

## Hydroponic culture as an Alternative Method for Agricultural Production in Morocco under Climate Change

### Problem/Challenge

Morocco, as one of the Mediterranean counties, faces intensifying agriculture challenges caused by the climate change, and water scarcity consider as the main challenge. Traditional farming systems are increasingly vulnerable to these pressures. Urgent action is needed to develop resilient, resource-efficient food production systems that align with the Water-Energy-Food-Ecosystem (WEFE) Nexus.

### Our Solution/Key Finding

The FrontAg Nexus project showcases UM6P trapezoidal closed loop hydroponic systems demo site. This soilless cultivation method offers precise control over nutrient delivery and water use, enabling significant resource optimization.

Adopting closed-loop hydroponic systems, especially when integrated with renewable energy and alternative water sources, enhances sustainability and circularity.

### Benefits & Impact

The hydroponic lettuce system at the UM6P demo site under the FrontAg Nexus project demonstrates a sustainable and water-efficient farming model, using significantly less water that offers water savings up to 90% compared to conventional agriculture while ensuring higher yields and consistent year-round production [1]. The system allows precise nutrient management, resulting in Uniform, high-quality lettuce with reduced fertilizer waste and lower pest and disease pressure. It also serves as a practical training and research platform, supporting capacity building, innovation, and the promotion of climate-smart agriculture solutions adapted to water-scarce environments.

### Practical Recommendations

For a hydroponic lettuce system, it is important to maintain optimal environmental and nutrient conditions to ensure healthy plant growth. The pH of the nutrient solution should

### Applicability Box

**Theme:** Climate-Smart Hydroponics, Resource Efficiency & Circularity

**Keywords:** Hydroponic, Lettuce Production, Water Efficiency, Climate Resilience, Renewable Energy.

**Context:** Arid and semi-arid regions, and policy development for sustainable food systems.

**Required Resources:** Greenhouse infrastructure, hydroponic equipment, quality seedling, nutrient solution, water supply, monitoring tools (pH and EC meters), reliable power, and trained technical staff.

**Scalability:** Suitable for both small indoor farms and large-scale commercial operations.

**Readiness Levels:** Evolving TRL (generally high for components, lower for full integrated systems), varying BRL/SRL due to high upfront costs but growing market interest.

**Risk Management/Considerations:** Precise control is needed of water quality, nutrient inputs and energy monitoring is required. In addition to high costs and limited labour availability in such systems.

be kept between 5.8 and 6.5, while the electrical conductivity (EC) should remain within the range of 1.8 to 2.2 mS/cm to provide the appropriate nutrient concentration. The nutrient solution should be circulated daily to ensure proper aeration of the roots and to avoid oxygen deficiency. In addition, lettuce plants must be well exposed to sufficient light to support photosynthesis and promote vigorous growth. Regular monitoring and adjustment of these parameters are essential to maintain a stable hydroponic environment and achieve optimal plant development and yield.

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### References and Further Information

- [1] B. Darkaoui, A. Oukarroum and UM6P, "D1.2: Supply and value chain analysis of climate smart and water saving agri-food production systems," FrontAg Nexus Project Deliverable, Ben Guerir, 2024.

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### About this practice abstract

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**FrontAg Nexus:** The project was launched in May 2023 to promote sustainable agri-food practices by applying the Water-Energy-Food-Ecosystems (WEFE) Nexus approach. Focusing on six Mediterranean countries—Israel, Italy, Morocco, Tunisia, Turkey, and Jordan—the project addresses climate change, resource scarcity, and food insecurity through collaborative research and innovation.

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**Project Website:** <https://frontagnexus.eu>

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