

Smart Water Management for Horticultural Crops in a Changing Climate

ARTICLE ID: 0056

Kalp Das

Ph.D. Scholar, Department of Vegetable Science, Punjab Agricultural University, Ludhiana (Punjab)

The realm of Indian Horticulture is undergoing a profound transformation in response to unpredictable environmental changes, necessitating a re-evaluation of both lifestyle and farming practices. The intensively cared-for horticultural crops experienced a decline in irrigated areas during the 1980s, driven by challenges such as high irrigation costs, soil salinization, and environmental considerations.

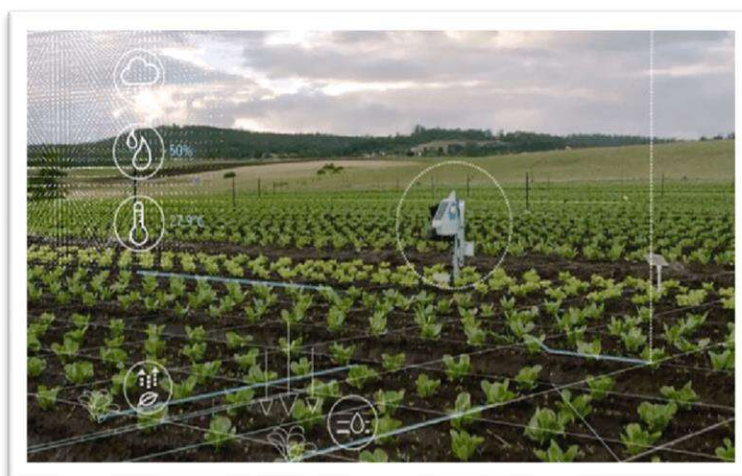
However, the shifting global climate has redirected focus towards sustainable water management practices. The primary goal is to amplify water use efficiency by minimizing losses during application. Climate-smart water management seeks to synchronize water availability and crop needs in terms of quantity and quality, both spatially and temporally, with reasonable costs and environmentally acceptable impacts. Instead of adopting a uniform irrigation approach, the emphasis is on demand-driven

strategies, with a priority on irrigation scheduling over specific methods.

Strategies for Smart Water Management in a Changing Climate

1. Precision Watering Through Localized Irrigation

Implementing sophisticated irrigation methods like drip systems and micro-sprinklers ensures precise water delivery to the plant's root zone, minimizing wastage and maximizing water use efficiency.



2. Optimized Irrigation Scheduling

Employing a blend of traditional farming knowledge and cutting-edge technology facilitates accurate irrigation scheduling. Techniques such as Time Domain Reflectometry (TDR) and tensiometer-based soil water potential measurement contribute to informed decision-making.

3. Plant-Centric Responses to Crop Stress

Monitoring plant stress parameters, including leaf water potential, diameter changes in stems and fruits,

sap flow, and canopy temperature, provides direct insights into plant water requirements, enabling timely interventions.

4. Data-Driven Insights from Climatic Parameters

Utilizing indirect methods that leverage weather data and empirical equations allows for accurate estimates of reference evapotranspiration (ET_o) and crop evapotranspiration (ET_c), ensuring efficient water management aligned with climatic conditions.

5. Holistic Approach with Soil Water Balance

Sophisticated models predicting soil water content based on soil characteristics, crop data, and climate information form the foundation of a holistic soil water balance approach, aiding in the development of precise irrigation calendars.

6. Fertigation for Nutrient Efficiency

Integrating fertigation, the simultaneous application of water-soluble fertilizers and water, proves beneficial for nutrient uptake in crops, contributing to increased nutrient use efficiency.

7. Strategic Deficit Irrigation Practices

In arid and semi-arid regions, practices like deficit irrigation, partial root drying, and subsurface irrigation are strategic solutions, enhancing yields without compromising critical growth stages.

Case Studies

➤ Revolutionizing Mango Orchards in Andhra Pradesh

Drip irrigation interventions in mango orchards significantly increased water use efficiency, fruit quality, and overall yield, showcasing the transformative impact of climate-smart water management.

➤ Pioneering Progress in Punjab Orchards

A progressive farmer in Punjab implemented climate-smart water management, emphasizing localized irrigation and advanced scheduling techniques. This resulted in optimized water usage, improved fruit quality, and reduced water wastage.

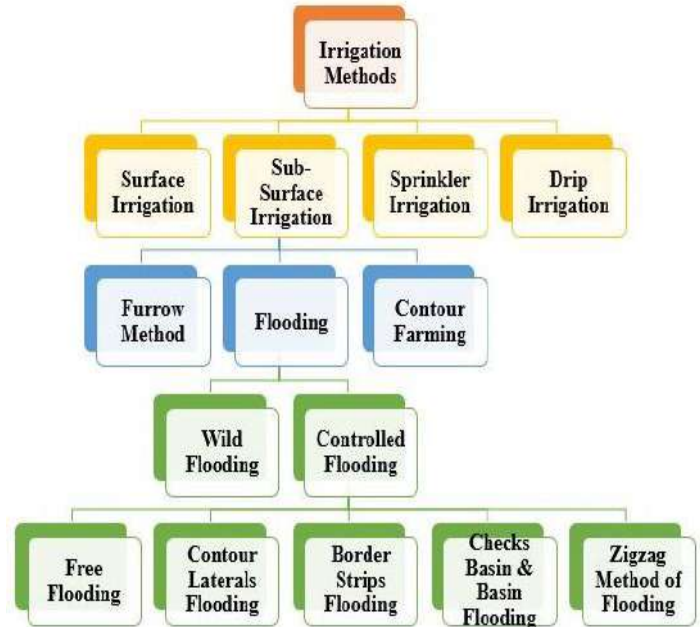


Fig 1. Different Methods of Irrigation in Horticultural Crops

Additional Examples of Smart Water Management in Horticultural Crops (SWMHC) Practices in India

- ❖ Mulching to reduce soil evaporation and retain moisture.
- ❖ Rainwater harvesting and storage for irrigation during dry periods.
- ❖ Precision agriculture tools like sensors and drones to monitor soil moisture.
- ❖ Farmer training and capacity building on SWMHC practices.

Benefits of Smart Water Management

- ❖ Increased water uses efficiency and crop yields.
- ❖ Improved soil health and fertility.

- ❖ Reduced greenhouse gas emissions from agriculture.
- ❖ Enhanced climate resilience and adaptation.
- ❖ Improved livelihoods and income for farmers.

Challenges and Opportunities

- ❖ Initial investment costs can be high.
- ❖ Limited access to technical knowledge for farmers.
- ❖ Institutional constraints and lack of awareness.

Despite challenges, SWMHC offers a promising approach for sustainable water management in horticultural crops in India, paving the way for enhanced production, improved water security, and heightened resilience to climate change.

Conclusion

In navigating the uncertainties posed by a changing climate, the adoption of climate-smart water management practices emerges as a beacon of hope for sustainable horticultural practices in India. The holistic framework, encompassing precision irrigation, optimized scheduling, plant-centric stress responses, data-driven insights, soil water balance, fertigation, and strategic deficit practices, not only mitigates environmental challenges but also enhances

productivity and resilience. The case studies from mango orchards in Andhra Pradesh and progressive orchards in Punjab exemplify the transformative impact of climate-smart water management. These success stories underscore the potential to revolutionize agricultural landscapes, optimizing water usage, improving crop quality, and securing livelihoods. As India grapples with challenges such as initial investment costs, limited access to technical knowledge, and institutional constraints, the benefits of climate-smart water management—from increased water use efficiency to improved soil health—underscore its potential to usher in a new era of sustainable agriculture.

To realize the full potential of climate-smart water management, ongoing efforts are needed to address these challenges, promote awareness, and provide support to farmers. Through a concerted and collaborative approach, India can build a resilient agricultural sector that not only adapts to climate change but also contributes to environmental sustainability and economic prosperity.

References

1. FAO. (2017). *Climate-Smart Agriculture Sourcebook* (2nd ed.). Food and Agriculture Organization of the United Nations.
2. IPCC. (2014). *Climate Change 2014: Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*.
3. Kadam, P., Saravanan, R., & Panigrahi, B. (2018). *Climate-Resilient Horticulture: Adaptation and Mitigation Strategies*. Springer.
4. Lal, R. (2020). *Climate-Resilient Food Security: Adaptive Land Use and Management*. CRC Press.
5. Singh, A. L., Saha, S., & Jat, M. L. (2019). *Water Management in Agriculture under Climate Change*. CRC Press.

6. Wani, S. P., Pathak, P., Sudi, R., & Hoanh, C. T. (2012). Climate Change Impact and Adaptation in Agriculture: A Global Assessment. CAB International.