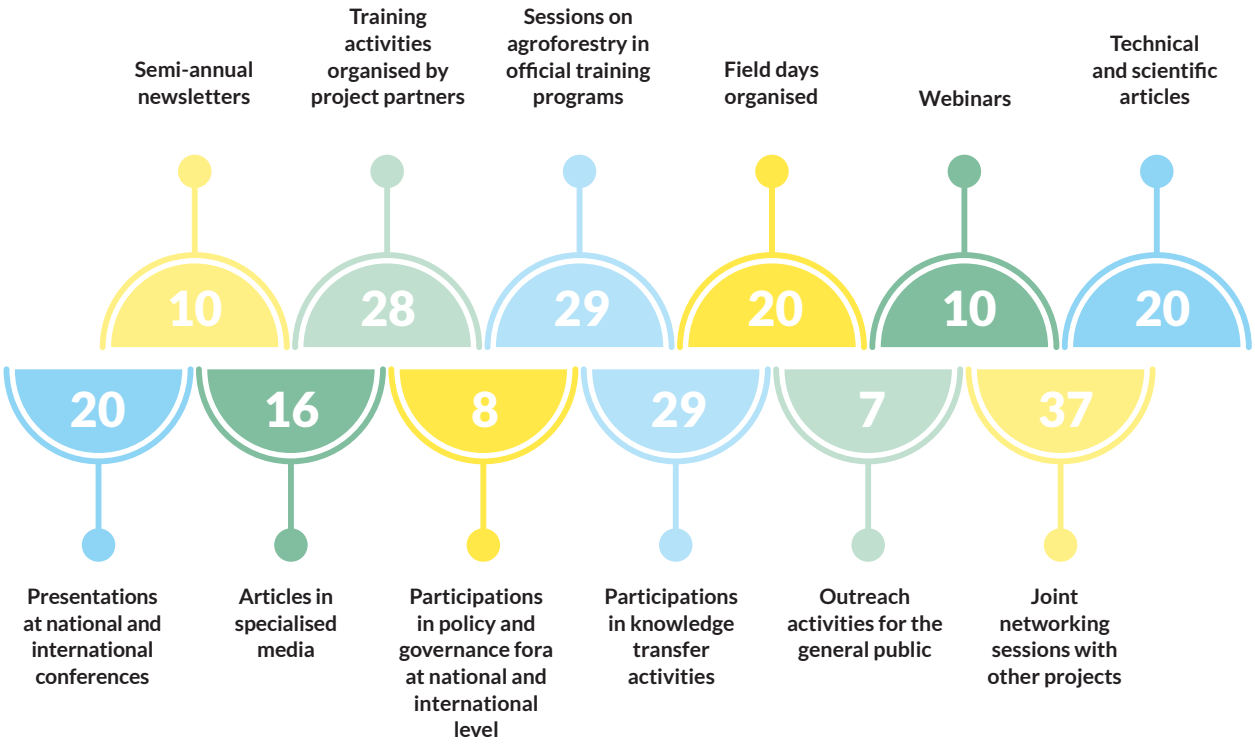
The "Manual on Biodiversity in Silvoarable Systems" (2026) analyzes how the integration of woody vegetation with crops enhances biodiversity in the Mediterranean. It is designed as a technical and outreach document for professionals, technical staff, and farm managers, as well as for agricultural and environmental policymakers.

The manual compiles scientific knowledge and practical experiences from the LIFE AgroForAdapt project, offering design, management, and monitoring criteria aimed at promoting biodiversity in silvoarable systems.



Technical Transfer, Training, and Dissemination

Throughout the project, numerous dissemination and transfer activities were carried out, targeting different audiences, including the following:











Future Challenges: “What Now?”

The technical feasibility and the socioeconomic and environmental benefits of agroforestry systems in the Mediterranean are a proven reality. However, the success of their widespread adoption depends on overcoming various strategic challenges, which the project beneficiaries will continue to address once this project is completed:



Policy advocacy and improvement of the regulatory framework (Toward an agroforestry-based CAP)

It is necessary to clarify and improve the role of agroforestry systems in the future post-2027 CAP, specifically:

- Ensure that the presence of trees in agricultural or livestock systems does not constitute a bureaucratic obstacle or result in a reduction in subsidies.
- Create stable incentives for the implementation and multi-year maintenance of agroforestry systems.
- Support agroforestry systems and other agroecological practices that enable progress toward agriculture and land use that are more economically, socially, and environmentally sustainable, thereby helping to sustain family farming and food sovereignty.



Marketing and Economic Valorization

- Market differentiation: ensuring that consumers associate products from agroforestry systems with values such as climate resilience, rural development, and animal welfare.
- Visibility tools: consolidate the Agroforestry Systems Products Portal to facilitate direct contact between producers and consumers.
- New revenue streams: explore carbon credit certification, agricultural credits, and ecotourism as ways to supplement farm profitability.



Strengthening Associations

- Expand the *Comunidad de Sistemas Agroforestales y Cultivos Mixtos*—already organized as an association—as an increasingly physical meeting point for producers, advisors, the scientific community, and administrations.
- Promote joint initiatives with other organizations related to agroforestry systems and agroecology.

Technical Training and Support

- Standardization of knowledge: integrating agroforestry systems into official training programs, both at the pre-university and university levels.
- Train producers, advisors, and technical staff within the public administration in the potential, design and management of agroforestry systems.
- Incorporate new technologies and innovative tools for the design, management, and simulation of agroforestry systems to optimize decision-making.

Awareness-Raising and Changing Perceptions

- Within the sector: to spark interest among farmers, livestock producers, and foresters in systems that will reduce their dependence on external inputs and their vulnerability to climate change, in synergy with other agroecological practices.
- Society at large: Communicate the direct and indirect benefits of agroforestry systems as a land-use practice with multiple social and environmental co-benefits.

Research and Knowledge Generation

- Long-term monitoring: Demonstration and replication agroforestry systems are living laboratories that can generate information over the medium and long term. It is essential to continue monitoring them from multiple disciplinary perspectives to generate first-hand information that allows for the quantification of their effects on multiple ecosystem services.
- Agroecological innovation: working to integrate agroforestry systems as an essential part of organic and regenerative agriculture approaches, incorporating innovations such as syntropic and hydrological designs.





Contact

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