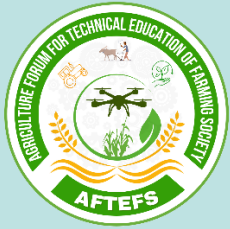


## AGRICULTURE FORUM FOR TECHNICAL EDUCATION OF FARMING SOCIETY

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### Precision Floriculture Smart Technologies In Flower Production

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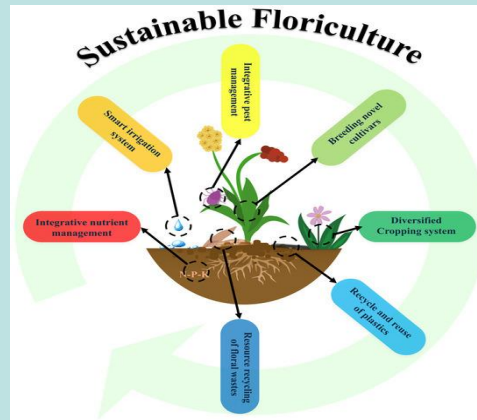
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## INTRODUCTION

Precision Floriculture refers to the application of advanced technologies, sensors, automation, and data-driven decision-making tools to optimize flower production. It integrates modern science with horticultural practices to enhance quality, productivity, resource-use efficiency, and sustainability in commercial floriculture systems. It is especially important for high-value flower crops grown under protected cultivation such as greenhouses and polyhouses.



#### Importance of Precision Floriculture

- Enhances flower yield and uniformity
- Improves post-harvest quality and vase life
- Reduces input wastage (water, fertilizers, pesticides)
- Minimizes environmental pollution
- Supports year-round flower production
- Increases profitability for growers

#### Key Smart Technologies in Floriculture

##### 1. IoT (Internet of Things)

Precision floriculture involves advanced greenhouse management systems that enable real-time monitoring of key environmental parameters such as temperature, humidity, CO<sub>2</sub> levels, and soil moisture, ensuring optimal growth conditions for flower crops. It also includes automated irrigation and fertigation scheduling, where water and nutrients are supplied in precise quantities

based on crop requirement and sensor data, improving resource-use efficiency. In addition, mobile-based greenhouse control systems allow growers to remotely manage and adjust environmental conditions through smartphones or digital platforms, providing flexibility and instant decision-making.

##### 2. Artificial Intelligence (AI) & Machine Learning

Artificial Intelligence (AI) in precision floriculture is transforming flower production through advanced data-driven applications. Disease and pest prediction models based on climate data help anticipate outbreaks by analyzing temperature, humidity, and weather patterns, allowing timely preventive measures. Yield forecasting and harvest timing optimization enable growers to estimate production levels accurately and determine the best stage for harvesting flowers to ensure maximum quality and market value. In addition, automated crop advisory systems provide real-time recommendations on irrigation, nutrition, and plant protection based on continuous field data analysis, reducing dependency on manual decision-making.

##### 3. Drones & Remote Sensing

Drones and remote sensing technologies play a vital role in precision floriculture by enabling efficient monitoring and management of flower crops. Multispectral imaging for crop health assessment helps in capturing data beyond visible light to evaluate plant vigor, chlorophyll content, and overall physiological status. This allows growers to identify variations in crop health that are not visible to the naked eye.

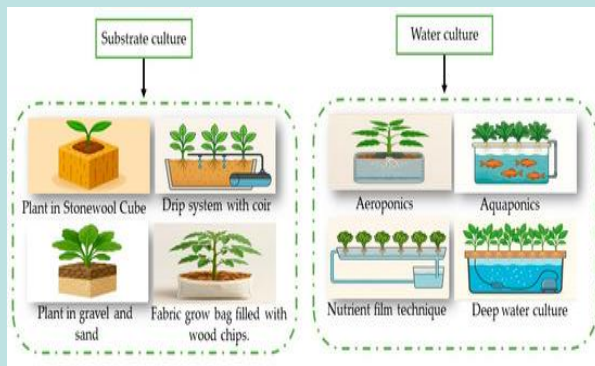


#### 4. Sensor-Based Smart Systems

Sensor-based smart systems are a core component of precision floriculture, enabling highly accurate crop management under controlled environments. Soil nutrient and EC sensors for precise fertilization continuously monitor nutrient concentration and electrical conductivity in the root zone, allowing growers to supply exact fertilizer doses according to plant requirements. Light intensity and photoperiod control for flowering regulation ensures that crops receive optimal light conditions, which is critical for regulating flowering time, flower quality, and uniformity in commercial production.

#### 5. Hydroponics & Soilless Cultivation

Soilless cultivation systems, particularly hydroponics, ensure precise management of plant nutrition and growing conditions for superior flower production. They allow accurate and controlled delivery of nutrients, ensuring that plants receive the right balance at the right time, which promotes optimal growth and development. This results in improved flower quality with uniform stem length, an important trait for commercial and export markets. Since crops are grown without soil, there is a significant reduction in soil-borne diseases and salinity-related issues, which are common limitations in conventional cultivation. In addition, these systems support efficient water recycling and reuse, making them highly resource-efficient and environmentally sustainable for modern floriculture production.



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#### 6. Big Data Analytics

Big data analytics in precision floriculture enables the analysis of environmental and production data to improve crop management decisions. It helps in the optimization of flowering cycles and market timing to ensure better quality and profitability. Additionally, demand forecasting for flower markets and export planning aligns production with market needs, reducing losses. Overall, decision support systems for growers integrate data to provide timely recommendations for efficient and smart flower production.

#### 7. Robotics and Automation

Robotics and automation in precision floriculture are revolutionizing flower production by improving efficiency and precision. They include automated planting and spacing systems that ensure uniform crop establishment and optimal plant density. Robotic harvesting of delicate flowers helps in careful and damage-free picking, maintaining high product quality. In addition, packaging and grading automation standardizes post-harvest handling, ensuring consistency in size, appearance, and quality for market supply. Overall, these technologies lead to a significant reduction in labor dependency, making floriculture more efficient, scalable, and cost-effective.

#### Applications in Major Flower Crops

- Rose: Precision irrigation and pruning systems
- Carnation: Climate-controlled greenhouse cultivation
- Gerbera: Nutrient film technique and hydroponics
- Orchid: Microclimate management and shade optimization
- Marigold: Large-scale field monitoring and pest management

#### Resource Optimization in Precision Floriculture

- Water use efficiency improved by drip irrigation systems
- Fertilizer application based on real-time nutrient monitoring
- Energy-efficient greenhouse climate control systems

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- Reduction in pesticide usage through targeted spraying

#### Environmental Benefits

- Reduced chemical runoff into soil and water
- Lower carbon footprint through efficient resource use
- Conservation of biodiversity in farming systems
- Sustainable intensification of floriculture production

#### Economic Benefits

- Higher returns per unit area
- Reduced input costs over time
- Improved market competitiveness
- Better export quality flowers

#### Future Prospects of Precision Floriculture

- Fully automated AI-driven smart greenhouses
- Blockchain-based flower supply chain tracking
- Robotics-integrated harvesting and packaging systems
- Climate-resilient flower production models
- Integration with vertical farming and urban floriculture

#### Challenges

- High initial investment cost
- Requirement of technical knowledge and training
- Limited access for small and marginal farmers
- Maintenance of advanced systems

#### CONCLUSION

Precision floriculture is emerging as a key approach for sustainable flower production. It combines advanced technologies such as IoT, artificial intelligence, sensors, and automation. These innovations enable real-time monitoring and precise management of crops. Farmers can optimize the use of water, nutrients, and other inputs efficiently. This leads to higher productivity and improved quality of flowers. It also minimizes environmental impact and supports eco-friendly practices. Precision floriculture reduces labor dependency and increases operational efficiency. Overall, it is transforming traditional floriculture into a smart, technology-driven industry.

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