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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.

Mediterranean mixed farming systems, benefits, and important considerations

The Mediterranean region faces significant challenges due to climate change, highlighting the need to enhance the resilience of agro-ecosystems through adaptation and mitigation strategies. Mixed farming systems are emerging as key solutions, as they integrate various crops and livestock in the same space.

Mixed farming systems belong to the agroecological practices family and can be closely related to agroforestry systems when a woody element is included (e.g., fruit trees). They can be tailored to any type of land conditions, crop (annual, perennial, fruit), and livestock (mammal, avian, bees). They offer multiple benefits through crop-livestock integration, crop rotation, and diversification. For instance, integrating livestock provides additional income streams and nutrient cycling, while crop rotation improves soil fertility. Diversification lets farmers increase production in smaller areas, enhancing the family farming viability and sustainability, by a more effective use of resources.

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.

Mixed farming systems enhance resilience by integrating livestock and crops, promoting nutrient cycling, and reducing chemical inputs through natural pest control. This synergy enriches soil fertility, improves productivity, and ensures sustainable resource use. Diversification reduces dependency, enhances soil health, and buffers against pests and climate fluctuations, strengthening farmers' resilience and sustainability.

The integration of crops and livestock in the Mediterranean is part of the rooted cultural practices dating back centuries [1,2], which passed down through generations as the *dehesa*, *montado* or *coltura promiscua* in Spain, Portugal and Italy, respectively [3, 4]. This synergy between crops and livestock, promotes nutrient cycling, improving land productivity, ensuring sustainable resource use and stability in fluctuating climatic conditions.

In the Mediterranean, typical mixed farming systems have historically included a combination of winter cereals (e.g., wheat, barley), woody species (e.g., olive, grapes, fruit trees, citrus, figs, date palms, argan, carob tree) alongside the raising of small ruminants (e.g., goats, sheep, pigs, cattle), adapted to the water limited conditions and complex landforms.

Advantages of mixed farming in the Mediterranean

Mixed farming is gaining interest as a key element to promote resilience to environmental variability in front of the need and challenges imposed by climate, market, and socioeconomical context. Its importance is widely recognized, as these systems are well in line with EU strategies of climatic and rural resilience and are compatible with most other agroecological approaches. Crop diversification and livestock provide a buffer against the risks of drought, pests, and diseases. Animal manure and crop residues promote nutrient recycle within the system, enriching soil fertility and reducing the need for external inputs. This closed-loop approach allows for efficient land use, maximising productivity per unit of land, while reducing environmental impact. Additionally, mixed farming systems offer economic benefits. By diversifying agricultural activities, farmers can spread their income sources and reduce market volatility. For example, in years of poor crop yields, income from livestock can compensate for losses, and vice versa.

Nowadays, innovation drives the adaptation to mixed farming systems to the current climate change scenario and to the local climatic and socio-economic conditions. We can find from combinations of sheep, cattle, and goats with cereals in Algeria or

dairy cattle and buffalo combined with cereals in Egypt, to cattle, sheep, pigs or poultry with cereals and forage crops in Spain, Italy, or France, but also grazing with sheep in vineyards with cover crops, olive trees with cover crops, multifunctional field margins, managed forest, and beekeeping. The adaptation of each type of system to the local reality is imperative since a number of factors could impact the success of the exploitation. The enormous diversity and versatility of these systems allow each farmer tailoring them to the specific socioeconomic, climatic and soil conditions. The main design decisions are related to the choice of crop(s), livestock type and the arrangement in time and space of both components to optimise their interaction.



[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

[3] Stevenson A.C. and Harrison R.J. 1992. Ancient forests in Spain: a model for land-use and dry forest management in south-west Spain from 4000 BC to 1900 AD. Proc. Prehistoric Soc. 58: 227–247.

[4] J.H.A. Meeus, M.P. Wijermans, M.J. Vroom, Agricultural landscapes in Europe and their transformation, Landscape and Urban Planning, Volume 18, Issues 3–4, 1990, Pages 289–352, ISSN 0169-2046, [https://doi.org/10.1016/0169-2046\(90\)90016-U](https://doi.org/10.1016/0169-2046(90)90016-U).



Algeria

Sétif area heterogeneity varies according to the level of aridity. The area is classified in three climatic stages semi-arid North (SAN), semi-arid Central (SAC), and semi-arid South (SAS).

Soils vary from deep, black, or grey soils (SAN) to limestone-based, light-textured, and occasionally crusted (SAC). The gradient from SAC to SAS is covered by shallow soils, changing in colour from light to reddish colours.

Cereals-livestock is the predominant production system. SAS and SAC have a higher diversity of annual crops (fruits and olive trees), employing coarse grains (barley and oats), fodder, and market garden crops. In SAN area durum wheat is the predominant crop.

- Given the uncertainties surrounding public land tenure in Sétif area, only **6%** of SAC and **1%** of SAS plots have perennial crops. In contrast, **70%** of SAN plots are planted with fruit and olive trees.
- The mixed farming increased organic matter by **1%** to **1.5%**.



Spain

A mixed farming system in El Penedès (Catalonia, Spain) includes vineyards and olive trees with cover crops, hedgerows in the land borders, and managed forest. It also includes winter sheep grazing and beekeeping. The holistic approach is a key point in this farm, with the aim of increasing the resilience of their agroecosystems since the region has arid/semi-arid environmental conditions. The strategy involves product diversification, biodiversity increase, and improved soil fertility.

The systems include, among other components, different crops trees and animals vineyards, olive trees, cover crops, typical Mediterranean forest species, sheep, bees.

- **18%** increase of water holding capacity in vineyards with cover crops regarding the vineyards without cover crops.
- **1,64%** of SOM in vineyards with cover crops, versus **4,95%** SOM of olive trees, and **2,28%** of SOM of hedgerows.

The TRANSITION project studies different mixed farming systems around the Mediterranean region. Analysing different aspects of the system, such as 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.

Mixed farming systems offer a comprehensive approach to land management that balances environmental, economic, and social needs. By incorporating mixed farming, 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.



Algerian and Spanish examples illustrate how mixed farming can lead to sustainable and resilient agroecosystems across different Mediterranean landscapes. The increase of soil organic matter and water retention capacity enhances soil fertility, thus supporting agricultural productivity and food security.

In the Sétif region of Algeria, these conservation agriculture practices, demonstrate that the integration of cereals and livestock allows farmers to diversify their production and adapt to climatic variations. leading to increased soil organic matter and water holding capacity. This



resilience enhances the region's agricultural productivity and contributes to food security, despite adverse weather conditions.

In El Penedès, Catalonia region of Spain, integrating grazing with sheep in vineyards, olive trees with cover crops, hedgerows, and managed forests, the system enhances biodiversity, soil fertility, and water retention capacity. Significant increases in soil organic matter and water holding capacity have been observed, highlighting the effectiveness of this holistic approach in contributing to the resilience of agroecosystems in the region.

In conclusion, mixed farming systems observed in the TRANSITION project underscore the importance of integrated approaches that consider local climatic conditions and agricultural practices. Further research and investment in mixed farming hold promise for enhancing agricultural productivity, conserving natural resources, and adapting strategies to climate change in the Mediterranean region.

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)



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Landfiles (LAND, Fr)



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@Transition_Med

transition-project

transition.info@uvic.cat

www.transition-med.org

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