THE PROBLEM

In coastal agricultural regions, and especially in arid and semiarid areas such as those of the Mediterranean basin, soil resources and crop production are highly compromised due to irrigation with saline water. This results in excessive accumulation of salts in soil at levels that hinder crop production, also known as soil salinization. Between 34 and 45 Mha or over 10% of irrigated land all over the world are characterized as salt-affected.

PROPOSED SOLUTION

Stakeholders and scientists of the Timpaki Case Study chose to focus on two soft mitigation solutions for soil salinization. The treatments undertaken during the experiment essentially simulate the use of two technologies:
- Application of *Trichoderma harzianum* (symbiotic beneficial fungus) in tomato rootstock for alleviation of high soil salinity effects.
- Installation of rainwater harvesting systems in greenhouses.

AIMS, OBJECTIVES AND EXPERIMENT DESIGN

A pilot-scale greenhouse tomato experiment was conducted in the campus of the Technical University of Crete (TUC), Greece. This experiment was designed to simulate as closely as possible greenhouse condition in the Timpaki region, about 80 km southeast of TUC. The reason for conducting these experiments at pilot and not field-scale is the convenient day-to-day control of input and growing parameters. In parallel monitoring took place at farm scale and various aspects of salinity were modelled.

The objective was to achieve a holistic understanding of the interactions of saline irrigation, soil and tomato crops in the presence of *T. harzianum*, in the context of soil and vegetation health. For this reason, data collected ranged from soil physiochemistry, nutrients, microbiome and mesofauna, to vegetation phenology, yield and fruit quality. During a season experiment, various treatments were setup, using different irrigation salinity levels (Electrical Conductivity (EC) ranging from 1 to almost 3 dS/m) and biological soil amendments (*T. harzianum*, Humate Amendment) to document their impact on tomato yield and the dynamics of soil salinity after subsequent crops under local practices and conditions. In parallel, modelling experiments aimed to assess the impact on saline irrigation under a warmer climate due to climate change.
While *T. harzianum* successfully reduced the effect of higher salinity irrigation and positively affected bioavailable nutrients concentration in the soil, its effect was limited, especially on subsequent cropping seasons. Results showed that soil quality was significantly affected by the irrigation treatment, and production loss due to saline irrigation was substantial (21-38%), especially for the marketable fraction of yield. Also, from a point onward, the increased taste characteristics associated with higher salinity came at a high cost for both yield and soil health. Furthermore, 2nd year crops showed an even higher productivity risk even under improved irrigation water quality and soil salinity mitigation measures. Moreover, modelling results show that future conditions will worsen the situation for greenhouses that already face a high salinity problem, either by rendering production non-feasible or by increasing water demand by as much as 25%.

**EXPERIMENT: MAIN RESULTS**

- Irrigation with good quality water, either from alternative sources or from dilution of saline groundwater with rainwater from rainwater harvesting, is a superior solution for sustainable soil quality and higher yield.
- Investing in rainwater harvesting proves more profitable than equal value investments in farm expansion.
- Future water demand is expected to increase for all users, and climate change is expected to increase evapotranspiration requirements, thus rendering the future of soil salinization more unfavourable for coastal areas.
- Besides soil sustainability, wide implementation of rainwater harvesting will greatly reduce water use conflicts and contribute to the general well-being of the local community.

**Stakeholder involvement and feedback**

A total of 21 stakeholders were involved in the demonstration activities, involving demonstration of sampling methods, planting, fertilisation pruning, harvesting equipment, regarding field symptoms of salinisation and other threats on the tomato production, and production costs. All stakeholders showed interest in the experimental results and treatment effectiveness, provided feedback and discussed their own observations from their fields. Farmers were mostly focused on questions regarding (a) the establishment costs and (b) the benefits either as reduced inputs or as increased yield, for each treatment. Local female stakeholders were typically more concerned about overall wellbeing. The most important barrier for widespread adoption of rainwater harvesting is the financial risk incurred by the investment. While rainwater harvesting is supported by soft policy measures (i.e. during procedures for issuing greenhouse permits), rainwater harvesting infrastructure by itself (e.g. existing greenhouses) is not promoted with material support.

**Key findings**

- Irrigation with good quality water, either from alternative sources or from dilution of saline groundwater with rainwater from rainwater harvesting, is a superior solution for sustainable soil quality and higher yield.
- Investing in rainwater harvesting proves more profitable than equal value investments in farm expansion.
- Future water demand is expected to increase for all users, and climate change is expected to increase evapotranspiration requirements, thus rendering the future of soil salinization more unfavourable for coastal areas.
- Besides soil sustainability, wide implementation of rainwater harvesting will greatly reduce water use conflicts and contribute to the general well-being of the local community.

**References**


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