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Precision Farming – A Tool for Higher Production

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ARTICLE ID: 49

Abstract

Precision agriculture (PA) is the science of improving crop yields and assisting management decisions using high technology sensor and analysis tools. Precision farming technologies have been commercially available since the early 1990s, but the pace of adoption among U.S. farmers has been modest. This study examines the relationship between the adoption of diagnostic and application techniques of precision farming and sources of information available to farmers about precision farming models. Precision farming, or site-specific farming, has emerged as a promising group of technologies that could increase agricultural productivity with environmental stewardship. It is knowledge-based system that integrates many advanced information technologies. Precision farming enables farmers to apply precise amounts of fertilizers, pesticides, water, seeds or other inputs to specific areas where and when they are needed for optimal crop growth. The major components include grid sampling, Global Positioning System (GPS), geographic information systems (GIS), remote sensing, yield monitors, variable rate application (VRA), and computer simulation models.

Keywords: Global positioning system (GPS) , Geographical information system (GIS), Remote sensing, Variable rate application (VRA).

Introduction

Precision farming is an approach where inputs are in precise amounts to get increased average yields compared to traditional cultivation techniques. Hence it is a comprehensive system designed to optimize production by using a key element of information, technology, and management, so as to increase production efficiency, improve product quality, improve the efficiency of crop chemical use, conserve energy and protect environment. Thus, precision farming is an appealing concept and its principles quite naturally lead to the expectation that farming inputs can be used more effectively, with subsequent improvements in profits and environmentally less burdensome production. The precision farming developments of today can provide the technology for the environment friendly agriculture of tomorrow.

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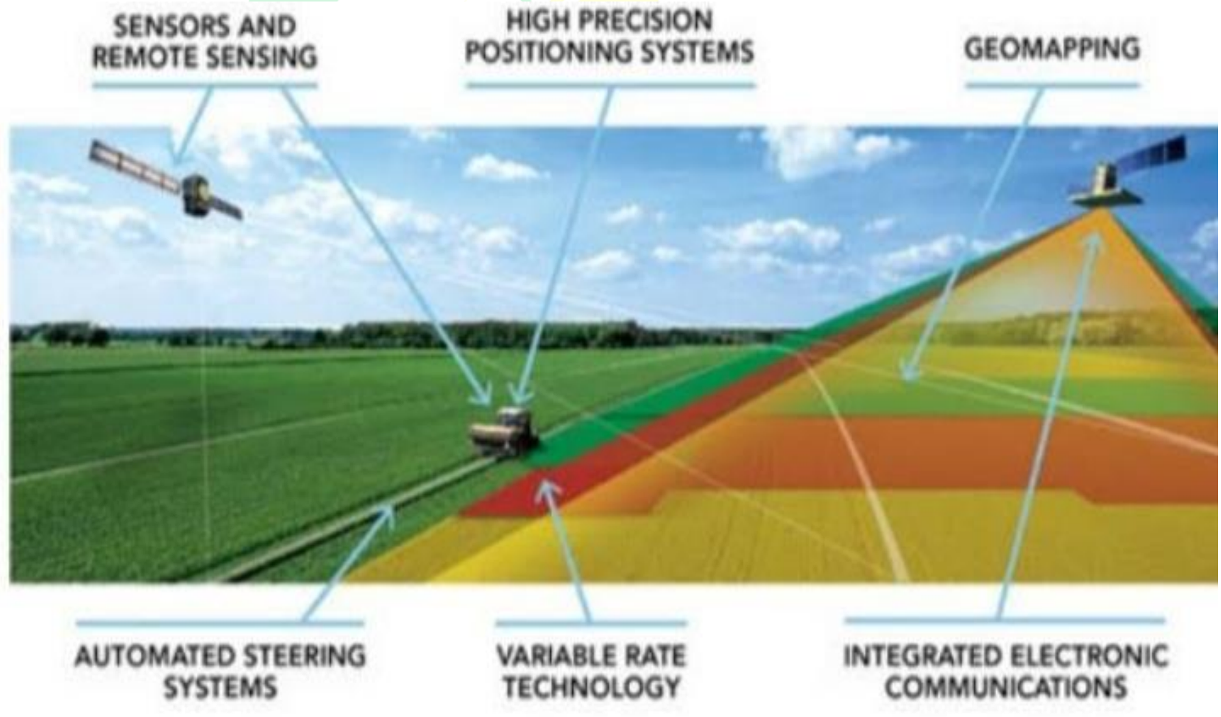
Requirement of Precision Farming

Precision global food system faces formidable challenges today that will increase markedly over the next 40 years. Much 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, lack of eco-regional approach, 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.



Components of Precision Farming

Geographical information system (GIS)

The precision farming is information-based technology that concerned with spatial and temporal variability wherein GIS is the key to extracting value from information on variability. GIS is the brain of precision farming system and spatial analysis capabilities of GIS that enable precision farming.

Global positioning system (GPS)

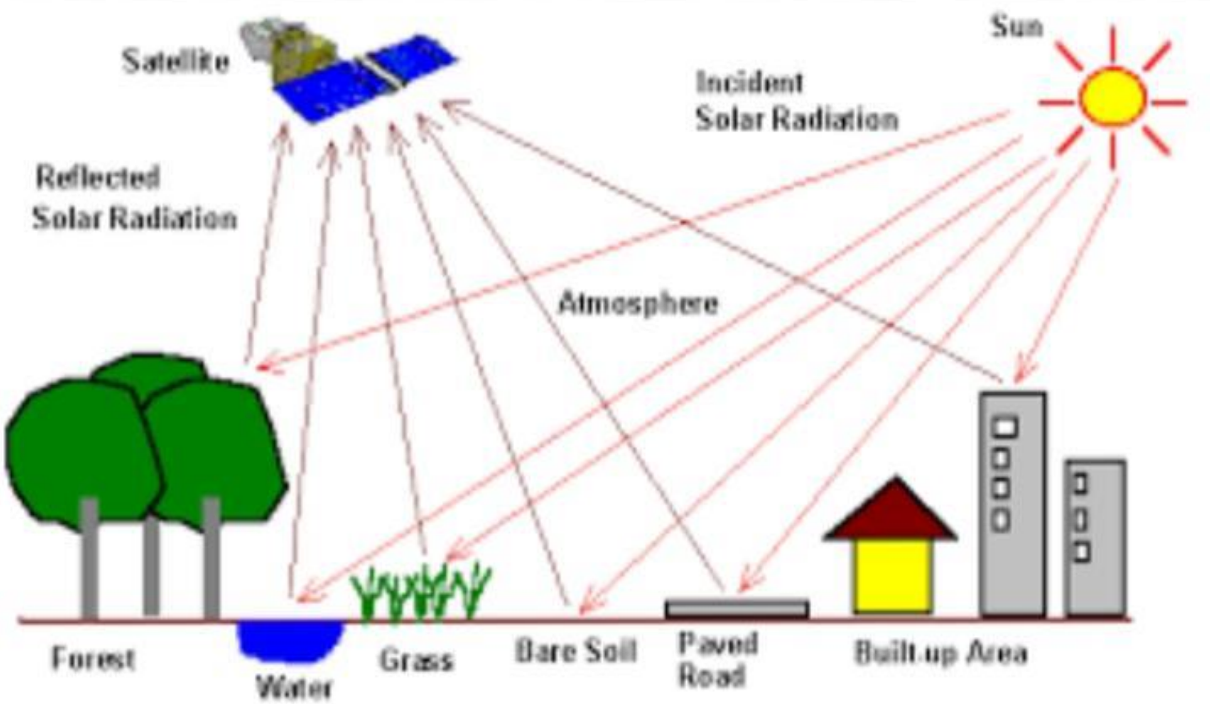
All phases of precision agriculture require positioning information and it can be provided by the GPS (developed by the US military) in an efficient manner. The GPS provides the accurate positional information, which is useful in locating the spatial variability with accuracy. The GPS can be used in two modes; single receiver mode and differential mode (DGPS) using two receivers. Single receiver collects the timing information and processes it into position.

Remote sensing

Remote sensing has been used in soil Mapping, terrain analysis, crop stress, yield Mapping and estimation of soil organic Matter, but on a scale larger than what is Required for precision agriculture. Remote Sensing at high resolution can be of great use In precision farming because of its capacity to Monitor the spatial variability. The remote Sensing satellites send a known signal towards the earth and portion of the signal is reflected Back. The image data are actively collected by Measuring these signals. Data are also Collected passively by measuring the sun's Energy reflected by an object or Electromagnetic energy emanated from an Object. Remote sensing can be of various Resolution, spectral coverage and frequency. In precision farming different applications Will require different spatial resolutions, Spectral coverage and frequencies. For eg., Measurement of the intensity of disease Infestation will require higher resolutions than What required for crop growth monitoring or Yield mapping.

Variable rate technology (VRT)

Variable rate application (VRA) in precision agriculture is an area of technology that focuses on the automated application of materials to a given landscape. The way in which the



materials are applied is based on data that is collected by sensors, maps, and GPS.These materials include things like fertilizers, chemicals, and seeds, and they all help optimize one's crop production. There are many forms of technology that are used in variable rate application for precision agriculture. They include everything from drones and satellites, to artificial intelligence (AI) and hyperspectral imaging. Regardless of which variable rate application technology is used, it is important to understand the general way in which this technology is applied.

Approaches for precision farming

In precision farming, inputs are to be applied precisely in accordance with the existing variability. Therefore, assessing the in-field variability soil and crop is very crucial and first step of precision agriculture. Spatial variability of all the determinants of crop yield (topography, soil properties etc) should be well recognized, adequately quantified and properly located. Construction of condition maps on the basis of the variability is a critical component of precision farming. Condition maps can be generated through (i) Surveys, (ii) Point sampling and interpolation, (iii) Remote sensing (high resolution) and (iv) Modeling.Grid sampling was the very first approach used to develop precision application maps wherein fields are sampled along a regular grid at sample spacing ranging from 60-150m depending on the field size and the samples are analysed for desired properties. The results of these analyses are interpolated to un-sampled locations by geo-statistical techniques viz. Kriging and Inverse Distance Weighing (IDW) and the interpolated values are classified using GIS techniques into limited number of management zones.

Crop management

Satellite data provide farmers a better understanding of the variation in soil conditions and topography that influence crop performance within the field. Farmers can, therefore, precisely manage production factors, such as seeds, fertilizers, pesticides, herbicides and water control, to increase yield and efficiency.

Soil and plant sensors

Sensor technology is an important component of precision agriculture technology and their use has been widely reported to provide information on soil properties and plant fertility/water status. A comprehensive list of current sensors as well as desirable features for new sensors to be developed in the future [9]. One of the most popular ways to characterize soil variability is surveying the field with soil apparent electrical conductivity (ECa) sensors that collect information continuously when pulled over the field surface. Because ECa is sensitive to changes in soil texture and salinity, these sensors provide an excellent baseline to implement site-specific management.

Yield monitor

Yield monitors are a combination of several components. They typically include several different sensors and other components, including a data storage device, user interface (display and key pad), and a task computer located in the combine cab, which controls the integration and interaction of these components. The sensors measure the mass or the volume of grain flow (grain flow sensors), separator speed, ground speed, grain. In the case of grains, yield is continuously recorded by measuring the force of the grain flow as it impacts a sensible plate in the clean grain elevator of the combine.

Precision livestock farming (PLF)

Precision livestock farming (PLF) is defined as the management of livestock production using the principles and technology from precision agriculture. Processes suitable for the precision livestock farming approach include animal growth, milk and egg production, detection and monitoring of diseases and aspects related to animal behaviour and the physical environment such as the thermal micro-environment and emissions of gaseous pollutants. Systems include milk monitoring to check fat and microbial levels, helping to indicate potential infections, as well as new robotic feeding systems, weighing systems, robotic cleaners, feed pushers and other aids for the stockman such as imaging systems to avoid direct contact with animals. New systems for data monitoring for feed and water consumption can be used to the early detection of infections is available now. Other developments include the monitoring on the growing herd where measurement of growth in real time is important to provide producers with feed conversion and growth rates.

Conclusion

Precision farming is still only a concept many developing countries and strategic support from the public and private sectors essential to promote its rapid adoption. Successful adoption, however, comprises at least three phases Including exploration, analysis and execution. Precision Agriculture can address both economic and environmental issues That surround production agriculture today. Questions remain About cost-effectiveness and the most effective ways to use the Technological tools we now have, but the concept of "doing the Right thing in the right place at the right time" has a strong intuitive Appeal. 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'. Ultimately, the success of precision agriculture depends largely on how well and how Quickly the knowledge needed to guide the new technologies can found.

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