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Remote sensing application techniques in precision agriculture

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Abstract: ***Agriculture provides for the most basic needs of humankind: food and fiber. Precision agriculture is an emerging farm management strategy that is changing the way people farm. At present, there is an increasing commitment to reduce reliance on excessive chemical inputs in agriculture. Numerous technologies have been applied to make agricultural products safer and to lower their adverse impacts on the environment, a goal that is consistent with sustainable agriculture. Precision agriculture has emerged as a valuable component of the framework to achieve this goal. Precision agriculture is based on information technology, which enables the producer to collect information and data for better decision making. Precision agriculture is an emerging farm management strategy that is changing the way people farm. Precision farming (PF) refers to the use of geographical information to determine field variability, ensure optimal use of inputs and maximize the output from a farm (yield). Large tracts of land usually have spatial variations of soils types, moisture content, nutrient availability and so on. Therefore, with the use of remote sensing (RS), geographical information systems (GIS) and global positioning systems (GPS), farmers can more precisely determine what inputs to put exactly where and in what quantities. This information helps farmers to effectively use expensive resources such as fertilizers, pesticides and herbicides, and more efficiently use water resources.***

This paper highlights on remote sensing technology and describes how it can be used as an effective tool in precision agriculture.

Key Words: Agriculture provides, humankind, agriculture, management strategy, increasing commitment.

INTRODUCTION- Precision farming is one of the most scientific and modern approaches to sustainable agriculture that has gained momentum in 21st century. Precision farming aims to improve crop performance and environmental quality (Ray, 2010). It is said, "Precision agriculture is a phrase that captures the imagination of many concerned with the production of food, feed, and fiber". The concept of precision agriculture offers the promise of increasing productivity while decreasing production cost and minimizing environmental impacts. Precision agriculture conjures up images of farmers overcoming the elements with computerized machinery that is precisely controlled via satellites and local sensors and using planning software that accurately predicts crop development. This image has been called the future of agriculture. (Elham et al. 2015). Precision Farming (PF), also called Precision Agriculture (PA) or site specific crop management (SSCM) is an integrated information- and production-based farming system that is designed to increase long term, site specific and whole farm production efficiency, productivity and profitability while minimizing unintended impacts on wildlife and the environment" (Earl et al., 1996).

It is clear that precision farming has several advantages, but it can make farm planning and management both easier and more complex. It does not happen as soon as a farmer purchases a GPS unit or a yield monitor. It occurs over time as the farmer increases his level of knowledge regarding precision farming technologies and realizes that PF is an integrative approach to manage the whole farm and not only increase yields. What is perhaps the most important for the success of precision farming, at least initially, is the increased knowledge that a farmer needs of his natural resources in the field. This includes a better understanding of soil types, hydrology, microclimates and aerial photography. A farmer should identify the variance of fact or within the fields that affect crop yield before a yield map is acquired (Dra. Veronica Andreo 2013).

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Precision agriculture system that harnesses recent advances in sensor technology can play a crucial role toward an intelligent crop production system. Specifically, remote sensing technology that allows non-destructive acquisition of information about the Earth's surface can facilitate the implementation of PA. For example, current crop status (including maturity period) and crop stresses such as nutrient and water stress, disease, pest and weed infestations can be discerned by means of remote sensing instruments such as cameras, laser scanners, linear arrays and area arrays, without actually being in contact with them. Information gathered via different sensors and referenced using a GPS can be integrated to create field management strategies for chemical application, cultivation and harvest. This paper highlights on remote sensing technology and describes how it can be used as an effective tool in Precision Agriculture.

How can remotely-sensed data be used in agriculture- Remote Sensing technology is a key component of precision agriculture and is being used by an increasing number of scientists, engineers and large-scale crop growers.

There is a wide range of satellite data that varies in (i) technique (active/passive, radiometer/scatterometer), (ii) spatial resolution from submeter to kilometers (iii) spectral range, and (iv) viewing geometry (Oza et al., 2008). The full commercial availability of very high resolution satellite data has opened up a number of new opportunities for the use of Earth Observation (EO) data. Today, we can perform many applications with EO data that in only the recent past were exclusive to manpower investigation and in situ surveys, which was time- consuming and hard-sledding, despite the geographic limitations of such data and techniques. Satellite imagery can be acquired over any area globally, in a time frame and at a given price. At present, higher resolution satellite imagery overcomes previous constraints and permits the use of such data as a quick and easy tool for territorial management, including agricultural analysis, statistics and subsidy control. QuickBird is currently the satellite with the highest resolution which is available for agricultural and civilian uses .

New RS multispectral and hyperspectral sensors are swiftly generating vast amounts of data in a cost-effective manner and at higher spatial and spectral resolutions. Hyperspectral and multispectral images, consisting of reflectance from the visible, near infrared and mid-infrared regions of the electromagnetic spectrum, can be interpreted in terms of physical parameters (such as crop cover, crop health and soil moisture) and are useful for operations such as stress mapping, fertilization and pesticide application and irrigation management (Barnes and Baker, 2000; Barroso et al., 2008; Lelong et al., 1998; 2003).

RS techniques also play an important role in assessing crop condition and yield forecasting, acreage estimates of specific crops, detection of crop pests and diseases, disaster location and mapping, wild life management, water supply information and management, weather forecasting, rangeland management, and livestock surveys.

Some disease and insect pests of crops may be monitored by remote sensing. Riedell et al. (2004) introduced remote sensing technology as an effective and inexpensive method to identify pest-infested and diseased plants. They used remote sensing techniques to detect specific insect pests and to distinguish between insect and disease damage on oat. Results suggested that canopy characteristics and spectral reflectance differences between insect infestation damage and disease infection damage can be measured in oat crop canopies by remote sensing but that these differences may not be consistent from one growing season to the next.

Kurtz et al. (2009) used multi-temporal Landsat imagery in order to classify land cover types and grazing intensity. Grazing intensity categories were defined based on percentage of bare soil, sward height and standing dead material. Correlation analysis between spectral ratio, i.e. Normalized Difference Vegetation Index (NDVI), and above ground biomass, was significant. Meanwhile, Moreau and Toan (2003) utilized Synthetic Aperture Radar (SAR) data to quantify biomass in an Andean wetland for the purpose of optimizing livestock management. The signal sensitivity corresponding to biomass variation was high enough to facilitate high accuracy biomass mapping.

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In semi-arid Northeast of Brazil, Folhes et al. (2009) employed Landsat imagery in conjunction with an evapotranspiration model to measure water use levels in an irrigated area. Results showed that the combination approach of RS and process modeling produced better predictability of water consumption in irrigated agriculture, and hence improved water resource management in irrigated areas.

Remote sensing also provide useful information to detect and map disaster location. Data from the NASA'S MODIS (Aqua and Terra) and EUMETSAT'S MSG-SEVIRI satellite sensors were used to characterize fire disaster in Swaziland. Use of RS and GIS for fire disaster and risk assessment in a developing country, where fire monitoring resources are limited (Dlamini, 2009). Conversely, Yang et al. (2007) demonstrated that satellite-based RS is a very useful method of forecasting heavy rainfall.

RS applications in agriculture have progressed to a stage where information from RS imagery is being used for a number of policy level decisions related to food security, poverty alleviation and sustainable development. Decision on buffer stock of food grains could be based on pre-harvest crop acreage and production estimates while the ground water potential maps serve as a major source of information in ensuring drinking water and other needs in rain-fed and less favorable areas. Nationwide land use, land cover, soil and wasteland mapping have helped in expansion and intensification of agricultural activities and also in identification of land capability classes and crop suitability indices (Venkataratnam, 2001).

CONCLUSION- Precision farming is essential for serving dual purpose of enhancing productivity and reducing ecological degradation. With increasing population pressure throughout the world and the need for increased agricultural production, there is a definite need for improved management of the world's agricultural resources. To make this happen, it is first necessary to obtain reliable data on not only the types of resources, but also the quality, quantity and location of these resources. Satellite-or aerial-based RS technologies will become important tools in improving the present system(s) of acquiring and generating agricultural and natural resource data. Fast processing by GIS systems and increasing the accuracy of satellite images data with the help of data collected from location experimental data provide appropriate solutions. Pest and disaster control, crop estimation and evaluating the status of plant growth are provided at a very wide level by satellite data and reduce the adverse effects of plans on the environment and smooth the ways to achieve sustainable, environmental, and dynamic agriculture development.

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