



ICT TOOLS FOR PRECISION FARMING

Mr.Vivek Parashar¹, Mrs. Amrita Parashar²
Amity School of Engineering & Technology^{1, 2}
Amity University, Madhya Pradesh, INDIA

I. INTRODUCTION

Precision farming is a very popular term now a day's but the importance and the actual meaning of the term is still not known to the people of the underdeveloped and developing countries like India. Human started agriculture more than 10,000 years ago with no resources, but now a days with number of new innovations in the field of agriculture technology we are able to cope up the food requirement of upcoming generations by adopting various precision agricultural techniques. In this paper we are going to discuss various tools and techniques used in precision agriculture. Precision Farming is defined as information technology based, relatively better management system that identifies, procures, analyzes & manages, natural variability amongst the fields & optimizes productivity, profitability, sustainability, which protects the land resources. In India, out of 169.7 million hectare about 144 million hectare of land are affected by water or wind erosion alone depletion of water resources. Socio Economic need for enhanced productivity per Unit of land, water and time. Environment Pollution is increasing because of Increased Use of Fertilizers and Chemicals. PF is Essential in Order to Address Poverty Alleviation, Enhance Quality of Life & Food Security In past few decades government of India along with state governments and other development agencies initiated many Information and Communication Technologies (ICTs) projects but economic survey done by government of India in 2006-07 shows decline in production of food grains, even after adopting all measures with a current population of around 1.2 billion with a increasing rate of around 16 million per year we will be about 1.6 billion by 2050, according to 11th five year plan(2007-2012) the total food grain demand is about 244mt while the production is about 214-240mt which is below the required demand and with increasing population and decreasing agricultural land we need around 70% growth in agricultural outcome to feed the entire population as 25% of world under nourished people around 212 million is in India only. To achieve the required target we need strong Information and Communication Technologies (ICTs) support in the areas of agriculture, health, Micro and Small Enterprises (MSEs) and education. Investigations from the study revealed that ICTs play major roles in the socio economic development of rural areas in India with a huge potential for accelerated development in these rural areas. ICTs have contributed immensely to improve communications, deepen decentralization, and attract Micro and Small Enterprises (MSEs). ICTs have also contributed in automation of Rural Banks, networking, information sharing and the provision of ICT enhanced distance learning in the rural areas of India. However, there are some serious challenges militating against the full realization of ICTs role in India's rural development. Issues such as unavailability of electricity, lack of ICTs equipment, high level of illiteracy, user acceptance and local content have to be addressed before the full potential of ICTs role in India's rural development can be achieved. In this paper, we are trying to discuss and recommend some measures like e-Agriculture and Precision farming in a socioeconomic manner which government and other development agencies can adopt to address these challenges.

II. DATA GATHERING TOOLS

Real time data gathering of field is very important there are different ways to gather data two important ways are GIS and GPS

A. GIS

Burrough and McDonnell (1998)[1] has defined GIS as a powerful set of tools for collecting, storing, retrieving at will, transforming and displaying spatial data from the real world for a particular set of purposes. Application of GIS is revolutionizing planning and management in the field of agriculture. The technology that has given vast scope to the applicability of remote sensing-based analysis is 'Geographic Information System (GIS)'. GIS provides ways to overlay different 'layers' of data: the ecological conditions, the actual physiognomy and human pressure indices. Agriculture always plays an important role in economies of both developed and undeveloped countries. Here in this study, we have used satellite based earth observation data

to analyze and calculate crop inventory. More accurate and reliable crop estimates helped to reduce uncertainty in the grain industry. 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 and managed with GIS applications such as crop yield estimates, soil amendment analyses, and erosion identification and remediation. Yang [2] has integrated remotely sensed data with an ecosystem model to estimate crop yield in north China. His paper describes a method of integrating remotely sensed data (the MODIS LAI product) with an ecosystem model (the spatial EPIC model) to estimate crop yield in North China. The traditional productivity simulations based on crop models are normally site specific. 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 Bingfeng and Liu Chenglin [3] worked on Crop Growth Monitor System with Coupling of AVHRR and VGT data.

B. GPS

The global positioning system (GPS) makes possible to record the in-field variability as geographically encoded data. It is possible to determine and record the correct position continuously. This technology considers the agricultural areas, fields more detailed than previously; therefore, a larger database is available for the user. 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 made into 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 [4]. The development and implementation of precision agriculture or site-specific farming has been made possible by combining the Global Positioning System (GPS) and geographic information systems (GIS). These technologies enable the coupling of real-time data collection with accurate position information, leading to the efficient manipulation and analysis of large amounts of geospatial data. GPS-based applications in precision farming are being used for farm planning, field mapping, soil sampling, tractor guidance, crop scouting, variable rate applications, and yield mapping. GPS allows farmers to work during low visibility field conditions such as rain, dust, fog, and darkness.

C. REMOTE SENSING

When farmers or ranchers observe their fields or pastures to assess their condition without physically touching them, it is a form of **remote sensing** [5]. Observing the colors of leaves or the overall appearances of plants can determine the plant's condition. Remotely sensed images taken from satellites and aircraft provide a means to assess field conditions without physically touching them from a point of view high above the field. Most remote sensors see the same visible wavelengths of light that are seen by the human eye, although in most cases remote sensors can also detect energy from wavelengths that are undetectable to the human eye. The remote view of the sensor and the ability to store, analyze, and display the sensed data on field maps are what make remote sensing a potentially important tool for agricultural producers. Agricultural remote sensing is not new and dates back to the 1950s, but recent technological advances have made the benefits of remote sensing accessible to most agricultural producers. Remotely sensed images can be used to identify nutrient deficiencies, diseases, water deficiency or surplus, weed infestations, insect damage, hail damage, wind damage, herbicide damage, and plant populations. Information from remote sensing can be used as base maps in variable rate applications of fertilizers and pesticides [6]. Information from remotely sensed images allows farmers to treat only affected areas of a field. Problems within a field may be identified remotely before they can be visually identified.

III. SOIL SAMPLING AND MAPPING

Soil sampling is the first step in generating field-specific information on which to base lime and fertilizer decisions and in monitoring soil nutrient status over time. Technological advances in GPS (global positioning systems) and GIS (geographic information systems) let producers design more intensive soil sampling schemes and to use this information for lime and fertilizer management decisions. Precision soil sampling provides information to identify localized regions of nutrient deficiencies and excesses within fields, increase lime and fertilizer use efficiency by directing applications to specific sites, and increase nitrogen

use efficiency (which reduces leaching and runoff losses) by correcting other nutrient deficiencies. In contrast, the analysis of a composite soil sample from a field provides lime and fertilizer response data for average field conditions. Since fields are not uniform with respect to acidity and nutrient levels, each field consists of regions with differing lime and fertilizer needs. Both grid and directed sampling are used to describe soil properties for management of variable rates of fertility. Grid soil sampling involves sampling at points on a square grid throughout a field. An alternative to grid sampling is directed sampling, which involves dividing a field into regular or irregular management zones based on features such as soil type, topography, or past yield performance. In either system, collect at least five or six subsamples from each cell or zone and mix them into one sample container [7]. The soil samples are collected from each section and then forwarded to a laboratory for analysis often guided by the advisory service. It is absolutely necessary to take care to assure that the soil sample you send to the laboratory accurately represents the area sampled [8]. When soil fertility data is returned from the soil testing lab, you can enter the data into your mapping program to create fertility maps.

A. SOIL ELECTRICAL CONDUCTIVITY

Soil EC is one of the simplest, least expensive soil measurements available to precision farmers today. Soil EC is a measurement that integrates many soil properties affecting crop productivity. These include water content, soil texture, soil O.M., depth to claypans, CEC, salinity, and exchangeable calcium (Ca) and magnesium (Mg). The two primary methods of measuring soil conductivity are by electromagnetic induction (EMI) or by means of direct contact. Contact methods use at least four electrodes that are in physical contact with the soil to inject a current and measure the voltage that results. On the other hand, EMI does not make contact but instead uses a transmitter coil to induce a field into the soil and a receiver coil to measure the response. Research has shown that the two methods produce similar results [9].

IV. VARIABLE RATE APPLICATION

Agricultural technologies using the global positioning system (GPS) and geographic information systems (GIS) have started to change how farmers are managing cropland. With these tools and the desire to manage existing field variability, variable-rate technology (VRT) has evolved. VRT describes any technology that enables the variable application of inputs. Therefore, VRT mounted on equipment permits input application rates to be varied across fields in an attempt to site-specifically manage field variability. This type of strategy can reduce input usage and environmental impacts along with increasing efficiency and providing economic benefits [10][11]. Variable-rate technology combines a variable-rate (VR) control system with application equipment to apply inputs at a precise time and/or location to achieve site-specific application rates of inputs. A complement of components, such as a DGPS receiver, computer, and VRA software and controller are integrated to make VRT work. Three different approaches exist to implement VRT: map-based, sensor-based, and manual. In the map-based approach, a prescription map is generated based on soil analyses or other information and then used by the VRT to control the desired application rate within each zone. In sensor-based approach system utilizes sensors to assess crop or field conditions to provide real-time VRA of inputs. Manual control can also be used to vary the application rates with the operator responsible for changing the rates on the controller during operation.

V. USE OF SENSORS FOR AUTOMATION

Many type of sensors are available now a days for measuring soil properties or variable rate application few type of sensors are explained below Electromagnetic Sensors are used for measuring electrical conductivity of the soil which helps in identifying various properties of soil so soil texture, salinity, organic matter, and moisture content, Optical sensor measure light reflections for identifying the properties clay, moisture organic contents, Mechanical sensors are used to identify the compaction of soil for proper cultivation, Electrochemical Sensors are used to measure the pH value of the soil. Life of sensor network is again a issue as it consists of batteries which will depletes after a given time frame hence using correct routing technology and packet size is very important [12]. Use of image processing techniques for identifying various defects in the growth of plants, diseases and various insects can also be used for timely identification of diseases and other issues [13].

VI. CONCLUSION

Precision farming techniques are the only way to feed the upcoming generations as the productivity of land is decreasing day by day because of excessive use of chemicals, fertilizers and unawareness of the farmer

specially in developing countries like india also the availability of precision farming tool is not frequently available in these countries and the level of literacy is also low which is a big hurdle in implementing the technology hence this is the responsibility of the government, universities and non-government organisations to spread the awareness about the technology and to find out the ways to reduce the cost of equipments by manufacturing them at local level which will also help in generating job opportunities for skilled people.

REFERENCES

1. Burrough, P.A., McDonnell, R.A., 1998, Principles of geographic information systems. Oxford University Press, Oxford, UK, pp 10–16
2. Yang, P., Tan G.X., Zha, Y., Shibasaki, R., 2004, Integrating remotely sensed data with an ecosystem model to estimate crop yield in North China. In: The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences, Istanbul, Turkey, Vol. XXXV, Part B7, pp 150-155.
3. Bingfng, W., Chenglin L., 2000, Crop Growth Monitor System with Coupling of AVHRR and VGT Data, vegetation 2000, conference, Lake Maggiore – Italy.
4. Liaghat, S., and Balasundram S.K., 2010, A Review: The Role of Remote Sensing in Precision Agriculture. American Journal of Agricultural and Biological Sciences 5(1): 50-55.
5. Adamchuk, V.I., Perk, R.L., & Schepers, J.S. 2003. Application of remote sensing in site-specific management. University of Nebraska, Cooperative Extension. Institute of Agriculture and Natural Resources.
6. Grisso, R., Alley, M., Thomason, W., Holshouser, D. & Roberson G.T. 2011. Precision farming tools: variable-rate application. Virginia Cooperative Extension, College of Agriculture and Life Sciences, Virginia Polytechnic Institute and State University
7. Stombaugh, T.S., Mueller, T.G., Shearer, S.A., Dillon, C.R. & Henson, G.T. 2001. Guidelines for adopting precision agricultural practices. Cooperative Extension Service, College of Agriculture, University of Kentucky.
8. Thom, W.O., Wells, K.L. & Murdock, L.W. 1997. Taking soil test samples. Cooperative Extension Service, College of Agriculture, University of Kentucky.
9. Sudduth, K.A., N.R. Kitchen, S.T. Drummond. 1998. Soil conductivity sensing on claypan soils: comparison of electromagnetic induction and direct methods Proceedings of 4th International Conference on Precision Agriculture. 979-990
10. Adamchuck, V.I. & Mulliken, J. 2005. Site-Specific Management of Soil pH (FAQ). University of Nebraska-Lincoln, Extension EC05-705.
11. Roberts, R.K., English, B.C. & Mahajanashetti, S.B. 2001. Environmental and economic effects of spatial variability and weather. In: Proceedings of the 3rd European Conference on Precision Agriculture . Edited by S. Blackmore & G. Grenier. AGRO, Montpellier, France, 545-550.
12. Vivek Parashar, Geetam S. Tomar, Ashish Doorwar. " Behavior of Cluster Based Wireless Sensor Network at Different Packet Sizes ", International Journal of Engineering Research & Technology (IJERT) (Vol.2 - Issue 10 (October - 2013)) , ISSN: 2278-0181.
13. Amrita Parashar, Vivek Parashar."Face recognition using multi scale frequency and orientation Gabor features with one against one Multiclass SVM classifier", " , International Journal of Advance research in Computer Science and Software Engineering (IJARCSS) (Vol.4 - Issue 4 (April – 2014)) , ISSN: 2277 128X.