

Abstract

AI-Powered DSS for Resource-Efficient Nutrient, Irrigation, and Microclimate Management in Greenhouses [†]

Nora Ibáñez Otazua 

INKOA SISTEMAS S.L., Ribera de Axpe 11 D1-208, 48950 Erandio, Spain; nibanez@inkoa.com

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A primary challenge for the horticultural industry is to ensure high yield and product quality while using resources in an efficient and sustainable way. Decision support systems (DSSs) are important tools used to manage greenhouses and can significantly affect resource efficiency and environmental impacts, but are not extensively used due to their complexity and lack of easy-to-use interfaces. Moreover, greenhouses are complex dynamic non-linear systems with different simultaneous physical, chemical, and biological processes and with different timescales, and are difficult to control with conventional control techniques.

HortiMED (H2020 PRIMA Grant No. 1915) aims to improve resource efficiency in greenhouses through an innovative and easy-to-use DSS supported by artificial intelligence (AI). HortiMED DSS integrates sensors, smart algorithms, and efficient greenhouse control procedures, and applies AI techniques to deliver: (1) expert advisory services to help farmers in intensive knowledge tasks where climatic, crop, and nutrient variables decisively influence crop growth and productivity (e.g., precise water and fertilizer needs); and (2) cost-effective automation of greenhouses, whether partial or full (e.g., fertigation, ventilation, and heating).

HortiMED takes advantage of the large datasets available in greenhouses to fuel AI algorithms, unleashing the power of greenhouse data and AI to shift from input-intensive to knowledge-intensive farming. HortiMED DSS relies on the use of: (1) hybrid modelling combining well-known mechanistic models with AI techniques for the smart determination of setpoints; (2) multilayer hierarchical control architecture to deal with the different time scales of greenhouse dynamics; and (3) Internet of Things to integrate information from diverse sources (e.g., sensors, actuators, growers' field book, historic records, weather forecasts, etc.).

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