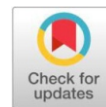


## Review Article

## Open Access

# A review on impact of climate change on indian horticulture and the way forward



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## ABSTRACT

Horticulture contributes 30.4% to India's agricultural GDP and supports over 50 million farmers. However, climate change is posing severe challenges, including rising temperatures, erratic rainfall, pest infestations, and extreme weather events like heat waves and cyclones. According to IMD (2023), India's average temperature has risen by 0.7°C since 1901, affecting flowering, fruit set, and crop quality. The 2022 heatwave reduced tomato yields by 15-20%, while erratic rainfall in Maharashtra's grape farms led to ₹700 crore in losses. This article explores the multi-faceted impact of climate change on Indian horticulture, supported by state-wise case studies and global best practices. It presents scientific and policy-driven solutions, including climate-resilient crop varieties, efficient water management, agri-tech innovations, and climate insurance. A multi-stakeholder approach, integrating farmers, policymakers, financial institutions, and researchers, is key to building a sustainable and climate-resilient horticultural sector in India.

**Keywords:** Horticulture, Climate Change, Temperature, Impact and Sustainable.

## Introduction

India is one of the world's largest producers of horticultural crops, with an annual production of over 345.6 million metric tons (MMT) in 2023, surpassing food grain production for the last decade [2]. The sector supports livelihoods for over 50 million small and marginal farmers, enhances nutritional security, and contributes significantly to exports, generating over \$6 billion in foreign exchange annually [10].

However, climate change is emerging as a major disruptor, impacting productivity, crop quality, and post-harvest management. The frequency of heatwaves, unseasonal rainfall, frost, and cyclonic storms has increased in recent years, leading to crop failures and economic losses. According to NICRA [5], horticulture crops are more sensitive to climate variations than cereals, as temperature, humidity, and soil moisture fluctuations directly affect flowering, fruit set, and post-harvest shelf life.

This article provides a comprehensive analysis of climate change impacts on Indian horticulture, supplemented by state-wise examples, scientific findings, and policy-driven solutions for a climate-resilient horticultural sector.

## Impact of Climate Change on Indian Horticulture

### 1. Rising Temperatures and Heat Stress on Horticultural Crops

- Temperature increases are reducing the flowering and fruit set of crops such as mangoes, apples, grapes, and tomatoes.

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- In Himachal Pradesh and Jammu & Kashmir, apple production is declining due to warming winters. The traditional apple belt has shifted to higher altitudes (above 2,000 meters) as lower elevations have become unsuitable [1].
- The 2022 heatwave in North India reduced tomato and onion yields by 15-20%, triggering price hikes across major markets [3].

#### Case Study – Apple Production Shift in Himachal Pradesh

Farmers in the lower Himalayas (Shimla, Kullu, Solan) report a 30% decline in apple yields over the past decade due to inadequate chilling hours. The cultivation is shifting to higher altitudes (Lahaul-Spiti, Kinnaur) where colder temperatures are still favorable [12].

### 2. Erratic Rainfall and Changing Monsoon Patterns

- Unseasonal rains during the flowering and harvesting season are damaging fruit quality and reducing yields.
- The Maharashtra grape industry suffered a ₹700 crore loss in 2021 due to excess pre-harvest rainfall that led to fungal infections [2].
- Karnataka's banana plantations faced 30% yield losses in 2022 due to unexpected cyclonic winds and erratic rainfall during fruiting stages [13].

#### Case Study – Grape Farmers in Maharashtra

In Nashik and Sangli, India's largest grape-producing regions, heavy unseasonal rainfall in 2021 and 2022 caused widespread fungal infections (downy mildew), affecting exports to Europe and the Middle East. Farmers are now shifting to protected cultivation (greenhouses and polyhouses) to mitigate climate risks.

## Global Best Practices in Climate-Resilient Horticulture

Country	Adaptation Strategy	Outcome
Israel	Drip irrigation & precision farming	90% efficiency in water use, increased yields [8].
Netherlands	Greenhouse cultivation & vertical farming	Year-round vegetable production despite extreme weather [4].
Spain	Drought-resistant citrus varieties	Reduced water needs, maintained exports [7].

### Way Forward: Policy and Technological Solutions

#### 1. Climate-Resilient Horticultural Varieties

- Develop and promote heat-resistant fruit and vegetable varieties (e.g., Mango hybrid 'Arunika', Heat-tolerant Tomato 'Arka Rakshak').
- Strengthen research at ICAR, IIHR, and State Horticultural Universities to develop climate-smart crops.

#### 2. Strengthening Irrigation and Water Management

- Expand micro-irrigation coverage (currently at 18% for fruits and vegetables) under Pradhan Mantri Krishi Sinchayee Yojana (PMKSY).
- Implement rainwater harvesting structures and farm ponds in water-scarce regions.

#### 3. Strengthening Digital and Agri-Tech Solutions

- Use AI-driven climate forecasting for real-time alerts on heatwaves, rainfall, and pests.
- Expand blockchain-based farm-to-market linkages to reduce post-harvest losses.

#### 4. Expanding Crop Insurance for Horticulture

- Enhance coverage under Pradhan Mantri Fasal Bima Yojana (PMFBY) for fruits and vegetables.
- Introduce weather-indexed insurance models like Kenya's mobile-based climate insurance [7].

### Conclusion

The impact of climate change on Indian horticulture is undeniable, affecting crop yields, quality, and farmer incomes. However, by adopting climate-resilient varieties, improving water efficiency, leveraging digital tools, and strengthening risk mitigation mechanisms, India can build a robust and sustainable horticulture sector. A multi-pronged strategy, integrating scientific innovations, policy support, climate-resilient farming practices, and financial investments, is essential to safeguard India's horticulture sector from climate threats and ensure long-term sustainability.

### References

1. Indian Council of Agricultural Research (ICAR). (2023). *Climate Change and Its Impact on Indian Horticulture*. ICAR Publications. Available at: <https://icar.org.in>
2. National Horticulture Board (NHB). (2023). *Horticulture Statistics of India 2023*. Ministry of Agriculture & Farmers' Welfare, Government of India. Available at: <https://nhb.gov.in>
3. India Meteorological Department (IMD). (2023). *Annual Climate Report*. Ministry of Earth Sciences, Government of India. Available at: <https://mausam.imd.gov.in>
4. Food and Agriculture Organization (FAO). (2023). *Climate-Resilient Horticulture Strategies*. FAO Reports. Available at: <https://www.fao.org>
5. National Innovations in Climate Resilient Agriculture (NICRA). (2023). *State-wise Climate Vulnerability Assessment*. ICAR-NICRA Reports. Available at: <https://www.nicra-icar.in>
6. NABARD. (2023). *Climate Finance for Indian Horticulture*. NABARD Publications. Available at: <https://nabard.org>
7. CGIAR (Consultative Group for International Agricultural Research). (2023). *Weather-Based Crop Insurance in Kenya*. CGIAR Reports. Available at: <https://www.cgiar.org>
8. World Bank. (2023). *Water-Efficient Irrigation: Lessons from Israel*. World Bank Reports. Available at: <https://www.worldbank.org>
9. United Nations Environment Programme (UNEP). (2023). *Sustainable Agriculture and Climate Adaptation*. UNEP Climate Reports. Available at: <https://www.unep.org>
10. APEDA (Agricultural & Processed Food Products Export Development Authority). (2023). *Horticulture Export Trends and Challenges*. Ministry of Commerce & Industry, Government of India. Available at: <https://apeda.gov.in>
11. Government of Maharashtra. (2023). *Climate Challenges in Horticulture: Case of Grapes and Pomegranates*. Maharashtra Horticulture Department Report. Available at: <https://maharashtra.gov.in>
12. Himachal Pradesh Horticulture Department. (2023). *Impact of Climate Change on Apple Production in Himachal Pradesh*. Available at: <https://hpagriculture.com>
13. Indian Institute of Horticultural Research (IIHR). (2023). *Advances in Climate-Resilient Horticulture in India*. IIHR Publications. Available at: <https://iihr.res.in>
14. Ministry of Agriculture & Farmers' Welfare. (2023). *State-Wise Horticulture Production in India: Trends and Challenges*. Available at: <https://agricoop.nic.in>
15. National Disaster Management Authority (NDMA). (2019). *Impact of Cyclones on Indian Agriculture and Horticulture: Case Study of Cyclone Fani*. Government of India. Available at: <https://ndma.gov.in>