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Precision Agriculture: Technology to Boost Crop Farming

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Precision agriculture, also known as precision farming, is generally understood to be a farm management system based on information and technology that identifies, analyses, and manages spatial and temporal variability within fields for maximum productivity and profitability, sustainability, and protection of the land resource by minimising the production costs. Inputs are used in precise amounts in precision farming, which results in higher average yields than traditional cultivation methods. In order to increase production efficiency, improve product quality, increase the effectiveness of crop chemical use, conserve energy, and protect the environment, it is a comprehensive system that combines information, technology, and management. Therefore, precision farming is a compelling idea, and it follows naturally from its principles that more efficient use of farming inputs will increase revenues and result in production that is less harmful to the environment. The technology for tomorrow's environmentally friendly agriculture may be provided by the precision agricultural advancements of today.

Need of Precision Farming

The food system around the world is currently facing significant difficulties that will only get worse over the next 40 years. With today's knowledge and technologies, a lot can be done right away with enough effort and money. The food system will need to undergo more significant changes in order to meet future challenges, and funding for research to develop fresh answers for brand-new issues will be necessary. Major issues in agricultural growth and development now include the decline in total productivity, diminishing and depleting natural resources, stagnating farm incomes, lack of an eco-regional approach, dwindling and fragmented land holdings, trade liberalisation on agriculture, limited employment opportunities in non-farm sectors, and global climatic variation. Therefore, one way to boost

farm productivity in the future is through the implementation of recently developed technology.

Advantages of Precision Agriculture

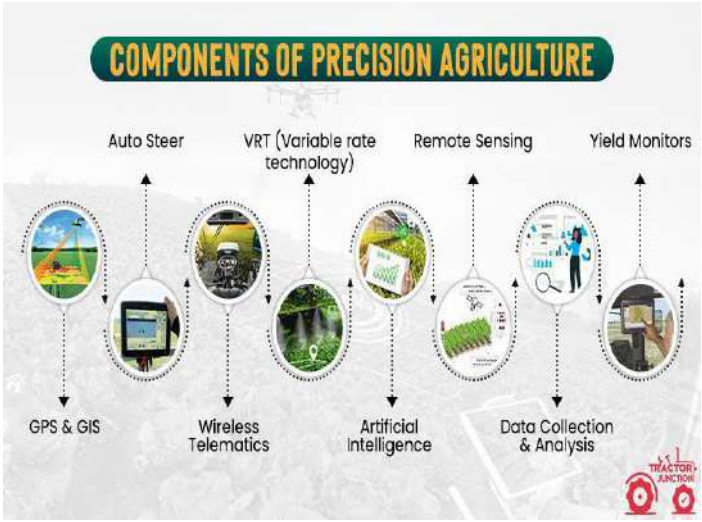
- ❖ Through regular plant inspections and data management, the precision farming approach detects all potential growth-related difficulties.
- ❖ Crop quality and output can be improved in a more efficient, precise, and time-saving manner.
- ❖ Simple precision farming chores include soil mapping and analysis.
- ❖ Precision farming is a technique used in modern agriculture to cut down on wasted fertilizer, herbicides, and irrigation water. Using accurate amounts of requirements is made possible by data management.
- ❖ In precision farming, making a chart to generalize and address a problem is simple.

In areas where there are few resources, precision farming has a big impact. For example, desserts often work quite well.

Precision Farming Has Drawbacks

1. Precision farming infrastructure is too pricey. It costs a lot of money and is currently impossible everywhere.
2. Precision farming cannot be used in rural areas for a number of reasons, including different types of land, ownerships, and infrastructure. Additionally, farmers in rural areas don't value the rapid advances in agricultural practices.
3. Precision farming is not a careless method of farming. It suggests that you need a proper team or individual to oversee and study daily information about needs, problems, and solutions.
4. Government subsidies for precision agriculture are not provided to farmers.

Tools and Equipment



1. **Global Positioning System (GPS):** With an accuracy range of between 100 and 0.01 m, GPS is a satellite-based navigation system that enables users to record positional data (latitude, longitude, and elevation). The precise location of field data, such as soil type, insect occurrence, weed invasion, water holes, boundaries, and impediments, can be found by farmers using GPS. There is an automatic controlling system with a DGPS, antenna, and receiver for light or sound. GPS receivers may determine their location by using the signals that are transmitted by GPS satellites. According to performance standards and prior input applications, the system enables farmers to accurately locate fields so that inputs (seeds, fertilisers, pesticides, herbicides, and irrigation water) can be applied to each field individually.
2. **Sensor Technology:** for sensors Measurements of humidity, vegetation, temperature, texture, structure, physical character, conductivity, photo electricity, and ultra sound are made using a variety

of methods, including electromagnetic, conductivity, photo electricity, and ultra sound. Crop species can be distinguished, stress points can be found, pests and weeds can be identified, and drought, soil, and plant conditions can all be tracked using remote sensing data. Sensors allow for the capture of enormous amounts of data without the need for laboratory examination.

3. **Geographic Information System (GIS):** The components of this system include hardware, software, and protocols for compiling, storing, retrieving, and analysing feature characteristics and position information to create maps. GIS connects data in one location so that it can be extrapolated as needed. Computerised GIS maps differ from traditional maps in that they include multiple layers of data (such as yield, maps of soil surveys, rainfall, crops, soil nutrient levels, and pests). GIS is a type of computerised map, but its true purpose is to evaluate people and places using statistical and spatial approaches. Information on field topography, soil types, surface drainage, subsurface drainage, soil tests, irrigation, chemical application rates, and crop production can all be found in a farming GIS database.
4. **VRT:** Automatic variable-rate technology (VRT) can be used in a variety of farming operations. Based on the soil type identified on a soil map, VRT systems determine the rate of delivery of agricultural inputs. Extrapolating data from the GIS can be used to control activities like planting, fertiliser and pesticide application, herbicide selection, and application at the proper time and place at a variable rate. The most common PFS technology in use in the US is probably VRT. The same concepts of soil sampling are applied in grid soil sampling, however sampling intensity is increased. The geographic location of soil samples gathered in a systematic grid also provides the ability to plot the data.
5. **Yield Monitor:** A mass flow sensor that has recently been developed operates on the idea of delivering microwave energy beams and measuring the amount of that energy that bounces back after striking the stream of seeds moving through the chutes. GPS receivers are utilised in all yield monitors to track the location of yield data and produce yield maps. Devices used in fodder crops to track weight, moisture, and other data on a per-bale basis are another type of yield monitoring system. Yield monitors are made up of a number of parts. They often contain a variety of sensors and other parts, such as a data storage device, user interface (display and keypad), and task computer, which is housed in the combine cab and manages the integration and communication of these parts. The sensors measure the speed of the separator, the ground speed, the mass or volume of the grain flow, and the grain itself. Grain yield is continuously monitored by measuring the force of the grain flow as it collides with a sensible plate in the combine's clean grain elevator.
6. **Precision Irrigation in Pressurized Systems:** Recent innovations in sprinkler irrigation are now being made available for commercial usage by regulating the motion of the irrigation equipment with GPS-based controls. In addition to motion control, wireless communication and sensor

technologies are being developed to keep track of soil and environmental conditions as well as the operation parameters of irrigation machines (such as flow and pressure) in order to increase the effectiveness of water application and crop utilisation. These technologies have amazing potential, but more work must be done before they can be bought on the open market.CTF is a whole-farm strategy that tries to reduce the costs associated with traditional methods by preventing unneeded crop damage and soil compaction by heavy machinery. Controlled traffic approaches use GNSS technology and decision support systems to restrict all field vehicles to the smallest possible area of permanent traffic lanes. Optimising the usage of fertilisers, starting with the three primary nutrients nitrogen, phosphorus, and potassium, is a significant application of precision agriculture in arable land. These fertilisers are administered consistently over fields at specific periods of the year in conventional farming. As a result, some areas experience overapplication while others experience underapplication. Overapplication, which permits nitrogen and phosphorus to leak from the field into the ground and surface waters, has a direct correlation to environmental cost.

Conclusion

In many developing nations, precision farming is still merely an idea, therefore it requires thoughtful assistance from both the public and business sectors to encourage its quick adoption. Exploration, analysis, and execution are the first three phases of a successful adoption, though. Environmental and economic concerns that now surround production agriculture can be addressed with precision agriculture. The idea of "doing the right thing in the right place at the right time" has a strong intuitive appeal, but questions remain regarding cost-effectiveness and the best methods to use the technical tools we now have. An all-out attempt should be made to leverage new technical inputs to transform the "Green Revolution" into a "Evergreen Revolution" in light of the pressing need of the day. Ultimately, the ability to swiftly and effectively find the knowledge required to lead the new technologies will determine how successful precision agriculture is. Using a systems perspective, precision farming offers a fresh approach to current agricultural problems like the need to strike a balance between productivity and environmental considerations. On cutting-edge information technology, it is based. It entails documenting and simulating soil and plant species variance, as well as integrating agricultural practises to satisfy site-specific needs.

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