Funded by
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المركز الوطني للبحوث الزراعية
National Agricultural Research Center

Water-efficient Innovative Solutions Portfolio for Enhancing Resilience (WISPER)

ENI/2020/417 630

Implemented by Istituto per la Cooperazione Universitaria (ICU) - ITALY
in partnership with
National Agricultural Research Center (NARC) - JORDAN
and
Institut National des Recherches en Génie Rural, Eaux et Forêts (INRGREF) - TUNISIA

OVERALL

Countries involved: **Tunisia and Jordan**

WISPER project works to introduce modern and innovative technologies in the partner countries. These technologies are known to be scarce in partner countries and to contribute to raising the water use efficiency to the optimum level.

Project seeks to introduce modern technologies that save water, while at the same time making sure to introduce low cost technologies to achieve the possibility of acceptance and application by farmers.

OBJECTIVES

GO: To contribute to the promotion of **efficient use of water in rural areas** in Tunisia and Jordan in order to adapt and enhance resilience to water related impacts of climate change.

SO: **Improved technical and institutional context that supports the adoption and scaling-up of innovative solutions** leading to efficient use of water in agricultural irrigation in Nabeul Governorate in Tunisia and in Balqa, Karak, Mafraq and Jerash Governorates in Jordan.

WIDER PROGRAM

WISPER is part of a wider program leaded by ICU in Jordan, Tunisia, Lebanon, Syria and southern Italy (EVE, PRESTo, PROSIM) and financed by various donors: EU, Italian Cooperation Agency and other public bodies and private foundations.

EXPECTED RESULTS

Identified, tested and showcased a portfolio of water-efficient innovative solutions at different maturity stages, that have the potential to be scaled up.

Improved institutional context to facilitate the local upscale of the innovative solutions of the portfolio.

JORDAN

1. TWW Systems
2. Soilless-system prototypes & Fertilizer injector for an existing hydroponic system
3. Water-retention polymer
4. Sub-surface tape irrigation system
5. Water boxes
6. Use of brine (desalination-by-product)
7. Automated irrigation systems/PV systems

JORDAN – TWW systems

PROS: Decentralized TWW systems using innovative low-cost prototype made from local materials with green energy (PV system).
The system reduces the cost of pumping from the septic tank thus reducing the environmental hazard of groundwater contamination and giving an option for agricultural water reuse (at least 80-90% of the produced WW could be used for agriculture).

CONS: At HH level, not more than 1 m^3 treated water per day (low cost/benefices ratio).
Not applicable on large scale.

JORDAN - Soilless-system prototypes & Fertilizer injector for an existing hydroponic system

PROS: Simple and “low cost” soilless system prototypes to make this innovation accessible.
3 ways of cultivation: water, volcanic soil and coconut fiber.
Save 30/60% water comparing with traditional cultivations.

“Low cost” hydroponic greenhouse prototype

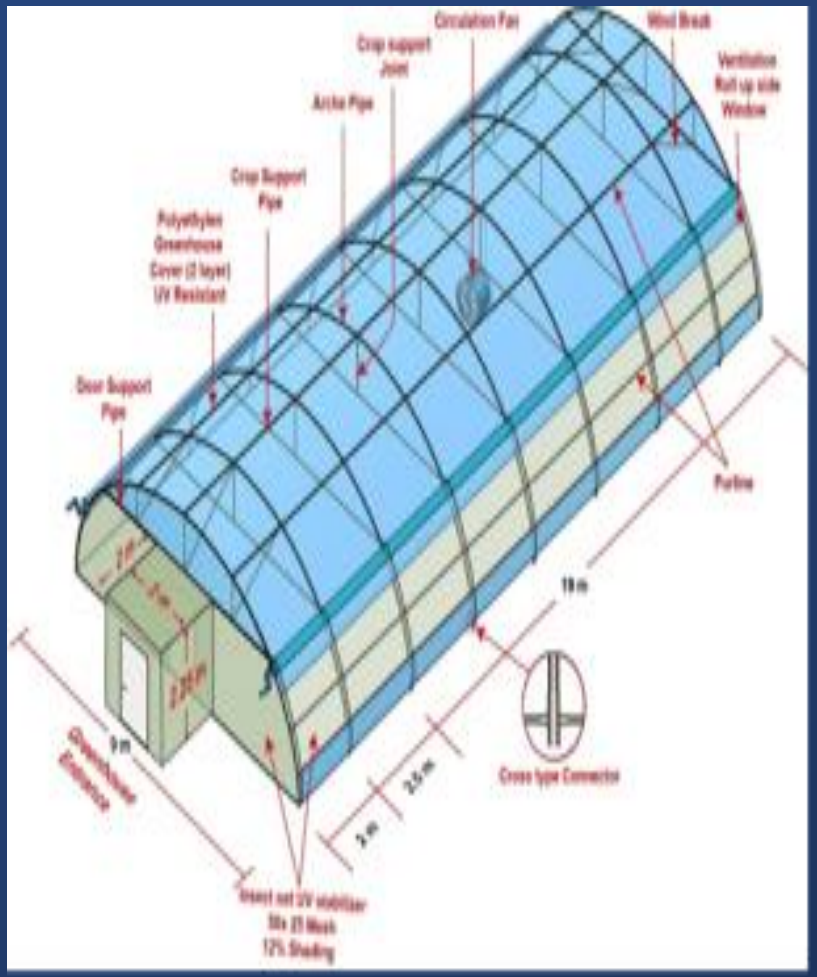


Figure 1. Layout and design of single greenhouse (Structure and Covers)

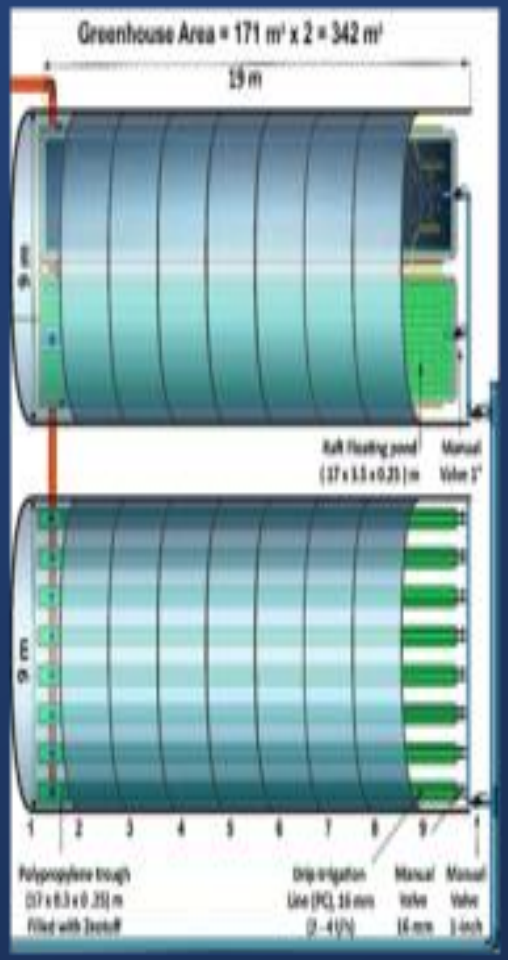
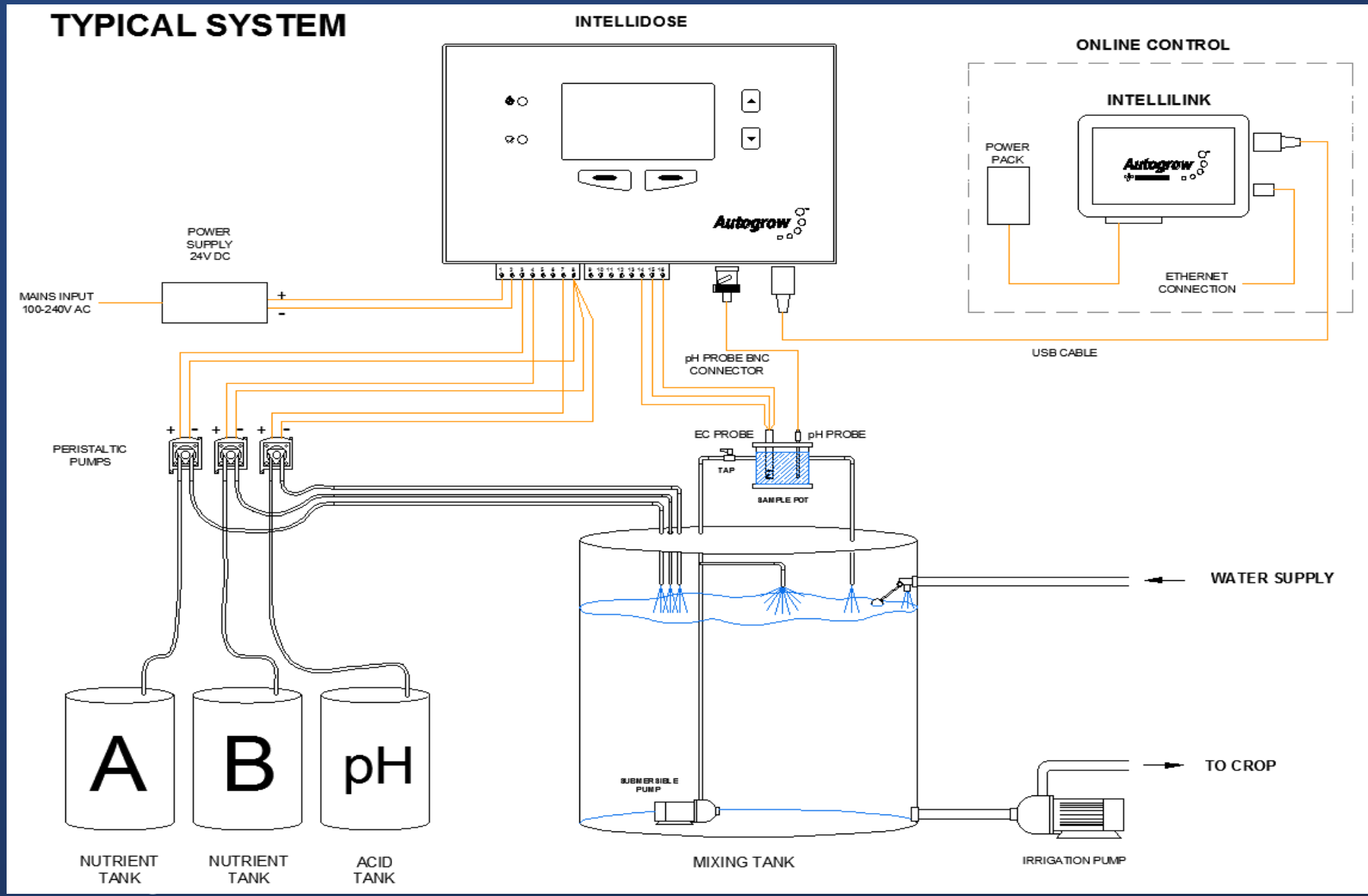


Figure 2. Design and Layout of low cost prototype hydroponic Greenhouse

Figure 3. Fertilizer Dosing unite Design and layout

Fertilizer-injector



JORDAN - Water-retention polymer

PROS: Innovative polymer (pollution free and 100% biodegradable). The polymer may retain water for 4 to 6 weeks, tested in an open field of 1 dun and 240 m^2 greenhouse. **About 20%** water saving in open field, **about 30%** in greenhouse

CONS: Biodegradability level still under verification.

JORDAN - Sub-surface tape irrigation system

PROS: Sub-surface drip irrigation tape system on 1 dunum open field in NARC Deiralla Research Center thus decreasing the evaporation losses of water. **About 30%** water saving.

JORDAN – water boxes

3 different cultivations (20-30 trees each) at different sites: ziziphus in Karamah, almond trees in Salt and olive trees in Karak.

CONS: Bad quality of boxes (mold) provided by Jordan Ministry of Agriculture (Chinese technology).

Water boxes (cocoon)

Cocoon technology

What is a cocoon?

A sustainable innovative solution to support tree growth and survival.

A cocoon consists of three parts a water reservoir, lid, and a protective tree shelter

Why Use cocoons?

- Low cost tree planting
- Little irrigation required
- High water storage capacity (~25 liters)
- High survival rate of seedlings (75-95%)
- Supports critical first year of plant growth
- Is 100% biodegradable

Benefits to the land

- Erosion control
- Restoration of topsoil (soil conservation)
- Cocoons serve as micro-water catchments
- Increase in soil water retention and infiltration
- Increase in biodiversity value
- Economically and ecologically sustainable

Product Data Sheet

LAND LIFE COMPANY

Land Life Company
Mauritskade 63
1092 AD, Amsterdam
The Netherlands
Phone: +31 (0)20 261 4875

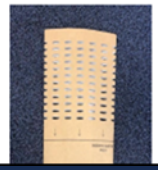
Product information

A Cocoon unit includes:	1 Moulded fibre reservoir 1 Moulded fibre lid 1 Tree shelter
HS Code	4823 7090

Product	Materials/Ingredients
Moulded fibre Reservoir Moulded fibre Reservoir	Pulp - recycled paper/carton Height: 20 cm; Diameter: 50 cm

Moulded fibre Lid Moulded fibre Lid	Pulp - recycled paper/carton Height: 2 cm; Diameter: 51 cm

Tree shelter	Kraft Line (biodegradable) (FDA approved)
Tree shelter	Height: 40cm; Diameter: 12 cm



JORDAN - Use of brine (desalination-by-product)

Experiment launched at Al-Karamah Research Station (reverse osmosis desalinization plant with capacity of 5 m³/day).
Rejected brine can be used for aquaculture, to cultivate spirulina and to irrigate forage shrubs and crops.

RESULT: The system was installed in September 2023.

TUNISIA

1. 20 improved PV systems for pumping water from private wells with salinity rate between 1,5 and 3 g/L in 4 GDA
2. 3 agrometeorological stations and sensors
3. Technology to measure and map the variability of soil salinity: CMD mini explorer
4. Experimental greenhouse for recovering rainwater and evapo-transpirated water
5. PV station (100 kW) for pumping treated waste water in SE4 station
6. Experimental study on use of br^{2}ine (desalination-by-product).
7. Experimental study to test different water mixes for irrigation and aquaculture.

TUNISIA – 20 improved PV systems for private wells

PROS: Reduces the cost of pumping from the wells by reducing the use of fossil energy thus reducing the environmental hazard and increase farmer incomes.

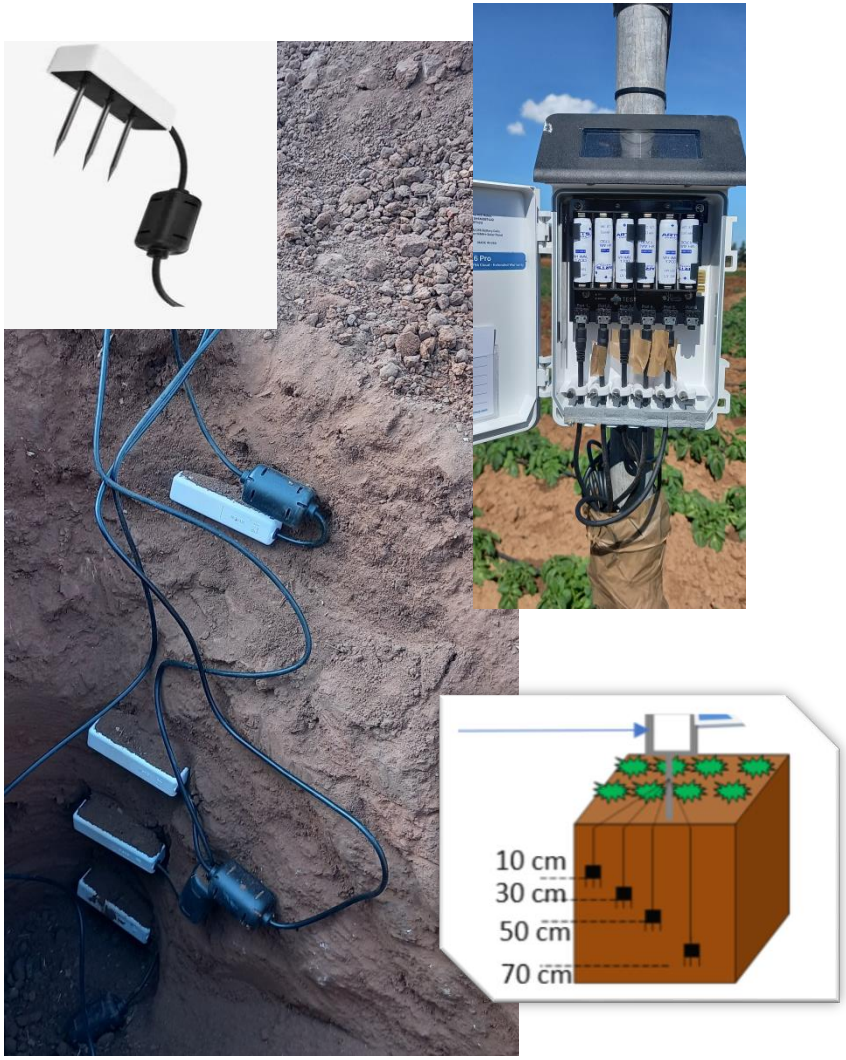
CONS: Risk of increase of groundwater salinity due to sea water intrusion.

TUNISIA - 3 agrometeorological stations and sensors

PROS: Agro-meteorological stations measure meteorological data such as temperature, rain, air humidity and are equipped with special sensors such as those for leaf wetness. All data collected by the agro-meteorological stations allow estimation of crop evapotranspiration for an accuracy estimation of crop water irrigation requirement.

Soil tillage

TUNISIA - 3 agrometeorological stations and sensors

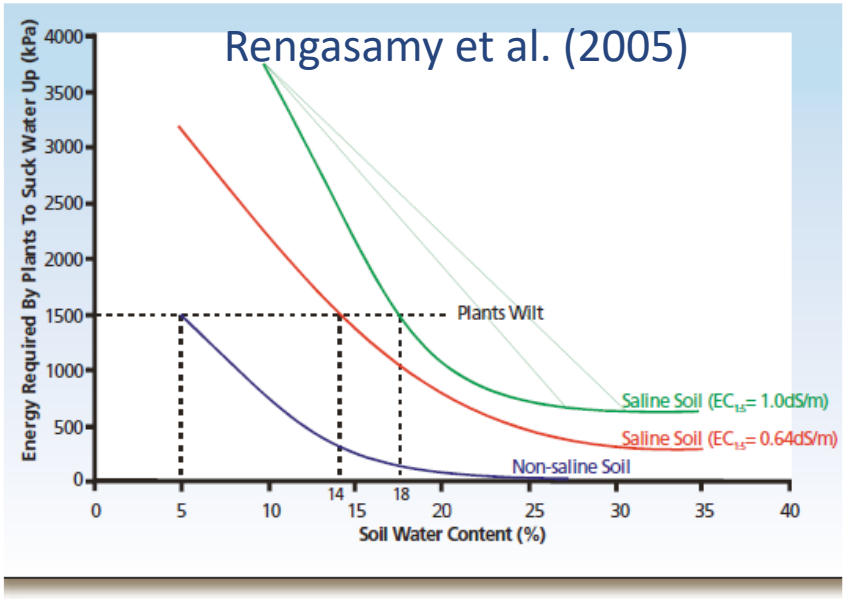


PROS: Low cost soil sensors installed at different depths in the root zone for real time measurement of Soil water content (θ) and soil salinity (ECp) to improve the irrigation scheduling (volume, frequency) according to soil properties (soil water retention capacities: θfc_ θwp) , crop water requirement and leaching fraction (to avoid soil salinization in the root zone).

All data collected: agro-meteorological stations, soil sensors and lab. water and soil properties were used in smart irrigation to improve water efficiency and productivity as well as to avoid the soil fertility degradation (soil salinization).

TUNISIA – Spatial scale: technology to measure and map (2D, 3D) the **soil salinity**: CMD mini explorer

The measurement of soil salinity is crucial because salinity impacts the nutritional balance of plants and make more difficult for the plant to extract water and thus grow healthy.



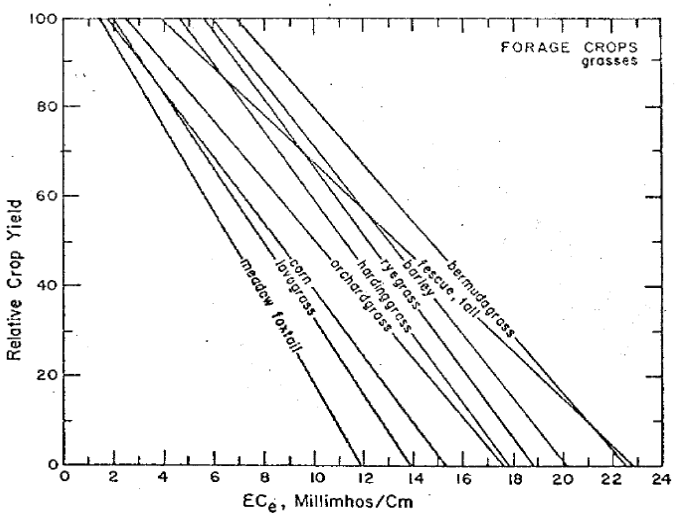
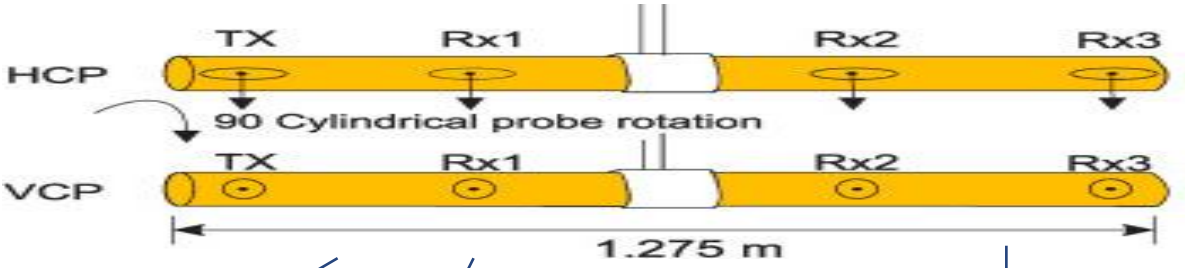


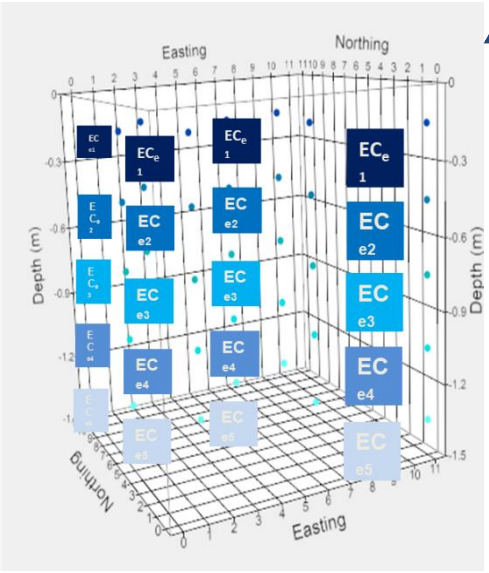
Figure 4: Salt Tolerance of Forage Crops - Grasses

Spatial scale: portable solution provided by the project measures soil salinity at different soil depths (CMD Mini explorer).

CMD mini explorer: soil salinity assessments



ECa



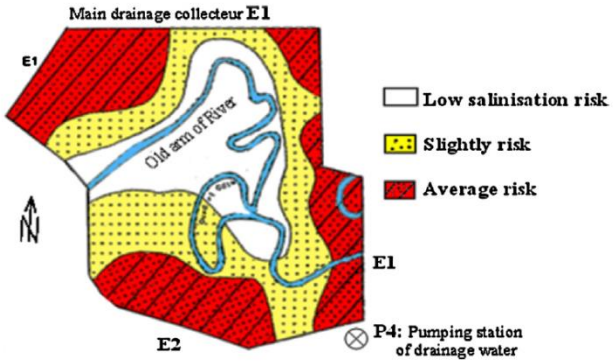
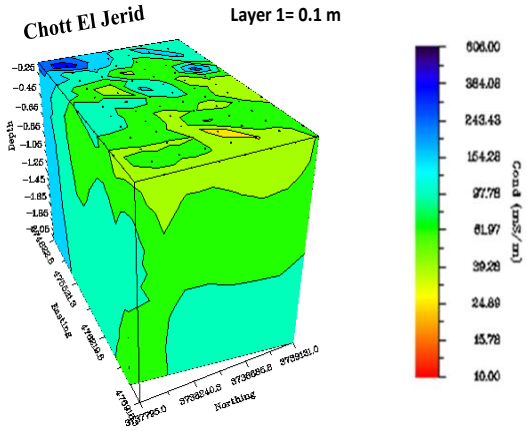


Fig. 5. Soil salinization risk unit (SRU).

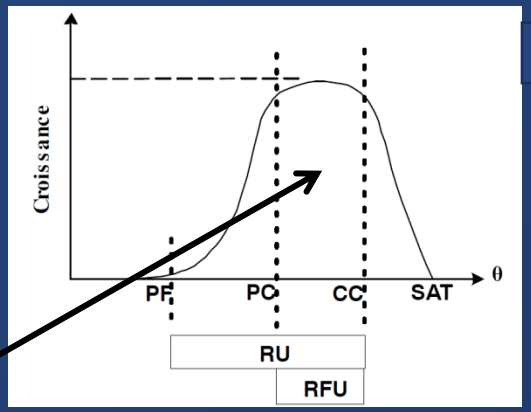
Kalaat Landalous (Bouksila et al., 2013)



Fatnassa Oasis_Kébili (Farzamian et al., 2023)

PENDING RESULT: CMD was delivered in September 2023

CC: Field capacity
PF: Permanent wilting point
PO: temporal wilting point
RU: Available water capacity
RFU: Easy available water



ET_0

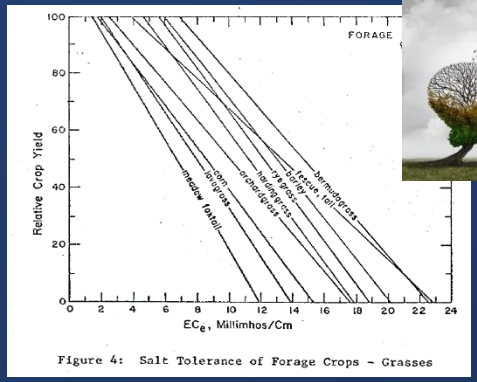
Crop water requirement

+

θ

ECp

+



Leaching fraction

Total irrigation water need

Dielectric methods:
Real time measurements

+

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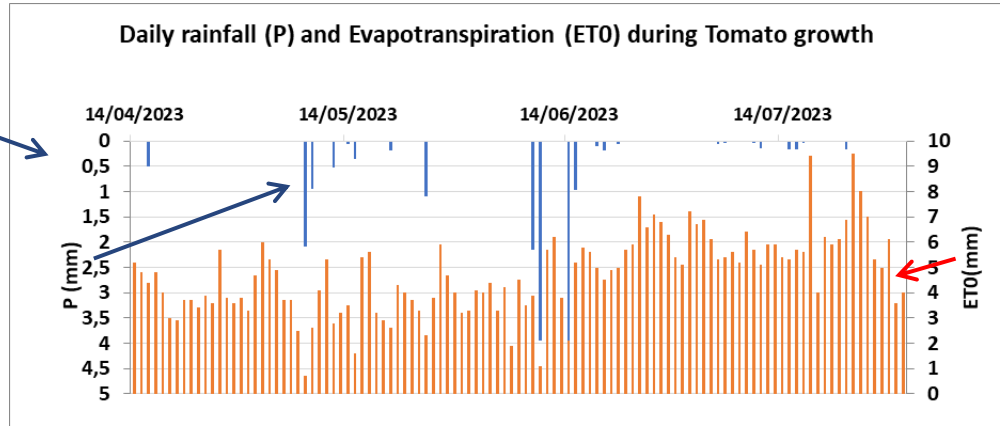
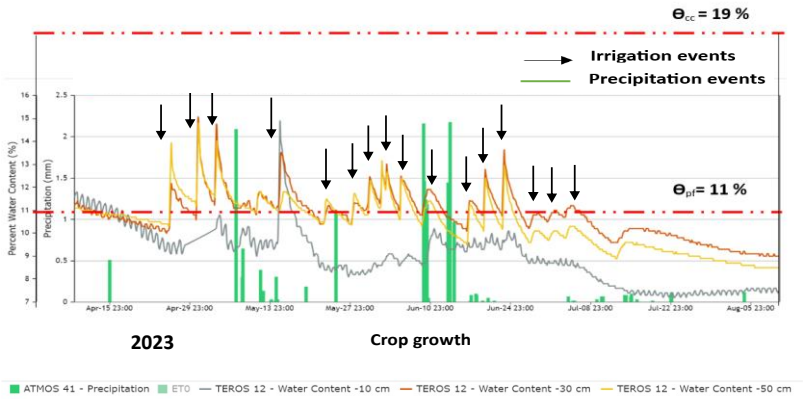
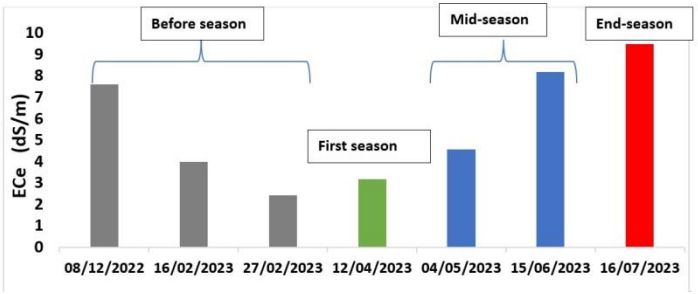


Production= 55 t/ha



Soil water content temporal variation under farmer's irrigation of Tomato



Soil salinity temporal variation

ECirrig: 3.6 dS/m (well) and 1.7 dS/m (Lac)

Soil salinity impact on crop production masked by significant chemical fertilization inputs

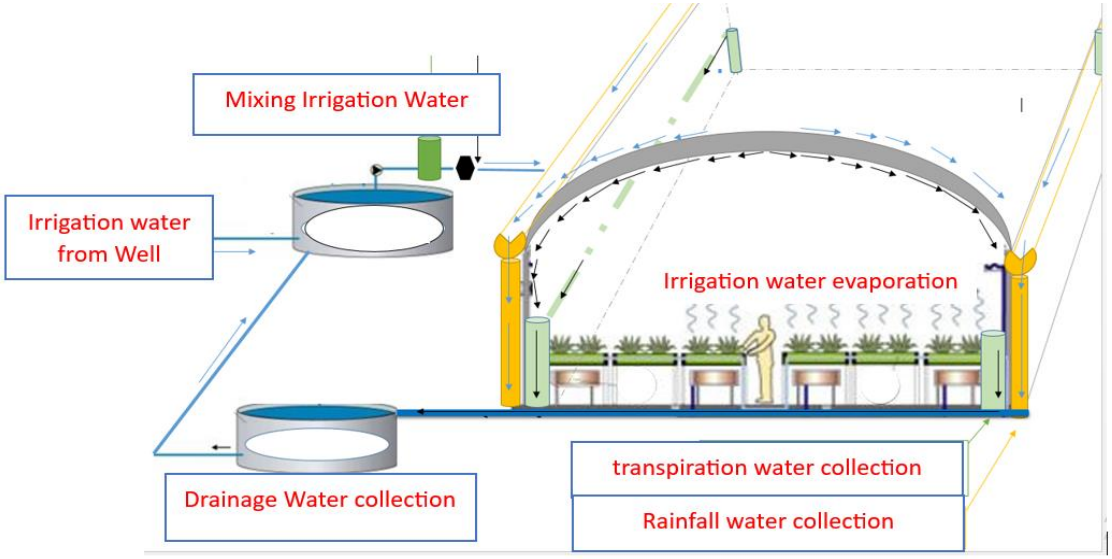
Impact of Farmer irrigation scheduling of Tomato on soil moisture and salinity temporal variation

TUNISIA - Experimental greenhouse for recovering rainwater and mixing water study

After 1 year assessment, the involved stakeholders asked to install a greenhouse with rainwater collection and mixing water system at the INRGREF station in *Oued Souhil* (Nabeul). This will be useful for crop response tests to different levels of salinity (mixing water study) and will be used for training and demonstration to local farmers and technicians. The greenhouse was installed in July 2023

Experimental study: mixing water for irrigation

The “mixing water“ experimental study was carried out by INRGREF with the purpose is to study how to minimize the effects of saline water for 3 different crops (tomato, strawberry, lettuce). Hydrus software have been be used to propose the best scenario for mixing available water (well or drain and rain transpiration or lake) to increase the water productivity but also to avoid the soil fertility degradation under salinity pressure.



RESULT: Greenhouse installed in July 2023. Activity: sensors calibration

TUNISIA - PV station (100 kW) for pumping treated waste water in SE4 station

A solar-energy pumping station to pump treated waste water from ONAS station at CRDA HQ in *Beni Khiar* (Nabeul) has been established.

PROS: Energy saving and CO2 reduction.

TUNISIA - Experimental study on use of brine (desalination-by-product)

PROS: Physio-chemical and biological study of the brine recovered from the desalination process.
Trial of the most appropriate technical solution on a small scale and suggest solutions for the reuse of the brine (cultivate spirulina and to irrigate forage shrubs and crops).
In aquaculture, brine could be used to increases fish biomass.

CONS: Theoretical study not fully tested at the Research and Technology Centre of Energy (CERTE) in Borj Cedria

Thank you!

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