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Precision Agriculture in Horticulture

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Precision Farming is defined as an information and technology-based farm management system which identifies, analyses, and manages geographical and temporal variability in fields to maximise productivity, profitability, and sustainability while minimising production costs. This comprehensive system aims to maximise productivity while minimising negative influence on the environment. Precision agriculture involves three essential components: information, technology, and management. This technology uses GPS, GIS, yield monitors, remote mapping sensors, and guidance systems to monitor field fluctuations at a variable rate over time

Technologies for Precision Farming

A. Global Positioning System (GPS)

- GPS is a network of satellites that transmit precise positioning information from space to Earth. It provides a bird's-eye view from space.
- GPS receivers collect signals to determine precise location and time. It has an accuracy of 100 to 0.01 metres.
- Farmers may detect field information, like soil type, pests, weeds, and water holes, depending on specific location. This helps farmers make decisions on seed plantation, herbicides, pesticides, fertilizers, and irrigation demands.

B. Geographic information system (GIS)

- It is a system for collecting, storing, manipulating, managing, analyzing, and presenting geographical or geographic data.
- GIS includes technology, software, and techniques for compiling, storing, retrieving, and analyzing geographical data to create maps. GIS organizes information and allows for easy extrapolation.
- Computerized GIS maps include information on yield, soil survey, crop kind, nutrient levels, and insect prone areas.

C. Grid soil sampling and variable-rate fertilizer (VRT) application

- Grid sampling is a rapid, straightforward, and unbiased way for managing soil on a single location.
- Variable-rate technologies (VRT) can be applied to many farming operations. They determine the delivery rate of farm inputs according on soil type.

D. Remote Sensors

- Remote sensing is the collection of data from sensors that detect visible, infrared, electromagnetic, and near-infrared light without physical contact with the object of examination.
- Remote sensing can accurately assess several agricultural parameters, including humidity, soil and air temperature, crop height, wind conditions, plant diameter and width.
- Unmanned Aerial Vehicles (UAVs), often known as drones, GPS satellites, and other data-gathering aircraft like balloons and blimps, typically carry remote sensing technology.

E. Drones

- Drones are inexpensive and can capture ground data with corresponding geographic coordinates. This allows the user to get a more complete and clear image of the ground information.
- Agriculture drone applications include monitoring biomass, crop growth, and food quality, precision farming (e.g., weed detection for pesticide treatments), and harvesting and logistics optimization. All of these applications need the processing of images captured by a drone-mounted camera.

F. Role of Artificial Intelligence in Precision Farming

- AI is an important research area in IT and computer science. Rapid technological advancements and diverse applications can enhance precision and cost-effectiveness in traditional farming practices.
- Traditional agriculture has serious challenges such as inadequate chemical application, pest and disease infestation, incorrect irrigation and drainage, yield forecast, and weed management. AI can address gaps in traditional farming and promote precision farming.

Applications of AI in Indian Farming

- As the world's population grows, the shortage of agricultural land has become a major issue. This underscores the need for creative and skilled individuals in the agricultural sector.
- Despite enormous efforts since independence, India's agricultural sector remains beset by climate-related uncertainty and a lack of effective technologies.
- AI can help increase crop output by optimizing land usage in the face of climate change and food security challenges.

G. Smart irrigation systems in precision agriculture

- Agriculture is one of the fields that uses a lot of water. Water waste is a significant concern in agriculture. Every time there is too much water applied to the fields. Unlike traditional irrigation methods, the smart irrigation system controls the amount of water provided based on the demands of the fields and crops.
- Users of smart irrigation systems can monitor their irrigation status, start and stop the operation with a single button click, and receive notifications about moisture levels, weather, and crop status.

Approach

- ❖ Precision agriculture falls into two categories: 'soft' and 'hard' precision farming.
- ❖ 'Soft' precision farming is based on eye observations of crops and soil. 'Hard' precision farming uses modern technologies such as GPS, RS, and VRT based on statistical analysis of scientific data.
- ❖ Fertilizing and crop maintenance decisions after planting are time-sensitive and weather-dependent. Farmers may avoid using fertilizer if strong rains are expected the next day to prevent it from being carried away.
- ❖ Weather forecasting influences decision-making. Predictive weather analytics can help attain this goal. Efficiently utilizing 70% of the world's fresh water for agricultural uses can significantly impact the global supply.

Obstacles

- ❖ Lack of whole-farm focus, almost 90% or more of the precision agriculture studies reported that Precision Agriculture techniques have been implemented mostly on a single field or on experimental basis or only on commercial farms. Therefore, farmers hesitate to choose modern agricultural techniques, which are not known to them.
- ❖ Farmers should be knowledgeable with and routinely upgrade their equipment.
- ❖ Strong and dependable internet connectivity remains unavailable in rural and remote areas worldwide, especially in developing countries.
- ❖ Improved network performance and bandwidth speeds are crucial for successful precision farming adoption.
- ❖ GPS signal reception might be difficult in farmlands with tall trees and uneven terrain.

Future Prospects

- ❖ Drones offer the most promising future for precision farming adoption.
- ❖ Drones eliminate the requirement for GPS and reliable internet connectivity.
- ❖ Drone technology can aid in crop scouting, diagnosing insect or nutritional concerns, detecting weather damage, locating irrigation system faults, and monitoring drainage system performance.

Conclusion

The successful implementation of precision farming involves three phases: investigation, analysis, and execution. While research and analysis are ahead, implementation is gradually catching up. Precision agriculture addresses economic and environmental concerns in farm production today. Coordination between farmers, MNCs, and the government is gathering momentum. However, determining the best cost-effective and efficient ways to use technology is still a work in progress.

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