POLICY BRIEF

Water management in Mediterranean Agrosystems

An In-Depth Comparison of Rainfed Agriculture and irrigated agriculture, Illustrated through a Case Study in the Lebna watershed, Cap bon Peninsula, Tunisia

Chiba dam in the governorate of Nabeul, Tunisia

Le lago di Liscia, Sardaigna, Italy

Lake Sau, Catalonia Spain

The Abdelmoumen dam, in the Souss-Massa Morocco

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EXECUTIVE SUMMARY

Introduction

This study is part of the euro-Mediterranean research project ALTOS that focused on water resource management within Mediterranean agrosystems. These regions face significant challenges related to water stress due to the semi-arid to arid climate. The study focused on Tunisia, with the Lebna watershed within the Cap Bon Peninsula as a case study. This choice is motivated by the agricultural importance of the region, its growing vulnerability to constraints related to water availability, and the duality between rain-fed and irrigated agriculture along an upstream-downstream hydrological transect.

Main findings

The main objective of the study is to carry out an in-depth comparison between rainfed agriculture and irrigated agriculture to formulate recommendations for strengthening the resilience of Mediterranean agrosystems to water stress. Three crucial aspects emerged from the study:

1. **Optimizing irrigated agriculture**
    - **Resource utilization**: Irrigated agriculture faces increasing constraints in terms of resource exploitation, including both renewable and non-renewable resources.
    - **Optimization opportunities**: Despite these limits, there are levers to be activated for optimizing water usage. Key recommendations include:
        - Collecting urban rainwater for irrigation.
        - Implementing water and energy-efficient irrigation systems.
        - Reusing treated wastewater for agricultural purposes.

2. **Sustaining rainfed agriculture**
    - **Traditional knowledge transfer**: There is a need to transfer traditional rainfed farming know-how to maintain and enhance this practice.
    - **Flood management integration**: Integrating rainfed agriculture into flood management strategies to control floods and improve water retention and flood management in urban areas.
    - **Economic Viability**: Promoting cash rainfed crops can make rainfed agriculture economically and technically viable.

3. **General recommendations for both methods**
    - **Drought-resistant varieties**: Selecting drought-resistant crop varieties is crucial for both rainfed and irrigated agriculture.
    - **Sustainable practices:** Implementing sustainable agricultural practices is essential to manage water stress effectively.

Conclusion

This policy brief emphasizes the need for a balanced approach to water management in Mediterranean agrosystems, combining the strengths of both rainfed and irrigated agriculture. By optimizing water use, integrating traditional and modern practices, and promoting sustainable methods, it may be possible to enhance the resilience and productivity of these vital agricultural systems.

Context and challenges : Tunisia, a country marked by severe water stress where agriculture is an economic and social pillar

Tunisian **agriculture** is a critical sector **facing significant challenges due to water stress**. According to the indicators from Sustainable Development Goal (SDG) #6, Tunisia's water stress indicator has alarmingly increased from 66% in 2000 to 109% in 2020. **This water stress is explained by factors we put forward in the Lebna case study**, as **shown in the table below**. **This water stress is not unique** to Tunisia; **other Mediterranean countries,** such as **Morocco, Italy, Spain, and France**, are **facing similar challenges.**

Category	Vulnerability factor	Impact
Climate change	• Fall in rainfall. • Rising temperatures. • Intensification of extreme weather events.	• Decreased freshwater reserves. • Increased water stress. • Negative impacts on agriculture and ecosystems.
Cultivation harmful to water resources	• Ploughing and overgrazing. • Speculative and intensive crops.	• Depletion of water tables. • Deterioration in water quality. • Loss of aquatic biodiversity.
Governance	• Inequalities in access to water. • Illegal practices in water uses. • Farmers' mistrust of the State.	• Restrictions on access to water for marginalised communities. • Worsening community tensions. • Unsustainable use of water.
Diversifying the uses of water resources	• National priorities for the potable water sector. • Increase in the volume of water abstracted for potable water.	• Increased competition for access to water between different users. • Over-exploitation of resources.
Malfunction of structures	• Reservoir siltation. • Water Waste : In some PPIs, the loss rate exceeds 40%.	• Reduced efficiency of water management systems. • Increased maintenance costs. • Risk of rupture and flooding.

Table 1 : Vulnerability factor in the in the Lebna watershed, Tunisia

To effectively address the increasing water demands of its population, **Tunisia must strategically plan its water resource management,** considering not only drinking water but also the requirements for ecosystem preservation and agricultural production. **Agriculture plays a crucial role** in the **country's socio-economic framework,** accounting for 15% of employment as of 2017 and contributing significantly to food security by meeting a large portion of the nation's food demand. Additionally, agriculture provides direct or indirect income for approximately 70% of the population in Tunisia's arid regions.

To develop a strategic plan for water management in the agricultural sector, it is **essential to gain a deeper understanding of the history, resilience factors, and vulnerabilities of both irrigated and rainfed agriculture**.

An in-depth comparison of rainfed agriculture and irrigated agriculture

Rainfed Agriculture

Rainfed agriculture refers to agricultural systems where crops and livestock rely exclusively on rainfall. With an average annual rainfall volume of 36 billion m³, rainfed agriculture is vital for Tunisia's agricultural economy. There are three main types of rainfed production systems: cereal crops, olive cultivation, and pastures. These systems contribute significantly to agricultural production, yielding about 950,000 quintals of cereals and 14,500 tons of olives.

Since Tunisia's independence in 1956, rainfed agriculture has undergone several transformations:

- **Green revolution**: The introduction of technological packages during the Green Revolution transformed rainfed agriculture, including the adoption of mechanized techniques and the increase of fertilizer and phytosanitary products. For example, the use of tractors increased from 18.2% of farmers in 1961-62 to 56.6% in 1980.
- **Traditional system abandonment:** Many traditional rainfed systems, such as the Meskats and Jessour in southern Tunisia, have been abandoned, partly due to rural migration and the emergence of irrigated agricultural systems
- **Climate adaptation strategies**: Recent strategies, such as the Third Water and Soil Conservation Strategy (CES), aim to enhance the resilience of rainfed agriculture by integrating innovations and adopting sustainable practices, with a vision for 2050 to ensure food security and preserving natural resources.

Irrigated Agriculture

Irrigated agriculture involves extracting water from intermediate storage sources and distributing it to plants through collective irrigation networks or individual water intakes. The mobilizable water potential for irrigated agriculture in Tunisia is 4.8 billion m³, with approximately 12.71% being less renewable, 31.25% renewable from groundwater, and 43.75% from annual runoff.

The evolution of irrigated agriculture in Tunisia can be summarized in several key phases:

- **Development of irrigation infrastructure (1940 - 1960)**: Initial efforts focused on establishing the basic infrastructure for irrigation.
- **Expansion beyond rainfed agriculture (1970s - 1980s)**: There was significant expansion of irrigated lands beyond traditional rainfed areas.
- **Modernization (1990s)**: Influenced by structural adjustment programs led by the IMF and the World Bank, there was a strong push towards developing export-oriented agriculture and the irrigated sector.
- **Technological advancements (2010 - 2020)**: Recent years have seen a shift towards sustainable and technologically advanced irrigation management. Key initiatives include:
    - **Alternative water sources**: Emphasis on using treated wastewater and desalinated water for irrigation, highlighted by the strategic REUSE plan.
    - **Irrigation system improvements**: Tunisia has launched extensive modernization programs, including the installation of drip irrigation systems and the renovation of irrigation canals to reduce water losses.

Role of both agricultures in Tunisia's agricultural economy & history

Rainfed and irrigated agriculture are both essential to Tunisia's agricultural economy, each with distinct roles and histories. Rainfed agriculture, crucial for crops like cereals and olives, has faced challenges such as the abandonment of traditional practices and the need for climate adaptation. Meanwhile, irrigated agriculture has expanded significantly, driven by infrastructure development, modernization, and the use of alternative water sources.

Vulnerability and Resilience Factors

The analysis of irrigated and rainfed agriculture in Tunisia reveals a complex balance of resilience and vulnerability factors amid significant water stress. Irrigated agriculture ensures higher yields and economic benefits but demands high water and energy resources, often leading to conflicts and sustainability issues. Conversely, rainfed agriculture supports biodiversity and requires less infrastructure but is highly vulnerable to drought and lacks sufficient financial and organizational support. Strategically managing water resources, promoting sustainable practices, aligning policies, and supporting farmers are crucial steps for Tunisia to enhance agricultural resilience and ensure food security in the face of climate change. The details of vulnerability and resilience factors are shown in the two tables below.

Vulnerability factors

	Irrigated agriculture	Rainfed agriculture
Environmental	→ **Exceeding water resource** capacity to support sustainable irrigation. → **Reduction** in **water resources** in terms of **quality** : salinisation and mineralisation. → **Reliant on fossil fuels** : The water sector is a **major consumer of energy in Tunisia** , particularly electricity.	→ More **sensitive** to **drought**
Economic	→ **High initial investment** → Requires **maintenance costs for irrigation system to avoid water waste** : In some PPIs, the loss rate exceeds 40%, → **Financial viability supported by a water tarif** that is lower than its real economic cost	→ **Difficulties** in arid regions with **insufficient rainfall** → **Problems** of **access to credit** → **Poor financial viability**: in Tunisia ¾ farms with size < 10 ha are incompatible with a profitable farming system.
Social	→ Irrigated agriculture exerts excessive pressure, **endangering potable water resources**. → Leads to **resource-sharing conflicts**.	→ Requires **strong maintenance, human resource linking** → **Lack** of **adequate professional organisation**.

Table 2 : Rainfed and Irrigated agriculture vulnerability factors

Resilience factors

	Irrigated agriculture	Rainfed agriculture
Environmental	→ **Compensates** for the **lack of regular rainfall**	→ Rain-fed farming practices **support biodiversity** and **soil health**, reducing erosion and increasing organic matter → **Less risk** of **salinisation** and **soil degradation** → Means of **combating flooding** and **erosion**.
Economic	→ **Higher incomes** for **farmers** → **Allows higher yields** : on average **at least twice as productive** per unit of land as rain-fed agriculture, → 35-40% of the **country's agricultural production**, potential up to 50%,	→ Does **not require complex irrigation. infrastructures for storage and distribution** → Contributing **65% of agricultural production** by value in 2017.
Social	→ A favourable impact on **rural development**. → **High social weight:** 20% of the agricultural **workforce**	→ **Revitalizing local economies:** safeguarding jobs and **indigenous expertise**. → **Reducing the rural exodus** → **Community practices**: jessour, Meskat, Tabia, ...
Strategic	→ **Ensuring stable agricultural production** due to climatic variations → 20% of **agricultural exports**.	→ Works with **very low rainfall** : Bassin **capture 150 mm/year**. → **National priority** of **Tunisia's Vision 2050 plan** [large progress margins].

Table 3: Rainfed and irrigated agriculture resilience factor

RECOMMENDATIONS

1. Sustaining rainfed agriculture	*2. Optimizing irrigated agriculture*
➢ ***Transferring traditional rainfed farming know-how***	➢ ***Harvesting urban rainwater for irrigation***
➢ ***Integrating rainfed agriculture into flood control strategies***	➢ ***Water and Energy - efficient irrigation***
➢ ***Investing in cash rainfed crops***	➢ ***Reusing wastewater***
➢ ***Selecting varieties resistant to drought and sustainable agricultural practices in the face of water stress***	

1. Sustaining rainfed agriculture

To sustain rainfed agriculture, **three key strategies** can be adopted. Below, **we will discuss the relevance of these solutions** and **outline how they can be implemented.** Our **focus will be on transferring traditional rainfed farming knowledge and integrating rainfed agriculture into flood control strategies**. For **more information** on these strategies or details about **cash rainfed crops**, please **refer to the related technical report** which is a piece of the ALTOS project deliverables.

This strategy **must take into account several key obstacles to ensure effective implementation**. **Labour shortages** pose a **significant threat to the economic viability of traditional agricultural systems**. Additionally, **farmers often face dispossession of their means of production**. The commercial relationship between farmers and processing factories is generally structured around seasonal contracts. Under these agreements, factories cover nearly all costs associated with vegetable production, including seeds, fertilizers, and pesticides, which are then deducted from the price at which the harvest is purchased. **This model**, which is common in the Lebna catchment, **along with other vulnerability factors detailed in Table 2, must be highlighted to successfully implement the strategy.**

1.1 Transferring traditional rainfed farming know-how

a. Justification

- **Argument 1: Exceptional water harvesting know-how at risk of extinction**
  - Traditional water harvesting techniques such as Sassi di Matera in Italy, Khettara in Morocco, Jessour in Tunisia, Boqueras in Spain, and Meskat in Tunisia are rich sources of knowledge that are on the brink of extinction. Preserving and transferring this know-how is essential for sustainable agriculture.
- **Argument 2: Resilient systems in the face of natural disasters**
  - These traditional systems are resilient against natural disasters like droughts, floods, and erosion, making them valuable for maintaining agricultural productivity under challenging conditions.
- **Argument 3: Lack of sector structuring**
  - There is currently no structured approach to preserving and utilizing traditional rainfed farming techniques, highlighting the need for systematic integration and support.

Photograph 1: A Jessour in southern Tunisia

b. Implementation

- **Activity 1: Inventory of traditional systems and identification of potential sites for implementation**

  This activity aims to **identify and classify traditional water harvesting systems**, as well as to **pinpoint potential sites for their implementation**. Existing projects that can strengthen this inventory include the *Water Husbandry in WANA (West Asia and North Africa)* project, which focuses on listing traditional water harvesting systems, and the *Jessour and Ksour de Béni Khédache* project, dedicated to restoring these traditional systems. To **identify potential sites for implementing these water harvesting techniques**, the **use of geomatic and climatic tools is essential.** These tools have proven effective, with an identification capability of 94% (87%) for existing Jessour structures in the Oued Jir (Oued Hallouf) watershed. By leveraging these projects and tools, the activity seeks to enhance the sustainable use of water resources and support agricultural resilience in Tunisia's arid regions.

- **Activity 2: National structuring of know-how transmission**

  This activity focuses on the **systematic transfer of traditional water harvesting techniques from experienced farmers in South Tunisia to other agricultural groups across the country**. **The senders, farmers using traditional methods** such as Meskat, Tabia, and Jessour systems, have a wealth of knowledge in sustainable water management. **The Agency for Agricultural Extension and Training (AVFA) could act as the facilitato**r, **leveraging its national reach to promote agroecological practices through training programs**. **The recipients of this knowledge transfer** could be **the Agricultural Development Groups (GDAs),** specifically those **comprising rural women**, such as GDA El Haouaria, GDA d'Albène, and the Agro Tourism Complex in Cap Bon. These groups are already trained in sustainable practices and can effectively integrate traditional water harvesting techniques into their practices. Such transmission aims to enhance water conservation, improve agricultural resilience, and empower rural communities with skills for sustainable farming.

- **Activity 3: Agro-Mediterranean structuring of know-how transmission**

  This activity focuses on **establishing a structured network across Mediterranean agrosystems, including countries like Italy, Spain, Morocco, and France,** to **facilitate the exchange of traditional rainfed farming knowledge and best practices**. By creating this network, agricultural stakeholders can share their experiences, techniques, and innovations related to sustainable rainfed agriculture, benefiting from each country's unique expertise. This cross-border collaboration will help enhance agricultural resilience, promote sustainable water management, and preserve traditional farming practices that are crucial for adapting to the Mediterranean region's climate challenges.

1.2 Integrating rainfed agriculture into the flood control strategy

a. Justification

- **Argument 1: Traditional Techniques for Flood Mitigation**
  - Techniques such as Jessour, Tabia, and Meskat are effective for flood mitigation and should be integrated into broader flood control strategies to enhance resilience and water management.
- **Argument 2: Increasing Flood Frequency and Intensity**
  - With floods becoming more frequent and severe, causing significant socioeconomic damage, incorporating rainfed agriculture into flood control strategies can mitigate these impacts.
- **Argument 3: Economic Viability Compensation**
  - The economic viability of traditional rainfed farming systems like Jessours, Meskat, and Tabia is currently low, with earnings below minimum wage. Compensation for flood control services provided by these systems can enhance their economic viability.

Photograph 2: Flood picture in Nabeul, Tunisia in 2018

b. Implementation

- **Activity 1: Mapping high-potential areas for traditional rainfed agriculture to combat floods**

  Identify priority areas susceptible to flooding and suitable for traditional rainfed agriculture using geomatic and climatic tools.

- **Activity 2: Integration into flood control projects**

  Integrate traditional rainfed agricultural practices into flood control projects. Notable projects include those on the Cap Bon peninsula, addressing flood risk and vulnerability.
  Example: An upcoming master thesis on the feasibility of traditional rainfed agriculture in Tunisia will explore this integration further.

- **Activity 3: Creation of a network for exchanging best practices across Mediterranean agrosystems**

  Establish a network to exchange best practices in traditional rainfed agriculture and flood management across Mediterranean agrosystems. Existing international networks such as C40, WRI Sustainable Cities, the Global Covenant of Mayors for Climate & Energy (GCoM), UCLG, and GFDRR can be leveraged, although they currently do not connect agriculture and flooding.

2. Optimizing Irrigated Agriculture

To optimize irrigation, three **key strategies can be adopted: harvesting urban rainwater for irrigation**, **implementing water and energy-efficient irrigation systems**, and **recovering / reusing wastewater for irrigation**. Below, we will discuss why these solutions are relevant and how they can be implemented. **Our focus will be on harvesting urban rainwater for irrigation, as this solution is less well-known and less commonly adopted compared to wastewater reuse** and **water and energy-efficient irrigation systems. Wastewater reuse strategy is** already well-advanced and addressed in the Water Reuse Plan. Optimizing energy and water consumption is also well-documented, involving the use of renewable energy sources like floating photovoltaic panels and better electricity distribution management with smart systems. Water optimization solutions include sensor-based irrigation, automated irrigation systems with GSM control, and minimizing water losses during transportation. These approaches are detailed in the related technical report.

It is important to note that **these solutions must be applied while considering the challenges they present**. The **growth of informal settlements in Tunisia**, from 34% in 2010 to 45% in 2020, **compromises the effectiveness of rainwater harvesting measures due to uncontrolled urban expansion**. Additionally, the **lengthy credit obtaining periods for rainwater harvesting systems should be shortened to encourage adoption by individuals**. For irrigation efficiency improvements, **the intermittency of renewable energy sources and the dependence of floating photovoltaics on water levels are critical challenges.** Regarding **water reuse, soil contamination and public perception and social acceptance** are important factors to consider. Addressing these challenges will ensure the effective and sustainable implementation of these solutions.

2.1 Harvesting Urban Rainwater for Irrigation

a. Justification

- **Argument 1: Urban and demographic expansion**
  - With Tunisia's population projected to increase to 13-14 million by 2040, mainly in coastal areas, urban rainwater harvesting presents a significant opportunity for irrigation.

Photo 3: Majels, rainwater storage tanks in Tunisia

- **Argument 2: Proximity between town and farmland**
  - The close proximity of urban areas to farmland, primarily for olive cultivation and market gardening, facilitates the use of harvested urban rainwater for irrigation.
- **Argument 3: Attractive volume of water**
  - Urban rainwater harvesting can provide a substantial volume of water, with an estimated 15 litres per day per inhabitant. For example, one household could irrigate 2.4 olive trees annually, increasing to 4 trees per household in areas like Lebna.
- **Argument 4: Encouraging legislative framework**
  - Tunisia's Water Code and Town and Country Planning Code support rainwater harvesting initiatives, providing a favourable legislative environment.
- **Argument 5: Financial incentives**
  - Subsidized loans for building storage facilities and interest-free loans for constructing majels (traditional rainwater storage systems) make rainwater harvesting financially viable.

b. Implementation

➢ **Activity 1: Strengthening and defining a legal framework for the use of rainwater**

The **current legal framework** in Tunisia, which **includes the Water Code, the Town and Country Planning Code**, **and Decree 1125 of August 22, 2016**, **provides some structure for the management and use of rainwater in specific contexts**. However, there are **no clear guidelines specifically for agricultural use,** and there is a **lack of defined health standards for rainwater usage**.
To address these gaps, it is **essential to establish clear water quality criteria**, including standards for treatment and storage systems. Additionally, **implementing subsidy and funding programs**, such as those provided by Article 28 of the 2023 Finance Act, can incentivize the installation of rainwater harvesting systems tailored for agricultural use. These measures will ensure the safe and effective use of rainwater, supporting sustainable agricultural practices.

➢ **Activity 2: Mapping high-potential areas for irrigating urban crops**

This activity involves developing a comprehensive mapping system to **identify priority areas that are susceptible to flooding** and have **high potential for rainfed agriculture**. By using climate models and GIS data, the mapping process will pinpoint urban regions where rainwater can be effectively harnessed for crop irrigation. This approach will help in mitigating flood risks and enhancing food security and resilience in urban areas.

➢ **Activity 3: Creation of a network for exchanging best practices across Mediterranean agrosystems**

This activity aims to establish a **network of pilot projects to facilitate the exchange of best practices among Mediterranean agrosystems**. The network will include **existing initiatives, ongoing projects, and new initiatives to promote sustainable water management and urban agriculture.** For example, in Tunisia, the Jardin de Tunis eco-neighbourhood project focuses on collecting rainwater and grey water to enhance food and urban security in Soukra. Additionally, the NAWAMED project, which features pilot installations in Italy and Tunisia, will be integrated into the network under the auspices of the Commission. By connecting these projects, the network will foster collaboration and knowledge sharing, improving the resilience / sustainability of agrosystems across the Mediterranean region.

3. Selection of drought resistant varieties and sustainable agricultural practices in the face of water stress

Whether for irrigated or rainfed agriculture, **crop systems must be resilient to water stress by adopting sustainable agricultural practices** (e.g., conservation agriculture, intercropping, mixed crop) or **utilizing drought-resistant varieties** (e.g., atriplex, quinoa, sorghum, moringa). A challenge to consider before implementing this strategy is **the need to harmonize agricultural policies with food policies** to ensure that drought-resistant varieties can find commercial markets for economically viability. Additionally,

implementing sustainable practices often requires more labour, which can be a barrier to widespread adoption. Addressing these challenges is crucial for building a resilient agricultural sector.

a. *Justification*

- **Argument 1: Economic and food security**
  - Drought-resistant varieties are essential for ensuring economic and food security, addressing both market demands and nutritional needs.
- **Argument 2: Adapted agricultural practices**
  - Adopting agricultural practices that are specifically designed for water-stressed conditions helps maintain productivity and sustainability.
- **Argument 3: Preservation of varietal resources**
  - Conservation activities focused on drought-resistant varieties in Tunisia help safeguard valuable genetic resources, supporting long-term agricultural resilience.

Photo 5: Sfax Olive Tree, Tunisia

b. *Implementation*

➢ **Activity 1: Setting up pilot projects and training in drought management**

Following the **example of the city of Sfax, other cities could set aside land for the preservation** and **improvement of drought-resistant genetic resources**. Identifying pilot sites for improving agricultural practices is also essential. According to the Cap Bon agrarian diagnosis, three agrotourism farms located between Oued El-Khatef and El-Haouaria adopt permaculture principles and serve as testing grounds for agro-ecological practices. These farms could be excellent candidates for experimentation or the adoption of new farming practices. Further investigation is needed to better select and target the towns or farms that could host such project**. The projects must be supported by adequate research capabilities** (e.g., INRGREF, INAT, LMI-NAILA, IRA), **Agricultural Development Groups (GDA) and Agency for Extension and Agricultural Training (AVFA).**

➢ **Activity 2: Dissemination of best practices at the Mediterranean agrosystems level**

This activity focuses on **identifying and disseminating the best agricultural practices across Mediterranean agrosystems** by **involving key stakeholders**. Potential actors could **include agricultural research institutes across Mediterranean countries** and **universities**. Farmers, **agricultural cooperatives, NGOs**, and **civil society organization**s would also play a crucial role in exchanging experiences and knowledge. If transnational cooperation is promoted, **international organizations like FAO, UNDP, CGIAR, and CIHEAM, alongside international projects** and **programs supported by entities such as the European Union, World Bank, and African Development Bank, could be involved.**

CONCLUSION

Sustaining rainfed agriculture and optimizing irrigated agriculture are essential strategies to enhance agricultural resilience in Tunisia. By transferring traditional rainfed farming knowledge and integrating **rainfed agriculture** into flood control strategies, the agricultural sector may be maintaining productivity and sustainability, even under challenging climatic conditions. To **optimize irrigation**, the focus should be on harvesting urban rainwater, implementing water and energy-efficient irrigation systems, and reusing wastewater. The selection of **drought-resistant varieties** and the adoption of sustainable agricultural practices further contribute to building a resilient agricultural system capable of withstanding water stress. These strategies are crucial for efficient water management, especially given the challenges posed by urban expansion and the need for legislative and financial support. Finally, the creation of **networks for exchanging** best practices across Mediterranean agrosystems will facilitate knowledge sharing and collaboration, promoting sustainable agricultural practices and water management throughout the region.