Interreg Co-funded by the European Union
NEXT MED
WISEMED

FIRST TRANSNATIONAL TECHNICAL MONITORING REPORT

MEDITERRANEAN JOINT WATER MANAGEMENT AND CONSERVATION SUSTAINABLE SOLUTIONS (WISEMED) PROJECT.

Date of the Report:

9 October 2026

ABSTRACT

The **WISEMED project** (*Mediterranean Joint Water Management and Conservation Sustainable Solutions*) is a transnational initiative co-funded by the European Union under the **Interreg NEXT MED** Programme. It brings together public and private institutions from across the Mediterranean to drive sustainable solutions that enhance agricultural resilience and address one of the region's most pressing challenges: water scarcity.

The WISEMED project aims to implement pilot actions to test, validate, and scale up sustainable irrigation practices based on two key technical irrigation practices: Water-Use Efficiency (WUE) and Non-Conventional Water (NCW) reuse. Pilot actions are first demonstrated at partner research stations and in selected farmers' fields, allowing for iterative adjustments before full-scale expansion.

A core priority of the project is strengthening the adaptive capacity of rural communities against climate change. This is achieved through capacity building, national workshops, cross-border technical visits, and knowledge transfer between research centers, private organisations, public institutions and local stakeholders.

Ultimately, WISEMED's findings and policy recommendations will provide institutions and practitioners with a reliable scientific reference to mainstream sustainable water management across the Mediterranean.

This document constitutes one of the two Transnational Technical Reports to be produced following the launch of the pilot actions, in accordance with the project monitoring framework. Developed through the active contributions and ongoing feedback provided by the Project Partners (PPs), it consolidates field monitoring data, operational observations, and practical experiences gained from implementing Water Use Efficiency (WUE) and Non-Conventional Water (NCW) solutions across all target areas.

TABLE OF CONTENTS

I. Introduction 5

II.PROJECT MANAGEMENT, METHODOLOGY AND MONITORING FRAMEWORK 9

III. MATERIALS & METHODS. 12

III.A. TRANSNATIONAL DEVELOPMENT OF JOINT WM ACTION PLANS (WP3): *Outputs 3.1: Transnational Joint WM Action Plans on water sustainability and irrigation.* 12

PARTNER, PP1: National Agricultural Research Center (NARC, Jordan). 12

PARTNER, PP2: National Research Institute of Rural Engineering Water & Forests (INRGREF, Tunisia) & PARTNER, PP6: Water Research and Technologies Center (CERTE, Tunisia) 14

PARTNER, PP3: Agencia Estatal Consejo Superior de Investigaciones Cientificas (CEBAS-CSIC, Spain). 15

LEAD PARTNER, LP: Istituto per la Cooperazione Universitaria (ICU,Italy) with the support of PARTNER, PP4: Consiglio per la Ricerca in Agricoltura e l'Analisi dell'Economica Agraria (CREA, Italy). 16

PARTNER, PP5: Lebanese University (LU, Lebanon) 17

III.B. COMMUNICATION & DISSEMINATION (WP2): *Outputs 2.6: Info Days to farmers, WUAs and farmers' associations/cooperatives* 18

PARTNER, PP1: National Agricultural Research Center (NARC, Jordan) 19

PARTNER, PP2: National Research Institute of Rural Engineering Water & Forests (INRGREF, Tunisia) & PARTNER, PP6: Water Research and Technologies Center (CERTE, Tunisia) 20

PARTNER, PP3: Agencia Estatal Consejo Superior de Investigaciones Cientificas (CEBAS-CSIC, Spain) 21

LEAD PARTNER, LP: Istituto per la Cooperazione Universitaria (ICU,Italy) with the support of PARTNER, PP4: Consiglio per la Ricerca in Agricoltura e l'Analisi dell'Economica Agraria (CREA, Italy) 22

PARTNER, PP5: Lebanese University (LU, Lebanon) 23

III.C. Demonstration & Capitalizations pilots according to Transnational Joint WM Action Plans (WP4): *Output 4.1: Pilot Actions* 25

PARTNER, PP1: National Agricultural Research Center (NARC, Jordan) 25

PARTNER, PP2: National Research Institute of Rural Engineering Water & Forests (INRGREF, Tunisia) 32

PARTNER, PP3: Agencia Estatal Consejo Superior de Investigaciones Cientificas (CEBAS-CSIC, Spain 37

PARTNER, PP4: Consiglio per la Ricerca in Agricoltura e l'Analisi dell'Economia Agraria (CREA, Italy) 49

PARTNER, PP5: Lebanese University (LU, Lebanon) 56

IV. CONCLUSION AND DISCUSSIONS. 60

PARTNER, PP1: National Agricultural Research Center (NARC, Jordan) 60

PARTNER, PP2: National Research Institute of Rural Engineering Water & Forests (INRGREF, Tunisia) 61

PARTNER, PP3: Agencia Estatal Consejo Superior de Investigaciones Cientificas (CEBAS-CSIC, Spain) 62

PARTNER, PP4: Consiglio per la Ricerca in Agricoltura e l'Analisi dell' Economia Agraria (CREA, Italy) 63

PARTNER, PP5: Lebanese University (LU, Lebanon) 64

REFERENCES 66

ANNEXES 67

I. Introduction

The WISEMED project (*Mediterranean Joint Water Management and Conservation Sustainable Solutions*) is a 36-month initiative funded by the European Union, spanning the period from 14 October 2025 to 13 October 2028. Led by ICU - Istituto per la Cooperazione Universitaria, the project aims to improve water use efficiency in the agricultural sector through sustainable, integrated, and innovative solutions, covering Jordan, Tunisia, Spain, Italy and Lebanon.

Water resources in Mediterranean basin countries are characterized by significant spatial and temporal disparities; water scarcity and drought occur frequently, with particular repercussions for countries in the south and east. Per capita renewable water availability in the Mediterranean region varies considerably, ranging from more than 1700 m3 /person/year in some northern areas (e.g., parts of France, northern Italy, Slovenia) to less than 1000 m3/person/year across much of the southern and eastern Mediterranean. Several countries (e.g., Jordan, Malta, parts of North Africa), have less than 500 m^3/ person /year, which is considered absolute water scarcity (Ref.1).

The agricultural sector accounts for approximately 70-80% of total water demand. Despite encouraging progress in water-use efficiency, losses during water transport and use are estimated at around 40% of total demand, amounting to more than 100 cubic kilometers annually for the entire Mediterranean region (Ref.2). In some countries (Egypt, Jordan, Libya, Malta, Syria, and the Palestinian territories), water withdrawal rates are approaching or even exceeding the limits of renewable resources (Ref.3).

Population growth and climate change will drive an increasing need for water. Consequently, efficient irrigation systems, regionally appropriate agricultural practices, and water-saving farming methods will be essential to ensure sufficient food production in the future.

Recent assessments by the Union for the Mediterranean and environmental organizations indicate that over 180 million people in the Mediterranean region face acute water scarcity. The boom in mass tourism drives up demand during dry months, with luxury resorts consuming up to seven times the amount of water used by local households, while prolonged droughts pose a severe threat to regional agriculture and food security (Ref.4).

Amidst growing water scarcity in parts of the region and the uncertainty caused by climate change, there is an urgent need to adapt water management policies, improve the management of various water uses, and ensure more efficient and effective resource utilization, all to meet the current and

future needs of populations and aquatic ecosystems, as well as development requirements.

Since the mid-1990s, political cooperation between the European Union and Mediterranean countries regarding water issues has focused on the problems of scarcity and drought. In this context, *"Integrated Water Resources and Demand Management"* was selected as a top-priority area of action within the Mediterranean Strategy for Sustainable Development (MSSD), adopted in 2005 by all Mediterranean littoral states and the European Community. This strategy serves as a *"strategic framework"* that can be used as a basis for developing or updating national sustainable development strategies, *"efficiency plans"* (or plans for the rational use of water resources, a principle endorsed at the 2002 Johannesburg Summit), and sectoral strategies, while acknowledging that each country bears the responsibility for defining its own specific objectives. Efficiency plans can be developed and implemented at various levels (national, catchment, aquifer, city, irrigation district, industrial sector, etc.). However, although Water Demand Management (WDM) has become a matter of growing interest among Mediterranean basin countries, it is still rarely formulated in terms of specific, quantifiable targets.

The most recent major meeting of the Mediterranean Commission on Sustainable Development (MCSD), its twenty-first session, was held in Corinth from June 24 to 26, 2025. The meeting focused on advancing the implementation of the Mediterranean Strategy for Sustainable Development (MSSD) for the 2026-2035 period, supporting the region's green transition, and preparing recommendations for adoption by the Contracting Parties to the UN Environment Programme/Mediterranean Action Plan (UNEP/MAP). Significant attention was also devoted to the issue of water as a cornerstone of sustainable development in the Mediterranean region. Key water-related outcomes included the following:

- Addressing water scarcity and drought.
- Promoting the WEFE Nexus.
- Integrated water resources management.
- Climate adaptation.
- Scientific support and research.

Overall, the meeting emphasized that water serves as the pivotal link connecting climate change, food security, energy production, biodiversity, and sustainable development in the Mediterranean region, and that integrated governance is essential to addressing these interconnected challenges.

The outputs of the WISEMED project align with the recommendations of the Mediterranean

Strategy for Sustainable Development (MSSD), particularly regarding integrated water resource management measures in irrigated agriculture. This is achieved through the installation of water-saving technologies, the improvement of irrigation practices, the measurement of consumption rates, and the raising of public awareness regarding water conservation to enhance usage efficiency, while simultaneously encouraging the use of alternative water sources, such as treated wastewater and desalinated or reclaimed water.

The project partners are:

- **National Agricultural Research Center** (NARC, Jordan): NARC is a government institution dedicated to applied agricultural research and agricultural consultancy; the Center's experimental research mandate involves conducting applied agricultural research and transferring agricultural technologies to farmers;
- **National Research Institute of Rural Engineering, Water and Forests** (INRGREF, Tunisia): It plays a significant role in research and technical support in Tunisia; the experimental research conducted by the Institute is frequently used to study irrigation management, water quality, soil fertility, crop production and sustainable agricultural practices within the environmental context of the Mediterranean region;
- **Agencia Estatal Consejo Superior de Investigaciones Científicas** (CEBAS-CSIC, Spain): It provides scientific research and technical expertise in sustainable agriculture, with particular emphasis on soil and water management, irrigation, plant resilience and climate-change adaptation;
- **Consiglio per la ricerca in agricoltura e l'analisi dell'economia agraria** (CREA, Italy): CREA is Italy's leading research institution in the agricultural field, conducting theoretical and applied research across the fields of crops, livestock, forestry, food science, and socio-economics; it also provides advice to the Italian government and public institutions;
- **Lebanese University** (LU, Lebanon): It is a public university which provides quality higher education, promotes scientific research and contributes to the economic development of Lebanon through implementation of development projects and research;
- **Water Research and Technologies Center** (CERTE, Tunisia): CERTE is a public institution with the mission of carrying out research and technological development in the field of water and its integration into the economic and social spheres in Tunisia.

Project Associates are: the Agricultural Engineering Research Institute (AEnRI, Egypt); the

Hellenic Agricultural Organization – DIMITRA / Soil and Water Resources Institute (SWRI, Greece), the Dokuz Eylül University (DEU, Turkey); United Nations Economic and Social Commission for Western Asia (UNESCWA); and the Union of Al Buhaira Municipalities (Lebanon).

The project aims to implement pilot activities to test, validate, and scale up sustainable irrigation systems by adopting diverse solutions across two technical tracks: water-use efficiency and non-conventional water sources, while leveraging and capitalizing on successful experiences, to mainstream technical practices and innovations. Project activities will include developing pilot initiatives based on partner-endorsed technical solutions. Additionally, the project will build the capacity of the project team and direct and indirect beneficiaries through national workshops, technical visits, and the strengthening of cooperation at both national and international levels.

Each partner held a co - creation workshop involving all relevant water stakeholders to present and endorse the project's proposed solutions in consultation with all parties, the resulting recommendations were incorporated into the National Action plan (*Annex I, Template NAP*), prepared by each partner, which outlines the approved solutions for actual implementation within the project activities.

Furthermore, Info days were organized as awareness-raising sessions for farmers, aiming to equip them with technical and practical knowledge, share new techniques and experiences, and provide updates on project activities. Beneficiary farmers were selected through a call for applications, with submissions evaluated based on the farmers' level of commitment and specific criteria proposed by each partner.

The project's final outputs and recommendations will be disseminated across various institutional levels and to relevant partners, thereby establishing a rigorous scientific standard for practical implementation.

II.PROJECT MANAGEMENT, METHODOLOGY AND MONITORING FRAMEWORK

The WISEMED project is managed by a team comprising the Project Manager along with specialized experts in technical coordination, financial management, and communication.

To ensure technical quality and cross-border alignment, a **Transnational Technical Committee (TTC)** has been established. The TTC is responsible for the overall planning, monitoring, and evaluation of technical solutions implemented under Work Packages 3, 4, and 5 (WP3–WP5). The committee consists of a Senior Technical Expert and dedicated technical teams from all Project Partners (PPs) and Associated Partners (APs).

Water Use Efficiency (WUE) and Non-Conventional Water (NCW) solutions to be implemented under the WISEMED project were determined based on the outcomes of the co-creation workshops held in each partner country, involving all relevant stakeholders and national experts.

A **National Action Plan (NAP)** was developed for each partner, containing the information necessary to flesh out project details, including assessments of economic, environmental, and social impacts, as well as alignment with national policies and legislation (*Annex 1, template NAP*). This process was carried out following the approval of all relevant authorities and stakeholders.

Furthermore, beneficiary farmers were selected based on specific criteria in each partner country for the implementation of pilot activities, with close and continuous monitoring ensured throughout the implementation phases.

meetings were held. The first meeting took place in Rome at the CREA headquarters on January 14, 2026, coinciding with the project's kick-off meeting, and was attended by the ICU team involved in the WISEMED project, the Project Manager, the communication and financial coordinators, the technical expert, as well as all national coordinators and teams from the various partners and collaborating entities. The meeting focused on four key points:

1- Discussion of the WUE and NCW solutions identified during the proposal stage and exchange of technical feedback and lessons learned; (*Annex 2: Annex A, list of WISEMED Solutions*).

2- Definition of Common indicators for monitoring the performance and impacts of WUE and NCW solutions tested and scale-up during the project;

3- Technical Reporting: structure and frequency of Transnational Technical Reports, concerning ongoing monitoring data and experience;
4- Scheduling of the next meetings.

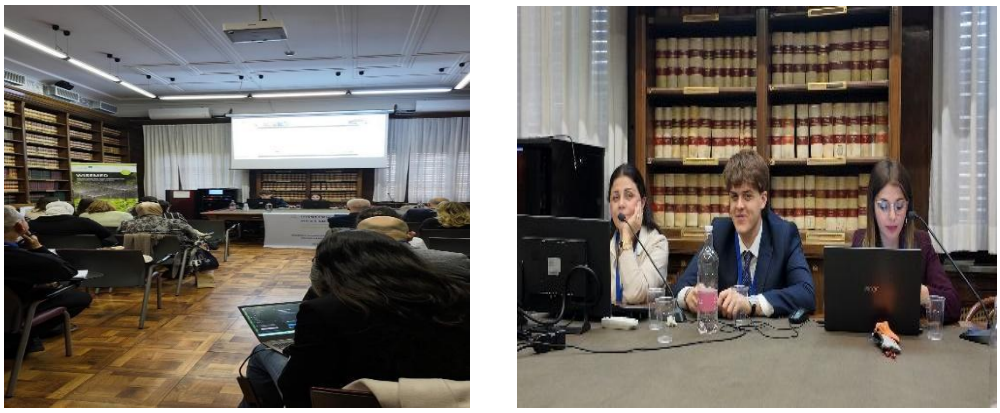


Figure 1: First TTC meeting.

The TTC held its second meeting remotely on March 30, 2026. The meeting focused on three main points:

1. Discussion on the indicators for monitoring the solutions to be tested and/or upscaled within WP4.
2. Structure of the technical monitoring report **(Output 4.2).**
3. Transnational validation of the Action Plans (**Activity 3.1.3) developed after the national co-creation workshops (Activity 3.1.2)**, including the list of solutions to be implemented within the WISEMED project in each target area.

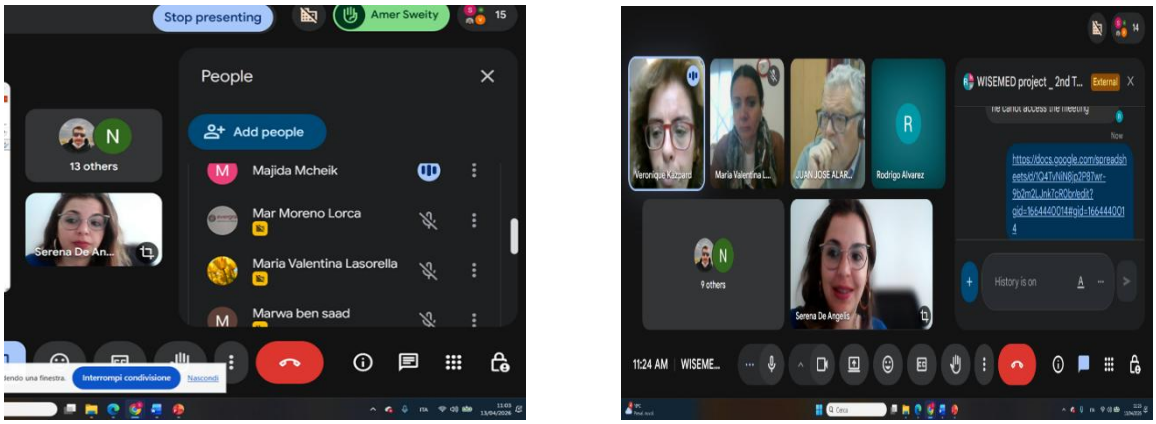


Figure 2: Second TTC meeting.

Two tables have been prepared and approved by the TTC to monitor and evaluate the project's technical activities. The first table aims to monitor and evaluate project implementation using specific indicators that outline expected outcomes, as well as the impact of project activities on agricultural production, water use efficiency, environmental issues, and farmers' income *(Annex 3: Annex 1, Table 1)*. The second table is used to monitor project activities in order to track progress and avoid implementation delays or potential challenges.

This document constitutes one of the two **Transnational Technical Reports** to be produced following the launch of the pilot actions, in accordance with the project monitoring framework. Developed through the active contributions and ongoing feedback provided by the PPs, it consolidates field monitoring data, operational observations, and practical experiences gained from implementing WUE and NCW solutions across all target areas.

Based on local data collected by each PP using the standardized reporting template established by the TTC *(Annex 3: Annex 1, Table 2)*, these findings are submitted to the Senior Technical Expert. The data are then synthesized and validated every six months by the Transnational Technical Committee to support transnational knowledge sharing and track regional progress across PPs and APs.

All National Action Plans prepared by the partners, as well as the selected technical solutions, have been approved based on the outcomes of the second meeting of the TTC.

Implementation of pilot measures has commenced, either through the preparation of relevant tender documents or via direct execution at pilot sites.

III. MATERIALS & METHODS.

III.A. TRANSNATIONAL DEVELOPMENT OF JOINT WM ACTION PLANS (WP3):

Outputs 3.1: Transnational Joint WM Action Plans on water sustainability and irrigation.

Two types of technical solutions, namely **Water Use Efficiency** and **Non-Conventional Water,** were identified during the project design phase by all the Project Partners (PPs). This selection was based on the project partners' prior experience and proposals for innovative technical solutions, aimed at providing affordable agricultural technologies that smallholder farmers can easily adopt.

The technical solutions identified for the project are as follows:

- **WUE**: **WUE 1** - drip irrigation with smart sensors, **WUE 2** - Subsurface irrigation system, **WUE 3** - Fertigation system, **WUE 4** - Organic mulching, **WUE 5** - Ecofriendly Super Polymers for soil water retention, **WUE 6** - Digital DSS For Irrigation Schedule**, WU7**- Drought -tolerant crops, **WUE 8** - Deficit irrigation strategy.
- **NCW: NCW 1**- Mixing of conventional waters (CWs) and non- conventional waters (NCWs) with low- cost sensors, **NCW 2** - Advanced water mixing with digital DSS, **NCW 3** - Tertiary Waste Water Treatment (WWT) with ultrasonic cavitation (sonication), for multiple users.

In accordance with the framework of Activity 3.1.2 ***"Transnational sharing of Draft Action Plans with local co-creation workshops in target areas"***, national co-creation workshops were held in each partner country involving all relevant stakeholders. These workshops aimed to co-design the action plans while taking into account the financial, technical, and environmental implications of implementation. The technical solutions selected in the National Action Plans were subsequently approved and validated during the second meeting of the Transnational Technical Committee (TTC). Below are the key outcomes of the co-creation workshops implemented by the PPs.

PARTNER, PP1: National Agricultural Research Center (NARC, Jordan).

In Jordan, a local co-creation workshop was held on February 16, 2026, at the Signia by Hilton Amman Hotel, with the participation of 45 stakeholders involved in formulating the National Action Plan. Participants represented diverse sectors, including:

- **Public Authorities and Policy Makers:** Ministry of Water and Irrigation, Jordan Valley Authority, Ministry of Agriculture, Agricultural Credit Corporation.

- **Academic and Research Institutions:** University of Jordan, Al Balqa Applied University, Al Ahliya University, German Jordanian University, and NARC.
- **Private Sector and Technology Providers:** Afkar Digital, MIRRA, Universal Drip Irrigation Pipe Manufacturing, CONDICO, Fai and Mai, I-Plant.
- **Civil Society and End-Users:** Farmers, Water User Associations, cooperatives, and local NGOs.

The workshop used a participatory, solution-oriented approach, combining facilitated discussion with technical review. Stakeholders considered how the proposed solutions could address local irrigation needs, what resources implementation would require, and which indicators should be monitored. Their recommendations informed the National Action Plan and the design of field demonstrations.

Following the presentation and discussion of the proposed solutions, the workshop informed the National Action Plan for Jordan. The planned water-use efficiency measures include: 1) drip irrigation with soil sensors, 2) subsurface drip irrigation, 3) fertigation, 4) mulching, 5) superabsorbent polymers (SAPs) for soil-water retention, and 6) digital decision support for water mixing. ultrasonic treatment was also included in the proposed non-conventional water activities. Demonstrations are planned at NARC facilities and selected farms in Balqa Governorate. Ultrasonic treatment (sonication) will be evaluated as a water-quality management measure. The assessment will examine whether it can:

- Improve irrigation water characteristics by preventing algae growth in irrigation water ponds.
- Reduce biofilm formation inside irrigation networks.
- Minimize emitter clogging.
- Improve the operational efficiency of drip irrigation systems.
- Reduce maintenance requirements.
- Support the long-term use of treated and blended irrigation water.

This pilot project will generate valuable scientific data on the applicability of ultrasonic treatment technologies under Jordanian agricultural conditions, and it will be implemented at the NARC facility in Balqa Governorate.




Figure 3: Co-creation workshop - NARC.

PARTNER, PP2: National Research Institute of Rural Engineering Water & Forests (INRGREF, Tunisia) & PARTNER, PP6: Water Research and Technologies Center (CERTE, Tunisia)

The local co-creation workshop was held from February 5 to 7, 2026, at the *"Bel Azur"* Hotel in Hammamet, Tunisia. It involved 39 stakeholders from diverse sectors, including the public sector, national and regional research centers, academic institutions, private companies, NGOs, civil society organizations, water user associations, and end-users. The workshop methodology was designed to be a participatory and collaborative process. It utilized visual and interactive tools and aimed to achieve consensus rather than merely reaching compromises.

Following the presentations of the proposed solutions, the workshop outlined the National Action Plan, specifying the technical solutions to be implemented, including capitalizing lessons learned, evaluating salt tolerant crop as a solution under drip irrigation systems equipped with low-cost sensors, and employing innovative solution to mix conventional and non-conventional (brackish) water sources using low-cost sensors for soil properties monitoring. Such water mixing improves water availability, enhances water quality, and supports crop growth. However, various mixing ratios must be evaluated to determine the optimal mix for high water-use efficiency, taking into account freshwater availability and the need for salt-tolerant crops. Irrigation water quality is often compromised by climate change and limited water resources (in terms of both quantity and quality). The proposed solutions will be implemented using low-cost drip irrigation systems, which are expected to achieve high efficiency in water conservation, soil fertility maintenance, agricultural productivity, and the improvement of farmers' incomes.




Figure 4: Co- creation workshop - INRGREF.

PARTNER, PP3: Agencia Estatal Consejo Superior de Investigaciones Cientificas (CEBAS-CSIC, Spain).

Based on the outcomes of the local co-creation workshop held on March 17, 2026, at the CEBAS-CSIC center, the team presented technical solutions proposed for adoption by various stakeholders in the Murcia region. The workshop brought together 34 stakeholders from diverse sectors, including institutional bodies, water consultants, Water User Associations (WUAs), producers, universities, and businesses ranging from SMEs to large enterprises. Additionally, the CEBAS-CSIC project team applied a methodology to prioritize and categorize ideas, aiming to select promising concepts that balance the operational efficiency of new technologies with compliance regarding European policies and regulations affecting agricultural development.

Following the presentation of proposed solutions, the workshop outlined the National Action Plan, incorporating technical solutions to be implemented during the project, such as soil stabilization and mulching, using an ecological approach designed to minimize water loss from runoff and enhance soil fertility through organic matter accumulation. The plan also included fertigation systems and the adoption of various methods to improve fertilizer use efficiency. Furthermore, it encompassed the development and implementation of specialized Decision Support Systems (DSS) to manage fertilizer application within drip irrigation systems, aiming to prevent pollution while maintaining crop yield levels, the DDS system aims to blend different types of water by integrating field data and predictive models, utilizing artificial intelligence and machine learning, to facilitate the use of water blends in regions facing severe scarcity of conventional water sources.



Figure 5: Co- creation workshop – CEBAS-CSIC.

LEAD PARTNER, LP: Istituto per la Cooperazione Universitaria (ICU, Italy) with the support of PARTNER, PP4: Consiglio per la Ricerca in Agricoltura e l'Analisi dell'Economica Agraria (CREA, Italy).

Building on the local co-creation workshop held in Rome on February 19, 2026, at the ITABIA headquarters, which brought together 29 stakeholders, this event was organized by ICU in collaboration with CREA. It was attended by representatives from the public and private sectors, NGOs, researchers, academics, universities, and farmers.

Proposed technical solutions for the project design were presented to secure stakeholder agreement and approval. The workshop methodology relied on a participatory approach and open discussion, alongside a prioritization exercise. Key insights highlighted that water stress is increasingly concentrated during peak summer periods and that performance depends heavily on (i) monitoring/metering and (ii) decision-support for irrigation scheduling; collective irrigation governance (bonifica consortia) is a key lever for scaling measures.

The workshop outlined the National Action plan and identified the technical solutions to be implemented in the project. These include *"capitalization"* solutions (leveraging previous results), Digital Decision Support Systems (DSS) for irrigation scheduling, Open-Source Low-Cost Device Coupled with an Adaptative Time-Lag Time-Series Linear Forecasting Modelling": an open-source soil moisture LoRa (long-range) device and analysis of the data collected and updated directly in the field (i.e., weather station and ground sensor), already tested in Trentino (Italy) for apple.

The system: a) Measures soil moisture/tension at multiple depths); b) Integrates real-time and 3-day weather forecast data; c) Calculates optimal irrigation volumes (mm or m^3/ha); d) generates irrigation bulletins for farmers.



Figure 6: Co- creation workshop - ICU.

PARTNER, PP5: Lebanese University (LU, Lebanon)

The co-creation workshop was held at the Lebanese University's central administration building in Beirut on 27 and 28 January 2026, with the participation of approximately 32 stakeholders. The methodologies employed included specialised presentations on specific themes, interactive digital voting (via the *Mentimeter* platform), open discussions, and prioritisation and ranking exercises.

The workshop identified water scarcity, declining groundwater levels, and inefficient irrigation as key obstacles facing Lebanese agriculture. Priorities include modernizing irrigation systems, strengthening governance, and improving data-driven decision-making. Digital tools, such as decision support systems, can optimize irrigation, while the use of non-conventional water sources (like treated wastewater and blends) requires rigorous monitoring. Low-cost field-level adaptations, such as cultivating drought-resistant crops, enhance resilience to climate change. Challenges include high investment costs, limited technical capacity, institutional fragmentation, and low farmer awareness. Short to medium-term strategies should integrate technological innovation, capacity building, and governance reforms.

Following the presentation of proposed technical solutions by the LU project team, the workshop defined the National Action Plan, which encompasses the technical solutions to be implemented under the project. These include solutions based on capitalizing existing expertise and practices, specifically: Drip irrigation with sensors (WUE1), Fertigation with NPK sensors (WUE3), Mixing conventional and non-conventional water (NCW1) and Advanced water mixing with DSS (NCW2) and the innovation technical solution, the Digital, DSS for irrigation scheduling (WUE6) The selected solution combines smart irrigation technologies, digital decision-support tools, and the safe integration of non-conventional water resources. The approach aims to improve irrigation

efficiency, optimize fertilizer use, increase water availability, and support climate-resilient agricultural practices.



Figure 7: Co- creation workshop - LU.

III.B. COMMUNICATION & DISSEMINATION (WP2): *Outputs 2.6: Info Days to farmers, WUAs and farmers' associations/cooperatives*

According to **Activity 2.6.1** *"implementation of Info days for farmers, WUAs and farmers' associations / cooperatives"***,** info days have been held in each target country. These sessions aimed to present the solutions identified in WP3, explaining their functioning, integration into farming practices and related economic, environmental and productivity benefits, while encouraging participation in pilot actions. This activity represents a key milestone in preparing the transition from technical design to field implementation. During the Info Days, WISEMED project, its objectives, the Call for Proposals and its selection criteria were explained.

PARTNER, PP1: National Agricultural Research Center (NARC, Jordan)

In Jordan, the National Agricultural Research Center (NARC) organized 4 Info Days (30 March-2 April 2026), in the Dead Sea area, engaging 159 participants.

The sessions were designed to introduce the proposed solutions, explain how to integrate them into the farmers' fields, highlight the expected benefits regarding crop performance and cost savings, and outline the application process for participation in the pilot actions phase. The sessions were also expected to clearly outline the selection criteria, ensuring the process was transparent and accessible to participants.

The study will be conducted at two locations: the NARC and farmers' lands in Balqa Governorate (specifically the areas of Ain Al-Basha, Al-Karameh, Al-Rama, and Deir Alla).

Two innovative technical solutions, soil mulching and a tertiary treatment system using ultrasonication for irrigation water quality management, will be implemented at the NARC facility in the Balqa region. Additionally, other technical solutions will be deployed across 100 farmer-level pilot plots in Balqa (averaging 2 to 4 hectares in size and utilizing diverse agricultural systems that include cash crops such as eggplants and date palms).





Figure 8: Info days - NARC



Figure 9: Invitation call - Info days – NARC.

PARTNER, PP2: National Research Institute of Rural Engineering Water & Forests (INRGREF, Tunisia) & PARTNER, PP6: Water Research and Technologies Center (CERTE, Tunisia)

In Tunisia, Info Days sessions for farmers were held between 2 and 27 March 2026 by CERTE, in collaboration with INRGREF and ICU, reaching about 100 farmers. They combined field visits, interviews and questionnaires for 94 farmers, to collect data on irrigation practices and water stress and supporting preparation of pilot activities.

The selected farmers predominantly face challenges related to water stress and salinity, and they show keen interest in the proposed innovative solutions. The selected group is characterized by high vulnerability, a genuine need for technical support, and strong motivation to participate in the project's pilot activities; thus, this selection process provides a representative and suitable sample for testing and evaluating the solutions developed under the project.

The study will be conducted at two locations within the Nabeul Governorate: the experimental station of the INRGREF in Oued Souhil, and agricultural sites in the Korba area.




Figure10: Info days – CERTE.



[Nella Saidi / Centre de Recherche et des Technologies des Eaux]
مركز بحوث و تكنولوجيات المياه بالقطب التكنولوجي
بيرج السدرية الطريق السياحية برج السدرية ص.ب 273 -8020 سليمان
Mobile : 54515212
E mail : nella_saidi@yahoo.fr

À l'attention de Monsieur le Commissaire
Régional au Développement Agricole de Nabeul
Avenue Mongi Bali – Nabeul 8000

Fait à Soliman, le 4 Mars 2026

Objet : Demande d'autorisation pour l'organisation de journées d'information (Infodays) pour Agriculteurs

Monsieur le Commissaire,

En tant que Coordinatrice CERTE dans le projet WISEMED, j'ai l'honneur de solliciter votre autorisation pour organiser des journées d'information (Infodays) destinées aux agriculteurs de la région de Nabeul. Cette activité, intitulée "WISEMED au Service des Agriculteurs de Nabeul », J'attire votre attention que nous allons suivre le calendrier ci-joint, vous recevrez prochainement l'agenda du programme plus en détail.

Figure 11: Invitation call - Indo days - CERTE.

.

PARTNER, PP3: Agencia Estatal Consejo Superior de Investigaciones Cientificas (CEBAS-CSIC, Spain)

In Spain, CEBAS-CSIC organised an Info Day on 25 March 2026 in Murcia with 35 participants. Then a call for participation was issued via the project's website and that of the CEBAS-CSIC center. This invitation was extended to farmers, producers, agricultural cooperatives, companies, and organizations facing challenges related to water scarcity and/or salinity, and who are interested in the topics addressed by the WISEMED project, as well as in solutions aimed at enhancing water use efficiency and utilizing non-conventional water sources. Participants were selected through personal interviews conducted by the project coordinator, based on a set of evaluation criteria that took the following into account:

• The extent of exposure to water and salinity issues affecting the productive land plots managed by the candidate;

• The interest shown by the candidate in developing their technical skills;

• The candidate's region of origin and the location of their productive land plots, with priority given to candidates from the Murcia region who operate in the agricultural areas of Campo de Cartagena and the Guadalentín Valley;

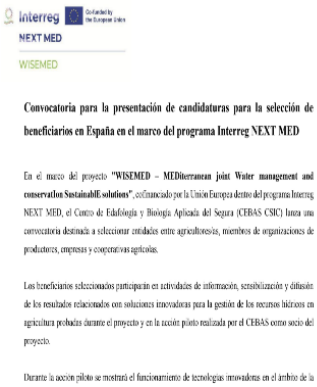
• The candidate's motivation and availability to participate in project activities;

• Consideration of specific cross-cutting criteria, such as the producers' age and gender (including young farmers and women); as well as prioritizing those who participated in the co-production workshop.





Figure 12: Info day - CEBAS-CSIC.



Interreg NEXT MED
WISEMED

Convocatoria para la presentación de candidaturas para la selección de beneficiarios en España en el marco del programa Interreg NEXT MED

En el marco del proyecto **"WISEMED – MEDiterranean joint Water management and conservatIon SustainablE solutions"**, cofinanciado por la Unión Europea dentro del programa Interreg NEXT MED, el Centro de Edafología y Biología Aplicada del Segura (CEBAS CSIC) lanza una convocatoria destinada a seleccionar entidades entre agricultores/as, miembros de organizaciones de productores, empresas y cooperativas agrícolas.

Los beneficiarios seleccionados participarán en actividades de información, sensibilización y difusión de los resultados relacionados con soluciones innovadoras para la gestión de los recursos hídricos en agricultura probadas durante el proyecto y en la acción piloto realizada por el CEBAS como socio del proyecto.

Durante la acción piloto se mostrará el funcionamiento de tecnologías innovadoras en el ámbito de la

Figure 13: Invitation call - Info Day - CEBAS-CSIC.

LEAD PARTNER, LP: Istituto per la Cooperazione Universitaria (ICU,Italy) with the support of PARTNER, PP4: Consiglio per la Ricerca in Agricoltura e l'Analisi dell'Economica Agraria (CREA, Italy)

On March 27, 2026, ICU and CREA organized a virtual Info Day. The meeting, attended by 20 participants, highlighted the limited availability of farmers and key stakeholders (such as cooperatives and agricultural enterprises). The aim of the selection process is to engage active participants who can benefit from technology transfer regarding:

• Innovative solutions for water use efficiency (WUE).

• The use of non-conventional water (NCW).

• Testing of the open-source device developed by CREA-IT in Monterotondo.

Subsequently, the selection process was based on objective evaluation criteria (with a maximum of 100 points) distributed across five Key Aspects: 1) Water Constraints and Salinity, 2) Technical Skills, 3) Focus Solutions WISEMED, 4) Commitment and participation, and 5) cross-cutting

criteria (such as farm location, gender, and the farmer's age). And it also fostered stakeholder engagement, supported the beneficiary selection process, and gathered farmer feedback regarding their needs and willingness to adopt the proposed solutions, thereby paving the way for the implementation of pilot activities. Numerical values were assigned to the assessment matrix based on specific scoring criteria.

The pilot initiative is currently being implemented at the CREA experimental site.

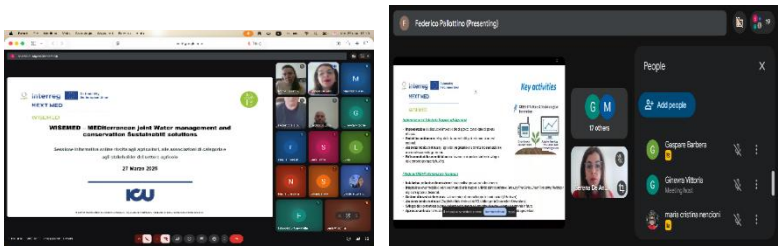


Figure 14: Info Day - CREA.



Figure15: Invitation call - Info Day – ICU & CREA.

PARTNER, PP5: Lebanese University (LU, Lebanon)

The Info Day in Lebanon was held on September 15, 2026, at the Mashghara Municipality building. The event brought together local authorities, farmers, agricultural stakeholders, and project representatives to discuss practical solutions for ensuring more efficient and sustainable water management in agriculture. The event was organized as an introductory and awareness-raising session, and it aimed to familiarize farmers with the WISEMED project and its pilot activities in Mashghara, as well as the innovative solutions proposed to improve irrigation efficiency and water management.

The five solutions presented were: (1) drip irrigation with sensors (WUE1); (2) fertigation with NPK sensors (WUE3); (3) digital decision-support systems for irrigation scheduling (WUE6); (4)

mixing conventional and non-conventional water (NCW1); (5) advanced water mixing supported by a decision-support system (NCW2). Particular attention was given to water quality and safe reuse of treated wastewater. Furthermore, the potential benefits and the risks associated with treated wastewater reuse were analyzed, reinforcing the principle that water analysis and monitoring should guide decisions on agricultural use.

The Info Day concluded with an overview of the next steps for farmer participation, including the *"Expression of Interest"* process and the upcoming *" Call for Expressions of Interest for Farmers."* The *"Call for Expressions of Interest"* was launched on September 18, 2026, followed by the beneficiary selection and notification process on October 1, 2026.



Figure 16: Info Day - LU.

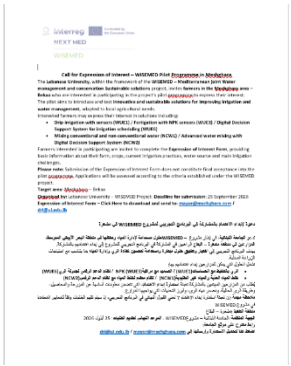


Figure 17: Expression of Interest - LU.

III.C. Demonstration & Capitalizations pilots according to Transnational Joint WM Action Plans (WP4): *Output 4.1: Pilot Actions*

In the framework of **Activity 4.1.2** "*Testing and demonstration of innovative solutions and scale-up of already developed solutions"*, capitalization solutions will be implemented in farmers' fields to demonstrate the feasibility of the solutions tested in previous projects and to scale up their application, while more innovative technical solutions will be piloted at the partners' research stations to test and showcase new technologies.

PARTNER, PP1: National Agricultural Research Center (NARC, Jordan)

Description of the area:

The project will be implemented in the Balqa Governorate of Jordan, a key agricultural region located in the northwestern part of the country, at approximate coordinates of 32.0° North and 35.7° East. Extending across the Jordan Valley highlands, the area encompasses fertile agricultural zones, including the city of Al-Salt and its surrounding rural areas. Balqa is considered one of Jordan's most important agricultural regions due to its fertile soil, relatively high rainfall compared to other parts of the country, and proximity to major markets. (Ref.5).

The Balqa region experiences a semi-arid Mediterranean climate, characterized by hot, dry summers and cold, wet winters. Annual precipitation generally ranges between 300 and 600 mm, with the majority of rainfall occurring between November and March. Average annual temperatures range from approximately 15°C to 18°C; summer temperatures often reach 30–35°C, while winter temperatures in higher-altitude areas can occasionally drop below 5°C. The region receives high levels of solar radiation throughout the year, while limited rainfall and high summer evapotranspiration rates create a critical need for effective water management and irrigation practices. (Ref.5).

Agriculture is a key economic activity in Al-Balqa Governorate; the region is renowned for cultivating wheat, barley, dates, olives, vegetables, fruit trees, and fodder crops. Olive production is a particular highlight, serving as a primary agricultural activity in the highlands, while irrigated agriculture supports the production of vegetables, such as tomatoes, cucumbers, peppers, and leafy greens. Al-Balqa also provides a significant agricultural setting for research and development activities focused on water management, drought adaptation, soil conservation, crop productivity, and sustainable farming practices within a semi-arid Mediterranean climate. Agricultural water

management in the Jordan Valley and Balqa Governorate is characterized by acute water scarcity, an increasing reliance on non-conventional resources, and centralized allocation and control. In the Jordan Valley, irrigation operations rely primarily on the King Abdullah Canal and its associated pressurized networks, managed by the Jordan Valley Authority, where a significant and growing share of the water supply consists of treated wastewater stored in dams and reused for agriculture, alongside limited surface and groundwater resources.

In Balqa, areas located in the valleys (such as Day'r Allah) follow the same system, whereas highland areas rely more heavily on groundwater extraction, springs, rain-fed agriculture, and small-scale water harvesting techniques, making them highly vulnerable to climate fluctuations and rising pumping costs.

Water allocations in both regions face constraints driven by competition with municipal and industrial uses, aging infrastructure, conveyance losses, and the impacts of climate change. This necessitates a strong focus on improving irrigation efficiency, reducing network losses, expanding the safe reuse of wastewater, adopting modern pressurized and drip irrigation systems, and implementing smart monitoring and decision-support tools to optimize water use and ensure sustainable agricultural productivity amidst chronic water stress (Ref.6). Farm sizes range from one to ten hectares, with the majority being family-run operations. Water tariffs are regulated by the Jordan Valley Authority, and farmers face steadily rising water costs due to water scarcity. While farmers are showing increasing interest in digital farming technologies, adoption remains limited due to costs, technical knowledge gaps, and a lack of technical support.

The three main challenges facing the irrigation sector in Jordan, at both national and local levels, are as follows:

1. **Severe Water Scarcity and Climate Stress.**
2. **Competition and Allocation Constraints.**
3. **Infrastructure Efficiency and Water Quality** (National Action Plan, Jordan partner, WISEMED project, 2026).

Experimental Site:

The study will be conducted at two locations: the NARC and farmers' lands in Balqa Governorate (specifically in the areas of Ain Al-Basha, Al-Karameh, Al-Ramah, and Day'r Allah). Innovative technical solutions, namely soil mulching and a tertiary treatment system utilizing ultrasonication for irrigation water quality management, will be implemented at the NARC facility in the Balqa

region, and the other technical solutions will be implemented in the Balqa region across 100 pilot plots at the farm level, with average areas ranging from 2 to 4 hectares, utilizing diverse agricultural systems that include cash crops such as eggplants and date palms.

The procurement of equipment for the technical solutions is still underway. As part of the NARC contribution, and integral to the technical solution, field trials were conducted using water-retention polymers on eggplant crops. NARC selected super-absorbent hydrogel polymers for these trials due to their low cost and their nature as innovative soil conditioners capable of absorbing and storing water up to hundreds of times their own weight, subsequently releasing moisture gradually into the root zone according to the plant's needs.

Other solutions include drip and subsurface drip irrigation, fertigation, mulching (using biochar, wood chips, or volcanic tuff), water blending/subsurface drip irrigation systems, ultrasonic treatment, and vegetable/palm tree cultivation, subject to final farm selection and site readiness. Irrigation system designs have been completed for ten host farms, covering the total area for drip/subsurface drip irrigation and the final layout of crops and palm trees. The scope of ultrasonic treatment depends on pond volume, flow rate, irrigation system capacity, and manufacturer specifications; implementation depends on supply logistics and site readiness, typically covering a range of 20 meters. Water quality monitoring is crucial when using blended or non-conventional water sources, and this quality will be tracked.

Biochar, sawdust, and volcanic tuff were selected as soil mulching materials due to their local availability, cost-effectiveness, and eco-friendly nature.

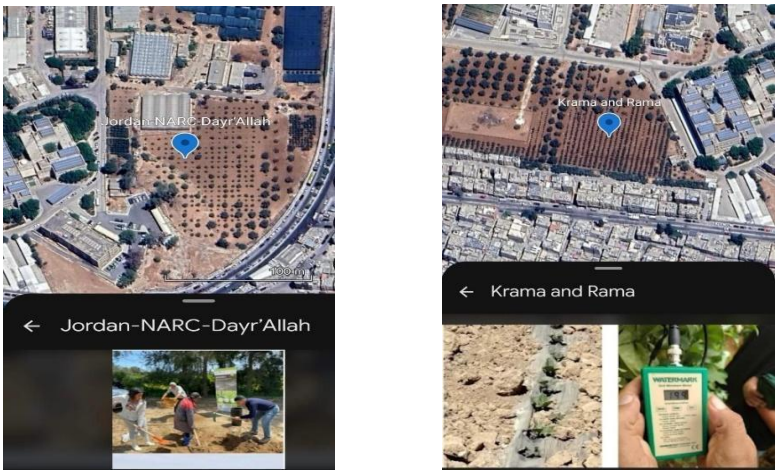


Figure 18: Experimental site's Locations - NARC.

Site: hydrogel/SAP soil-water-retention experiment.

A field trial was conducted in April 2026 in order to evaluate the impact of varying application rates of hydrogel polymer on soil water-retention capacity and crop performance (eggplant, Local variety, Baladi) under field conditions. The experiment covered an area of 0.10 hectares and utilized a drip irrigation system. A commercial potassium polyacrylate-based hydrogel product was used across the treatments, which included a control (no addition) and rates of 60, 120, 300, 480, and 600 grams of superabsorbent polymer (SAP) per 25-meter planting row; approximately 10 rows were assigned to each treatment, with a total estimated SAP quantity of about 15.6 kilograms. Each planting row measured approximately 25 meters in length and 0.50 meters in width, with the soil tilled to a depth of 0.40 meters.

The volume of soil represented by each row was calculated as follows:

Soil volume per row = 25 * 0.50 * 0.40 = 5m^3

Using an assumed soil bulk density of 1,200 kg m^{-3}, the estimated soil mass per row was:

Soil mass per row = 5 *1,200 = 6,000 kg

This estimated soil mass was used to calculate the required quantity of hydrogel polymer for each treatment.

Five hydrogel polymer application rates and one untreated control were included in the experiment. The treatment rates were calculated as percentages of the estimated dry soil mass within each planting row, with 0.5 hectare.

Treatment	Hydrogel concentration	Hydrogel quantity per 25 m row
T1	0.001%	60 g
T2	0.002%	120 g
T3	0.005%	300 g
T4	0.008%	480 g
T5	0.010%	600 g
Control	0%	0 g

The required hydrogel quantity was calculated using the following equation:

Hydrogel quantity=Soil mass per row× (Application rate/100)

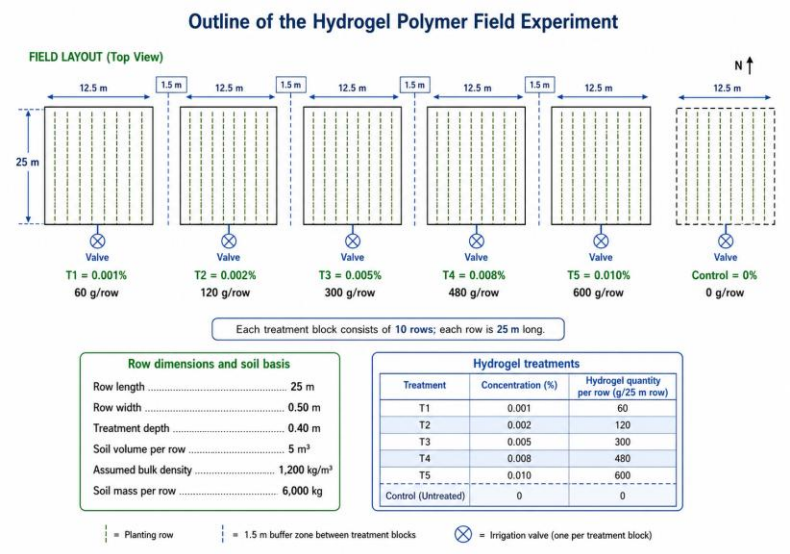
For example, the amount required for T1 was calculated as:

6,000 *(0.001/100) =0.06 kg =60 g

The same calculation procedures were applied to all other treatment rates.

The objective of the experiment is to compare eggplant growth under five hydrogel application rates and an untreated control, to assess whether hydrogel improves moisture persistence within the main rooting zone, to identify the application range that gives the strongest crop response without unnecessary polymer use, to relate crop response to monitored root-zone conditions, including soil moisture content (RH), soil temperature and soil EC, and to Develop a complete basis for calculating irrigation-water saving and water productivity at harvest.

Experimental Layout



The hydrogel polymer was weighed separately for each treatment using a precision balance, and the measured quantity was distributed uniformly along the entire length of each planting row.

All treatments were irrigated using the same irrigation system and general scheduling criteria; however, each experimental unit (treatment) was operated via an independent valve to allow for precise monitoring and control of water usage.

Soil moisture and temperature were also monitored periodically within each treatment, with measurements recorded at fixed soil depths and at specific locations representative of each experimental unit.





Figure 19: Used of Soil Moisture Tension Meter in Eggplant field.

Preliminary Results:

1- Branch formation

T1, T2 and T3, each produced seven branches per plant, compared with four branches in the untreated control. T4 and T5 each produced five branches. The absolute increase was three branches per plant under T1-T3 and one branch per plant under T4-T5.

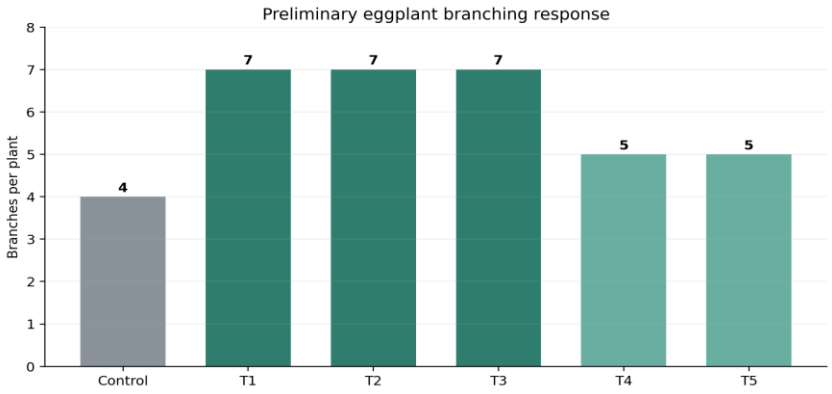


Figure 20: Observed branch number by treatment. Values are preliminary field observations and require replication-level statistics.

The response was not linear across the tested dose range. Branching rose sharply between the control and T1, remained at seven branches through T3, then declined to five branches under T4 and T5. This pattern identifies a promising response plateau between 60 and 300 g per row. It also indicates that applying more polymer did not produce a stronger vegetative response in this assessment. A likely explanation is that low and medium hydrogel rates improved plant-available water while maintaining favorable aeration. At higher rates, greater swelling and water retention might alter soil porosity or reduce oxygen availability after irrigation. This mechanism remains a hypothesis and should be tested using soil water content, irrigation records and root measurements.

2- Soil moisture content

The column labeled RH represents soil moisture content (%). Mean soil moisture was calculated from the numeric daily records in each treatment sheet. The control mean was 48.4%. Treatment means ranged from 79.1% to 80.7%. T2 and T5 recorded the highest mean soil moisture, followed by T1, while T3 and T4 recorded equal means.

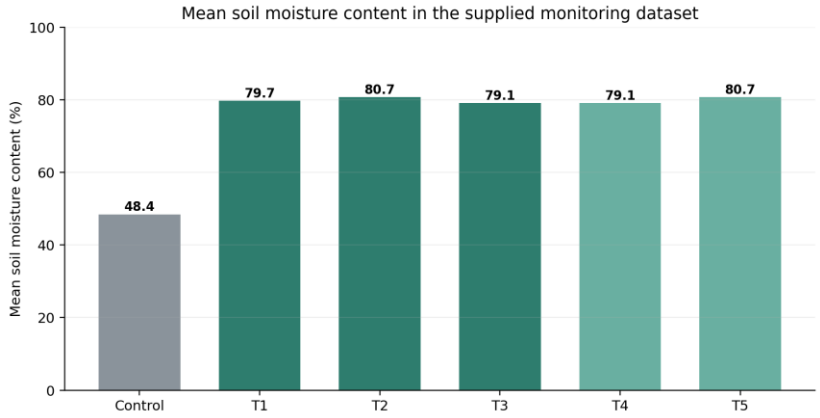


Figure 21: Mean soil moisture content by treatment. RH in the supplied workbook refers to soil moisture content expressed as a percentage.

The soil moisture results provide direct evidence that water remained available for a longer period in the treated root zone. Mean values close to 80% under all hydrogel treatments were approximately 31-32 percentage points higher than the control. This greater water reserve reduces the speed at which the root zone reaches moisture-stress conditions. The seven branches recorded under T1, T2 and T3 are consistent with better water availability. The lower branch number under T4 and T5, despite similarly high soil moisture, suggests that water retention alone did not control plant response. Excess water retention, reduced soil aeration, polymer distribution or other field factors may have limited the response at the highest rates.

Result to date indicates that:

- The hydrogel treatments produced more branches than the untreated control.
- T1-T3 achieved the strongest recorded vegetative response at substantially lower polymer rates than T4-T5.

- The supplied soil moisture data show substantially greater root-zone water retention in every hydrogel treatment.
- The combined evidence supports strong water-conservation potential, but the saved irrigation-water percentage still requires measured irrigation volumes.



Figure 22: Used of Hydrogel Polymer in Eggplant Field.

NARC will continue its demonstration of hydrogel usage through regular field inspections, aiming to complete the analysis and interpretation of all data, determine crop response to the polymer, monitor soil moisture content, and calculate irrigation water savings and crop yields; subsequently, the hydrogel polymer will be applied to another experimental plot to validate the previously reported results.

Furthermore, NARC emphasizes finalizing procurement procedures and commencing the installation of the acquired technologies at the pilot sites. Activities will include operating the decision support system, deploying soil monitoring sensors, installing ultrasonic water treatment units, and integrating all field equipment into a unified digital monitoring platform.

PARTNER, PP2: National Research Institute of Rural Engineering Water & Forests (INRGREF, Tunisia)

Description of the area:

The project will be implemented in the Ouadi Souhil and Korba areas of Nabeul Governorate in northeastern Tunisia, focusing on research related to agriculture and soil and water conservation. Both areas are located on the Cap Bon peninsula, approximately 65 km southeast of the capital, Tunis, and rank among the country's most important agricultural regions (Ref.7).

The Nabeul region’s climate is characterized by hot, dry summers and mild, rainy winters, with the majority of annual rainfall occurring between October and April. Temperatures frequently

exceed 35°C, while winter lows rarely in night drop below 7°C. The region enjoys abundant sunshine throughout the year and experiences relatively high rates of evapotranspiration during the growing season, making irrigation essential for intensive agriculture (Ref.8).

Agriculture is the dominant economic activity in the Nabeul Governorate; the region is renowned for producing citrus fruits, tomatoes, peppers, potatoes, strawberries, and other horticultural crops grown in both open fields and greenhouses. Olive groves, vineyards, and various types of fruit trees are also widely cultivated. Greenhouse vegetable production plays a significant role in the local agricultural economy, thanks to favorable climatic conditions and the availability of irrigation water (Ref.9). *"Agricultural Development Groups"* (GDAs) often handle the day-to-day management of water distribution from the Lebna Dam, organizing farmers' access to irrigation water. Groundwater is pumped using diesel and/or solar-powered systems. The tariff set by these groups for Lebna Dam water, which is not available year-round, is approximately 0.150 Tunisian Dinars per cubic meter ($0.05/m³). However, given the frequent lack of sufficient fresh water in the dam, farmers must also bear the energy costs associated with pumping the water (approximately $0.30/m³).

The main challenges facing the irrigation sector at both national and local levels are as follows:

- **Water Scarcity and Climate Variability.**
- **Excessive pumping of coastal aquifers (e.g., Cap Bon).**
- **Inefficient Water Use and Limited Digitalization.** (National Action Plan, Tunisia Partner, WISEMED Project, 2026).

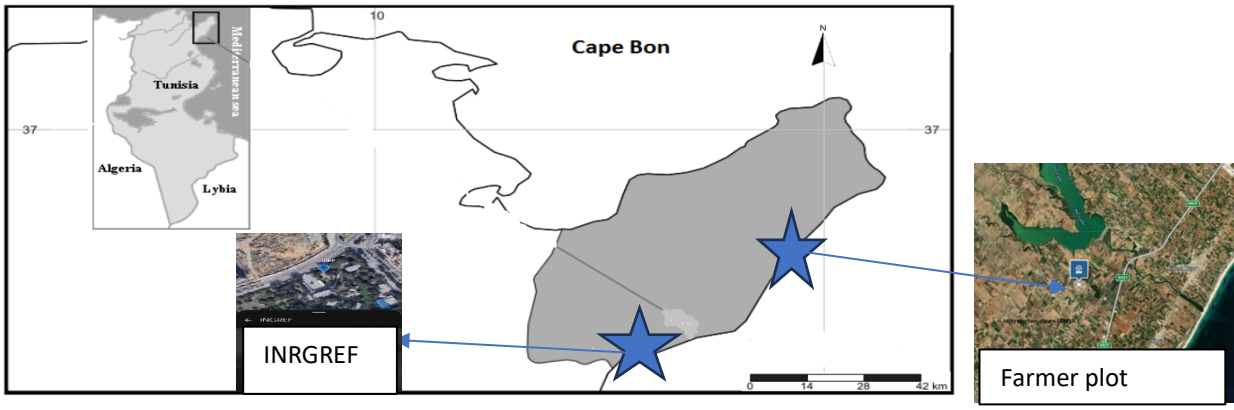


Figure 23: Experiment site's location –Ouad Souhil INRGREF field station and farmer plot.

FIELD Experimental:

Solution 1: Mixing water solution under controlled condition

the field experiment was performed in Oued Souhil Inrgref station, under Controlled condition where four varieties of tomatoes were cultivated: **Savera, Firenze, Rio Grande and Saada** on 7 May 2026 with 5 Mixing treatment trials:

1- ***T1: 100% brackish groundwater (well water)***
2- ***T2: 100% good-quality surface water (dam water)***
3- ***T3: 50% brackish groundwater + 50% dam water***
4- ***T4: 70% brackish groundwater + 30% dam water***
5- ***T5: 60% brackish groundwater + 40% dam water***

Each variety included 20 pots, with 4 replicates per treatment with a total of 82 pots.

The experiment aims to monitor soil salinity (EC) and moisture content, water salinity (ECw), and vegetative growth stages in order to determine the optimal mixing ratio of saline groundwater and dam water for various tomato varieties.

Rio Grande is a determinate open-pollinated highly productive (97.0–145.4 t/ha) tomato varieties, while Firenze, Safera, and Saada are F1 hybrids varieties originally developed by global commercial seed companies to produce abundant yields of pear-shaped, blocky tomatoes. The different varieties tested are considered as resistance to extreme temperatures, high sugar content (Brix), and viscosity, these varieties have become staples for tomato farms and processing plants in Tunisia. Imported via European seed suppliers, they have been widely adopted by Tunisian farmers and traders for over two decades, thanks to their uniform shape, highly resistant skin, and vibrant red color.

A second experiment on mixing water solution will be launched in mid-October 2026, focusing on only one variety, depending on the results obtained from the first experiment.



Figure 24: Farmer Experimental site -Tomatoes cultivation under controlled condition.

Solution 2: Salt tolerant crop solution:

A-Site Korba under farmer condition

Three varieties of Tomatoes Savera, Firenze, Rio Grande were cultivated in 29 April 2026, with 2500 m^2 of area with surface drip irrigation under farmer condition located in Korba. The aim of this study is to assess the impact of salinity on tomato yield by monitoring soil salinity (ECe), soil moisture, and irrigation water salinity (ECw), along with vegetative growth and yield throughout the crop cycle. The study focuses on salt-tolerant tomato varieties and uses low-cost sensors to monitor soil and crop conditions, supported by a continuously installed and monitored climate station.

The experiment was implemented on one farmer plot with 0.5 ha, the field is located at Lebna dam irrigated district, with comparison of the growth and yield of three tomato varieties (Severa, Firenze, Rio Grande (Local variety)) that differ in their degree of tolerance to salinity, the farmers often use the mix water from Lebna Dam (good quality) with brackish groundwater. Field visits for sampling and monitoring began on April 29, 2026, with measurements taken on a weekly basis, specifically, once or twice a week during the growth cycle.



Figure 25: Farmer Experimental site -Tomatoes cultivation.

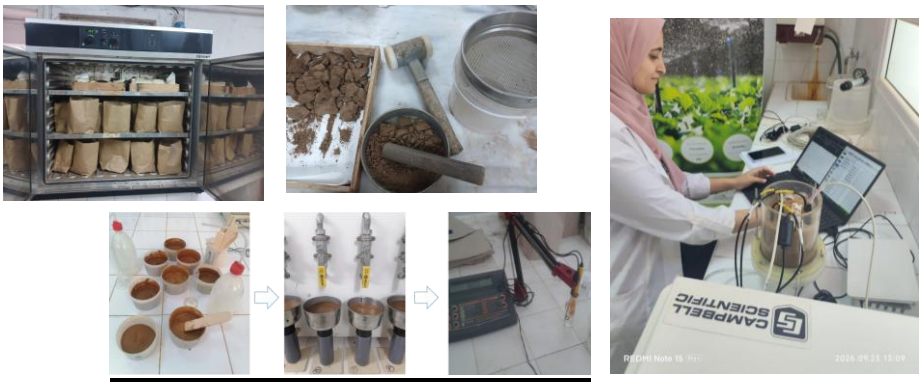


Figure 26: Laboratory analysis.

B-Site Oued Souhil under Field controlled condition

Another trial will be done for salt tolerant crop solution under controlled conditions at OUED SOUHIL INRGREF Field station, with automated drip irrigation and real-time monitoring, in mid-

October 2026, for off-season tomato cultivation. The pilot phase will subsequently start at the end of October. This site will serve as a Living Lab pilot site for farmers under control conditions.
INRGREF Field experimental station at Oued Souhil (Nabeul-Cap Bon): Surface area (80 m x 50 m= 400 m2), 3 tomatoes varieties. Surface drip irrigation will be used as a system.

Preliminary Results:

The first experiment in Oued Souhil was conducted, involving the technical solution of mixing water (Brackish ground water and dam water) under controlled conditions while monitoring soil salinity (EC) and moisture, water salinity (ECw) and vegetative growth stages; a second experiment on mixing water is scheduled for mid-October 2026 to build upon the results of the first.

Regarding the salt-tolerant crop solutions at the Korba site, conducted under actual farm field conditions, the field trial has been completed, all collected samples are currently undergoing laboratory analysis, to be followed by statistical analysis to support data interpretation and the assessment of the effects of various treatments. A second trial concerning these salt-tolerant crop solutions is scheduled for mid-October 2026 under controlled field conditions at the Oued Souhil station, affiliated with the National Research Institute for Rural Engineering, Water, and Forests (INRGREF), with the aim of reinforcing and validating the results of the first trial.

Under the framework of WISEMED project, technical manuals are being developed to provide farmers with practical, simplified information on the key technical aspects of tomato cultivation. These materials also aim to instruct farmers on the proper installation and use of low-cost soil sensors, enabling a better understanding of soil water availability, water requirements, and crop status. The manuals will serve as tools to enhance farmers' technical knowledge and encourage the effective use of monitoring technologies, thereby ensuring more efficient irrigation management.

PARTNER, PP3: Agencia Estatal Consejo Superior de Investigaciones Cientificas (CEBAS-CSIC, Spain

Description of the Area:

The Region of Murcia is a historic city, located in southeastern Spain and is one of the most important horticultural and fruit-growing areas in Europe. Set in the Segura River valley, it is characterized by a semi-arid Mediterranean climate with limited and irregular rainfall (often <300

mm/year). Murcia generally features a Mediterranean climate with hot, dry summers and mild, rainy winters. These conditions create chronic water scarcity and make irrigation indispensable for agriculture. However, the high technology development for agricultural water management has positioned Murcia as a key region for Spain's fruit, vegetables and citrus for the domestic and European market. The principal irrigated crops include: Horticultural crops: lettuce, tomatoes, peppers, melons. Citrus fruits: lemons are especially important. Other high-value fruit trees (peaches, apricots, grapes, olives) and specialty products (e.g., aromatic plants like sage, oregano or lavender). Protected crops in greenhouses also contribute significantly to production and export: tomato, pepper, cucumber, zucchini.

Farms in the region range from small family holdings to medium-sized agri-business operations oriented to export markets. The sector has strong cooperative structures and a significant export orientation: Murcia produces a large portion of Spanish fruit and vegetables sold across Europe.

Water supply for irrigation is a mix of traditional freshwater, imported water via the Tajo-Segura transfer, and increasingly reclaimed/treated reuse water, the latter is cheaper and encourages reuse.

Typical water tariffs depend on the source:

- Desalination: 0,327 €/m3 with subsidies– 0,55 €/m3- without subsidies.
- Conventional river transfer (Tajo-Segura): 0,26 €/m3
- Irrigation communities' average price: 0,35€/m3

The three main irrigation challenges at the national and local levels are:

- **Conventional water management solutions often energy-intensive and costly.**
- **Non-conventional water (NCW) treatment technologies often lack scalability, simplicity, and efficiency.**
- **Over-fertilization use often generates soil and aquifers contamination** (National Action Plan - Spain partner, WISEMED project, 2026).

Experimental sites:

CEBAS-CSIC has identified five key agricultural areas within the region where experimental farms and commercial holdings are available as WISEMED demonstration farms These areas cover a broad spectrum of crops, climatic conditions, and farm typologies.

Area 1	Altiplano — Stone fruits (Jumilla / Yecla).
Area 2	Huerta de Murcia — Citrus, fruits, greenhouse (Santomera).
Area 3	Bajo Guadalentín — Citrus: lemons and mandarins.
Area 4	Campo de Cartagena — Vegetables, citrus, stone fruits, greenhouse.
Area 5	Alto Guadalentín — Vegetables and table grapes.

As water is in short supply, the farmers used the drip irrigation, and these areas are famous as mentioned above, in stone fruits, vegetables, lemon, mandarins, vegetables and table grapes.
The capitalization solutions, fertigation system and organic mulching will be applied in all the farms in five areas, and the DDs, mixing of non-conventional and conventional water will be used in Area number 4, Campo de Cartagena. This area encompasses a range of Mediterranean fruit crops across multiple experimental plots, enabling controlled multi-crop experiments under identical climatic conditions. Its proximity to CEBAS-CSIC headquarters facilitates intensive monitoring and rapid data collection.

Irrigation water is sourced from:

- Local aquifers and the Tajo–Segura transfer scheme, Area 1;
- The Tajo- Segura transfer scheme, Area 2;
- Treated waste water and the Tajo- Segura transfer scheme, Area 3
- A desalination plant and the Tajo- Segura transfer scheme, Area 4;
- Water from the upper Guadalentín river, Area 5;

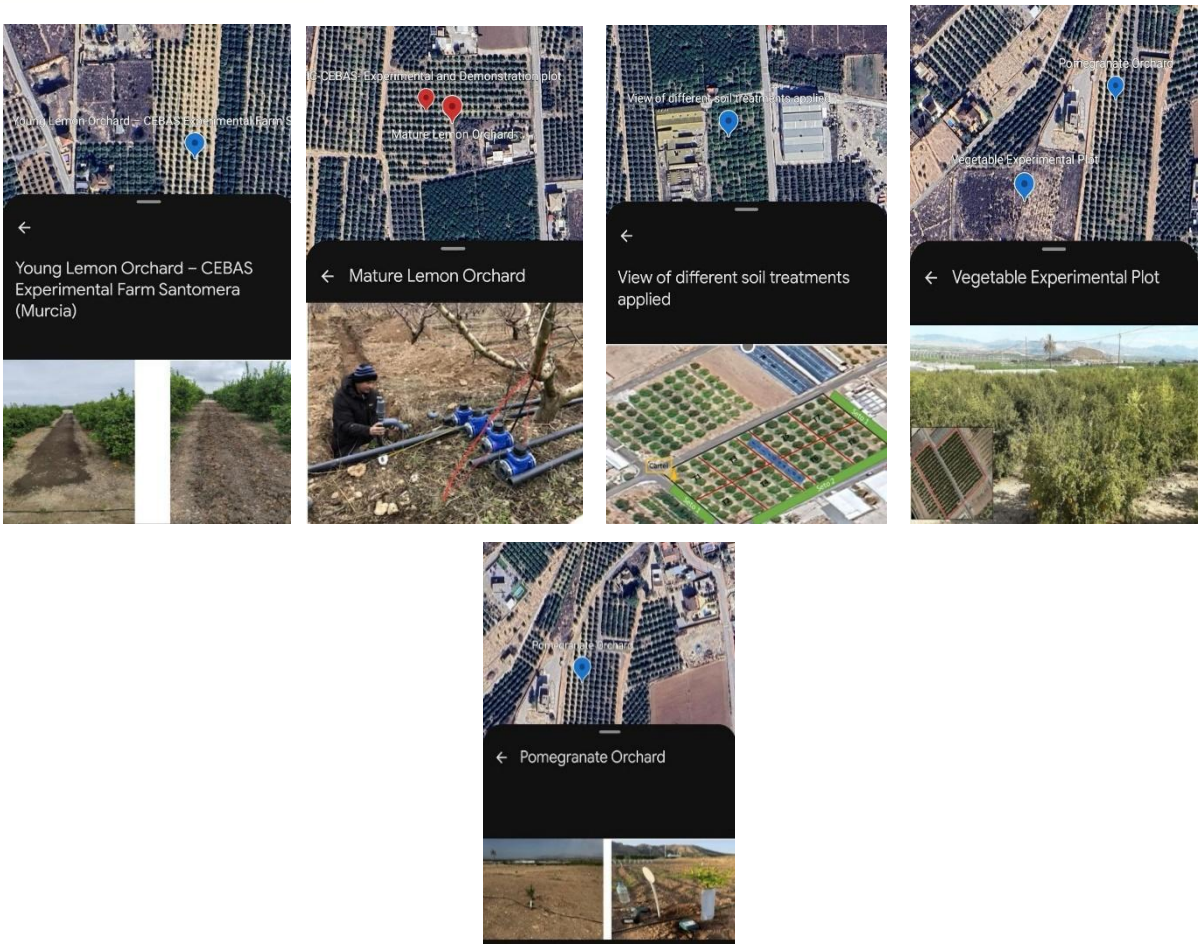


Figure 26 : Experimental site's Locations – CEBAS-CSIC.

1- Altiplano:

The site is located in Altiplano, high inland plateau of the Region of Murcia, covering the municipalities of Jumilla and Yecla in the northeast. Elevations range from 400 to over 800 m, giving the area a continental-Mediterranean climate with cold winters, hot dry summers, and annual rainfall of approximately 300 mm. These conditions are distinct from the rest of the region and impose specific irrigation and soil management challenges.

Soils are generally calcareous and moderately deep. Irrigation is primarily from local aquifers and the Tajo–Segura transfer scheme. Drip irrigation dominates, and fertigation is widely practiced in commercial orchards.

Sensor-based irrigation scheduling, cover-crop soil management, and precision fertigation practices will be implemented at this site, which comprises 3 ha of peach orchards located at a high elevation of 578 m. Irrigation will be managed at 100% ETc, with organic fertilizer applied

through the fertigation system. The objective is to demonstrate integrated water and nutrient management under real field conditions, while assessing the effectiveness of sensor-based irrigation scheduling and evaluating yield responses to soil cover crops.



Figure 27: Peach Orchards.

2- Huerta de Murcia:

The site is Located in the municipality of Santomera (north of Murcia city, 38.104°N, 1.033°W). This farm is fully equipped with scientific instrumentation for soil moisture monitoring, plant water status assessment, and precision fertigation management. It serves as the reference site for method development and validation before scaling to commercial farms.

The farm covers a range of Mediterranean fruit crops across multiple experimental plots, enabling controlled multi-crop experiments under identical climatic conditions.

The technical solutions will be implemented across four different farms:

1. Farm 1 (2 ha): A precision drip irrigation trial will be conducted on ‘Fino 95’ lemon trees. Deficit irrigation treatments will be applied at 100% and 75% of ETc, combined with either conventional NPK fertilization or a fertigation programme. Cover crops consisting of alfalfa and sainfoin will also be evaluated.
2. Farm 2 (1 ha): The trial will be conducted on young lemon trees under 100% ETc irrigation. Conventional fertilization will be applied, and the effects of cover vegetation will be assessed by comparing covered-soil and bare-soil treatments.

3. Farm 3 (1 ha): The farm will consist of pomegranate trees managed using automated drip irrigation, DDS, and a fertigation programme.
4. Farm 4 (200 m²): Under controlled conditions, lettuce will be used to test a fertigation calibration and precision irrigation system. Different fertigation treatments will be applied, varying the proportion of nitrogen supplied as nitrate (NO_3^-) and ammonium (NH_4^+). This will allow the evaluation of the interaction between irrigation frequency and nitrogen form in terms of crop performance, nutrient uptake, and resource-use efficiency.

These technical solutions will demonstrate the integrated water and fertilizer management under real field conditions, and to test the sensor-based irrigation scheduling and decision support systems.



Figure 28: Vegetables Growth.



Figure 29: View of different soil treatments applied (compost supplies, sown of cover crops).

3- Bajo Guadelentin:

The site is located in the lower valley of the Guadalentín river, running from the Alhama de Murcia area eastward towards the Murcia plain. The area sits at elevations between 100 and 250 m with a

semi-arid Mediterranean climate (annual rainfall ~250–300 mm). The Guadalentín valley is one of the most productive citrus zones in Spain, particularly concerning lemon production.

Soils range from loamy to clay-loam, often with calcareous B-horizons. Irrigation water is supplied mainly from the Tajo–Segura transfer and treated wastewater, making this area directly relevant to WISEMED's interest in non-conventional water resources.

The technical solutions will be implemented in three farms comprising lemon and mandarin Orchards. The farms will employ automated drip irrigation, precise fertigation, and organic mulching. One farm will also use sensor-based drip irrigation, with two lemon plots managed under different irrigation and fertigation regimes, as well as a mandarin orchard. This setup will allow a direct comparison of fertigation requirements between lemon and mandarin orchards.



Figure 30: Lemon Orchard.

4- Campo de Cartagena:

Campo de Cartagena is located in a coastal plain of southeastern Murcia, extending between the city of Murcia and Cartagena. It is one of the most intensively farmed areas in Europe, with a warm semi-arid Mediterranean climate, very low annual rainfall (<300 mm), and high summer temperatures. The area relies heavily on irrigated horticulture, supplied by the Tajo–Segura transfer scheme and increasingly by desalination plants.

The agricultural landscape is diverse, combining open-field vegetable production, protected horticulture (greenhouses and plastic tunnels), citrus orchards, and stone fruit farms. This diversity makes it an ideal test bed for WISEMED's multi-crop approach. Its proximity to CEBAS-CSIC headquarters facilitates intensive monitoring and rapid data collection.

Three farms in this area will benefit from the project: one farm comprising 16 ha of lemon orchards, another comprising 10 ha of grapefruit orchards, and a third farm with 4 ha of melon, broccoli, and potato crops. Trials across these three farms will follow a randomized block design

with four fertilization treatments: one conventional mineral fertilization control and three commercial sustainable organic fertilization protocols, with four replicates per treatment.

In addition, the prototype water-mixing system will be tested on lettuce crops in the Roldán area.

Host Institution: Collaborating Farm (ESAMUR company).



Figure 31: Broccoli cultivation.



Figure 32: Monitoring station equipped with soil sensors & a solar-powered data acquisition system for irrigation.

5- Alto Guadalentin

The Alto Guadalentín is located in the upper Guadalentín river basin, centered on the Lorca municipality and extending towards Puerto Lumbreras and Águilas, with elevations of 200–500 m, the area has a semi-arid to arid continental-Mediterranean climate, with annual rainfall below 250 mm. Water scarcity is particularly acute here, making efficient irrigation and fertigation management a pressing priority.

Agriculture is highly diversified, with vegetable production (watermelon, melon, artichoke, broccoli, leafy vegetables) predominating in the valley floors, and table grapes occupying hillside terraces. Several farms are linked to agri-food cooperatives and research-oriented entities.

Four farms will be involved in the project, comprising multiple experimental plots representative of typical vegetable production areas, including lettuce, celery, fennel, watermelon, and melon. These farms will be used to study the impact of crop rotation under low-input fertigation strategies. Their established institutional links, receptiveness to experimentation, and availability of multi-season monitoring data will support the implementation and long-term evaluation of the trials.



Figure 33: vegetables crops.



Figure 34: Harvested grapefruit fruit collected in field crates within the experimental orchard.

Preliminary Results:

By the end of July 2026, CEBAS-CSIC established eighteen farms or experimental plots to test the solutions proposed under the "National Action Plan" (including fertigation systems, organic soil mulching, and the development of a prototype for blending conventional and non-conventional water). Treatments have already been implemented at eight farms (with data and activity details provided in this report; see the table below), while implementation at the remaining farms will commence in the coming months, subject to climatic conditions.

These trials are characterized by meticulous planning and the establishment of effective relationships with various beneficiaries.

Experimental Orchard

Experimental Orchard and Location.	Status	Short Description / Solution.
Farm 1 - Peach Orchard – Urbano Farm, Jumilla **(Altiplano).**	Ongoing	- Crop: Peach. - Monitoring of cover crops and plant water status. - Solutions: Fertigation management & cover cropping.
Farm 2 - Mature Lemon Orchard – CEBAS Farm, Santomera **(Huerta de Murcia).**	Ongoing	- Crop: "Fino 9"" lemon. - Design: Fertilization × irrigation × ground cover. - Solutions: fertigation management & organic mulching.
Farm 3 - Young Lemon Orchard – CEBAS Farm, Santomera **(Huerta de Murcia).**	Ongoing	- Crop:" Verna" lemon. - Design: 2×2 factorial (ETc/RDI × conventional/agroecological). - Solutions: Cover-crop management, organic mulching and organic fertilizers.
Farm 4 - Pomegranate Orchard – CEBAS Farm, Santomera **(Huerta de Murcia).**	Ongoing	- Crop: Pomegranate. - Design: fertigation using different indicators. - Solution: fertigation management.
Farm 5: Vegetable Crops in Greenhouse-CEBAS Farm, Santomera (**Huerta de Murcia).**	Ongoing	- Crop: "Summer Wonder" Lettuce. - Design: Four different irrigation and fertilization treatments. - Solution: Fertigation management.
Farm 6; Vegetable crops – Manuel Madrid Farm, Torre Pacheco **(Campo de Cartagena).**	Starting: October 2026.	- Crop: Potato. - Up to five precision fertigation treatments. - Solution: Fertigation management.
Farm 7: Vegetable Crops – El Nido (Florette), Torre	Starting: September 2026.	- Crops: Lettuce and other leafy vegetables. - Monitoring with soil sensors and nutrient balance assessments.

Pacheco (**Campo de Cartagena).**		- Solution: fertigation management.
Farm 8: Lemon Orchard – El Colorao Farm, Alhama de Murcia **(Lower Guadalentín Valley).**	Starting: September 2026.	- Crop: Organic lemon orchard. - Organic fertilization vs. control. - Solution: organic fertilization and organic mulching.
Farm 9: Lemon Orchard – Toñifruit, Alhama de Murcia **(Lower Guadalentín Valley).**	Starting: September 2026.	- Crops: Organic lemon and mandarin orchards. - Monitoring of water status, nutrition and ground cover. - Solution: organic fertilization and organic mulching.
Farm 10: Lemon Orchard – Alcaraván Farm, Alhama de Murcia **(Lower Guadalentín Valley).**	Starting: September 2026	- Crop: Organic lemon orchard. - Monitoring of water and nutritional status. - Solution: organic fertilization and organic mulching.
Farm 11. Vegetable Crops – Agroraiguero, Lorca **(Upper Guadalentín Valley).**	Starting: September 2026.	- Crops: Watermelon, broccoli and artichoke. - Characterization of crop rotations. - Solution: fertigation management.
Farm 12. Vegetable Crops – Biobehr, Lorca **(Upper Guadalentín Valley).**	Starting: September 2026.	- Crop: Organic lettuce. - Characterization and comparison of organic systems. - Solution: fertigation management.
Farm 13: Vegetable Crops – Alimer Foundation, Lorca **(Upper Guadalentín Valley).**	Starting: September 2026.	- Crops: Pumpkin and broccoli. - Characterization and demonstration pilot. - Solution: fertigation management.
Farm 14. Vegetable Crops – José María Martínez, Lorca **(Upper Guadalentín Valley).**	Starting: September 2026.	- Crops: Melon, watermelon, fennel, celery and lettuce. - Characterization and demonstration pilot. - Solution Fertigation management.

Farm 15: Lemon Crop – Collaborating Farm /Isidro owner). Location: Fuente Álamo, Murcia, Spain **(Campo de Cartagena)** Host Institution: Collaborating Farm (Isidro owner).	Ongoing	- Crop: Lemon trees. - Experimental Area: 16 Ha, Irrigation System: drip irrigation under commercial management. - Solution: Eco fertigation management.
Farm 16: Grapefruit trees. Location: Los Camachos, Cartagena, Spain (**Campo de Cartagena).** Host Institution: Collaborating Farm (Juan Francsico owner).	Ongoing	- Crop: Grapefruit trees. - Experimental Area: 10 Ha, Irrigation System: drip irrigation under commercial management. - Solution: Eco fertigation management.
Farm 17: Crop: Melon–Broccoli Crop Rotation Location: Balsicas, Cartagena, Spain **(Campo de Cartagena).** Host Institution: Collaborating Farm (Felix Garre owner).	Ongoing	- Crop: Melon–Broccoli. - Crop Rotation, Experimental Site experimental Area: 4 Ha, Irrigation System: drip irrigation under commercial management. - Solution Eco fertigation management.
Farm 18: Solution: Prototype mixing water. Crop : Lettuce. Location: Roldán, Cartagena, Spain (**Campo de Cartagena**). Host	Starting: September 2026.	The development of this prototype will be organized into two complementary phases. The first is a technical acceleration phase focusing on reviewing and restructuring the current Excel-based Decision Support System (DSS), known as PROSIM, developing an initial soil module, defining the preliminary nitrogen balance logic, and preparing an experimental validation plan. This phase will commence in September 2026 and will include scenario testing for irrigated lettuce cultivation using three different water

Institution: Collaborating Farm (ESAMUR company).		sources: reclaimed water, desalinated water, and a mixed water source prepared as a prototype. Validation will take place in the greenhouse at the Roldán experimental platform (Campo de Cartagena area, Region of Murcia).

The results from the eight pilot farms, which utilize fertigation and organic mulching solutions, are currently being analyzed, and the implementation of these solutions across the remaining farms is scheduled to begin between late September and October. Concurrently, the water-blending process, incorporating reclaimed water, desalinated water, and other source of water, following the prototype model developed for this purpose, will commence in September.

PARTNER, PP4: Consiglio per la Ricerca in Agricoltura e l'Analisi dell'Economia Agraria (CREA, Italy)

Description of the area:

The target area is located in the coastal plain of the Lazio Region, specifically in Monterotondo, at the CREA experimental site, which is managed as an experimental farm through a consortium/private management arrangement. The region has a Mediterranean climate, characterized by hot, dry summers and wet winters, with evapotranspiration rates peaking between May and September. The area also experiences increasing water stress during the summer, as well as significant soil variability across the site, with multiple soil types occurring within a single plot. Agricutural water management in Italy relies on a model that combines collective irrigation systems managed by irrigation consortia (surface water distribution networks) with individual groundwater use (private wells). Irrigation plays a strategic role in ensuring productivity, particularly for high-value crops (such as horticultural crops, fruit, vineyards, and maize). The primary crops are cereals grown in open fields using sprinkler irrigation systems.

The Lazio region is characterized by small- to medium-sized farms, where irrigation is managed through a collective system, specifically "irrigation consortia", with a water tariff of €0.80 per cubic meter. There are growing regulatory requirements regarding irrigation monitoring and the use of Decision Support Systems (DSS), particularly given summer water stress and fluctuating water availability, which intensify competition for water resources during peak periods. Furthermore, operational constraints related to distribution (such as rotational irrigation, pressure

fluctuations, and network efficiency), alongside groundwater salinity, can impact farm-level performance.

The key irrigation-related challenges, at both national and local levels, are as follows:

- **Summer drought and climate variability.**
- **Network efficiency and rotation management.**
- **Farm fragmentation and uneven technical capacity**. (National Action Plan, Italy partner, WISEMED project, 2026).



Figure 35: Experimental site's Location - CREA.

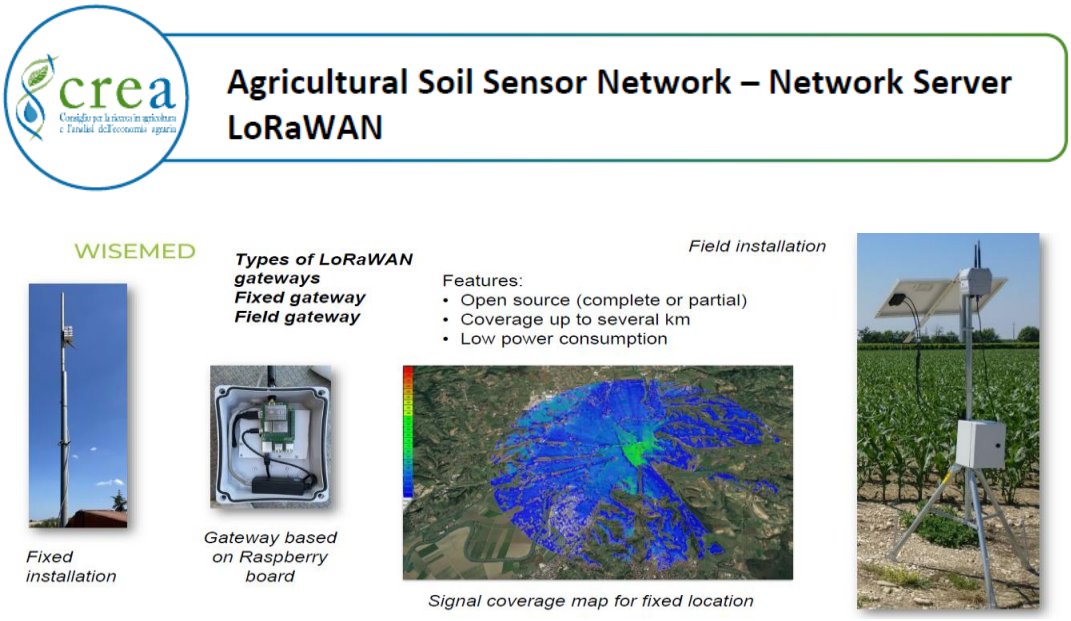
Experimental Site:

The target area is located in the coastal plain of the Lazio Region, specifically at the CREA experimental farm in Monterotondo. The pilot action in Italy is currently being implemented at the CREA experimental site and, at this stage, does not involve individual farms as direct end-users. The pilot action focuses on the testing, calibration, and validation of the open-source irrigation Decision Support System (DSS) under controlled experimental conditions. The primary objective is to ensure its robustness, scalability, and replicability at the farm level.

CREA-IT is responsible for the installation, testing, and demonstration of an open-source, low-cost precision irrigation solution integrating an adaptive time-lag time-series linear forecasting model with a LoRaWAN-based IoT platform. The Italian solution developed by CREA within the WISEMED project relies on an open-source technology stack comprising ChirpStack/TTN for LoRaWAN connectivity, MQTT for data communication, and open dashboards for data

visualization. In particular, the solution is composed by different parts and allows the collection of the following information:

- Soil moisture % VMC (multi-depth);
- Soil temperature °C (root zone);
- Rainfall mm/event & cumulative;
- Flow rate L/h & cumulative volume m³;
- ETo (FAO-56) mm/day derived from met;
- Battery voltage V & LoRaWAN RSSI/SNR.

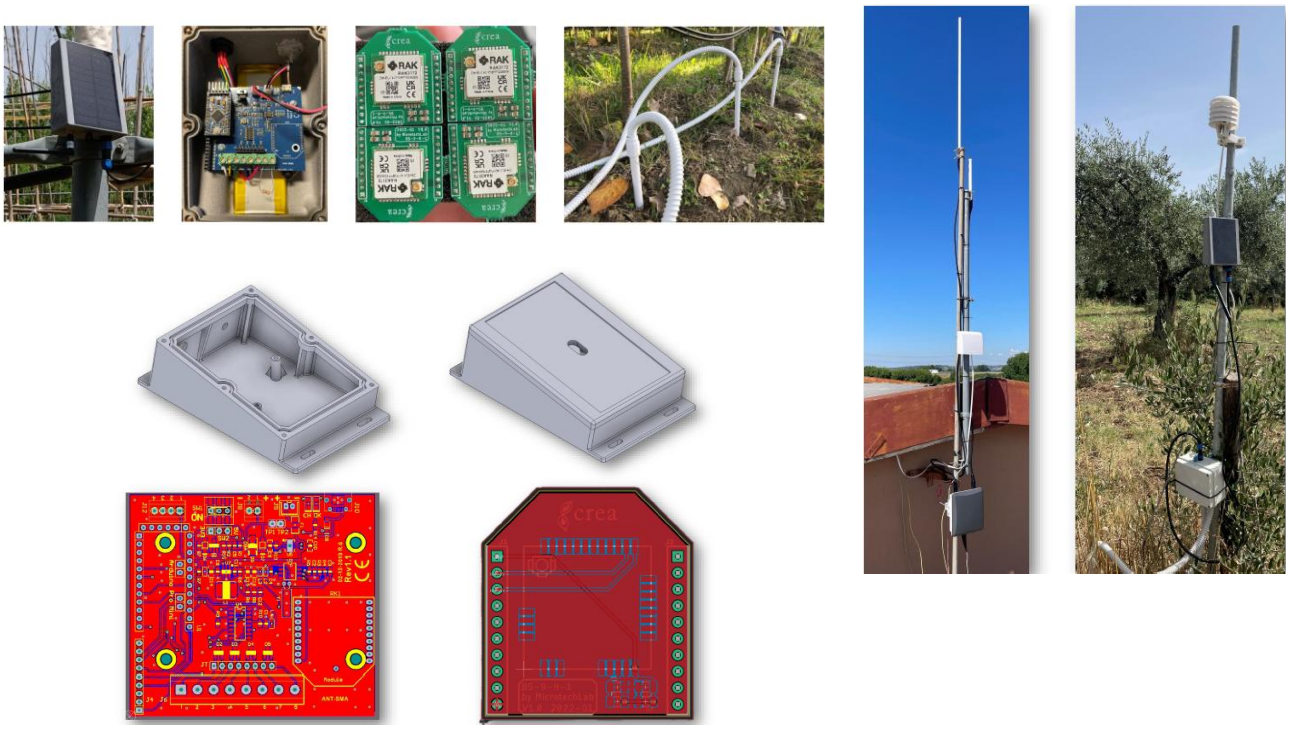


The proposed solution is an open-source system. The latter originally referred to open-source software (OSS), designed to be publicly accessible. It means that anyone can view, modify, and distribute it according to their needs.

Hardware board for field sensors

The hardware board for field sensors has been entirely designed and manufactured based on open-source, flexible projects, with further expansion and improvements to meet the specific requirements of the WISEMED project. The board can manage a minimum of three Watermark

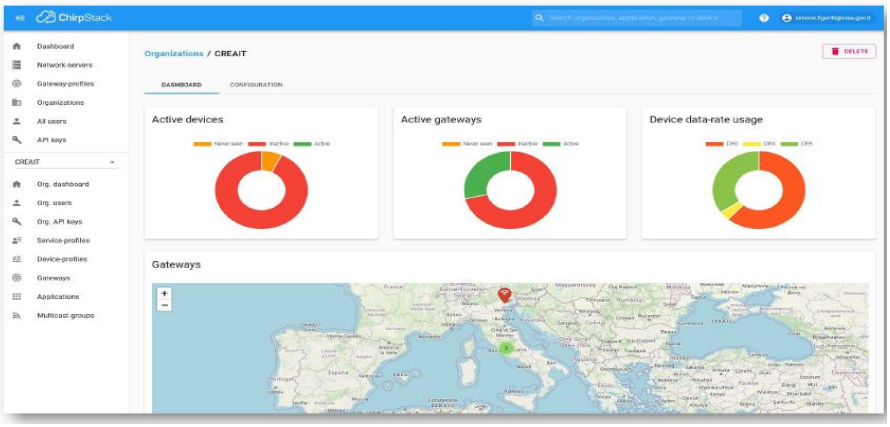
sensors as standard, where Watermark sensors are used to measure soil water tension, as well as other types of sensors, such as soil temperature sensors.



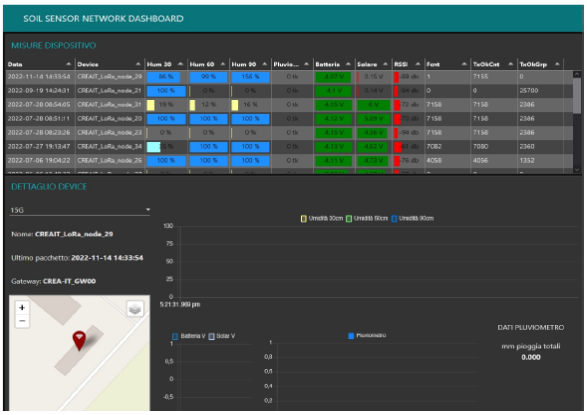
Application Server

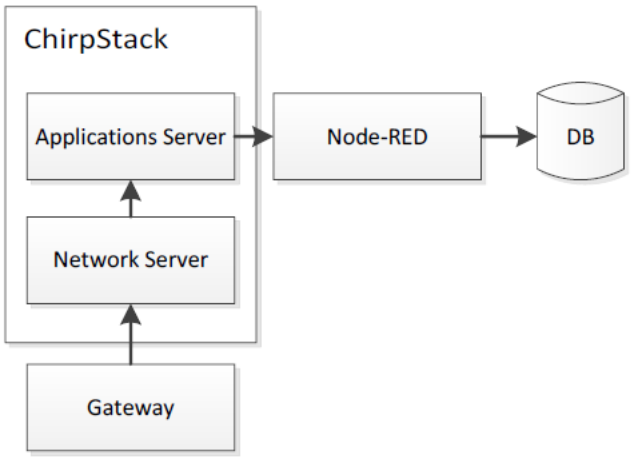
The functioning of all system components is supported by an application server based on ChirpStack. ChirpStack manages nodes and gateways and is responsible for the reception, interpretation, and forwarding of data packets transmitted by the nodes. It is a fully open-source

project that includes both Network Server and Application Server functionalities.



Synthesis architecture of Agricultural Soil Sensor Network from gateways to dashboard and data backup





The solution provides benefits from both economic and environmental perspectives.

Reduced Initial Investment Costs: Open-source control units are more affordable than proprietary systems, allowing farmers to access the technology with limited financial resources.

Savings on Operating Costs: Targeted irrigation reduces water consumption and the energy required for pumping. Automation and remote management also reduce the need for manual labour.

Optimization of Crop Yields: Improved water distribution based on real-time data, including soil moisture, temperature, and rainfall, can increase crop quality and quantity, with potential benefits in terms of market value. The system can also reduce losses caused by water stress or over-irrigation by helping to prevent unnecessary or delayed irrigation.

Reduced Crop Damage and Recovery Costs: Open-source systems may facilitate access to incentives and funding opportunities under sustainable and digital agriculture programmes. Their compatibility with public procurement procedures and European funding programmes can further support their adoption. The use of readily available and upgradeable components also improves scalability and reduces maintenance, service, and repair costs compared with proprietary solutions.

Technical Feasibility - Proven and Accessible Technologies

- Use of IoT platforms with the LoRaWAN protocol, ideal for agricultural environments thanks to its long range and low power consumption.
- Easily available and customizable open-source components.
- Advanced predictive models.
- Integration of Adaptive Time-Lag Time-Series Linear Forecasting algorithms for irrigation forecasts based on historical and real-time data.
- Sophisticated decision support to optimize irrigation timing and volumes.
- Pilot applications already operational.
- Testing on various crops: corn, poplar, and horticultural crops.
- Validation in national (Italy) and international contexts (e.g., the Caribbean with the REACH project).

These solutions have also been implemented in several projects, including AGRIDIGIT – AGROFILIERE, funded by the Italian Ministry of Agriculture; FAO REACH – Resilient Environment & Agricultural Caribbean Habitats; FAO FVC – Digital Solutions to Improve Horticultural Crop Management in the Caribbean; and Trento PSR – AGRI 4.0: A New Integrated Approach to Optimising Agricultural Resources and Preserving the Environment.

Scalability and Adaptability

Adaptability to the Local Context: The system is designed to be scalable and adaptable to the specific climatic, agronomic, and regulatory conditions of the different partner countries.

End-User Autonomy: Capacity-building activities are included to train farmers in the independent use and maintenance of the system. This promotes operational sustainability and facilitates large-scale deployment.

Modularity and Replicability: The modular architecture allows for the gradual expansion of the system and enables the model to be replicated in new geographical areas and for different crops at relatively low cost.

Environmental Impact and Sustainability: The system contributes to water conservation and is designed to support improved integrated water management in the Mediterranean region. Precision irrigation reduces water waste and promotes the sustainable use of water resources.

Water Efficiency and Reduction of Environmental Impact: Sensors and control units enable irrigation to be applied only when necessary. Lower water and energy consumption compared with traditional irrigation methods contributes to a reduced environmental footprint.

Sustainable Management of Agro-Ecosystems: CREA-IT's activities support agricultural practices aimed at preserving soil health, biodiversity, and rural ecosystems. The use of meteorological and climate data enables more responsible and environmentally sustainable agronomic decision-making.

Preliminary results:

Preliminary results from the technical experiments conducted by CREA-IT demonstrate the feasibility of designing and field-validating low-cost, open-source meteorological units integrated with cloud-based predictive Decision Support Systems (DSS) to optimise crop Water-Use Efficiency (WUE).

The edge hardware is based on open architectures, specifically Arduino Pro Mini microcontrollers and RAK3172 LoRaWAN transceivers integrated into customized PCBs. The units are housed in custom 3D-printed ASA/PETG radiation shields and powered autonomously through photovoltaic panels and battery systems. The sensing system adopts a dual-tier configuration, acquiring real-

time atmospheric measurements, including solar radiation and precipitation through tipping-bucket rain gauges, together with multi-depth subsurface measurements of the crop root zone.

Subsurface monitoring combines Frequency Domain Reflectometry (FDR) capacitive soil moisture probes with Watermark matric potential sensors installed at different depths, ranging from 20 to 90 cm. These sensors enable the assessment of volumetric water content, soil matric potential/tension (bar/kPa), and soil thermal properties.

Field measurements are transmitted through low-power LoRaWAN links to Raspberry Pi gateways and processed through a fully open-source software stack comprising ChirpStack, Node-RED, and advanced time-series and time-lag modelling. The predictive model implemented within the DSS is based on an Adaptive Time-Lag Partial Least Squares (PLS) Regression Model. By incorporating time-lagged historical predictors together with forecast data, the model dynamically predicts root-zone moisture depletion and generates precise, quantitative irrigation recommendations designed to prevent both crop water stress and deep-percolation losses.

The system has been field-validated across diverse agro-ecosystems, including apple orchards, maize fields, poplar plantations, and other crops. Its modular architecture reduces capital expenditure compared with proprietary commercial weather and irrigation stations. In commercial orchard trials, the platform achieved water savings of 197-255 mm/m² and reduced pumping energy consumption by 34,000 - 44,000 kWh over a 77day period, demonstrating its potential to improve climate resilience and reduce agricultural water losses and associated environmental impacts.

PARTNER, PP5: Lebanese University (LU, Lebanon)

The Bekaa region is located approximately 30 kilometers (19 miles) east of Beirut and is characterized by a hot, dry summer climate and a cold, wet winter that often sees snowfall. Mashghara is a large town situated in the Bekaa Governorate, specifically within the Western Bekaa District of Lebanon, approximately 45 kilometers southeast of Beirut.

Fruit production accounts for the largest share of Machghara's agricultural output; apples make up nearly 80% of the total fruit trees, alongside varieties such as grapes, cherries, pears, peaches, and olives, as well as winter field crops like wheat and barley.

Agricultural water management in Lebanon is characterized by increasing water scarcity, a heavy reliance on groundwater and surface water, and a variety of irrigation methods (drip, sprinkler, and

surface irrigation). Stakeholders have confirmed that agricultural systems are moderately to highly vulnerable to water shortages; monitoring and data systems remain fragmented, and access to digital tools and smart irrigation technologies is still limited. Meanwhile, the use of non-conventional water resources is emerging as a viable option, and one well-understood by stakeholders, though large-scale implementation remains limited. Governance and institutional coordination issues remain key systemic and structural challenges.

The target area is located in the Western Bekaa District (Bekaa Governorate), specifically in the Mashghara-Aitanit area, where irrigation water will be supplied through a combination of the Mashghara spring (freshwater) and the Aitanit wastewater treatment plant. The area lies within the Litani River Basin. Climate change is intensifying drought periods and increasing irrigation demand during the growing season.

Soils in the area are predominantly clay–loam, with moderate water retention capacity but increasing risk of salinity and water stress under prolonged drought conditions.

The selected area is highly suitable for the implementation of smart irrigation and non-conventional water solutions due to its water scarcity, existing irrigation pressure, and proximity to treated wastewater resources.

Agricultural production in the target area covers approximately 75 hectares. The dominant crops are: Apple orchards (40 ha), Wheat (35 ha). Current farming practices are characterized by traditional flood irrigation for apple orchards and rainfed cultivation for wheat. Fertilization and irrigation practices are mostly conventional and lack digital monitoring tools or optimized scheduling. Irrigation scheduling is often long and inefficient, negatively affecting crop yield and quality.

Agriculture in the area is dominated by small and medium-scale farms, with limited financial capacity to invest in modern irrigation technologies.

Water tariffs determined and collected payment through an agreement between farmers and municipality.

The three main irrigation challenges at national and local level are:

1. Water scarcity and uneven distribution across regions.

2. Inefficient irrigation practices, including outdated infrastructure and limited adoption of smart irrigation.

3. Weak governance, fragmented institutional coordination, and insufficient technical support for farmers. (National Action Plan**,** Lebanon partner, WISEMED project, 2026).



Figure 36: Experimental site's location - LU.

Experimental Site:

The study will be conducted in the Mashghara Valley, an ideal location for implementing smart irrigation solutions and utilizing non-conventional water sources, due to the area's water scarcity, and its proximity to sources of treated wastewater.

Apple trees grown in the Mashghara Plain frequently suffer from water shortages; therefore, the WISEMED project aims to supply irrigation water by blending treated wastewater with fresh spring water at an appropriate ratio, in compliance with Lebanese national standards (NL819/2024) regarding the agricultural reuse of treated wastewater.

A field assessment was conducted in collaboration with the Mashghara Municipality to gather essential, detailed information, covering technical, agricultural, environmental, and infrastructure aspects, needed to select the pilot area and lay the groundwork for the preliminary engineering assessment, in preparation for the drafting of procurement documents.

The project will also provide water storage tanks and install solar and electric powered pumps to supply the tanks with treated water, in addition to installing a main pipeline to transport water from the wastewater treatment plant for the purpose of blending treated water with conventional water sources; the system will also include an irrigation network for farmers' fields and tanks for fertigation system.

See below the pilot Scheme – Mashghara:

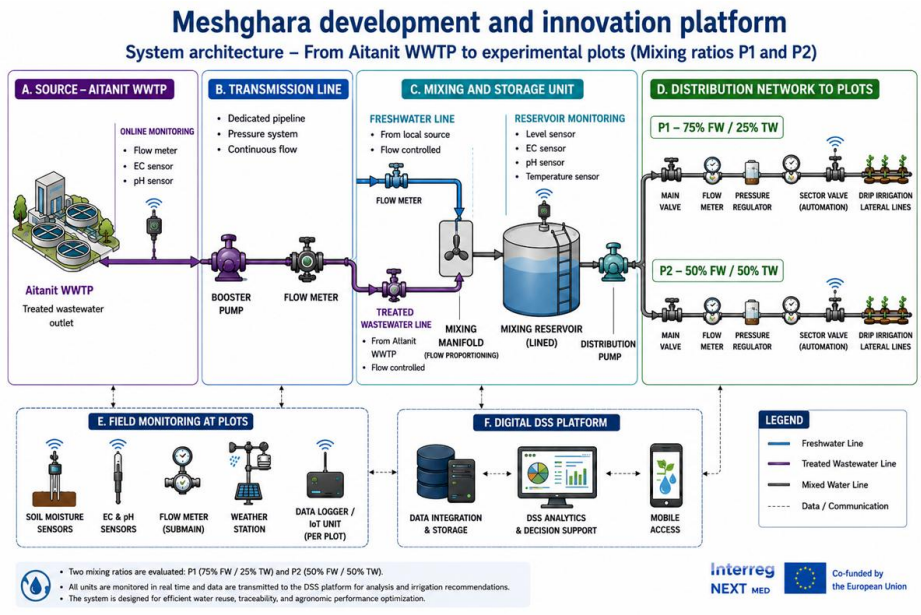


Fig 37: Pilot Scheme – Mashghara.

IV. CONCLUSION AND DISCUSSIONS.

In accordance with Activity 3.1.2 *(Transnational sharing of Draft Action Plans with local co-creation workshops in target areas)*, a total of 179 stakeholders (representing public institutions, the private sector, researchers, and farmers) participated in co-creation workshops. The aim of co-creation workshop was to contribute to drafting each partner's National Action Plan and to identify practical solutions that had previously been proposed during the project design phase.

Preliminary results and conclusions gathered from the pilot actions started in April 2026. They will be further validated during the upcoming phase of experimental trials and are detailed below:

PARTNER, PP1: National Agricultural Research Center (NARC, Jordan)

NARC has identified the solutions, the WUA technical application with 1) Drip Irrigation with low-cost sensors, 2) Subsurface irrigation system, 3) Fertigation system,4) Organic mulching, 6) Digital DSS for irrigation schedule and the NCW technical, innovation technique with Tertiary treatment, sonication system. The two innovative technical solutions - i.e. organic mulching and the tertiary treatment/sonication system for irrigation water quality management - will be implemented at the NARC facility in the Balqa region.

The other capitalization technical solutions will be deployed across 100 farmer-level pilot plots in Balqa (averaging 2 to 4 hectares in size and utilizing diverse agricultural systems that include cash crops such as eggplants and date palms).

NARC is working on completing the procurement procedure and initiating the installation of the acquired technologies across the pilot sites. Activities will include commissioning the Decision Support System, deploying the soil monitoring sensors, installing the ultrasonic water treatment units, and integrating all field equipment into a unified digital monitoring platform.

NARC conducted the field experiment to evaluate whether the addition of small amounts of hydrogel improves the water-holding capacity of the root zone and supports eggplant growth, (Local variety, Baladi), under water-scarce conditions. The experiment compared five application rates against an untreated control group; each 25-meter planting row represented a soil mass estimated at 6,000 kg, based on a row volume of 5 cubic meters and an assumed bulk density of 1,200 kg/m³.

The Early plant assessment revealed a distinct response regarding branching: treatments T1, T2, and T3 produced seven branches per plant, whereas the control plot (untreated) produced four, and

treatments T4 and T5 produced five. Compared to the control group, the rate of branch formation increased by 75% in treatments T1–T3 and by 25% in treatments T4–T5. These results indicate that low and moderate application rates elicited the best vegetative response; however, while the number of branches serves as an indicator of crop vigor and potential fruiting sites, it is not a definitive measure of final crop yield.

Mean soil moisture ranged from 79.1% to 80.7% in the hydrogel-treated groups, compared to 48.4% in the untreated control plot. This difference indicates that the treated soil retained significantly more water during the monitoring period; indeed, these elevated soil moisture levels provide a direct and logical explanation for the increased branching observed in treatments T1, T2, and T3. While the measurements demonstrate improved moisture retention, determining the final percentage of irrigation water savings still requires knowledge of the actual volume of water used for each treatment.

NARC will continue to review and evaluate the use of hydrogel through periodic field visits. This aims to complete the analysis and interpretation of all data, determine crop response to the polymer, monitor soil moisture content, and calculate irrigation water savings and crop productivity. Subsequently, the hydrogel polymer will be applied to another experimental plot to validate the previously observed results.

At the same time, NARC will intensify stakeholder engagement activities through the "Jordanian Living Lab," facilitating knowledge exchange among farmers, researchers, policymakers, and water management experts to support the broader adoption of innovative solutions aimed at optimizing water consumption.

PARTNER, PP2: National Research Institute of Rural Engineering Water & Forests (INRGREF, Tunisia)

Technical solutions have been identified, incorporating lessons learned, utilizing drip irrigation systems equipped with low-cost sensors, and adopting innovative solutions:

Water-mixing solution: This solution involves mixing brackish well water with high-quality surface water from the Lebnah Dam. Different mixing ratios will be evaluated to identify the optimal mixture that ensures efficient water use while maintaining suitable salinity levels for crop production. This solution is combined with the use of salt-tolerant tomato varieties, namely Severa, Firenze, Rio Grande, and Saada.

A water-mixing trial will be conducted under controlled conditions at the Oued Souhil Research Station. The experiment involves monitoring soil salinity (ECe), soil moisture, irrigation water salinity (ECw), and vegetative growth stages throughout the crop cycle. A second water-mixing experiment is scheduled for mid-October 2026 to build on the findings of the first experiment and further evaluate the performance of the different mixing ratios.

Salt-tolerant crop solution: Following the selection of the participating farmers, the second solution, involving the cultivation of salt-tolerant crops, will be implemented on a 0.5-hectare plot belonging to one of the farmers in the Lebnah Dam irrigation district.

The salt-tolerant crop trial at the Korba site was conducted under actual farm-field conditions. The field trial has been completed, and all collected samples are currently undergoing laboratory analysis, to be followed by statistical analysis to support data interpretation and assess the effects of the various treatments. A second trial concerning salt-tolerant crops is scheduled for mid-October 2026 under controlled field conditions at the Oued Souhil Station, affiliated with the National Research Institute of Rural Engineering, Water and Forests (INRGREF), with the aim of reinforcing and validating the results of the first trial.

PARTNER, PP3: Agencia Estatal Consejo Superior de Investigaciones Cientificas (CEBAS-CSIC, Spain)

The CEBAS-CSIC centre has identified technical solutions, specifically soil mulching and fertigation, as scalable options suitable for widespread implementation. Additionally, it has developed a Decision Support System (DSS) that facilitates the use of water blends in regions facing severe water scarcity. The system integrates field data, predictive models, and artificial intelligence and machine learning technologies to manage the mixing of different water sources, such as treated and desalinated water.

Furthermore, CEBAS-CSIC has identified five key agricultural areas in the region, featuring experimental farms and commercial holdings that serve as model farms for the WISEMED project. These areas encompass a wide range of crops, climatic conditions, and farming systems. The key agricultural areas are as follows:

Area 1: Altiplano – Stone fruits (Jumilla/Yecla);

Area 2: Huerta de Murcia – Citrus, fruit crops, and greenhouse production (Santomera);

Area 3: Bajo Guadalentín – Citrus, particularly lemons and mandarins;

Area 4: Campo de Cartagena – Vegetables, citrus, stone fruits, and greenhouse production;

Area 5: Alto Guadalentín – Vegetables and table grapes.

CEBAS-CSIC has established eighteen experimental farms or plots across these five areas to test solutions proposed under the National Action Plan, including fertigation systems, organic soil mulching, and a prototype for blending conventional and non-conventional water sources. Treatments have already been implemented on eight farms, while implementation on the remaining farms is scheduled to begin in the coming months, subject to climatic conditions.

The results from eight pilot farms using fertigation and organic mulching solutions are currently being analysed, and implementation of these solutions across the remaining farms is scheduled to begin between late September and October. Concurrently, the water-blending process, incorporating reclaimed water, desalinated water, and other water sources according to the prototype model developed for this purpose, will commence in late September.

PARTNER, PP4: Consiglio per la Ricerca in Agricoltura e l'Analisi dell' Economia Agraria (CREA, Italy)

CREA-IT has identified the following technical solution: a Digital Decision Support System (DSS) for irrigation scheduling, based on an Open-Source Low-Cost Device Coupled with an Adaptive Time-Lag Time-Series Linear Forecasting Model. The solution consists of an open-source soil-moisture LoRa (Long Range) device and an analytical system for processing data collected and updated directly in the field, including data from weather stations and ground sensors. The system has already been tested on apple orchards in Trentino, Italy.

The pilot action focuses on the testing, calibration, and validation of the open-source irrigation Decision Support System (DSS) under controlled experimental conditions. The primary objective is to ensure its robustness, scalability, and replicability at farm level. The system:

a) measures soil moisture/tension at multiple depths;

b) integrates real-time and three-day weather forecast data;

c) calculates optimal irrigation volumes (mm or m^3/ha); and

d) generates irrigation bulletins for farmers.

The target area is located in the coastal plain of the Lazio Region, specifically at the CREA experimental farm in Monterotondo. The pilot action in Italy is currently being implemented at the CREA experimental site and, at this stage, does not involve individual farms as direct end-users.

Preliminary results from the technical experiments conducted by CREA-IT demonstrate the feasibility of designing and field-validating low-cost, open-source meteorological units integrated with cloud-based predictive Decision Support Systems (DSS) to optimise crop Water-Use Efficiency (WUE).

The edge hardware relies on open architectures, specifically Arduino Pro Mini microcontrollers and RAK3172 LoRaWAN transceivers integrated into customised PCBs, housed within custom 3D-printed ASA/PETG radiation shields and powered autonomously by photovoltaic panels and battery systems. The unit deploys a dual-tier sensing payload that acquires real-time atmospheric measurements, including solar radiation and precipitation via tipping-bucket rain gauges, alongside multi-depth subsurface root-zone soil data.

Subsurface monitoring combines Frequency Domain Reflectometry (FDR) capacitive soil moisture probes with Watermark matric potential sensors across depth profiles ranging from 20 to 90 cm to evaluate volumetric water content, soil matric tension (bar/kPa), and thermal inertia.

Field measurements are transmitted via low-power LoRaWAN links to Raspberry Pi gateways and routed through a fully open-source software stack comprising ChirpStack, Node-RED, and advanced time-series and time-lag modelling. The model in the DSS is based on an Adaptive Time-Lag Partial Least Squares (PLS) Regression Model. By incorporating time-lagged historical predictors alongside forecast data, the model dynamically predicts root-zone moisture depletion and generates precise, quantitative irrigation bulletins designed to prevent both crop water stress and deep-percolation losses.

The system has been field-validated across diverse agro-ecosystems, including apple orchards, corn fields, poplar plantations, and other crops. This modular system reduces capital expenditure compared with proprietary commercial stations. In commercial orchard trials, the platform achieved water savings of 197-255 mm/m² and reduced pumping energy consumption by 34,000–44,000 kWh over a 77- day period, demonstrating its effectiveness in enhancing climate resilience and mitigating agricultural runoff.

PARTNER, PP5: Lebanese University (LU, Lebanon)

LU has identified solutions based on existing expertise and practices, specifically drip irrigation with sensors (WUE1), fertigation with NPK sensors (WUE3), mixing conventional and non-

conventional water (NCW1), and advanced water mixing with DSS (NCW2). The innovative technical solution identified is the Digital DSS for irrigation scheduling (WUE6).

The selected solution combines smart irrigation technologies, digital decision-support tools, and the safe integration of non-conventional water resources. The approach aims to improve irrigation efficiency, optimize fertilizer use, increase water availability, and support climate-resilient agricultural practices.

A field assessment was conducted in collaboration with the Mashghara Municipality to gather essential and detailed information covering technical, agricultural, environmental, and infrastructure aspects. The assessment was needed to select the pilot area and lay the groundwork for the preliminary engineering assessment, in preparation for the drafting of procurement documents.

REFERENCES

1- L.V.Noto et al; Climate Change in the Mediterranean Basin (Part II): A Review of Challenges and Uncertainties in Climate Change Modeling and Impact Analyses, Management: An International Journal, Published for the European Water Resources Association (EWRA), Springer; European Water Resources Association (EWRA), vol. 37(6), pages 2307-2323, 2023.

2- Water use in Agriculture; The role of Green, Blue, and Grey Water, Tunley Environmental, 2025.

3- Guiseppe; Reclaimed Water to Face Agricultural Water Scarcity in the Mediterranean area: An Overview Using Sustainable Development Goals Preliminary Data, Advanced in Chemical Pollution, Environmental Management and Protection, V5, pp113-143.2020.

4- Union for the Mediterranean Water, Environment & Blue Economy, Water Regional Strategies of World Water Day, 2026

5- Y.Al-Husban et al; Urban expansion and shrinkage of vegetation cover in Al-Balqa Governorate, the Hashemite Kingdom of Jordan, Environmental Earth Science, 2019.

6- World Bank – ministry of Water and Irrigation of Jordan; Jordan Country Environmental Analysis: Water Security and Agricultural Resilience Diagnostic" (incorporating data frameworks from the World Bank and the Jordan Valley Authority's Water Sector Capital Investment Plan, 2023.

7- INRGREF; From wastewater treatment plants to Oued Souhil agricultural experimentation unit: A study of treated wastewater quality reused for irrigation, Tunisia, 2016.

8- S. Sabbah; From wastewater treatment plants to Oued Souhil agricultural experimentation unit: A study of treated wastewater quality reused for irrigation, Tunisia; Desalination and Water Treatment Journal, 2025.

9- J. Faby et al; Use of groundwater and reclaimed water for agricultural irrigation in Tunisia: Farmers' practices, behavior, and awareness of related risks; Chemosphere, 2022.

ANNEXES

1- Annex 1: National Action Plan template.
2- Annex 2: Annex A, List of WISEMED solutions.
3- Annex 3: Annex 1, Technical Report: monitoring indicators, structure and frequency report mission.