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Precision Agriculture

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Precision farming or precision agriculture is about doing the right thing, in the right place, in the right way, at the right time. Managing crop production inputs such as water, seed, fertilizer etc to increase yield, quality, profit, reduce waste and becomes eco-friendly. The intent of precision farming is to match agricultural inputs and practices as per crop and agro-climatic conditions to improve the accuracy of their applications.

Why Precision Farming?

1. To enhance productivity in agriculture with respect to profit.
2. Prevents soil degradation in cultivable land.
3. Reduction of chemical use in crop production
4. Efficient use of water resources
5. Dissemination of modern farm practices to improve quality, quantity & reduced cost of production in agricultural crops

Advantages

Agronomical perspective: Use agronomical practices by looking at specific requirements of crop.
Technical perspective: allows efficient time management.
Environmental perspective: eco-friendly practices in crop.
Economical perspective: increases crop yield, quality and reduces cost of production by efficient use of farm inputs, labour, water etc.

The concept of precision farming is strictly based on the Global Positioning System (GPS), which was initially developed by U.S. (United States of America) defense scientists for the exclusive use of the U.S. Defense Department. The unique character of GPS is precision in time and space. Precision agriculture (PA), as the name implies, refers to the application of precise and correct amounts of inputs like water, fertilizers, pesticides etc. at the correct time to the crop for increasing its productivity and maximizing its yields. The use of inputs (i.e. chemical fertilizers and pesticides) based on the right quantity, at the right time and in the right place. This type of management is commonly known as “Site-Specific Management”.

Precision Farming or Precision Agriculture is generally defined as information and technology based farm management system to identify, analyze and manage spatial and temporal variability within fields for optimum productivity and profitability, sustainability and protection of the land resources by minimizing the production costs.

Tools and Equipment

Precision Farming is a combination of application of different technologies. All these combinations are mutually inter related and responsible for developments. The same are discussed below:

1. Global Positioning System (GPS): It is a set of 24 satellites in the Earth orbit. It sends out radio signals that can be processed by a ground receiver to determine the geographic position on earth. It has a 95% probability that the given position on the earth will be within 10-15 meters of the actual position. GPS allows precise mapping of the farms and together with appropriate software informs the farmer about the status of his crop and which part of the farm requires what input such as water or fertilizer and/or pesticides etc.

2. Geographic Information System (GIS): It is software that imports, exports and processes spatially and temporally geographically distributed data.

3. Grid Sampling: It is a method of breaking a field into grids of about 0.5-5 hectares. Sampling soil within the grids is useful to determine the appropriate rate of application of fertilizers. Several samples are taken from each grid, mixed and sent to the laboratory for analysis.

4. Variable Rate Technology (VRT): The existing field machinery with added Electronic Control Unit (ECU) and onboard GPS can fulfill the variable rate requirement of input. Spray booms, the Spinning disc applicator with ECU and GPS have been used effectively for patch spraying. During the creation of nutrient requirement map for VRT, profit maximizing fertilizer rate should be considered more rather than yield maximizing fertilizer rate.

5. Yield Maps: Yield maps are produced by processing data from adapted combine harvester that is equipped with a GPS, i.e. integrated with a yield recording system. Yield mapping involves the recording of the grain flow through the combine harvester, while recording the actual location in the field at the same time.

6. Remote Sensors: These are generally categories of aerial or satellite sensors. They can indicate variations in the colours of the field that corresponds to changes in soil type, crop development, field boundaries, roads, water, etc. Arial and satellite imagery can be processed to provide vegetative indices, which reflect the health of the plant.

7. Proximate Sensors: These sensors can be used to measure soil parameters such as N status and soil pH) and crop properties as the sensor attached tractor passes over the field.

8. Computer Hardware and Software: In order to analyze the data collected by other Precision Agriculture technology components and to make it available in usable formats such as maps, graphs, charts or reports, computer support is essential along with specific software support.

9. Precision irrigation systems: Recent developments are being released for commercial use in sprinkler irrigation by controlling the irrigation machines motion with GPS based controllers. Wireless communication and sensor technologies are being developed to monitor soil and ambient conditions, along with operation parameters of the irrigation machines (i.e. flow and pressure) to achieve higher water use efficiency.

10. Precision farming on arable land: The use of PA techniques on arable land is the most widely used and most advanced amongst farmers. CTF (contolled Traffic Farming) is a whole farm approach that aims at avoiding unnecessary crop damage and soil compaction by heavy machinery, reducing costs imposed by standard methods. Controlled traffic methods involve confining all field vehicles to the minimal area of permanent traffic lanes with the aid of decision support systems. Another important application of precision agriculture in arable land is to optimize the use of fertilizers especially, Nitrogen, Phosphorus and Potassium.

Scope and Adoption of Precision Farming in India

Precision agriculture for small farms can use small farm machinery and robots which will not compact the soil and may also run on renewable fuels like bio oil, compressed biogas and electricity produced on farms by agricultural residues. For small farms, precision agriculture may include sub-surface drip irrigation for precise water and fertilizer application, weed removal, harvesting and other cultural operations. Some of these robots are already being used on small farms in the US and Europe and it is expected that they may be deployed in large scale in the near future. For small farms, precision agriculture may help in sub-surface drip irrigation for precise water and fertilizer application and robots for weed control, harvesting and other operations. Similarly, drones have also been introduced in Japan and the U.S. for mapping the farms, identifying diseases and so on. Most robotic machines and drones are compact and thus suitable for small farms. India's small farms, therefore, are ideal for the large-scale application of precision agriculture.

The way forward

The most important component in taking PA forward will be in creating a huge resource of engineers, scientists and agriculturists to develop various components of the technology. Without excellent manpower and consequently good R & D, PA will not succeed. Unfortunately, most good students want to get into engineering and medical streams and ignorantly, agriculture becomes an afterthought. There is also a need for excellent engineers from institutions like IITs, NITs, etc. to design machinery like robots and drones for PA. This can be facilitated by establishing a new branch of engineering called agricultural mechanotrics or robotics where faculty and students from ICAR institutes, IITs, industries and farmers work together, interact and collaborate to develop smart systems for PA. Industries have to take charge since they will develop the machinery and set up the leasing agencies resulting in jobs creation in PA system and better students will pursue a career in agriculture.

Conclusion

Precision farming in many developing countries including India has numerous opportunities for farmers to identify better high yielding location specific crops and in fact a farmer turns in to a breeder to produce better and higher yielding varieties by using PA system. Three components, namely, ‘single PA technology’, ‘PA technology package’ and ‘integrated PA technology’, have been identified as part of the general adoption strategies of PA in developing countries. Suitable application sectors of these strategic components have been highlighted. PA may provide a platform for industrial corporate social responsibility (CSR) activity by helping the rural poor to improve their livelihood through high-tech farming. The government of India can facilitate in this process by giving soft loans to the industry so that they get encouraged and engaged themselves in agriculture and PA activities. High-tech PA therefore can help in bringing next green revolution in India and can produce tremendous rural wealth in a sustainable and environmentally sound way. In the light of today's urgent need, there should be an all out effort to use new technological inputs to make the 'Green Revolution' as an 'Evergreen Revolution'.

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