PRECISION FARMING:
THE FUTURE OF INDIAN AGRICULTURE

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INTRODUCTION

Precision agriculture is the management of spatial and temporal variability of the fields using ICT (Information, Computers and Technology). Spatial and temporal variability of the field and crop properties are analyzed, leading to areas of the field with common characteristics called management zones. Management zones can be used to apply the appropriate inputs to achieve the best management to increase profitability and reduce environmental impact. The concept of precision farming first originated in the United States of America during 1980s.

Precision-agriculture image by Montri Nipitvittaya/Shutterstock.com

Professor Pierre C. Robert who is considered as the father of precision farming defined precision farming as precision agriculture is not just the injection of new technologies but it is rather an information revolution made possible by new technologies that result in a higher level, a more precise farm management system.

It is an approach to improve the agricultural management by application of information technology (IT) and satellite based technology to identify, analyze and manage the special and temporal variability of agronomic parameters (e.g. soil, disease, nutrient water etc.) within field by timely application of only required amount of input to optimize profitability, sustainability, with a minimize impact on environment.

PRINCIPLE

In principle, the precision crop production technologies developed for field crops could be adapted to tree fruit production; and precision tree fruit production is precision farming applied to enhance orchard performance by optimizing fruit yield and quality while minimizing adverse environmental impacts.

NEED OF PRECISION FARMING:

• The global food system faces formidable challenges today that will increase markedly over the next 40 years. Much can be achieved immediately with current technologies and knowledge given sufficient will and investment. But coping with future challenges will require more radical changes to the food system and investment in research to provide new solutions to novel problems.

• The decline in the total productivity, diminishing and degrading natural resources, stagnating farm incomes, declining and fragmented land holdings, trade liberalization on agriculture, limited employment opportunities in non-farm sector, and global climatic variation have become major concerns in agricultural growth and development. Therefore, the use of newly emerged technology adoption is seen as one key to increase agriculture productivity in the future.

For assessing and managing field variability:

Precision agriculture offers the potential to automate and simplify the collection and analysis of information.

1. For doing the right thing in the right place at the right time
2. For higher productivity
3. For increasing the effectiveness of inputs
4. For maximum use of minimum land unit

Importance of Precision Farming

- Improve crop yield
- Provide information to make better management decisions
- Reduce chemical and fertilizer costs through more efficient application
- Ability to achieve optimum produce of uniform and higher quality
- Provide more accurate farm records
- Reduction in cost of cultivation and Increase in production efficiency of inputs
- Reduction in chemical doses through variable rate application technology
- Reduction in application of irrigation water, thus reduce the leaching of nutrients along with deep percolation
- Reduced runoff, erosion and sedimentation of water bodies and reduction in environment pollution

Components of Precision Farming in Fruit crops

1. REMOTE SENSING

Remote sensing is the process of detecting and monitoring the physical characteristics of an area by measuring its reflected and emitted radiation at a distance (typically from satellite or aircraft). The principle behind remote sensing is the use of electromagnetic spectrum (visible, infrared and microwaves) for assessing the earth's features.

2. GEOGRAPHIC INFORMATION SYSTEM (GIS)

Geographic Information System (GIS) is an important system which includes organised collection of computer hardware, software, geographic data and personal designed to efficiently captured, stored, update, manipulate, analyze and display all forms of geographically referenced information.

3. GLOBAL POSITIONING SYSTEM (GPS)

GPS is a navigation system based on a network of satellites that helps users to record positional information (latitude, longitude and elevation). It allows farmers to locate the exact position of field information, such as soil type, pest occurrence, weed invasion, water holes, boundaries and obstructions

4. DIFFERENTIAL GLOBAL POSITIONING SYSTEM (DGPS)

A technique to improve GPS accuracy that uses pseudo range errors measured at a known location to improve the measurements made by other GPS receivers within the same general geographic area.

5. VRT – VARIABLE RATE TECHNOLOGY

Variable rate technologies (VRT) are automatic and may be applied to numerous farming operations. VRT systems set the rate of delivery of farm inputs depending on the soil type noted in a soil map. Information extrapolated from the GIS can control processes, such as seeding, fertilizer and pesticide application, herbicide selection and application at a variable rate in the right place at the right time.

6. SENSOR TECHNOLOGIES

Various technologies such as electromagnetic, conductivity, photo electricity and ultra sound are used to measure humidity, vegetation, temperature, texture, structure, physical character, nutrient level, vapour, air etc. Remote sensing data are used to distinguish crop species, locate stress conditions, identify pests and weeds, and monitor drought, soil and plant conditions.

7. YIELD MONITORING AND YIELD MAPPING

Yield monitoring: Yield monitors are crop yield measuring devices installed in harvesting equipment. The yield data from the monitor is recorded and stored at regular interval along with positional data received from the GIS unit.

Yield mapping: Mapping of yield and correlation of that map with the spatial and temporal variability of different agronomic parameters helps in development of next season crop management strategy.

8. QUALITY MAPPING

In high value crops, quality is seen as the crucial factor for marketing. The influence of spatial variability of chemical soil properties on spatial pattern of fruit diameter was analysed in pear grown in continental, temperate climate.

APPLICATION OF PRECISION FARMING

1. Soil and crop sensing technology
2. Controlled environment structure
3. Precise space utilization
4. Precise Water management
5. Precise Nutrient Management: Fertigation, DRIS
6. Precision plant protection measures

CONSTRAINTS OF PRECISION FARMING

- Fragmented land holding (80 % farmers hold less than 2 ha land)
- Poor financial status of the farmers
- Prevalence of highly diversified crops or cropping sequences
- lack of specific software for PA of general Indian farmers
- Un-assured availability of quality seed or planting material of desired crop and variety