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Determination and investigation of information technology parameters effective to precision agricultural development

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In this research IT parameters that are effective to PA development has been investigated. Also the effective present of those parameters in PA development was determined. According to the results GIS, GPS, DBA, MIS and MCS are respectively more effective in PA development. The results of research showed that using the DBA could improve the electronic field management, using Internet can improve the PA development. Also IT indexes have played a significant role in the development and use of simulation models of agricultural systems, in the development and use of spatial and temporal datasets of relevance to the management of the rural sector. Results of this research can help managers of agricultural ministry to planning precision farming development.

Key words: Information technology, precision agriculture, IT parameters, management

Introduction

Information technology (IT) parameters are very important to the Precision agriculture (PA) development. PA is a rapidly developing methodology heavily tied to proprietary standards across many manufacturers. This makes it difficult and frequently frustrating to develop complete PA systems that encompass yield monitoring and variable input rate technology. Software often lags the pace of hardware development and is ever changing. The result is that the various data file types created by geo-referencing instrumentation are frequently incompatible among different brands of DGPS receivers/monitors and commercial GIS software (Srinivasan, 2006; Baschab *et al*., 2007).

Today, agriculture demands improved productivity and efficiency. Cutting costs, saving time and ensuring the entire agricultural enterprise is more efficient and accountable, is essential to compete in domestic and global

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markets. Positioning, wireless, and information technologies are changing the farmer relationship with the land, bringing them quite literally down to earth. Farmers can now manage every aspect of agricultural operations to improve overall productivity and efficiency from planting to harvest. Now in this year, emphasis is being focused on improved seasonal forecasting, improved access to use of climate data, and improved management of climate variability per se, including making use of decision support systems (DSS) and remotely sensed data (Smith and McKeon, 1998; White *et al*., 1999). Some tools access large databases for information, while others use mathematical models to simulate the whole, or part of a grazing enterprise. CSIRO has developed the GRAZPLAN series of DSS tools to assist decisions about the feeding of livestock and the management of grazing enterprises (Donnelly *et al*., 1997). Other technologies to aid the farmer include `precision farming' in which the information from yield monitors on harvesting equipment, real-time GPS (Global Positioning Systems) and other information technologies is integrated to improve crop management (Cook and Bramley, 2000). This is done by improving crop management by reducing the level of uncontrolled variation that currently exists in farming systems. Addressing problems of land degradation were used in these years in precision agriculture. Novel applications of computers and related technologies are also enabling such problems to be addressed. These include models to better understand the causes of land degradation and how they may be alleviated (White *et al*., 1993).

Studies included using grassland and crop models and remote sensing to determine the severity of drought in different environments. These studies are reported in a special issue of Elsevier's Agricultural Systems (July 1998). It was concluded that rainfall, soil moisture, grassland and crop production (or an index thereof), NDVI data, live weight gain, supplementary feed requirements, and net farm income or a measure of financial stress are all useful indicators of exceptional droughts. The feasibility of taking account of significant long-term climate shifts in assessing droughts has also been demonstrated (Smith and McKeon, 1998). Srinivasan (2006) stated that nutshell some recent application of IT maintained as near real-time interpolated grids or surfaces of climate variables. Soil maps with linked parameter sets (e.g. available water range) derived from field collection and soil surveys. Pasture community maps with linked parameters derived from pasture enclosure studies, grazing trials and extensive field assessment. Estimates of tree density derived from time series of remotely-sensed green cover. Time series of reported sheep and cattle numbers, and estimates feral animal densities. The use of forecasts based. The grazing systems model GRASP which simulates soil water balance and dry matter flow in woodlands comprising grasses and trees and a supercomputing environment allowing data storage and daily time-step simulation were concerned.

Subject of this research was determination and investigation of IT parameters that are effective to PA development. Also the effective present of those parameters in PA development have been determined.

Materials and methods

IT parameters that are effective to PA development have been determined and investigated by spreading the question sheet among our populations. Statistical population to determine the IT parameters was the employers and managers of Agricultural Ministry. Data of question sheets has been analyzed by statistical software (SPSS) and useful information was extracted from them.

Independent variables in this study were IT parameters. IT parameters that have been considered as follows:-

Internet

Global positioning system (GPS)

The ability to know where you are and where you are going is crucial to many activities. Over the years, all kinds of technologies have tried to help us figure this out. To date, none have had more impact than the Global Positioning System (GPS). GPS farming systems provide precise guidance for field operations, or collection of map data on tillage, applications, planting, weeds, insect and disease infestations, cultivation and irrigation.

Machine control systems

Machine control systems automate equipment to save time and costs associated with field operators.

Geographic information system (GIS)

Field data can be downloaded to office systems to analyze management, practices and determine optimal strategies for infield operations. For example, a farming GIS database might include layers on field topography, soil types, surface drainage, subsurface drainage, soil testing results, rainfall, irrigation, chemical application rates, and crop yield. Once this information is gathered, it can be analyzed to understand relationships between the different elements that affect crop production in a specific location.

Decision support system (DSS)

Computer-based decision support system (DSS) tools are designed to help farmers to focus on features of their business that lift profitability and to estimate the biological and financial risks.

Management information system (MIS)

Management information systems (MIS) are the study of the design, implementation, management and use of information technology applications in field to get different report about the field for get decision.

Strategic information systems (SIS)

A process for developing a strategy and plans for aligning information systems with the business strategies of an organization, any farmer can use this technology to get these supports.

- Top management in huge farm assures that core competencies and strategic direction are fully supported by IS.
- Middle and operational management end up with the tools they need to make immediate and informed decisions.
- Marketing & Customer Service Management of farmer is able to provide better sales and follow-on support.
- Information management is better able to manage expectation and technology decisions at all levels of the organization.

Data base application (DBA)

A database is a structured collection of records or data that is stored in a computer system. The structure is achieved by organizing the data according to a database model. The model in most common use today is the relational model. Other models such as the hierarchical model and the network model use a more explicit representation of relationships.

PA is exposed to several factors, including , site & boundary verification, soil sampling, yield monitoring, electrical conductivity measurements, variable-rate fertilizer application, monitoring herbicide applications, 2 and 3 D surface mapping models and wire Grids, static and dynamic DGPS source comparisons, herbicide application and weeds species mapping, identify individual and patches of plants with RTK and GPS, Electronic field management. These were dependent parameters in this study.

Results

IT indexes have played a significant role in the development and use of electronic benefit to precision agriculture. The results showed that the benefit percent of each IT parameters on PA indexes.

Site and boundary verification

One of the initial steps in the application of precision agriculture is site verification and mapping field or regional boundaries. This involves using differentially corrected GPS to digitize single points or sets of points (lines and polygons) and to geo-reference those points with respect to latitude, longitude, and elevation. Results showed that GPS is an important factor to develop this PA index. Results showed that GPS is more important than other parameters to develop the site and boundary verification. Fig. 1 shows the effect of each IT parameters on Site and Boundary Verification.

Soil sampling

With geo-referenced soil tests, the spatial distribution of soil physical and chemical properties at specific depths can be plotted by GIS software to produce color maps depicting soil variability. According to questioning, the result showed that GIS is more important factor to develop this factor to PA index (Fig. 2).

Yield monitoring

Real-time, geo-referenced grain yield, test weight, and moisture content data are stored on electronic media and subsequently plotted by GIS software to produce yield maps corrected to constant moisture content and field summaries on a load-by-load basis. According to Fig. 3 GIS and MCS are respectively more important factors to yield monitoring system. GIS and MCS can help us to determine the yield operating.

Electrical conductivity measurement

Soil electrical conductivity (EC) has the potential to identify and quantify contrasting soil areas within a field. This information may be highly relevant to site-specific management. The objective was to use EC maps as an easily obtained foundational data layer to interpret soil variability and thereby enable optimization of production inputs based on that variability. DBA and MIS are two parameters that help us to improve the efficiency of electrical conductivity measurement. Fig. 4 shows the effect of each IT parameters on electrical conductivity measurement.

Variable rate fertilizer application

The Geo-referenced soil analyses or other quantified variables can be interpolated by GIS software to generate maps that divide fields into zones having similar levels of specific attributes (e.g., nutrients, texture, organic matter, weed pressure, insect infestations, etc.). Such maps are fundamental to prescription application of production inputs and can drive variable-rate controllers. Results showed that four factors respectively are effective to improve the ability of farmer to determine rate fertilizer machine. Those are GIS, MCS, DBA, and MIS (Fig. 5).

Monitoring herbicide application

A light bar or automated guidance system provided precise, reliable, parallel swathing for a variety of farming operations. This technology is often used for planting and spraying and can help to reduce costs by minimizing skips and excessive overlap. The more effective parameters to monitoring herbicide were MCS, GPS, and GIS. To improve the ability of farmer to monitor the herbicide application to their field, these factors can be developed at their area (Fig. 6).

2 and 3-D surface mapping models and wire grids

GIS software supports interpolation of discrete XYZ data into regularly spaced grids to produce different types of 2- and 3-D maps including, contour, vector, wire frame, image, shaded relief, and surface. Fig. 7 shows the effect of each IT parameters on two and three surface mapping models and wire grids.

Static and dynamic DGPS source comparisons

GPS is most important factors to improve this index (Fig. 8). Static (non-mobile) and dynamic (mobile) comparisons of differences in the accuracy and variability of position fixes derived from autonomous GPS and three DGPS sources referenced to Real Time Kinematics (RTK) GPS allow assessment of DGPS performance across sources.

Herbicide application and weeds species mapping

Variable-rate technology is suited for efficient comparison of herbicide treatments and measurement of response by geo-referencing counts of weed species and crop yield using a one meter square grid in treated and control areas. This research was to improve this subject more useful IT parameters is DSS, MIS, SIS, and DBA (Fig. 9).

Identify individual and patches of plants with RTK and GPS

GPS is effective parameter to identify individual and patches of plants. Long term terrestrial ecological studies have typically involved the need to return to an individual point or sample plot, which requires a stake or marker in the ground (metal, wood, plastic). There are problems with any size or type of marker. The typical solution to livestock problems has been used markers that are small and cryptic, or large and robust. But small markers are difficult for human to find, especially in dense cover, and conspicuous markers attract livestock (Fig. 10).

Electronic field management

According to results, entire information technologies are affected to improve the electronic field management. The MCS is the most effective IT parameter to improve precision farming (Fig. 11).

Knowledge and skills improvement

The most information technology parameters to improve knowledge and skills and relationship between farmers are Internet. The internet is opening up all sorts of opportunities for scientists and crop and livestock producers in the world to communicate with each other, exchange information, `virtually visit' each other's institutions and collaborate in addressing common goals and issues. (Fig. 12).

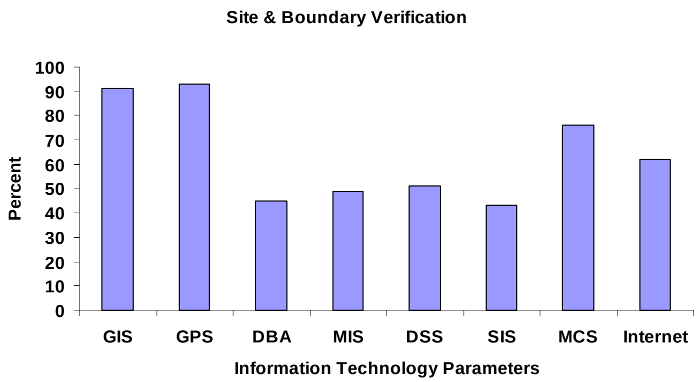

Fig. 1. The effect of each IT parameters on site and boundary verification.

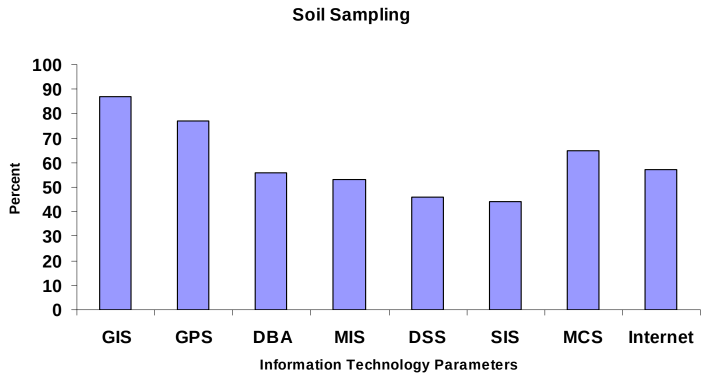

Fig. 2. The effect of each IT parameters on soil sampling.

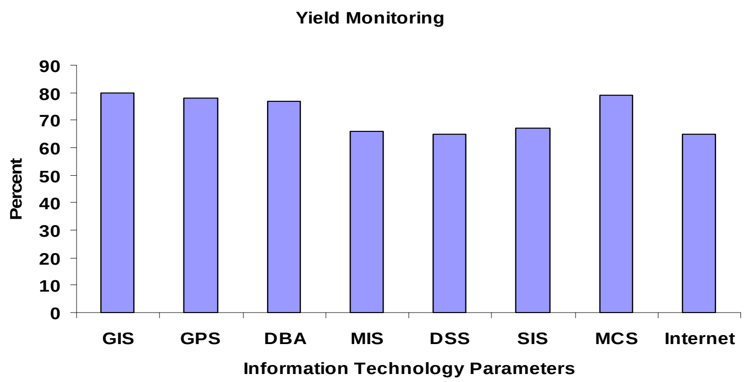

Fig. 3. The effect of each IT parameters on yield monitoring.

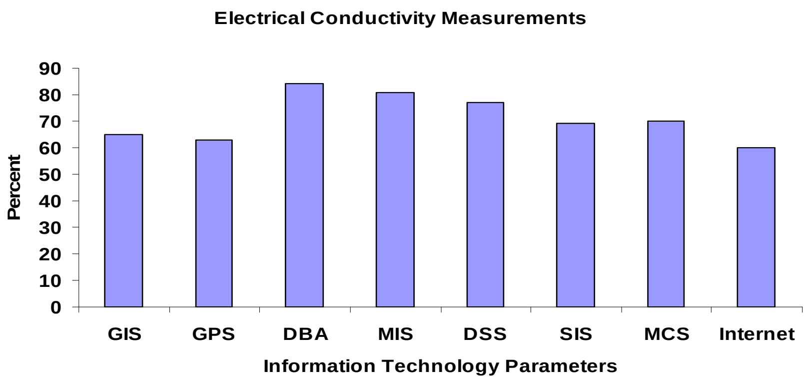

Fig. 4. The effect of each IT parameters on electrical conductivity measurement.

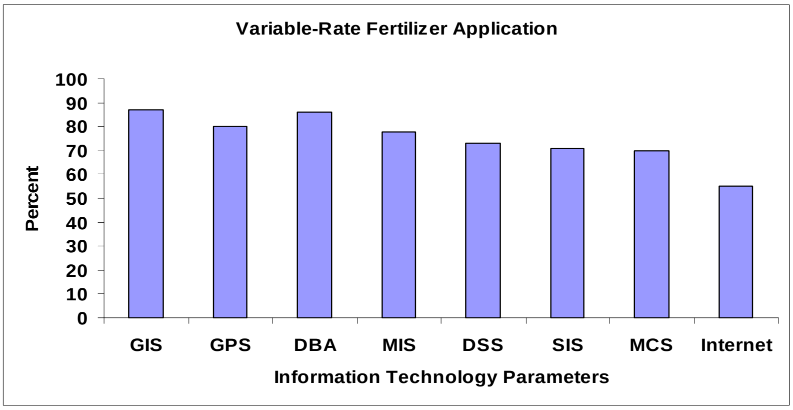

Fig. 5. The effect of each IT parameters on variable rate fertilizer application**.**

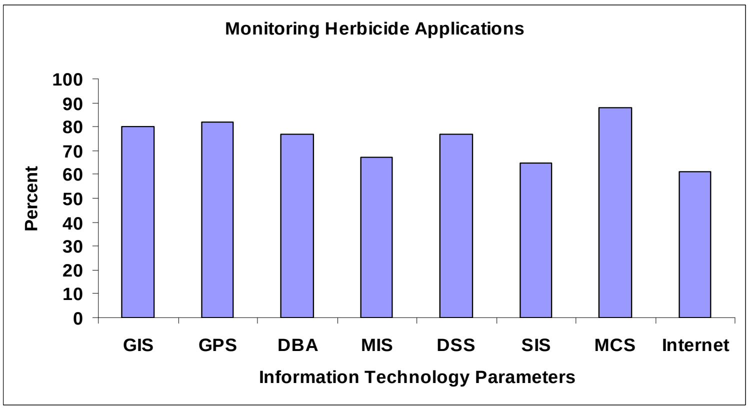

Fig. 6. The effect of each IT parameters on monitoring herbicide application.

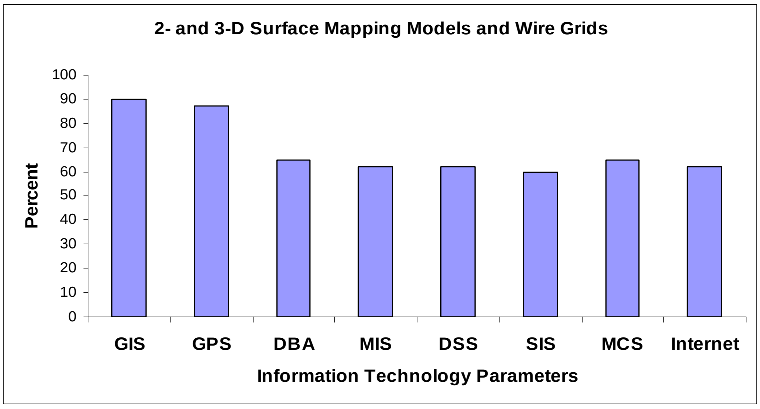

Fig.7. The effect of each IT parameters on two and three surface mapping models and wire grids.

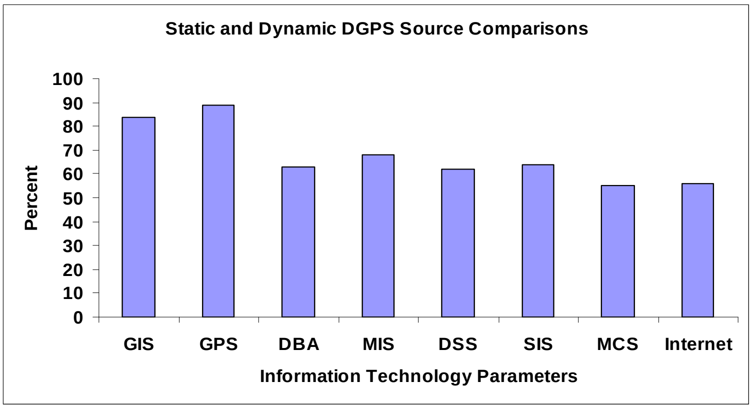

Fig. 8. The effect of each IT parameters on static and dynamic DGPS source comparisons.

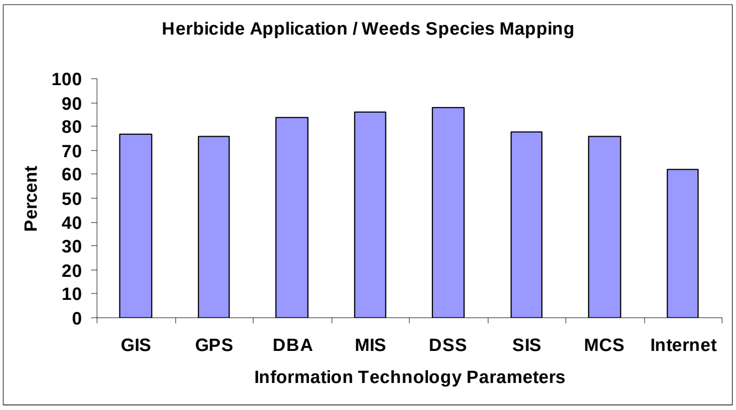

Fig. 9. The effective of each IT parameters on herbicide application and weeds species mapping.

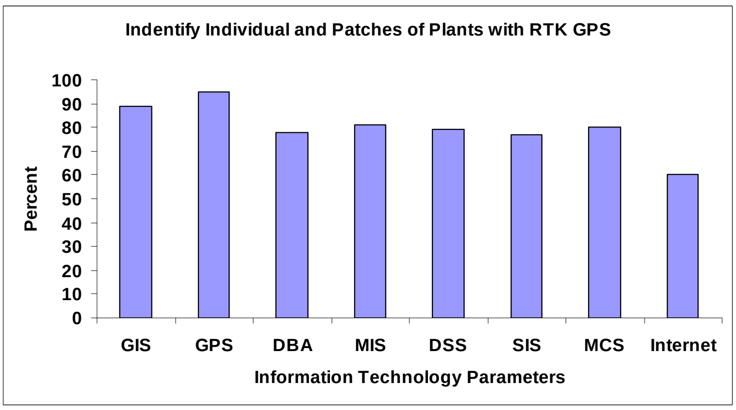

Fig. 10. The effect of each IT parameters on identify individual and patches of plants with RTK and GPS.

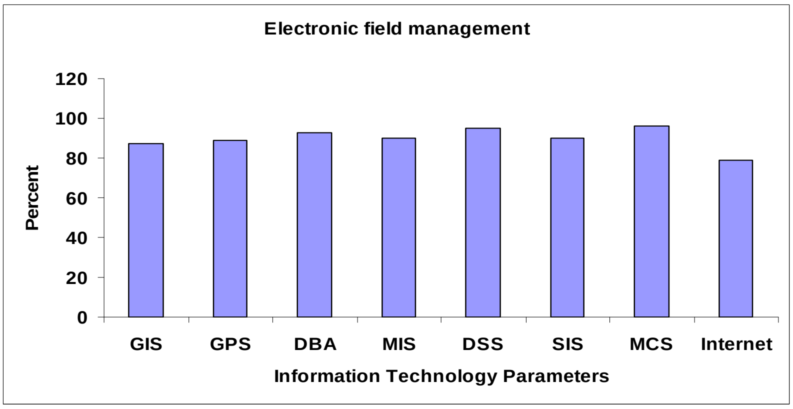

Fig. 11. The effective of each IT parameters on electronic field management.

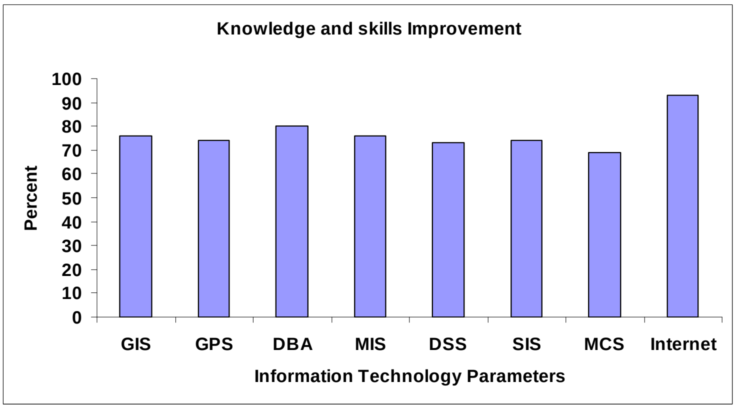

Fig. 12. The effective of each IT parameters on knowledge and skills improvement.

Conclusions

PA is exposed to several factors including site & boundary verification, soil sampling, yield monitoring, electrical conductivity measurements, variable-rate fertilizer application, monitoring herbicide applications, 2 and 3 D surface mapping models and wire Grids, static and dynamic DGPS source comparisons, herbicide application and weeds species mapping, identify individual and patches of plants with RTK and GPS, and Electronic field management. The IT indexes have played a significant role in the development and use of simulation models of agricultural systems, in the development and use of spatial and temporal datasets of relevance to the management of the rural sector, these models and datasets often being integrated and applied using Geographic Information Systems. This study was able to present only a few examples of the many applications of information technologies that are being used by agriculture today in field of precision agriculture.

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