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AN OVERVIEW OF PRECISION FARMING IN HORTICULTURE

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Horticulture is the systematic study and practice of growing fruits, vegetables, flowers, or decorative plants. Plant conservation, soil management, landscape restoration, and the planning, building, and upkeep of gardens and landscapes are also included. In horticulture, science can also be used to determine the ideal temperature and growing conditions for plants to yield the highest-quality fruits. Precision farming is a cutting-edge method in horticulture that has revolutionised conventional farming methods. Precision farming in horticulture provides exact control over elements like fertilisation, irrigation, and pest management, improving crop yields and resource efficiency.

Precision farming relies on the Global Positioning System (GPS) because of its distinct feature of accuracy in both time and space. GPS was developed by American defence specialists exclusively to support the US Defence Department. In order to maximise harvests and boost production, precision agriculture (PA) applies the right quantity of inputs, including water, fertiliser, pesticides, and other chemicals, to crops at the right times. Inputs (such chemical pesticides and fertilisers) should be applied in the right amount, at the right time, and at the right place. The phrase "Site-Specific Management" refers to this type of management.

Importance of Precision Farming in Horticulture

A new method of growing crops that makes use of technology to increase sustainability and efficiency is called precision farming. It entails modifying interventions according to the unique requirements of every plant, including changes in the microclimate and soil composition. This aids farmers in making the most use of their resources and supports a more robust and fruitful agricultural system.

Precision farming in horticulture is similar to creating a customised treatment plan for every plant. Farmers can promote healthier and more fruitful harvests by adjusting the strategy to the particular needs of each crop. Precision farming is a crucial tool for the future since it adapts agricultural methods to the changing demands of our planet. Precision farming promises greater improvements for a more effective and sustainable method of agricultural cultivation as technology develops.

Specific Applications of Precision Farming in Horticulture

In the field of horticulture, precision farming is essential. This innovative approach to agriculture offers horticulture producers customised solutions to improve the sustainability and efficiency of their horticultural operations. Its particular uses result in a significant change in the way crops are raised and cared for.

1. **Precision Irrigation:** Precision farming horticulturists employ sensors and monitoring systems to measure soil moisture and deliver water where and when it's needed. By doing this, water is conserved and plant root problems are avoided.
2. **Fertilizer and Pesticide Management:** These farmers use the technology to administer precisely the proper amount of pesticides and nutrients to the crops by analysing the soil and crops in real-time. Resources are saved, and the environmental impact is lessened.
3. **Disease and Pest Detection:** Farmers can utilise sensor-equipped automated systems to identify diseases and pests early thanks to precision farming. By focussing on impacted regions, farmers may reduce the use of toxic pesticides and protect the health of crops and the environment.
4. **Yield Prediction and Harvest Optimization:** Precision farming technology helps horticulturists make well-informed decisions about when to harvest crops for optimal yield by analysing data on crop health, weather patterns, and soil conditions. As a result, harvest quality and quantity are enhanced.
5. **Protected Cultivation (Greenhouses and Tunnels):** Farmers are able to grow a range of crops that are not native to their nation thanks to the construction of greenhouses and tunnels, which provide controlled settings with year-round ideal growth conditions for plants. In the end, this increases crop productivity and quality by enabling farmers to grow crops even in areas with harsh climates.

Components of Precision Farming in Horticulture

In horticulture, precision farming functions as a well-coordinated system, balancing several elements to facilitate and facilitate crop management. As we already know, each element is essential to precision farming and functions in concert to provide the best possible crop care. These elements, which range from data sensors to automated machinery, revolutionise horticulture and usher in a period of sustainability and efficiency. The current agricultural method relies heavily on the integration of these cutting-edge technology and meticulous attention to detail, which guarantees a data-driven and perceptive approach to farming. Let's examine the main elements that make precision farming an effective ally for contemporary farmers and horticulturists.

- 1. Data Sensors:** Data sensors gather real-time information about crop health, soil conditions, and environmental elements, serving as the watchful eyes and ears of precision farming in horticulture. These sensors give farmers access to a steady flow of information that helps them make wise decisions. By keeping an eye on these insights, horticulturists may adjust their interventions to give each plant the exact attention it needs to thrive to its full potential.
- 2. Global Positioning System (GPS):** GPS technology acts as the compass for precision farming, enabling farmers to traverse their fields with exceptional accuracy. With the use of this technology, fields may be precisely mapped, enabling focused actions like harvesting and planting. Horticulturists and farmers can maximise resource utilisation, minimise overlap, and improve overall crop management efficiency by employing GPS.
- 3. Automated Machinery:** Automated machinery is the workhorse of precision farming, executing tasks with unparalleled accuracy and efficiency. From automated planters to harvesters, these machines carry out operations based on data-driven insights. This not only reduces labour intensity but also ensures that tasks like planting, harvesting, and spraying are executed with precision, minimizing waste and maximizing productivity in horticulture.
- 4. Drones for aerial insights:** Precision farming literally reaches new heights thanks to drones. These unmanned aerial vehicles provide a bird's-eye view of fields by gathering high-resolution data and photographs. With the help of this overhead view, farmers can evaluate plant health, spot crop differences, and spot possible problems like pest infestations. The greatest method for monitoring vast regions and providing

a rapid and thorough overview of crops, drones allow for prompt and focused treatments.

- 5. Data-driven Decision Support Systems:** Processing the massive volumes of data gathered by sensors and other technologies, decision support systems are the brains behind precision farming. By analysing data and producing useful insights, these tools help farmers make well-informed decisions. Horticulturists and farmers can choose how best to allocate resources, lower the chance of crop failure or decay, and carry out targeted interventions for better crop management by utilising data analytics.

Potential of Precision Farming in India

- Precision farming is still relatively new in countries like India, although it is commonly used in wealthier countries.
- India faces the following challenges in precision farming: The culture and mindset of Indian landowners and farmers.
- Small farms are owned by the farmers, and there aren't enough success stories to share.
- These include cropping system heterogeneity and market inefficiencies.
- Infrastructure, institutional restraints, and land ownership.
- A failure to understand local protocols.
- A lack of expertise and technical restrictions.

Precision Farming's Advantages for Horticulture

It's critical to comprehend the precise areas in which precision technology might aid farmers as we examine the different ways that horticulturists and farmers can use it to improve their farming operations. Even though precision farming is a relatively new technology, its major goal is to create more environmentally conscious and sustainable farms by minimising waste and maximising resources. Here are some advantages that precision farming offers to the horticulture industry.

- 1. Resource Efficiency:** Strict control over vital elements like water, fertiliser, and pesticides is made possible by precision farming. By reducing resource waste, this type of tailored strategy guarantees that every plant gets precisely what it requires for healthy growth.

2. Higher Crop Produce: Precision farming helps to increase crop yields by refining and enhancing cultivation techniques. Harvests from the seeds seeded are healthier and more productive as a result of farmers' newfound capacity to address the unique needs of each plant, from soil composition to microclimate differences.

3. Ensuring Sustainability: Horticulture's negative environmental effects are lessened by precision farming. Farmers may improve irrigation and lessen their reliance on agrochemicals by knowing the precise requirements of the plants. Additionally, it minimises pollution and protects natural resources by encouraging the sustainable use of the resources that are available.

4. Data-Driven Decision Making: Farmers can make well-informed decisions thanks to precision farming, which gives them access to real-time data and analytics. Having access to precise information enhances the capacity to quickly handle issues, whether they are related to crop health monitoring or risk prediction.

5. Labour Efficiency: Farmers can free up human resources for more strategic and subtle parts of farming by implementing automated machinery and robotics to streamline labour-intensive operations. In addition to improving productivity, this helps the agriculture industry's work force problem.

6. Risk Reduction: By enabling early identification of possible problems with crops, weather, and soil, precision farming helps with risk management. detecting pest infestations on crops or predicting unfavourable weather patterns that could compromise a crop's capacity to survive. This aids farmers in making plans in advance and acting proactively to protect crops and reduce losses.

7. Increase Economic Viability: Although precision farming requires an initial technological investment, the long-term advantages help to increase horticulture's economic viability. With their new, in-depth knowledge, farmers may increase yields, save money on resources, and improve operations, all of which increase the overall profitability of their farming endeavours.

8. Adaptability to Climate Change: Precision farming provides flexibility in the face of climate change issues. Farmers can respond to shifting climatic conditions and provide crop resilience in an unpredictable climate by modifying agricultural procedures based on real-time data.

Prospects for Precision farming in Horticulture: In horticulture, precision farming holds great promise for the future, particularly in a nation like India. Driven by technical

advancements and the changing demands of agriculture, precision technologies have a lot to offer horticulture, particularly for younger, new-generation farmers. Several trends are influencing precision farming as we look to the future, offering horticulturists a glimpse of the logical changes that will occur. It is anticipated that decision-making procedures will be improved in the upcoming years by a greater combination of machine learning (ML) and artificial intelligence (AI). It is anticipated that these technologies will improve precision agricultural systems' predictive capacities, enabling more precise evaluations and preemptive actions.

Conclusion

In India, horticulture is a fast expanding industrial and technological sector. India is the world's second-largest producer of fruits and vegetables, with an astounding 351.92 million tonnes produced in 2022–2023 (based on the Second Advance Estimates). This sum exceeds the total agricultural output of the majority of nations. Precision farming's incorporation into horticulture is a fundamental change that holds promise for a more sustainable and productive future, not just a passing fad. The article's discussion of precision farming's significance, applications, components, technologies, advantages, and future trends demonstrates its revolutionary impact on horticulture. Precision farming can become an essential part of crop cultivation by combining cutting-edge technologies, data-driven methods, and useful inventions, guaranteeing a peaceful coexistence of technology and nature. It is clear that precision farming is not merely a tool for contemporary farmers; rather, it is the model for horticulture's future, forming a landscape in which sustainability and precision coexist.

When it comes to raising India's GDP, the idea of acting morally at the appropriate moment and location could be revolutionary. However, for precision farming to be successful, new technology information needs to spread more quickly so that rural areas can also adopt this agricultural method.

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