APPLICATION OF INFORMATION TECHNOLOGY IN AGRICULTURE – AN INDIAN EXPERIENCE

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ABSTRACT

Agriculture in India is well thought-out to be a primary occupation for a major part of population in India. A vast majority of rural population depends upon agriculture as their primary occupation. However, agriculture in India is in doldrums and needs rejuvenation. Information Technology in Agriculture is one of the greatest opportunities to develop this sector and to maintain the food stability in the country.

Some of the benefits of ICT for the improvement and strengthening of agriculture sector in India include timely information on weather forecasts and calamities, better and spontaneous agricultural practices, better marketing exposure and pricing, reduction of agricultural risks and enhanced incomes, better awareness and information, improved networking and communication, facility of online trading and e-commerce, better representation at various forums, authorities and platform, etc. E-agriculture can play a major role in the increased food production and productivity in India. The different IT Technologies like Expert System in Decision support system, Remote sensing, Gyandoot (Community-Owned Rural Internet Kiosks) etc. have brought revolution in Indian Agriculture. Even corporate like ITC, MSSL, HLL are now looking forward to extract huge benefits out of this collaboration of IT with Agriculture.

Keywords: E-agriculture, Agriculture Information Technology, Remote sensing, Decision support system, Problem solving approach

INTRODUCTION

Information technology (IT) has connected the world globally and is now changing our lifestyle and social consciousness dynamically. Of late, it has emerged as a best tool for information sharing and mutual communication. None of the walks of life have been left untouched by the IT sector be it grain threshing or global business.
29.1% share of GDP (3rd quarter of 2003-04) in India is from Agriculture sector and nowadays this sector is becoming more technical and business-oriented which requires skilled and qualified people. Technical knowledge is growing to a large extent in all the areas of Agriculture as well as Information Technology. In the present scenario, Agriculture is multi-billion dollar industry and it will flourish much more after implication of WTO agreements by 2005. The most reputed names of business like HLL, Tata, Reliance, Wipro, Infosys etc. are entering in this field to extract huge benefits.

**Agriculture Information Technology (AIT)**

Agriculture Information Technology (AIT) is the latest and emerging branch of applied science in which Agriculture, Computer Science and Information Technology merge into a single discipline. Its application are in the form of precision farming, analysing agriculture information, developing database and algorithms for agriculture research, genetic information analysis, transfer of technology, agri-business etc. AIT is the new global wave. Private as well as public sector companies engaged in the business of agriculture, marketing enterprises, hybrid plants, fertilizer industry, pesticide, seed, floriculture, medicinal plant industry, drugs, information Technology are developing AIT division to provide new avenues and research output to help to replace scarce sources.

The different IT Technologies like Expert System in Decision support system, Remote sensing, Gyandoot (Community-Owned Rural Internet Kiosks) etc. have brought revolution in Indian Agriculture. Even corporate like ITC, MSSL, HLL are now looking forward to extracting huge benefits out of this collaboration of IT with Agriculture. Agriculture has also been greatly influenced by IT in the present era though the share of IT in agriculture is only 1.3%.

**Problems faced in Agriculture and need of IT**

- The population of the earth is burgeoning every minute and there is sufficient evidence of impending food crisis, especially in the developing countries even after attaining self-sufficiency.
- The politics and economics in any country and the world trade mechanism are now dependent on the balance of supply and demand of the food.
- Inefficient recording and storage of data in spite of huge data collection.
- Lack of timely forecasting of weather and agriculture productivity.

Considerable opportunities are also emerging in the area of rural development through effective use of Information Technology in Agriculture. Moreover all the research and policies are based on database; hence most of the companies and government agencies are being engaged in this field and hunting for AIT experts however they find it difficult to get the candidates.

In the current scenario, the role of IT assumes great importance and only with proper integration of IT with agriculture, the problem of food crisis can be solved and the world can move towards a sustainable production. Integration of IT with agriculture must be done with following main objectives in mind.
Objectives of Information Technology in Agriculture

- Develop multi-level decision support models for synergizing the natural resource system with economic and social imperatives.
- To develop indicators of sustainability for agricultural production system.
- Based on the above scientific assessment, suggest alternatives to conserve and improve the health of natural resource system.

So there arises a great need to reduce the agricultural losses, forecast the productivity, and enhance the production with proper vertical integration of the production centers and the markets. In addition to this there is also an emerging need to evenly distribute the food grain from the source to the sink. Several models such as decision support system, Global Information Technology (GES) e-procurement, rural networking etc., can all be achieved by aligning IT with agriculture.

II APPLICATION AREAS OF IT IN AGRICULTURE

Some of the main areas where the information technology can work in collaboration with agriculture are:

- Global Information system-remote sensing
- Decision support system
- ERP and SAP
- Rural networking
- E-procurement

1. Expert System in Agriculture

An “Expert system” is an intelligent computer program that uses knowledge and inference procedures to solve problems that are difficult enough to require significant human expertise for their solution. These software programs typically fit into the category of decision support tools. Decision support programs imitate an expert by involving a client in a problem-solving situation, often providing a recommendation in response to a client’s request for help in making a decision. Expert systems have the potential to help farmers run their business more economically.

Although there is no general standard for expert systems, most include:

- A knowledge base of domain facts and associated heuristics
- An inference procedure or control structure for utilizing the knowledge base
- A natural language user interface

The knowledge base component includes both

- Domain facts and
- Heuristics.

Domain constitutes a body of information widely shared and generally publicly available within the domain. Heuristic knowledge is mostly privately and individually held. It includes rules-of-thumb, judgments, and sometimes, experience-based guesses that typically characterise human expert level decision-making.

To solve a problem by the Expert System, a program must have both kinds of knowledge, facts and heuristics, in its knowledge base. In addition to knowledge base, systems include an
inference system or procedure, also commonly called the inference engine. This system contains the general problem solving approach deciding which heuristics are applied to the problem, accessing the appropriate rules in the knowledge base, executing the rule, and determining when an acceptable solution has been found. In effect, the inference system ‘runs’ an expert system.

The remaining component part of the expert system permits bi-directional communication. It is known as the input/output system. The most basic difference of expert systems with that of conventional computer programs is that expert systems manipulate knowledge while conventional programs manipulate data.

**Popular Expert Systems used in agriculture**

The expert system is designed to answer questions typed at a keyboard attached to a computer on such diversified topics. Some of the expert systems that have been developed for use in agriculture are given as:

- **GRAIN MARKETING ADVISOR** is an expert system for determining marketing alternatives and supports grain producers in finding optimal strategies. Individual farm conditions are considered. Information on storage and dryer availability, price level, price trends, government program eligibility, and timing, is required as input data.

- **COMAX** provides information on integrated crop management in cotton. The system uses a combination of expert derived rules and results generated by the cotton crop simulation model.

- **GOSSYM** requires external information such as weather data, soil physical parameters, soil fertility levels, and certain pest management information. Based on this input data, the system makes daily management decision recommendations.

- **POMME** provides information about pest and orchard management of apples. External information such as weather data including forecasts and crop symptoms are utilized by the system to generate management decision recommendations.

- **PLANT/ds** supports the diagnosis of soybean diseases and can be used by growers and country agents alike.

- **SUBERMAX** is an expert system prototype that can help storage managers, especially during hectic harvest times by taking information on potato quality, bin environment, outside environment, bin facilities, and give recommendations.

- **SOYEX** is a soybean oil extraction expert system. Justifications and certainly factors for remedies help the user to select an effective solution.

- **FINDS** is a Farm-level Intelligent Decision Support system was developed to assist in determining optimal machinery management practices for farm-level system.

Programs have been developed to make recommendations on such diverse topics as feed rations for dairy cattle, strategies for corn marketing and aeration system design for grain storages. In general, the knowledge transfer in agriculture could be improved and the extension service work performed more efficiently. Most importantly, lot of research information could be translated to levels of applicability to end users.
2. Remote Sensing

Remote sensing has shown potential for use in agricultural management for a number of years; however, the availability of fine spatial resolution, near real-time data has limited its application in the past (Jackson, 1984). New companies that provide aircraft-based imagery to meet the resolution and temporal requirements for agricultural management are now emerging. The promise of commercially available, high resolution satellite imagery will also provide additional sources of remotely sensed data (Fritz, 1996).

Advances in precision farming technology (Geographic Information Systems [GIS], global positioning systems, and variable rate equipment) provide the tools needed to apply information from multi spectral images to management problems. Following are a few examples of how remote sensing can currently meet some of the information needs in precision agriculture.

Soil Properties: Soil physical properties such as organic matter have been correlated to specific spectral responses. Therefore, multi spectral images have shown potential for the automated classification of soil mapping units.

Pest Detection: Sprayer mounted sensors have been found useful for the control of herbicide applications. Brown and Steckler (1995) developed a method to use digitized color-infrared photographs to classify weeds in a no-till cornfield.

Water Stress: The difference between remotely sensed surface temperature and ground-based measurement of air temperature has been established as a method to detect water stress in plants (Jackson et al., 1981). More recently, methods to integrate spectral vegetation indices with temperature have been used to improve remotely sensed estimates of evapo-transpiration. Spectral indices are used to determine ‘real-time’ crop co-efficient to improve irrigation scheduling (Bausch, 1995).

3. e-Sagu (Web-based Agricultural Expert Advice Dissemination System)

In this project, by exploiting advances in Information Technology (IT), we are making an effort to build a cost-effective agricultural information dissemination system to disseminate expert agriculture knowledge to the farming community to improve the crop productivity.

4. Pest Prediction Systems

In this project an effort to understand pest population dynamics and build pest prediction systems by applying data mining techniques on pest surveillance data set of Helicoverpa Armegira, Bacterial Leaf Blight, Groundnut leaf miner regarding Chickpea, Pigeonpea, Cotton, Groundnut, and Rice crops. This project is carried out in collaboration with ICRISAT, Hyderabad (India) and CRIDA, Hyderabad (India).

**FUTURE POSSIBILITIES**

Several applications have been developed to use remotely sensed data to infer both plant and soil characteristics. Three development approaches appear to be emerging in the application of remote sensing and site-specific agriculture. In one approach, multispectral images are used for anomaly detection; however, anomaly detection does not provide quantitative recommendations.
that can be directly applied to precision farming. A second approach involves correlating variation in spectral response to specific variables such as soil properties or nitrogen deficiency.

III. INDIAN INITIATIVES IN AIT

I. E-procurement in Dairy sector — a live project

In recent years, India’s National Dairy Development Board (NDDB) initiated the milk co-operative movement, which has led to a substantial increase in milk production in India.

A successful approach of particular interest is the fact that the dairy sector is already using computers in 2,500 rural locations to buy milk from the farmers quickly and transparently. The number of farmers selling to their local co-operative milk collection center varies from 100 to 1,000 and the daily milk collection varies from 1,000 litre to 10,000 litre. Each farmer is given a plastic card as identification.

How it works:
- At the counter he/she drops the card into a box, which reads the card electronically and transmits the identification number to a personal computer.
- The milk is then emptied into a steel trough kept over a weighbridge.
- Instantly, the quality of the milk is displayed to the farmer and communicated to a PC.
- Then, an operator sitting by the side of the trough takes a 5-mi. sample of milk and holds it up to a tube connected to an electronic fat testing machine.
- By moving the machine’s hand lever three times, the fat content of the sample is determined in just a few seconds.
- The fat content is displayed to the farmer and is communicated to the PC.
- The computer calculates the amount due to the farmer on the basis of a rate chart that indicates the price for milk with different levels of fat content.
- The total value of the milk is then printed out on a payment slip and given to the farmer, who can collect the payment at an adjoining window.
- In many centers this entire transaction takes no more than 30 seconds.

This application is used in approximately 2,500 rural locations, exposing half a million people daily to the benefits of information technology.

The E-Governance Center of the Indian Institute of Management (IIMA) has worked to extend the benefits of this application by developing Diary Information System Kiosk (DISK) software, which will replace the existing application at the milk collection centers.

It has two major components:
- An application with enhanced database and reporting running at the society level.
- Connectivity to a Dairy Portal serving transactional and information needs.

2. Gyandoot: Community-Owned Rural Internet Kiosks

Gyandoot is recognised as a breakthrough in e-government, demonstrating a paradigm shift which gives marginalized tribal citizens their first ever chance to access knowledge, with minimum investment. Started in the Dhar district in central India having a population of 1.7 million; where 60% live below the poverty line. The goal of the Gyandoot project has been to establish
Gyandoot project was launched on January 1, 2000 with the installation of a low cost rural Intranet covering 20-village information kiosk in five Blocks of the district and later it is extending to 11 more kiosks. Villages that function as block headquarters were chosen for establishing the kiosks.

The following services are now offered at the kiosks:

1. Agriculture Produce Auction Centers Rates: Prevailing rates of prominent crops at the local and other recognised auction centers around the country are available on-line for a nominal charge of Rs. 5.
2. Copies of Land Records: Documents relating to land records including khasra (record of rights) are provided on the spot at a charge of Rs. 15.
3. On-line Registration of Applications: Villagers had to make several visits to the local revenue court to file applications for obtaining income/caste/domicile certificates.
4. On-line Public Grievance Redress: A complaint can be filed and a reply received within 7 days for a cost of Rs 10.
5. Village auction site: This facility began in July 2000. It makes auction facilities available to farmers and villagers for land, agricultural machinery, equipment, and other durable commodities. One can put one’s commodity on sale for a charge of Rs. 25/- for three months.
7. Other services offered at the kiosks include on-line matrimonial advertisements, information regarding government programs, a forum for school children to ask questions, ask an expert, e mail (free for information on child labor, child marriage, illegal possession of land belonging to Scheduled Tribes, etc.).

Some kiosks also have added photocopy machines, STD PCO, and horoscope services. In January 2000, the first month of operation, the kiosk network was accessed, 1,200 times for a variety of services.

That number reached nearly 9,000 in July. During the first 11 months, the 31 Gyandoot kiosks were used nearly 55,000 times.

3. A Client-Centered Networking Project in Rural India

With over 70% of the population in rural areas, India’s network must reach the villages if it is to make a meaningful contribution to the quality of life. If it serves only the cities, it will increase the pressure for urban migration, a problematical worldwide trend.

M S Swaminathan Research Foundation (MSSRF) was established in July 1988 with a commitment to harnessing science and technology for environmentally sustainable and socially equitable development. The founder, M. S. Swaminathan, is UNESCO Professor of Eco-technology at the Centre for Research on Sustainable Agriculture and Rural Development. Since agriculture is the major industry in the villages, they also researched communication patterns, focusing on the farmer. They found that the most important information source for farmers was other farmers.
Armed with this background information, they are establishing Information Shops in six villages. The information Shops will both collect and disseminate information. For example, they will collect demographic and soil information and distribute information on health, relief agencies, availability and prices of agricultural inputs, transportation availability and schedules, crop costs, risks and returns, market prices, local micrometeorology, pest surveillance, ground water, and government welfare and infrastructure entitlements. Individuals on a semi-voluntary basis will operate the village information shops. They will need 10 years of schooling, and women, people between 20 and 25 years old, and members of landless families will be given preference in hiring.

IV. CORPORATES USING IT IN AGRICULTURE IN INDIA

ITC e-choupal

ITC, which exports Rs. 1200 crore worth of agricultural commodities, has discovered a way to bypass the age-old mandi system and buy directly from farmers.

Launched in June 2000, ‘e-Choupal’, has already become the largest initiative among all Internet-based interventions in rural India. E-Choupal services today reach out to more than a million farmers growing a range of crops — soyabean, coffee, wheat, rice, pulses, shrimp — in over 11,000 villages through 1900 kiosks across four states (Madhya Pradesh, Karnataka, Andhra Pradesh and Uttar Pradesh).

Till the end of last year, it picked up almost Rs. 50 crore worth of soybean crop from farmers in MP. In the next couple of years, it expects the off take to pick up to about Rs. 150-200 crore. By buying directly from farmers, ITC derives two primary benefits. It can source produce of a far better quality. This commands a higher price in the international market. That’s because most farmers tend not to mix impurities the way a middleman would. Besides, by avoiding the intermediaries, ITC is able to save an estimated Rs. 250 a tonne. The farmer, too, stands to gain much more than he would if he sold through the mandi. For a long time, farmers had no other option but to hit the local mandis, where they realized only 70-75% of the end prices. But now they can hope to do better. For India’s antiquated agricultural system, that’s a big deal. All that ITC set up was a battery-powered Internet-enabled Pentium desktop computer along with a printer.

The portal carries the mandi prices across the state, which is fed in daily by each of the mandi commission agents who have joined the ITC system. It also offers the prices that ITC hopes to buy at. So, once the farmers of e-choupal know the prevailing prices at the mandi as well as at the choupal, they can choose to either go to the mandi or take their produce directly to ITC’s processing plant 25 km away, ITC’s prices are almost the same as those prevailing in the mandi.

ERP and SAP:

ERP and SAP are the two very important tools for different purposes like financial accounting in the company, reducing the cost of production, maintaining an up to date database and many other varied functions. A striking example of this is the Positive Solutions Private Limited, an Andhra Pradesh-based company working in association with Andhra Pradesh (AP) Farmers
Association. It has developed an agriculture-based portal, www.indian-farmers.org. The site aims at disseminating information and educating farmers in various sectors of agriculture by introducing them to areas like IT and Biotechnology. The latest happenings and news in the field of agriculture will also be available on the site, Indian-Farmers.org is agriculture based portal web site that is developed in association with Federation of Andhra Pradesh Farmers Association, India. Internetyard.com is a portal that has been developed with the goal of offering web-solutions at the most competitive cost.

V. CONCLUSION

Some of the benefits of ICT for the improvement and strengthening of agriculture sector in India include timely information on weather forecasts and calamities, better and spontaneous agricultural practices, better marketing exposure and pricing, reduction of agricultural risks and enhanced incomes, better awareness and information, improved networking and communication, facility of online trading and e-commerce, better representation at various forums, authorities and platform, etc. E-agriculture can play a major role in the increased food production and productivity in India.

Finally to conclude it can be rightly stated that though IT in the agriculture is in budding stage in the Indian context and has just started to spread it shoots, but with its immense potential to standardise and regulate the agricultural processes and solve the problems it is sure to be one of the most important areas to shine in the near future. The above examples of successful application of Information technology in agriculture has proved beyond any doubt that its one of the best tool for prospering of Indian agriculture.

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