PRIMA
PARTNERSHIP FOR RESEARCH AND INNOVATION IN THE MEDITERRANEAN AREA

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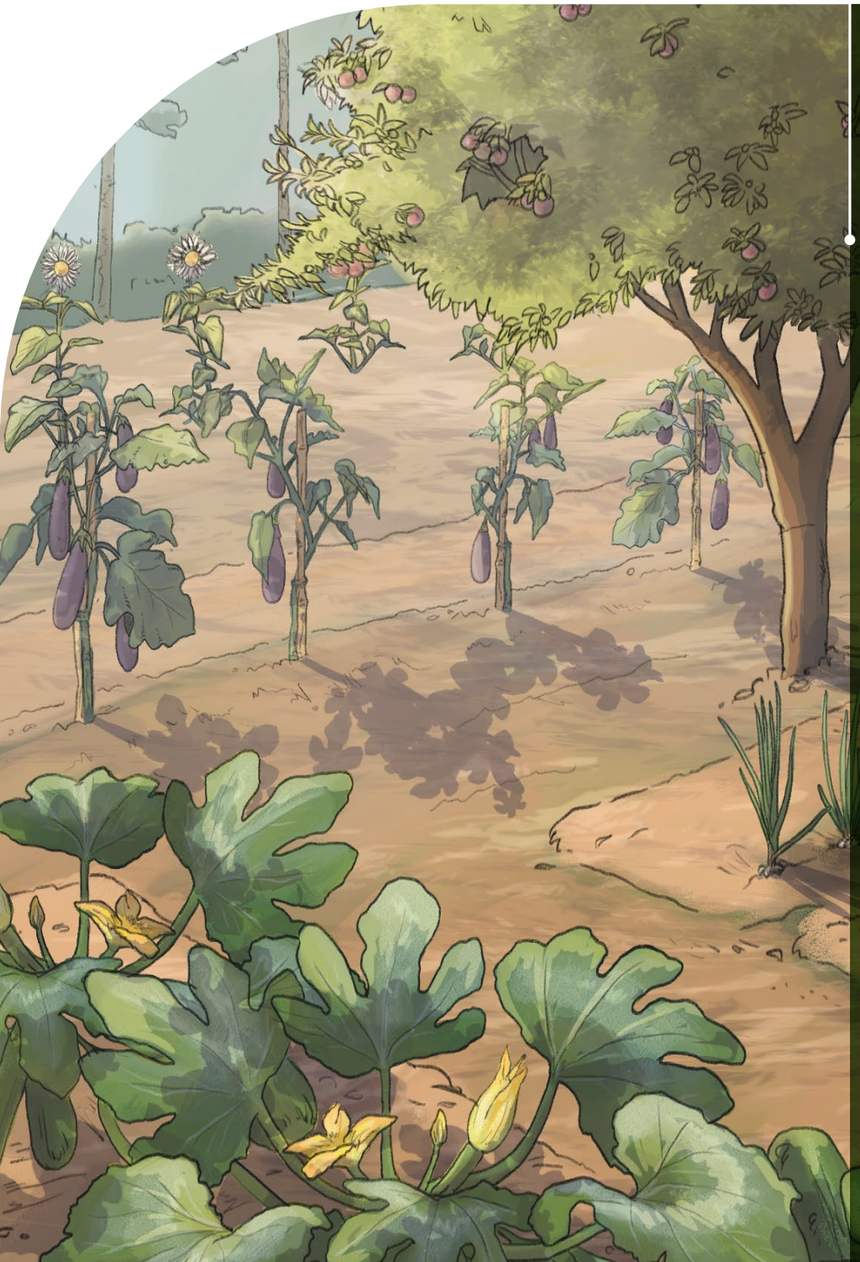
Transition

Innovative resilient farming systems in Mediterranean environments



Pave the way for a TRANSITION towards resilient agriculture in the Mediterranean, while increasing resilience of agroecosystems, rural societies and return on assets to farmers.

Innovative resilient farming Systems in Mediterranean environments

The Mediterranean region faces significant challenges due to climate change, underscoring the need to enhance the resilience of agro-ecosystems. In this context, adaptation and mitigation become fundamental elements for the sustenance of agriculture and ecosystems in this context. Agroforestry and mixed farming systems (farming systems with different combinations of crops, trees, and livestock) are emerging as key solutions, adapted to the specific conditions of the region.

These practices provide resilience against adverse market and climatic fluctuations, leading to higher farm viability in technical, environmental, and social terms. They also these practices play a crucial role in mitigating climate change through carbon capture and soil conservation.

Furthermore, the introduction of innovative and locally adapted crops considered in the implementation of agroforestry systems would also strengthen the resilience of rural societies to the climate change.

Team: 10 partners from 6 different countries. 5 study regions (3 in the north Mediterranean: France, Italy, Spain; 2 in the south Mediterranean: Algeria, Egypt), and climate modelling specialists (Greece).

Project duration:
06/2021 - 11/2024

To cope with the effects of global change, agro-ecosystems in the Mediterranean basin require a significant shift from conventional farming towards more diverse, productive and long-term sustainable systems, including agroforestry and mixed farming. This transition would allow to strengthen the resilience of farmers and rural communities, while restoring traditional uses and incorporating innovative activities.

Using a participatory approach, TRANSITION works to provide:

- ✓ A solid understanding of the barriers that limit the adoption of sustainable agricultural practices including agroforestry and mixed farming systems.
- ✓ Tools for evidence-based decision-making aligned to stakeholder priorities.
- ✓ Development of a basin-level roadmap for wider adoption.

To cope with the effects of global change, agro-ecosystems in the Mediterranean basin require a significant shift from conventional farming and agroforestry uses towards longer-term sustainable systems, including agroforestry and mixed farming. This transition needs to strengthen the resilience of farmers and rural communities, while restoring traditional uses and incorporating innovative activities.

There are different definitions of agroforestry systems. The European Association of Agroforestry (EURAF) defined its own during the constituent assembly in 2012: Agroforestry systems are all forms of association between trees and crops and/or livestock production on an agricultural plot, whether in the centre or on its edges [1]. Recently, the same institution published a compilation of different definitions, including those published by the member states [2].

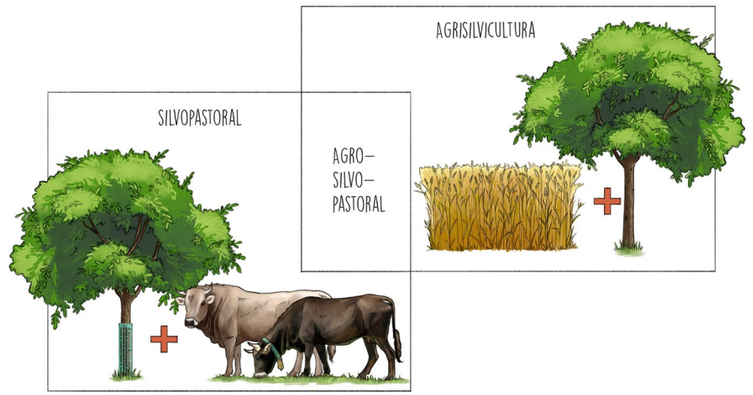
[1] Statuts validés par l'Assemblée Générale Constituante du 16/11/12 à Paris. 2012. Available at: https://euraf.isa.utl.pt/files/pub/docs/statutes_euraf.pdf

[2] Lawson Gerry, 2023. 22. Agroforestry definitions in the new CAP. EURAF Policy Briefing 22 v1, Feb2023. Available at: 10.5281/zenodo.7828435

Agroforestry systems in the Mediterranean region are silvoarable, silvopastoral, and agrosilvopastoral. Silvoarable systems combine crops with woody vegetation, while silvopastoral systems combine trees with livestock grazing. Agrosilvopastoral systems are the combination of these two systems, including crops, trees, and livestock pastures. These combinations allow achieving a more effective use of resources and lead to synergies between the system components (Scordia et al., 2023).

Historically, the most relevant combined systems in the Mediterranean region have been grazed open woodlands in the northern rim such as the Dehesa in Spain, the *Montado* in Portugal, the *Bocage* in France, and the *Coltura promisqua* in Italy. In the southern rim, such as Egypt or Algeria, traditional agroforestry systems consisted of scattered trees of high natural, socio-economic, and cultural value, intercropped with grasses and legumes species for fodder and hay. Nowadays, innovation is driving the adaptation of these systems to the current climate change scenario and to the local climatic and socio-economic conditions. They range from growing tomatoes with jatropha trees in Egypt, combining cereals with livestock in Algeria, to mixed fruit tree-vegetable systems in France, or cereals with olive and other fruit trees in Italy and Spain.

The intrinsic diversity of these combined systems (two or more components, with dynamic interactions between them) requires that they be adapted to local conditions. There is a wide range of factors that influence the success of the exploitation. Environmental factors, such as climatic conditions, soil characteristics, type of animals present on the area, type of cultivated species and their arrangement, etc., could determine the biological performance of the system. On the other hand, socio-economic factors such as the number of workers on the exploitation, self-sufficiency index, local market structure, possibilities for the valorisation of added-value products, etc., could determine the viability of the system.



The TRANSITION project study different agroforestry systems around the Mediterranean region. Analysing different aspects of the system, such as cultivated species diversity, crop yield, soil analysis or register of water requirements, between others, the project identify the main advantages of each different system to better assess the optimal strategy to local conditions, needs and resources.

France

The innovative and resilient farming system we study is the mixed fruit tree-vegetable system (MFVS). A MFVS is a system where diversified fruits trees and diversified vegetables are intercropped.

The different components can be organised in parallel rows or in a more complex arrangement that does not necessarily follow a geometric pattern. This study examines how farmers manage mixed fruit tree-vegetable systems to cope with various disturbances that hinder their objectives, such as good organisation and agro-ecological management, which contribute to their satisfaction.

34 vegetable species on average per MFVS system

9 fruit tree species on average per MFVS system

68% of the studied farms transformed their products and 56% raised poultry

Italy

The study aims to evaluate the productivity and the solar radiation interception of an agroforestry system composed of olive trees (*Olea europaea*) and annual crops, namely durum wheat (*Triticum durum*), common wheat (*Triticum aestivum*) and rye (*Secale cereale*). The field trial is being carried out in a 4-year-old olive grove with trees spaced 5.5 m between the rows and 5 m along the row located in a mountainous area (970 m a.s.l.) in Sicily (Italy). The rows of trees run along an east-west axis. Herbaceous crops were sown in a 4.5 m strip between two adjacent tree rows and in an adjacent field as monocropping control.

20% increase in soil organic carbon in intercropping vs monocropping (common wheat)

0% reduction of yield in intercropping vs monocropping (common wheat)

From **1,2** to **2** Land Equivalent Ratio in intercropping vs monocropping (the equivalent surface of monocropping needed to obtain the same combined yield of the agroforestry system)

Egypt

At the SRTA-City pilot farm, a silvoarable system is being studied. It consists of growing tomatoes (*Solanum lycopersicum*) with Jatropha trees (*Jatropha sp.*). In this system, the organic fertiliser mixture developed by the research team (a mixture of local biochar, vermicompost, and NPK mineral fertiliser) is being used to assess the system's resilience to warmer climatic conditions and water salinity.

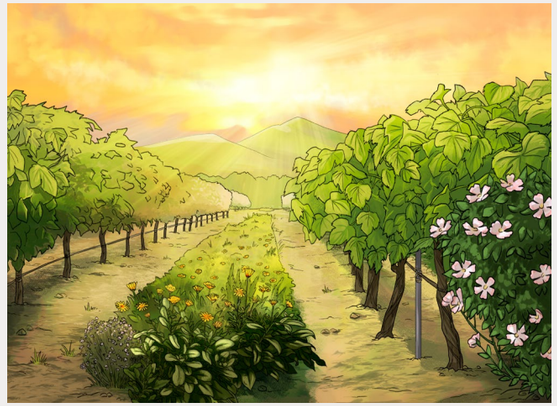
The impact of each cropping system on the soil carbon budget is evaluated. All these components work together to optimise the cost, while protecting the underground and the drainage water channels from excess nutrients supply. Drip irrigation system is used for water efficiency. Irrigation frequency is twice a day, every 4 to 5 days depending on the air temperature.

Soil organic carbon (%) showed a **2**-fold increase from the vegetative stage to the harvest in agroforestry system

4-fold increase in soil organic carbon (%) in agroforestry system compared to the initial level

The drip irrigation system used in agroforestry system saved **18%** of water compared to the traditional water use

Agroforestry systems offer a comprehensive approach to land management that balances environmental, economic, and social needs. By incorporating agroforestry, agricultural landscapes can become more resilient and sustainable, benefiting both current and future generations through improved environmental health, economic stability, and social cohesion. The TRANSITION project provides valuable information in this regard.



Agroforestry systems improve ecosystem services. These systems promote soil health by reducing erosion, increasing organic matter, and improving water retention, thus mitigating the impacts of climate change. As shown in the previous examples in Italy and Egypt, organic matter increased by 20% and 4-times respectively compared to the baseline. Agroforestry enhances nutrient cycling, decreases reliance on chemical fertilisers, and diversifies farmers' income streams by offering products such as timber, fruits, nuts, and medicinal plants. In other words, agroforestry systems improve the economic resilience of rural societies.

Additionally, the diverse vegetation in agroforestry systems provides habitats for wildlife, supporting biodiversity conservation. These systems also contribute to carbon sequestration, helping to climate change mitigation. The case studies in France, Italy and Egypt show not only the diversity of crop/vegetation types, but also the diversity of adapted crops across the Mediterranean basin. The results of research on these systems could help farmers to make evidence-based decisions to improve the adaptation of rural communities to climate change.

At the social level, agroforestry systems can strengthen communities through shared knowledge and resources, and a reduce dependence on the price of inputs and products, fostering sustainable development. They also provide opportunities for the preservation of traditional knowledge and innovation. For exemple, in the above-mentioned cases in France, Italy and Egypt. There, the research centres involved in the Transition project work together with farmers and different stakeholders to increase the viability of the agro-ecological systems and the resilience of rural societies.

Overall, agroforestry systems offer a holistic approach to land management, that balances environmental, economic and social needs. Adopting these systems can lead to more resilient and sustainable agricultural landscapes, benefiting both present and future generations.

Partners

BETA Technological Centre (UVic-UCC, Es)

University of Catania (UNICT, It)

Algerian National Institute of Agronomic Research (INRAA, Dz)

City of Scientific Research and Technological Applications (SRTA-City, Eg)

National Observatory of Athens (NOA, Gr)

Edge in Earth Observation Sciences (EDGE, Gr)

Forest Science and Technology Center of Catalonia (CTFC, Es)

French Agroforestry Association (AFAF, Fr)

French National Institute of Agricultural and Environment Research (INRAE, Fr)

Landfiles (LAND, Fr)

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