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Precision Agriculture: The Future Aspects

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Introduction

Precision agriculture is one of the many modern farming practices that makes production more efficient. Farmers use precision agriculture practices for apply nutrients, water, seed and other agriculture inputs to grow more crops in a wide range of soil environments. Precision agriculture can help farmers to know how much & when to apply these inputs. It reduces the misapplication of inputs and increases crop productivity and the farm efficiency. The concept of precision agriculture offers the promise of increasing productivity while decreasing production cost and minimising environmental impacts. Precision farming system is based on the recognition or spatial and temporal variability in crop production. The three main components of precision agriculture are information, technology and management.

The general definition is information and technology based farm management system to identify, analyze & manage spatial and temporal variability within fields for optimum productivity and profitability, sustainability and protection for the land resource by minimizing the production costs. Simply put, precision farming is an approach where inputs are utilized in precise amounts to get enhanced average yields compared to traditional cultivation techniques. Hence it is a comprehensive system designed to optimize production with reduced adverse impact on our terrestrial system.

The major Components of precision farming

1. Remote Sensing (RS)
2. Global positioning system (GPS)
3. Geographical information system (GIS)

Remote Sensing

Remote Sensing deals with the art science of observing and measuring items on the Eaarth's surface from a distance. "Acquisition of physical data of an object without touch or contact."

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The term remote sensing was introduced in USA in the late 1950s.and Remote sensing definition was given by Parker.Ther term Remote sensing was first introduced in 1960 by Evelyn L. Pruitt, and he is also considered father of Remote sensing in World.
Pisharoth Rama Pisharoty was an indian physicist and meteorologist, and he is considered to be the father of Remote sensing in India.

Lillesand & kiefer, (2004) defined it as "The science and art for obtaining information about an object, area or phenomenon by the analytics of data acquired by a device which is not in direct contact with the object, area, or phenomenon under investigation."

Types of Remote Sensing

- **Active Remote Sensing**

  There exist two main types of remote sensing classified according to the source of signal they use to explore the object, active vs. passive. Active remote sensing instruments operate with their own source of emission or light, while passive ones rely on the reflected one. Radiation also differs by wavelengths that fall into short (visible, NIR, MIR) and long (microwave).Radars and lidars are the most epic examples of active remote sensing.

- **Passive Remote Sensing**

  Passive sensors in remote sensing do not streamline energy of their own to the researched object or surface, unlike active ones. Passive remote sensing depends on natural energy (sunrays) bounced by the target. For this reason, it can be applied only with proper sunlight, otherwise there will be nothing to reflect.Passive remote sensing employs multispectral or hyperspectral sensors that measure the acquired quantity with multiple band combinations. These combinations differ by the number of channels (two wavelengths and more). The scope of bands includes spectra within and beyond human vision (visible, IR, NIR, TIR, microwave).

Role of Remote Sensing in Agriculture

Remote sensing has been long used in monitoring and analyzing of agricultural activities. Remote sensing of agricultural canopies has provided valuable insights into various agronomic parameters. An advantage of remote sensing is its ability to provide repeated information without destructive sampling of the crop, which can be used for providing valuable information for precision agricultural applications. RS provides a cheap alternative

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for data acquisition over large geographical areas (De beurs and Townsend, 2008). In India, the satellite remote sensing is majorly used for the crop acreage and production estimation of agricultural crops. Remote sensing technology has the potential of revolutionizing the detection and characterization of agricultural productivity on the basis of biophysical attributes of crops and/or soils (Liaghat and Balasundram, 2010).

NDVI (Normalized Difference Vegetation Index) in Remote Sensing

The normalized difference vegetation index (NDVI), which is denoted from remote-sensing (satellite) data, is closely linked to drought conditions. To determine the density of green on a patch of land, the distinct wavelengths of visible and near-infrared sunlight reflected by the plants are observed. Range of NDVI is −1 to +1, but the typical range is between about 0.01 (NIR less than VIS for not very green area.) to 0.6 (for a very green area). Positive value for vegetation and crop, negative value for bare soil. Higher value of NDVI refers to healthy vegetation. Lower NDVI values show sparse vegetation where RED and NIR stand for the spectral reflectance measurements acquired in the red (visible) and near-infrared regions, respectively.NDVI is determines by Green seeker.

NDVI can be obtained by near-infrared radiation minus visible radiation divided by near-infrared radiation plus visible radiation and can be expressed as:

NDVI = (NIR - Red) / (NIR + Red)

Figure.1 Measuring NDVI by green seeker hand help optical

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Global Positioning System (GPS)

In the late 1980s, a new technology - the global positioning system (GPS)- became a valuable tool in spatial data acquisition.GPS allows farmers to accurately navigate to specific locations in the field, year after year, to collect soil samples or monitor crop conditions. Location information is collected by GPS receivers for mapping field boundaries, roads, irrigation systems, and problem areas of crops such as weeds or disease. The GPS is a navigation system based on a network of satellite that helps users to record positional information (latitude, longitude, and elevation) with an accuracy of between **100 and 0.01 m**.There are **24 satellites (21 in Use, 3 spares)** that make up the GPS space segment are orbiting the earth about **12,000 miles** above above grownd level , travelling at speeds of roughly 7,000 miles an hours. In GPS signal of at least three satellite is required to calculate a 2D position (latitude and longitude) and track movement. With signal from or more satellites, the receiver can determine the 3D position (latitude, longitude and altitude).

Geographic Information System (GIS)

GIS is powerful set of tools for collecting, storing, and retrieving the data at will, transforming and displaying the spatial data for particular purpose (Burrogh and McDonnell, 1998). The ability of GIS to analyze and visualize agricultural environments and work flows has proved to be very beneficial to those involved in the farming industry. Balancing the inputs and outputs on a farm is fundamental to its success and profitability. Spatial data are commonly in the form of layers that may depict topography or environmental elements. Nowadays, GIS technology is becoming an essential tool for combining various map and satellite information sources in models that simulate the interactions of complex natural systems. GIS can be used to produce images, not just maps, but drawings, animations, and other cartographic products. From mobile GIS in the field to the scientific analysis of production data at the farm manager's office, GIS is playing an increasing role in agriculture production throughout the world by helping farmers increase production, reduce costs, and manage their land more efficiently. While natural inputs in farming cannot be controlled, they can be better understood an managed with GIS applications such as crop yield estimates, soil amendment analyses, and erosion identification and remediation. To simulate regional crop productivity, the spatial crop model is developed firstly in this study by integrating Geographical Information System (GIS) with Environmental Policy Integrated Climate

(EPIC) model. (Wu Bingfng and Liu Chenglin .2000) worked on Crop Growth Monitor System with Coupling of AVHRR and VGT data. GIS provides ways to overlay different 'layers' of data: the ecological conditions, the actual physiognomy and human pressure indices. GIS is a layer based and thematic system which provides the flexibility to overlay and review the indices for various changes in the site. The technology is utilised to its fullest in the planning and managing.

S.No	Achievements	Year
1.	1st successful weather satellite	1960
2.	ISRO Formed	1969
3.	1st indian satellite, Aryabhata Launched	1975
4.	INSAT-1A Launched	1982
5.	1st Operational indian Remote sensing satellite (IRS-1A)	1988
6.	IRS - 1B launched	1991
7.	IRS - 1C launched	1995
8.	Successful flight test of GSLV	2001
9.	METSAT (Renamed Kalpana) by PSLV Launched	2002
10.	Launched of third generation INSAT-3A	2003

Table 1. Some Important Achievements

Conclusion

The development of precision agriculture cannot be separated from the advance of technology which is dynamic in accordance with the dynamic of environment and market demand. Therefore, PA research still play some part in the future agricultural development policy which is focused not only on the effort of inventing new technology but also on its technology dissemination so that it can reach and can be implemented on the farmer level.

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