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Implementation of Remote Sensing and GPS in Agriculture Sector

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***Abstract:** This paper analyzes on the application of Geographic Information System (GIS) and Global Positioning System (GPS) in the field of precision agriculture. There is an extensive use of the precision agriculture is seen in recent years which brings down many problems caused in traditional and recent developed practices. Precision Agriculture ensures safe, sustainable and modernized form of agriculture which helps the cultivators, analysts, and researches to study the farming in a wider perspective.*
***Keywords:** GPS, GIS, Remote sensing and Precision Agriculture.*

I. INTRODUCTION

Due to Industrial revolutions, agriculture practices in developed countries have tended to support greater energy inputs using large machineries and increased applications of chemicals and fertilizers. But using these practices leads to societal and environmental implications such as soil erosion and salinization, soil fertility, compaction of subsoils and soil/water pollution, they have generally supported the food and fiber needs of a rapidly growing human population.

A major shift towards the new and creative production method that ensures safe and sustainable agriculture. Across the world, Precision Agriculture (PA) is changing the way people farm as it offers a myriad of potential benefits in profitability, productivity, sustainability, crop quality, environmental protection, on-farm quality of life, food safety and rural economic development. The implementation of precision agriculture is done by improvising the traditional farming practices to maximum benefits to the small and large site specific locations.

PA is an innovative, integrated and internationally standardized approach which aims to increase the efficiency of resource use and to reduce the uncertainty of decisions required to manage variability on farms. It is one of the most modern and scientific approaches towards modern agriculture. There is an increasing requirement of using less chemicals in farming, which lead to development of a safer and less environmental impact agricultural products. In order to achieve this objective precision agriculture came as a valuable component in the frame work.

PA is based on innovative systems approach and these new systems approach depends on a combination of fundamental technologies such as Geographic Information System (GIS), Global Positioning System (GPS), computer modeling, ground based/airborne/satellite remote sensing, variable rate technology and advanced information processing for timely in-season and between season crop management.

A. The PA Database Generally Includes (Venkataratnam, 2001)

1) Crop information such as growth stage, health, nutrient requirement.
2) Soil physical and chemical properties, depth, texture, nutrient status, salinity and toxicity, soil temperature, productivity potential
3) Microclimatic data (seasonal and daily) such as canopy temperature, wind direction and speed, humidity
4) Surface and sub surface drainage conditions
5) Irrigation facilities, water availability and planning of other inputs

B. The Protocol for PA Implementation is Generalized to 3 Steps

1) Gathering information about variability
2) Processing and analyzing information to assess the significance of variability and
3) Implementing change in the management of inputs.

One of the major advantages of such applications is it provides vast information which can be referenced by millions of users this results in easy accessible information that can be used for implementing the new strategies in precision farming.

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II. 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). RS and GIS technologies has been extensively used by planners in planning for efficient use of natural resources at national, state and district levels.

The persons who are involved in farming industry got beneficial due to use of GIS since they have the ability to analyze and visualize agricultural environments and work flows. Balancing the inputs and outputs on a farm is fundamental to its success and profitability. In GIS, the spatial data are commonly in the form of layers, which may depict topography or environmental elements.

Application of these technologies in the management of natural resources are increasing rapidly due to great strides made in space-borne RS satellites in terms of spatial, temporal, spectral and radiometric resolutions (Venkataratnam, 2001).

This can be used to produce images, drawings, animations and other cartographic views. (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.

III.GPS

The advent of the Global Positioning System (GPS)has not only enhanced the ease and versatility of spatial data acquisition, but has also diversified the approaches by which it is integrated with remote sensing and geographic information systems (GIS)

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. It can be used for different requirements such as farm planning, field mapping, soil sampling, tractor guidance, crop scouting, variable rate applications, and yield mapping in precision agriculture

GPS is used to record the in-field variability as geographically encoded data. It gives a continuous data of the positions by simultaneously determining and recording the details of place. This technology considers the agricultural areas and fields in a more detailed manner, due to which the user can have a greater amount of database for analysis. The accurate yield data can be reported only in the points where GPS position recording has happened. GPS receivers coupled with yield monitors provide spatial coordinates for the yield monitor data. This can be included for the yield maps of each field. Information collected from different satellite data and referenced with the help of GPS can be integrated to create field management strategies for chemical application, cultivation and harvest. (Liaghat and Balasundram 2010).

IV.REMOTE SENSING

Remote Sensing (RS) is the science of obtaining and interpreting information from a distance, using sensors that are not in physical contact with the object being observed (Jensen, 1996) Remote Sensing is a key factor of PA and is being used by an increasing number of scientists, engineers and large-scale crop growers.

During the last two decades, development in RS data acquisition capabilities, data processing and interpretation of ground based, airborne and satellite observations have made it possible to couple RS technologies and precision crop management systems (Waheed et al., 2006).

These modern technologies involves to monitor regularly which can be used for enhancing the agricultural methods. This provides a better option like providing frequent turnaround time (24-48 hrs), High spectral resolution, low cost data, high spatial resolution and high temporal resolution.(10-15 days). (Oza et al., 2008) Currently the satellite data varies in 3 ways,

A. Technique (active/passive, radiometer/scatterometer),
B. Spatial resolution from sub meter to kilometres
C. Spectral range, and
D. Viewing geometry

V. USES OF GPS, GIS AND REMOTE SENSING

A. Crop Growth Stages

GIS, GPS and RS is majorly used to observe and track the growth of the crops. The information gathered are used to integrate the strategies used for field management creations for chemical application, cultivation and harvest. The maturity period, crop stresses such as nutrient and water stress, disease, pest and weed infestation can be identified by using RS and GIS.

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B. Weed Insect and Disease Infestation

Mapping is done for crop disease infestations which is carried out when crop is almost destroyed. GIS and RS in integrated form provide a solution where mapping for the disease incidences can be carried out. Once mapping is achieved experts can understand the causes which led to the crop infestations. Mapping the disease occurrences areas it can be spatially integrated with the agro ecological zones. This is the one of the major advantages of the GIS and Remote sensing since this provides maps and also the analytical tools of RS and GIS can be used to simulate and provide the farmers with the early warning system.

C. Soil fertility, Micro and Macro Nutrients

GIS and RS are basically layer based systems. This system provides the user with the flexibility of overlaying the various real world layers and finding the best model for précising the agriculture practices. The mapping of soil status as evident from the latest on-going National level projects where the soil sampling have been carried out. A national level datasets is being generated at village level scale. Mobile soil sampling units being run by National and State level Govt. not only conduct the soil test but also take sampling coordinated on the GPS . These datasets are then maintained at state level spatial inventory. The Soil mapping can be used for simulating crop yield with different sets of varieties and other agriculture inputs.

VI. CONCLUSIONS

Precision farming allows the precise tracking and tuning of production. The surveys in the field of agriculture are conducted all over the world in order to gather information on crops, field, fertility, nutrients, and other factors related to agricultural resources. These information is critical for effective management of depleting and scarce resources.

This also involves the factors risk i.e., as the amount of data increases the more work is needed to interpret the data and this increases the risk of misinterpretation. Farmers implementing this technique will work closer with several professionals under agricultural field. The future prospects for integrating GPS with remote sensing and GIS are in the development of enhanced location-aware multi-media PDA systems.

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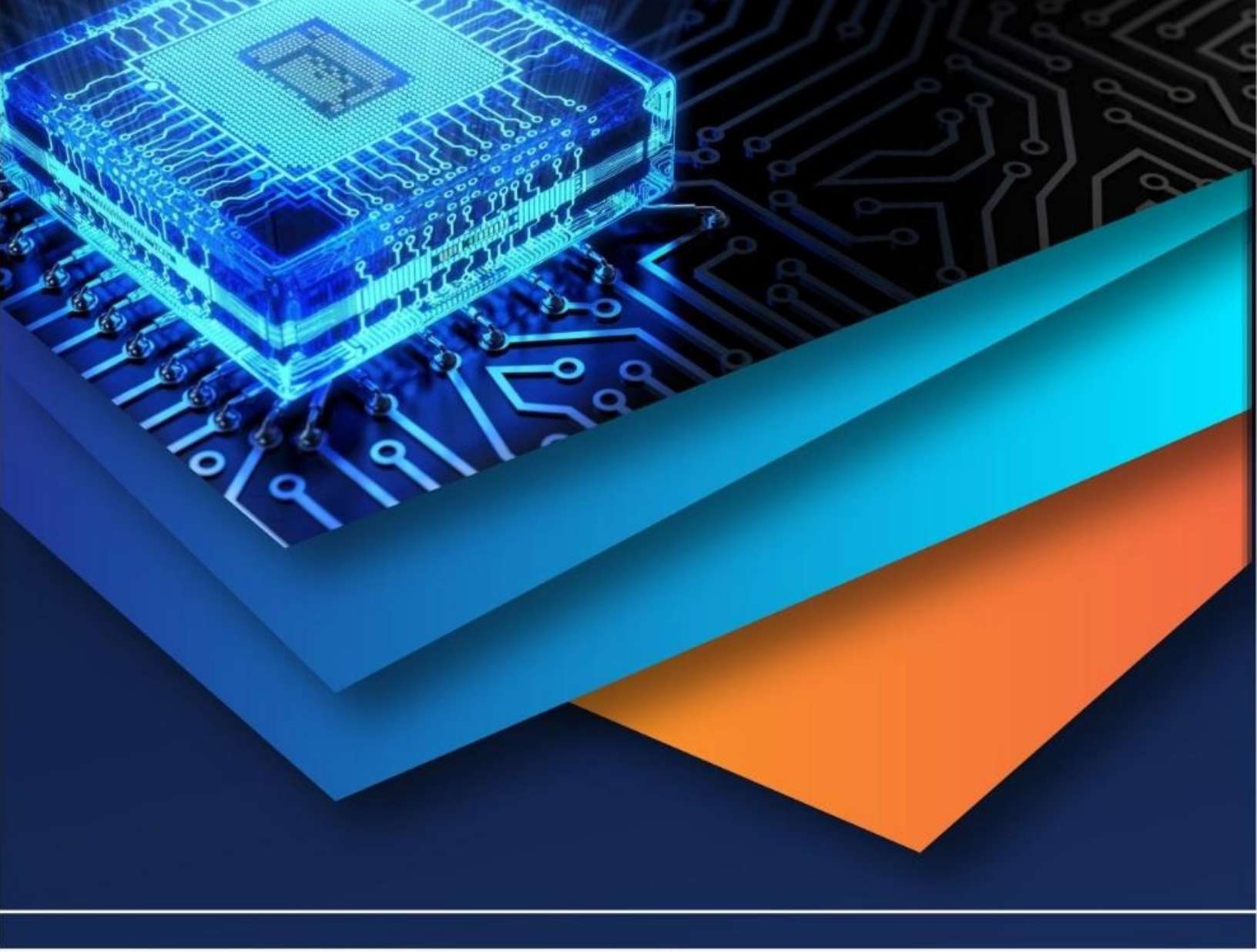

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