



HortiMED Towards circular horticulture Closing the loop on Mediterranean greenhouses



WHY HORTIMED?

Irrigation demands in the Mediterranean region are projected to increase between 4 and 18% by the end of the century due to climate change alone; while population growth and increased demand, may escalate these numbers to 22-74%.

Food products, crop and fish yields are projected to decline in many Mediterranean areas due to climatic and other stress factors.

Urgent need for technological updating of greenhouse industry to

- face the increasing competition arising from globalisation
- minimize the environmental impacts (e.g. discharge of nutrients and growing eutrophication trends, intensive water use, excessive pesticide use...)

Optimal greenhouse management is required to ensure unrestricted growth at a yield close to the maximum potential, while minimizing unsustainable exploitation of resources, especially energy, soil & water.

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WHO IS BEHIND HORTIMED?



Overall objective

HortiMED aims to provide the Mediterranean farming community with **innovative tools to enable resource efficient year-round greenhouse** cultivation by harnessing the potential of both simple & advanced technologies for smart nutrient, irrigation & climate control, and Integrated Pest Management (IPM) taking into account their feasibility and cost-effectiveness at individual greenhouse level.

Specific objectives

SO1- To develop and test a user-friendly and flexible **Decision Support System (DSS)** allowing smart nutrient, irrigation & climate control, and integrated pest management in greenhouses through: (1) Expert advisory services to help farmers in intensive knowledge tasks where climatic, crop and nutrient variables decisively influence crop growth and productivity; and (2) efficient and cost-effective partial or full automation of greenhouses

SO2- To demonstrate the potential of biological agro-ecological technologies to close the loop in Mediterranean greenhouses by validating **aquaponics systems based on the combination of IMTA and hydroponics** to deliver high quality Mediterranean horticultural and fish products with improved WUE and NUE.

SO3- To provide farmers with tools for **environmentally friendly integrated pest management** by testing bio-based pest management tactics for effective pest control in horticultural greenhouses.

SO4- To validate HortiMED technologies in **low, medium and high technology greenhouses** from Egypt, Algeria and Spain

SO5- To achieve well-targeted communication and effective transfer of the project results to stakeholders **to successfully embed the HortiMED results into local horticultural community systems.**



HORTIMED CASE STUDIES

	CS1-Egypt	CS2-Algeria	CS3-Spain
Technology level	Low Technology Greenhouse (LTG)	Medium Technology Greenhouse (MTG)	High Technology Greenhouse (HTG)
Conditions	Desert area	Oasis climate	Atlantic climate
Objective	Test HortiMED DSS under IMTA-NFT and IMTA-FRS systems	Test HortiMED DSS with bio-based pest management strategies	Test HortiMED DSS with a focus on AI for enhanced automation
Crops	Broccoli, tomato, pepper, lettuce	Tomato and pepper	Tomato
Aquatic species	Tilapia, mullet spp., freshwater prawn and freshwater clams	Tilapia	NA



EXPECTED IMPACTS



IMPROVED RESOURCE EFFICIENCY AND INCREASED CIRCULARITY

- Water Use Efficiency (WUE) (m³/m²/kg) improved by 15%
- Nutrient Use Efficiency (NUE)(kg of fertilizer/m²/kg) improved by 10%
- Energy Use Efficiency (EUE) (Kwh/m²/kg) improved by 10%
- Reduction of chemical pesticides use by 5%
- Feed Conversion Ratio (FCR) improved by 10% in IMTA system
- Net aquatic species biomass production in IMTA increased by 15%



REDUCTION OF ENVIRONMENTAL IMPACTS

- Reduced pollution from nutrient leaching thanks to precise fertiliser applications
- Minimized GHG thanks to optimized fertiliser applications and minimised energy use
- Reduction of chemical pesticides residues in food, soil & water



INNOVATIONS ENABLING SUSTAINABLE AND EFFICIENT AGRICULTURE AND FOOD SYSTEMS

- Automatic control system for the management of aquaponics and hydroponics
- AI-based software platform for smart monitoring of greenhouses
- IMTA aquaponics for water and nutrient efficient fish and crop production
- Hybrid modelling for smart greenhouse control



ACCESS TO NOVEL TOOLS

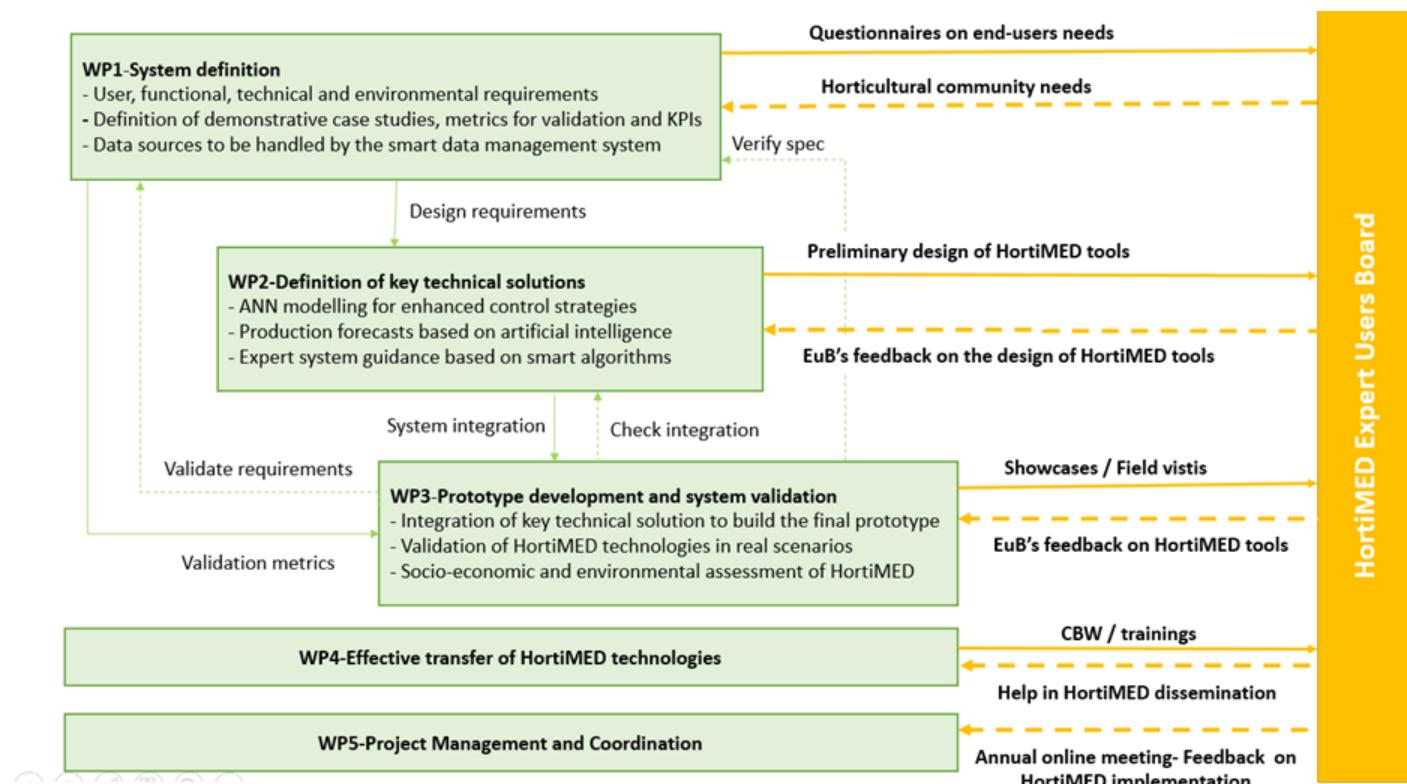
- User friendly and easy to integrate DSS for greenhouse production

INCREASED COMPETITIVENESS

- Reduction of production costs by 5% thanks to improved WUE, NUE and EUE

HortiMED Expert users Board

The **HortiMED Expert users Board (EuB)** was officially launched in May 2020. It is an external board comprised by 30 members from 11 different Mediterranean countries and embracing diverse type of stakeholders such as farmers associations, universities and research institutes, private producers, greenhouse technology providers, etc. HortiMED EuB's main purpose is to serve as an external source of information and guidance for the HortiMED Project.



Understanding end-users needs

A series of questionnaires, specifically designed for each target group of end-users, was developed and distributed among HortiMED EuB members and other relevant stakeholders in order to obtain their feedback for the design of HortiMED tools and to identify their main needs and requirements.

These surveys have allowed HortiMED consortium to:

- get insights into the **current agricultural practices in the Mediterranean area** in relation to protected horticulture and aquaponic systems,
- to detect **major constraints** that hamper the application of resource efficient practices and environmentally friendly pest management strategies among Mediterranean farming actors, and
- to identify and rank **end-users preferences in relation to HortiMED DSS**.

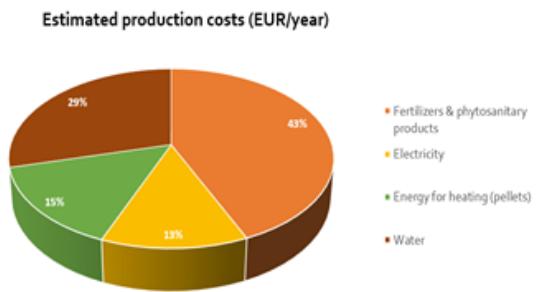
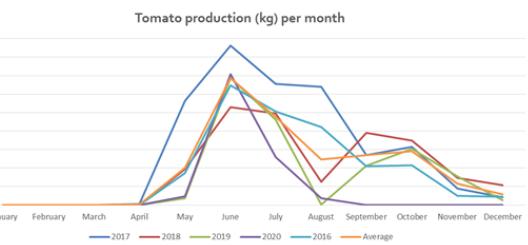
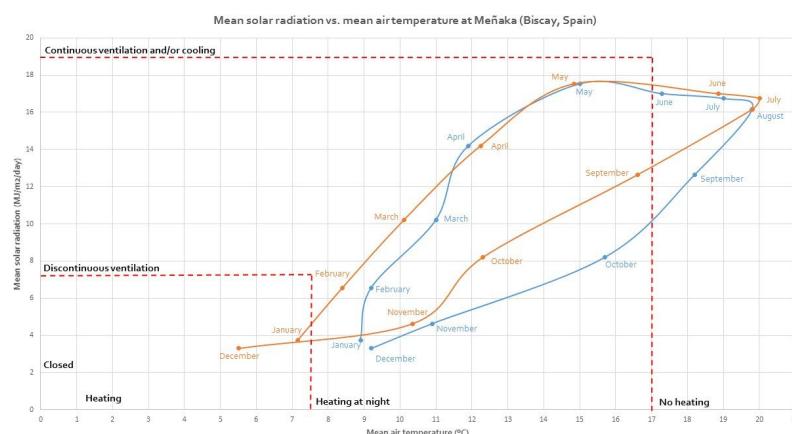
Listening to the voice
of HortiMED end-users

Analysis of demonstrative greenhouses

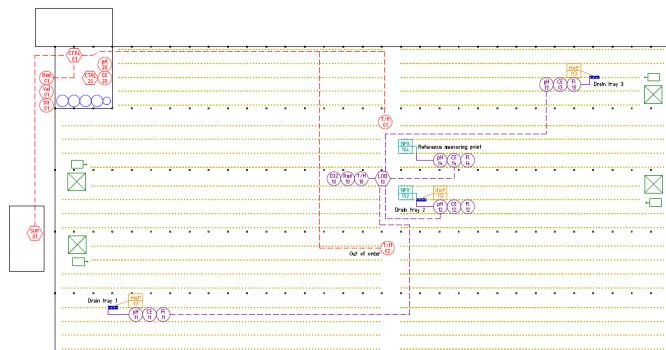
HortiMED has accomplished the design and planning of the three demonstrative Case Studies, as well as the definition of the Key Performance Indicators (KPIs) and metrics for validation, including the establishment of the methodology for collecting the required data (definition of the frequency and registration procedures based on the defined KPIs) and the collection of the baseline data for each scenario.

HortiMED has identified the **data sources to be handled by the HortiMED data management system**, including local repositories (e.g. governmental agencies, meteorological stations...) and available data sources at each demonstrative greenhouse, considering both **digital** (e.g. climate, crop, soil sensors deployed in the greenhouses, outside weather stations, etc.) **and non-digital data sources**. The greenhouse non-digital data sources considered comprise visual inspection data, results of experimental campaigns and historic records of previous crop seasons, such as greenhouse productivity per hectare, final product quality, pest outbreaks and associated crop damages, water, energy and nutrient consumption, etc. The data sources will be used to fuel the Artificial Intelligence (AI) algorithms of the Decision Support System (DSS) that will be developed and tested in the framework of the project.

HortiMED has also addressed the **characterisation of the demonstrative greenhouses to analyse the features controlling resource consumption** (i.e. water, energy, nutrients & agrochemicals) **and climate-fertigation-crop interactions**.



HortiMED has **deployed additional sensors** in the demonstrative greenhouses **for the automatic monitoring of relevant greenhouse climate and water quality parameters**.

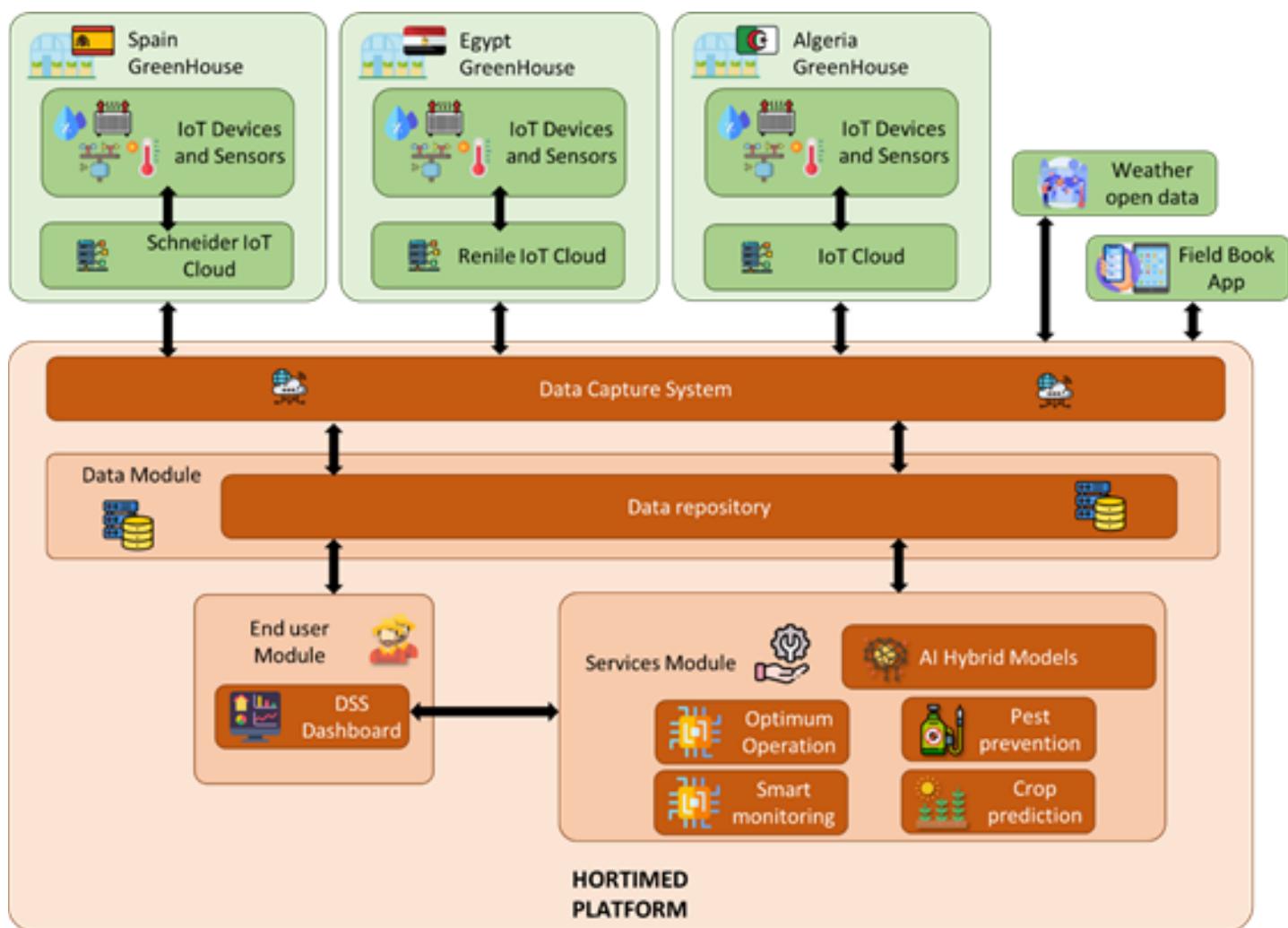


Unleashing the power of greenhouse data



HortiMED DSS will handle a **wide range of heterogeneous data** and will apply artificial intelligence techniques to continuously **learn from historical databases** to forecast production yields and expected greenhouse conditions, allowing developing enhanced adaptive smart algorithms for climate, irrigation and nutrient control and automation.

HortiMED Architecture



HortiMED FieldBook App developed

The image displays the HortiMED FieldBook application's user interface. It features three cards comparing greenhouse operations across different regions:

- Qalyubia governorate, Egypt:** All operations and monitoring activities are conducted manually (LTG).
- Basque Country, Spain:** Several of the systems are fully automated (shading, ventilation, heating and fertigation) (HTG).
- Biskra, Algeria:** Some of the greenhouse systems are partially automated (cooling, ventilation, shading) (MTG).

To the right, a hand holds a smartphone displaying a specific data capture screen within the app. The screen shows fields for "Type of insect" (Bemisia tabaci (fusca)), "Variety of vegetable" (Tomato), and "Measurement date" (17/06/2021). It includes a table for "Plague management" with columns for Leaf 1 through Leaf 6, each with "Number of insects" and "Number of Insects". A green "SAVE" button is at the bottom.

HortiMED has enabled semi-automated mechanisms to record the available greenhouse information, which will be especially useful for greenhouse with low technological level where most of the data are manually collected.

HortiMED FieldBook is a **web and mobile application that facilitates the integration and digitization of manually collected data** (e.g. visual inspection data, measurements of portable sensors, results of laboratory analysis, etc.)

HortiMED FieldBook App integrates an **Optical Character Recognition system**, allowing the **digitization of handwritten historical information**.

First Project Workshop held

The first workshop of HortiMED Project was on December 2020. **The workshop was attended by 173 persons**, 110 participants remotely connected by means of Zoom, and 63 attendees at the headquarters of the Institute's Branch of Inland Water and Fish Farms (Egypt).



WHO IS BEHIND?

PARTNERSHIP FOR RESEARCH AND INNOVATION IN THE MEDITERRANEAN



PRIMA
PARTNERSHIP FOR RESEARCH AND INNOVATION
IN THE MEDITERRANEAN AREA



PRIMA is the most ambitious joint programme to be undertaken in the frame of Euro-Mediterranean cooperation.

By funding R&I through competitive calls, PRIMA aims to: "build research and innovation capacities and to develop knowledge and common innovative solutions for agro-food systems, to make them sustainable, and for integrated water provision and management in the Mediterranean area, to make those systems and that provision and management more climate resilient, efficient, cost-effective and environmentally and socially sustainable, and to contribute to solving water scarcity, food security, nutrition, health, well-being and migration problems upstream".

PRIMA also aims at to contribute to United Nations' Agenda 2030 through the achievement of the **Sustainable Development Goals (SDGs)**.

The PRIMA Programme is supported under Horizon 2020 the European Union's Framework Programme for Research and Innovation.

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Stay tuned!

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