The role of information and communication technologies (ICT) in agricultural development

Sharareh Khodamoradi [1] and Mohammad Abedi[2]

[1] Department of Agricultural Extension Education, Science and Research Branch, Islamic Azad University, Tehran, Iran
[2]Department of Agricultural Management, Islamic Azad University, Qaemshahr Branch, Iran
*Corresponding author: abedi114@yahoo.com

Abstract: Policy makers and service providers have increasingly come to view information and communication technologies (ICT), and particularly the Internet, as an important tool in providing disadvantaged groups and areas with access to information, services and markets that would otherwise be inaccessible. The concept of development of the rural, today, is not just project initiatives and governance; it is much more beyond that. This paper uncovers a whole plethora of ICT emergence as a technology of the new millennium. Against the backdrop of the ongoing ICT boom, this paper makes an attempt towards studying its applications and usage planning process and policy making for the rural communities focusing on how it helps in aligning the key factors and reduce the problems of alienation, fragmentation and dislocation of knowledge.
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Introduction:

The importance of communication in the development process has been acknowledged for many years by the development community. FAO has spent at least thirty years pioneering and promoting - both in thinking and practice - the centrality of communication in development. The most essential ingredient of good communication – putting people at the centre of the communication process - has similarly been understood and documented for many years.

Agriculture extension and farmer-outreach programs face three major challenges – cost-effective outreach, solutions tailored to needs of individual farmers and an image that is farmer-friendly. The internet and mobile networks have the potential to provide agro-information services that are (i) affordable, (ii) relevant (timely and customized), (iii) searchable and (iv) up to date. Large sections of the farming community, particularly the rural folk, do not have access to the huge knowledge base acquired by agricultural universities, extension-centers and businesses. While telecenters are beginning to dot the rural landscape [1], one of the big barriers remains the lack of agro-content that (i) is in the language of the farmers (ii) is relevant to their needs and (iii) is delivered in a form that is of immediate use to them.

Information Technology, more precisely the Information and Communication Technology (ICT), has emerged world over as a technology of the new millennium. By augmenting the process of information exchange and reducing the transaction costs, this ubiquitous technology is instrumental in increasing productivity, efficiency, competitiveness and growth in all spheres of human activity. The potential benefits of, however, can be harnessed only if the technology diffuses across the different sectors of the society. Unfortunately, we are living in a world of 'digital divide' wherein half of the world population have never made a telephone call . The digital divide is not only an international problem, but for most developing nations including is also a national phenomenon. Nonetheless, it has been argued that in an era of globalization, the ability to harness this technology for the 'rural' improves the capability of the developing country.

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. Agriculture has also been greatly influenced by IT in the present era though the share of IT in agriculture is only 1.3%.

P

roblems faced is that:

- 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.

- Even the major powers in the world are finding it difficult to balance the agricultural productivity with the environmental

requirement and meet the expectation of the millions round the world.

- 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.

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:

- Develop multi-level decision support models for synergising 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.

Two fundamental steps exist in establishing an innovation as a valuable, readily used tool: diffusion and adoption. Both diffusion and adoption must occur in order for an innovation to successfully reach its target user and be implemented (Mahajan, et al.). First, diffusion, the process by which an innovation "is communicated through certain channels over time among the members of a social system" (Rogers), must occur. In this study, the StratSoy project was a major factor in the IT diffusion process in state soybean organizations. Other factors that influenced diffusion included the media, word-of-mouth, and experiences of friends, associates and family members.

In addition to individuals having access to a new technology, adoption must also occur, which means individuals accept the innovation as valuable and use it. Numerous factors could influence IT adoption and use in agricultural organizations and can be grouped into five categories: access to IT, demographic, IT training/education, trust, and time. It is possible for adoption factors to fit into more than one category.

In the case of IT, access to the technology means an individual must have access to a computer equipped with IT such as e-mail and access to the WWW. The category "access to IT" would not only include the use of a computer with IT ability, but would also include the ability to upgrade computer hardware and software to facilitate IT use. The price of needed computer equipment and the expense of Internet use are also related to access to IT. It is predicted that the higher the level of access to IT, the higher the level of IT use by an individual.

The demographic category includes adoption factors such as age, education level, gender, and income level. It is hypothesized that factors in the demographic category will not significantly influence IT adoption and use. Although previous literature suggests that IT use will be higher for younger, more educated individuals (Batte, et al.), 1997 survey results suggest that demographic factors have little influence on IT adoption and use. This may reflect that demographic factors may influence the decision to adopt a new technology, but once that decision to adopt is made, demographic factors may have little influence on use.

Another category of IT adoption factors is IT training/knowledge. This IT adoption factor can be measured with variables such as type of IT training, days of IT training, and the level of knowledge on IT use. It is hypothesized that as the quality and level of IT training increases, the use of IT will also likely increase.

An important factor influencing the adoption of any new technology is an individual's perception of that technology. It is hypothesized by this research that one of the key perception aspects influencing the adoption of IT is the level of trust that the potential adopter has in the IT system and in those who use IT. Trust can be defined as "an individual's optimistic expectation about the outcome of an event" (Hosmer 1995). There are different aspects of trust related to IT.

An individual must first trust that information technologies will work and that IT will be beneficial in accomplishing his/her goals and in completing his/her tasks. An individual must also trust that the information they obtain via IT is accurate and the information they send via IT will not be tampered with and privacy levels will be maintained.

Trust proves to be a difficult variable to measure. Factors included in the trust category include an individual's perception of the ease of use of IT as well as the benefit of IT. In this study, trust is measured by variables such as helpfulness of IT for work-related communication, problem solving ability, and banking and shopping via the Internet. Some individuals, either due to their background or current environment, have a fear of IT and feel that it is difficult to use. It is hypothesized that an individual will use IT more if they have a positive perception or high trust level in IT.

The final IT adoption category proposed by this research is the passage of time. It is hypothesized that individuals will increase their use of IT over time, as access to IT becomes more commonplace. In this

study, the same group of people were surveyed twice to evaluate their changes in IT use over time. Time was measured by establishing a dummy variable where each survey response from the 1997 survey was assigned a value of zero and each survey response from 1998 was assigned a value of one. Time-interaction variables were also created for each variable by multiplying the original variable by the time variable. For example, the “days of training” variable (tdays) was multiplied by the time variable and became the “timeinfluenced days of training” variable (tdayst).

Managerial Implications

Identifying the determinants of IT adoption and use will help industry participants, especially managers, use information technologies to increase information flow and increase the level of trust in the firm and the demand for the firm’s products or services. For example, if a livestock company promotes the use of IT to its producers, it will open up more efficient means of communicating product information and providing other services to its customers. As consumers increase their use of IT, firms will be able to communicate more effectively with them, and demand for the firm’s product may increase.

Determining the factors that influence IT adoption can assist companies in determining the IT use profile of their customers based on the significant adoption factors identified in this study. Knowledge of the factors that influence IT adoption can also help companies target individuals, who due to their progressiveness and use of IT, may be potential customers of the company’s products and/or services. The company can then focus marketing and advertising campaigns on attracting these individuals to their business. This research is also important because IT can possibly substitute for trust with an organization just as trust often substitutes for contracts. A customer’s comfort and trust level with a company may increase as they are able to gain more information about a company via IT. For example, a customer’s trust level with a company will increase if he is able to track his shipment order via the Internet.

In addition to the general managerial implications of identifying IT adoption factors, this research also suggests specific ways in which a manager can promote IT adoption that can lead to more efficient communication and increased demand for the firm's products and services.

First, the research shows that IT training increases IT adoption and use. Therefore, firms may benefit from providing training on information technologies for both employees as well as customers.

Second, managers should proactively use IT to promote the trust their employees, customers, and other business associates have in IT, and thus increase the overall use of IT. The positive coefficient on the variable "e-mail is helpful for work related communication" suggests that the more those with whom you communicate use e-mail, the more helpful e-mail is in communicating with them. An agricultural producer might consider using e-mail to communicate with the firm because she observes that her well-respected chemical sales representative uses IT successfully.

This research also suggests that an individual’s use of IT is greater when the individual’s access to IT is not restricted. Therefore, managers may want to provide greater access to IT by providing each employee his or her own computer hardware equipped with Internet capabilities.

The employees will be free to use IT at their convenience and will be less concerned with privacy or security problems related to sharing a computer. Managers should promote the use of IT in all aspects of employees' and customers' personal lives and work. The significance of the variable "time-influenced do job related work at home" indicates that employees use e-mail more when they are physically separated from work.

The implication for managers is that IT use is greater when people work outside the office, or have flexible work relationships such as telecommuting. Increasingly, individuals will turn to IT when they need information or to communicate with the firm for personal or work-related reasons.

Certainly many individuals and organizations within society at large still have a fear or mistrust of IT. At the same time, agriculture constantly experiences advances in technology and the use of information technologies is becoming more common place each day. Therefore, it is essential for firms and managers to understand the reasons for IT adoption to remain competitive and to best serve their industry and customers.

Information Technology and its Components

Induction of IT as a strategic tool for agricultural development and welfare of rural requires that the necessary IT infrastructure is in place. The rapid changes and downward trend in prices in various components of IT makes it feasible to target at a large scale IT penetration into rural. Some of the broad factors to be noted with respect to various components of IT are listed below :

1. Input devices :

Radical improvements are witnessed with respect to the means of communication by human

beings with computers such as key boards, mouse devices, scanners. The advent of touch screen monitors that allow users to give input to computers by touching on the appropriate location of the monitor has made it possible to develop user-friendly interface for farmers which is easy, intuitive, circumvents language barrier and at the same time provides a relaxed environment to the users. The present day digital cameras make it possible to capture and store good quality graphics and large video clips. The small size and low weight of these digital cameras, which are increasingly becoming affordable, open up the possibilities of providing computer based demonstration clips to educate the farmers.

2. Output devices :

Monitor screens, printers & plotters, data projectors support high resolution and good quality output. The quality of these output devices have the potential of generating renewed interest in the farmers in using IT based services. The light weight portable data projectors can be easily carried by the agricultural extension personnel for serving larger audience. Similarly, speakers can also be attached to the computers to incorporate voice based trainings for farmers.

3. Processors:

The processing speeds of computers have gone up. At present, Intel P-IV based processors @ 1.5 Ghz are available in the PC range which makes it possible to undertake substantial processing of data at the client side.

4. Storage Devices :

40GB and even higher hard disk drives have become common in PC range of computers. This makes it possible to store substantial information at the local level which facilitates faster access. Similarly, high capacity floppy disk drives, CDs make it possible to transfer large volumes of data to locations which can not be connected to networks immediately. These storage devices are also used for backup of crucial data. As a precaution, many corporates store their backups at locations away from the place of work.

5. Software :

Various operating systems are available which act as interface between the user and the machine. The graphic user interface (GUI) has become an accepted prerequisite for end users. Microsoft's 'Windows' continues to be a favourite. Application softwares which can support complex user requirements are available. Of the shelf solutions for office automation packages, groupware applications, complex database solutions, communication products, solutions based on remote sensing & geographical information systems are available. In addition, solutions based on some or all of these are also readily available. The present downward trend in the IT industry provides an opportunity get customised application for any specific task developed at an affordable price. Rapid Application Development and Deployment (RADD) is a popular model for quick development and deployment of applications. Development environment itself is simplified with tools that quicken the pace of software specialists. Project management and monitoring software are available that facilitate efficient execution of large and complex applications that are required for rural

6. Networking devices:

The capacity of modems, used to convert the data from digital to analog and vice versa, which are popularly employed to use telephone lines have increased. Internal modems are available integrated into the computer so that they are not exposed to outside environment. The capacities of other networking devices such as routers have also gone up which makes it possible to create large networks with smooth data transmission.

7. Transmission Media:

The media through which the data transfer takes place has also undergone revolutionary change. Telephone lines are still the popular source although the reliability and low bandwidth are still major issues. High capacity cables, optical fibre, radio, wireless local loops, satellite transmission and various solutions based on a combination of these are already being used in many parts of the country.

8. Other accessesories :

Uninterrupted Power Supply (UPS) devices are crucial to ensure the longetivity of the IT equipment as well as provide backup mechanisms. The potential of solar power packs to provide a feasible solution to shortage of power in the rural areas needs to be exploited.

Role of IT in Agriculture

In the context of agriculture, the potential of information technology (IT) can be assessed broadly under two heads : (a) as a tool for direct contribution to agricultural productivity and (b) as an indirect tool for empowering farmers to take informed and quality decisions which will have positive impact on the way agriculture and allied activities are conducted.

Precision farming, popular in developed countries, extensively uses IT to make direct contribution to agricultural productivity. The

techniques of remote sensing using satellite technologies, geographical information systems, agronomy and soil sciences are used to increase the agricultural output. This approach is capital intensive and useful where large tracts of land are involved. Consequently it is more suitable for farming taken up on corporate lines.

The indirect benefits of IT in empowering farmer are significant and remains to be exploited. The farmer urgently requires timely and reliable sources of information inputs for taking decisions. At present, the farmer depends on trickling down of decision inputs from conventional sources which are slow and unreliable. The changing environment faced by farmers makes information not merely useful, but necessary to remain competitive.

Conclusion

Information and Communication Technologies (ICT) has the potential to change new and old forms of economic activity. This can result in e-literate groups, low skilled or low paid workers, unemployed people, sole parents, and those with disabilities that do not have access to these ICTs. However, it is likely therefore that assisting people to improve their access to and skills in ICT will be an important means for a Government to grow an inclusive, innovative economy for the benefit of a country. Therefore the ICT-Hub model or mechanism for integrated service delivery to rural communities may be applied for this purpose.

The face of the agriculture can be transformed by a well conceived deployment of IT. The potential of IT as yet remains untapped and urgent measures are required to derive maximum benefit. The key players involved in this process such as industry, government and educational institutions and research centres are required to make contributions in this endeavour. The initiative to develop necessary IT based agricultural services need to be developed immediately. Parallel steps to develop necessary IT communication infrastructure are to be taken up along with the utilisation of fiber optic network whereever it is passing through the rural segments.

It is necessary for the industry related to agriculture, in particular fertilizer companies, to review their present I.T. infrastructure with respect to marketing function and undertake measures to strengthen the same. Online integrated systems, well developed executive information systems, applications to enhance the productivity of the field personnel and efficiently serve the requirements of channel partners & consumers are to be taken up at the earliest. Marketing field personnel need to be provided with the necessary hardware, software, training and brought on to Internet so that smooth integration is possible. Internet based technologies can facilitate creation of applications which can be operated by the field personnel by using simple browsers. Customer support services can also be partially provided over the Internet which will increase the reach of such programmes. The state and central governments should initiate urgent measures to jump in to IT bandwagon for effective e-governance.

***Corresponding Author:**
Mohammad Abedi
Department of Agricultural Management, Islamic Azad University, Qaemshahr Branch, Iran
E-mail: abedi114@yahoo.com

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