

ICT Adoption Issues and Opportunities in Agriculture- Andaman & Nicobar Islands

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ABSTRACT

ICT is becoming one of the most significant development-enabling factors. Prior research has acknowledged the significance of the adoption procedures. They do not, however, specify the theory and guiding principles needed to effectively manage them. While discussing the inability to adopt information technology in general, the majority of research concentrate on assessing important adoption success elements. This study is a concentrated effort to advance knowledge of the elements that influence adoption success and the challenges associated with ICT adoption in agriculture. Additionally, it draws attention to e-Agriculture, a new discipline that focuses on improving information and communication systems to advance agricultural and rural development. According to the paper's conclusion, "End Users" are crucial in identifying the requirements and crucial success criteria for the development and application of ICT.

KEYWORDS: Electronic Cultivation, Information Technology, Information and Communication Technology(ICT), Agricultural Technology, Agriculture, Agribusiness, Adoption, Incentive, Barriers, Economic, Productivity, Governance, Andaman & Nicobar Islands

I. INTRODUCTION

Developing agriculture and rural economy is one of the most important orientations of any Government. In Andaman and Nicobar Islands, the vigorous development of ICT has strongly influenced every socio-economic aspect to become the most significant motivation of the socio - economic development and poverty reduction. Nearly 75 % of Islanders live in rural areas and are predominantly farmers. ICT has been creating not only opportunities but challenges to business in rural areas to narrow the gap between different regions, realize gender equality and the advancement of women to promote sustainable growth and poverty reduction. The potential benefit of computerizing data input and information management is well known and apparent. Information promotes competition and improves market.

Accurate and complete information is vital performance (Thompson and Sonka, 1997). At the firm level, information promotes the efficiency and effectiveness of production and customer service. Information may also increase the level of trust consumers have in a product or firm leading to increased demand.

It is readily accepted that increased information flow has a positive effect on the agricultural sector and individual firms. However, collecting and disseminating information is often difficult and costly. Information technologies (IT) offer the ability to increase the amount of information provided to all participants in the agricultural sector and to decrease the cost of disseminating the information. Research and literature already conducted regarding IT and the food and agribusiness industry have predominately focused on the effects that IT will have on the industry (Cragg, 1996). Fewer works can be found that attempt to understand the factors that cause the adoption and use of IT in agricultural organizations. Therefore, the need exists to understand why some agricultural industry participants adopt use of IT faster and more readily than others.

An understanding of the factors associated with IT adoption and use in agriculture will enable the development of strategies to promote IT adoption and increase the effectiveness and efficiency of information use in agriculture.

II. OBJECTIVE

Agriculture constantly experiences advances in technology. Recently, the use of information technologies (IT), such as e-mail and the World Wide Web, has become commonplace. Information technologies afford the agriculture industry the opportunity to increase information flow to all industry participants at a decreased cost. Identifying the factors

associated with IT adoption and use in agriculture will allow the industry, especially managers, to increase information flow and increase the demand for a firm's products and services, while increasing the level of trust in the firm.

Thus, the objective of this research is to contribute to the understanding of the adoption and use of information technology (IT) over time in agricultural organizations. More specifically, the research focuses on identifying the reasons why some individuals in agricultural service organizations use IT more than other individuals. It is hypothesized that multiple factors are associated with IT use. These factors include, among others, user knowledge of IT, trust level in the IT system, and access to IT.

III. FACTORS ASSOCIATED WITH ADOPTION AND USAGE OF ICT IN AGRICULTURE

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., 1990). First, diffusion, the process by which an innovation "is communicated through certain channels over time among the members of a social system" (Rogers, 1995), must occur.

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., 1990), 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 or 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. The same group of people may be surveyed twice to evaluate their changes in IT use over time. Time can be measured by establishing a dummy variable where each survey response from a survey will be assigned a value of zero and one according to the respective year. Time-interaction variables

can also be created for each variable by multiplying the original variable by the time variable. For example, the “days of training” variable (tdays) can be multiplied by the time variable to become the “time influenced days of training” variable (tdayst).

IV. ROLE OF ICT IN AGRICULTURE

ICT is another physical infrastructure which has a tremendous role to play in agriculture in respect of bridging the communications divide created by geographical barriers. Andaman and Nicobar Islands is a typical case. How to reach out to the individual farmer in each and every village, so that he/she is included in the developmental process? ICT can bring education, capacity building and training to rural people all over the world. In effect it would be a knowledge transfer mechanism from the have's to the have not's, enabling this socially relevant development process to happen. Andaman and Nicobar Islands should build a high capacity ICT infrastructure and use it to develop traffic of information flow from cities, academic and R&D institutional knowledge centres to the illiterate and economically disadvantaged. Same case with other developing countries as well. It could also encompass the information flow from the 'North' to the 'South' hemispheres of Earth, if political support is there.

V. ICT IN MARKET LINKAGES TO FARMERS

ICT can help in the following ways:

i. Spot exchanges to function

Spot exchanges helps arbitrage the price levels effectively and help farmers to find buyers at right prices. In effect, it breaks down barriers of communication which farmers face in finding the optimal price and its buyer. Combined with an operational feature exchange, it can integrate speculation and other aspects of trading, making the price discovery transparent to the individual farmer.

ii. Supply chain management

ICT can help individual small farmers to find such aggregators who can buy small lots and sell to big buyers. This function can also be shortened and facilitated by electronic means of the exchanges, if agricultural produce becomes standardised and conforms to specified quality standard levels. Buyers place orders with minimal inspection as to quality, which add to the cost of supply chain management. ICT alone cannot help, if physical infrastructures like warehousing, quality standardisation, grading systems are not in place. Warehousing also creates commerce through trade in warehouse receipts, which in effect become a commercial bill of exchange.

iii. B2B commerce

ITC E Choupals are reaping the benefits since its Choupals connect to the rural market. Similarly Hindustan Level Ltd (HLL) in India is expanding its Shakti network which includes women and Self Help Groups, who become entrepreneurs with an alternative livelihood in direct marketing of HLL consumer goods.

iv. Communications

Indian Postal Service (INPOST) serves many villages in remote locations. Electronic mail can help it deliver better services, improve logistics of information flow, reduce costs and benefit rural Nigeria. There are plans in the works to make Post Offices as ICT centres.

v. Health services

Some services are already operational or are about to become operational. Agricultural Extension Workers, Doctors, etc. can be accessed for consultations through ICT networks, thereby bringing expert advice to reach farmers.

It is worthy of note however that despite the greats and good of ICT, without a proper intermesh with the environment, physical aspects of agriculture and rural economic development, as well as other physical infrastructure bottle necks like good road and rail connections, even water ways, it will remain a non starter.

VI. REASONS FOR SUCCESSFUL ADOPTION OF ICT IN AGRICULTURE

The reasons for the successful adoption process seem to be as follows:

i. An increased need for information

Agricultural production is in the process of constant structural adaptation dictated by deteriorating terms of trade and characterized by larger, commercialized production units (Ministry of Agriculture and Rural Development, 1999). The

larger the production unit and crop diversity the larger the need for more sophisticated data management and support for decision making.

ii. Prevalence and simplicity

The prevalence of computers is consistently increasing which in turn reduces reluctance to adopt them. Eventually reduced inhibition and lower costs lead farmers to seek and adopt software to suit their needs. The less sophisticated farmers tend in time to join the process by seeking suitable simple, non-challenging solutions.

iii. Returns on investment

Farmers that found ICT to be beneficial and compatible with their needs pointed out the following advantages: easy collection of data, favourable comparisons of cost and income, follow-up of data input, establishment of cumulative data sets, their use and information accessing all translating into management efficiency. Measuring the benefit from the use of information systems is difficult (Rapley, 1997). One reason is the unavailability of quantifiable variables, although attempts to measure information have been made (Srorey and Barnett, 2000). This makes measuring the expected benefit of information systems very difficult. One of the intuitively obvious variables is the return on investment but the level of investment is not necessarily correlated to profitability. Contrary to expectations it was found that quantifiable changes were modest at best (Christensen, 1992). Since performance goals are usually presented as justification for investment in information technology the measure should be an improvement in the production process and not necessarily a direct return on investment. In this case if ICT indeed improved the production processes, these improvements should eventually be evident. Examples would include better decisions in a specific production process, shorter supply lead-time, etc. No effort was made to quantify the benefit from ICT although the negligible cost of such package contributes to the farmer's favourable cost benefit ratio.

iv. Maintaining existing competencies

An adopter's level of education and training correlates positively with the ability to manage information, production processes and attain benefit from adopting a new technology (Gelb, 1998). It stands to reason as well that an adopter's level of education correlates positively with the level of benefit accrued to adoption of the managerial information systems. ICT enables even the most conservative farm managers to utilize the system for supporting decisions without a threat of unfamiliar changes in management procedures. Older and traditionally trained managers can easily adopt ICT without a need to study new background data sets and / or management methodology. As such prior knowledge for using ICT is not a prerequisite for adoption. Despite the approach that agriculture is a comprehensive business as any other, most farmers limit their management efforts to production aspects. In comparison to other businesses, farmers are usually isolated professionally in their decisions. This is a self-perpetuating situation that encourages resistance to changes in production methods and changes in business management methodology. It is in line with the contention that individuals tend to justify their actions according to their beliefs, past experience and reluctance to relinquish their time proven traditions and experience (Varela et al., 1994). This may result in disassociation from a new technology and diversion of time and efforts to alternatives (Von-Krogh et al., 2000). ICT enables the user to maintain his habits thereby minimizing the resistance.

v. Flexibility

ICT is not confined to a specific crop or crop-pattern which in turn allows the farmer maximum adaptation flexibility. Consequently, different farmers growing the same crop may utilize the program differently. Experience indicates that in many cases dedicated programs, attempting to be all-inclusive become inflexible, and eventually irrelevant.

vi. On time Information

When information is unavailable when needed on time at a decision point, the decision is taken based on a currently different situation. This can distort the managerial processes. ICT enables accessing data and information when needed. This is due to the simplicity of entering data as well as extracting reports.

vii. Training and support

Operational proficiency training is a necessary condition for successful information technology adoption, the more so with complicated software (Ptak and Schragenheim, 1999). Some ICT packages needs limited training being technically simple enabling adaptation to various production patterns. Regardless, on-line and phone support are available on request without charge. Occasional refresher courses are held on demand.

VII. MAJOR ICT ADOPTION CONSTRAINT

Following are some of the major ICT adoption constraints and observations emphasized during the presentations and discussions of this paper:

- a. If ICT cost and infrastructure as constraints are neutralized developed and developing countries face identical problems in developing and adopting ICT for Agriculture and Rural Development. This regardless of “digital divide” definitions, generation divides, digital immigrants/natives and/or “divide” definition components;
- b. Significant “wrong” (non-optimal) ICT development and implementation decisions are prevalent. They are extremely costly in economic and scarce human capital terms. Not least - they are continuously resulting in considerable loss of benefit and opportunity;
- c. “End Users” are the key factor in defining the needs and critical success factors for ICT development and implementation. “End User” lack of ICT awareness does not seem to be a significant impediment while lack of their involvement is. “End User” complaints of “ICT related waste of time” seem to be diminishing in importance as an adoption constraint;
- d. The constant oversupply of ICT innovations and cost reductions blended with the ever changing information and Internet characteristics emphasize the critical need for an “ICT Intermediary” and training. This can be provided by an Extension officer, scientist, consultant, etc. In this situation proficient End Users are becoming an influential source of innovation and information. Their role as “agents of change” is becoming indispensable. A lack of “between End User” information exchange and “training” were indicated in this context as effective adoption impediments.

Introducing a new technology to farmers poses obstacles. Other adoption and dissemination difficulties usually encountered are listed below:

- i. Not all farmers are interested in a computerized managerial information system. Some are satisfied with cost accounting at seasons’ end, sometimes not even that.
- ii. Some of the farmers use other software packages, including Excel spreadsheets or dedicated software which may or may not be adequate.
- iii. Personal impediments of various kinds.
- iv. Personal preferences. There are farmers who tried ICT and decided to quit because they did not find it user-friendly enough, special needs were not met, etc.
- v. Dissatisfied farmers will discourage others from using ICT, even after installation.
- vi. Marketing of ICT to farmers is non-existent.
- vii. Awareness of managerial information systems benefits is limited, resulting in situations where they have yet to be internalized.
- viii. Experience shows that farmers unassociated with the extension service are left behind professionally, which includes the use of ICT.

VIII. PROSPECTS OF ADOPTING ICT IN AGRICULTURE

Development economy has witnessed industrial revolution, agricultural revolutions (green-food grain, white-milk, yellow-edible oil, blue-fish, and now rainbow), information technology revolution, and bio-technology revolution. Information Technology and Bio-Technology have now become the “drivers” of globalisation of the economy, with their complementarities of liberalisation, privatisation and tighter intellectual property rights.

As we entered into the 21st century, the realm of electronic communication, which encompasses telecommunication, broadcasting, information technology, and services and industries, is undergoing profound changes, leading to a Global Information Infrastructure (GII), which will be capable of carrying any type of information, be it text, data, voice or video. Information is now broadly defined to embrace voice in telephony, text in fax and newspapers, images in video and TV broadcasting, and data in computers. All information can be digitised, transported, stored, retrieved, modified, and then

distributed.

The application of Information and Communication Technology (ICT) in agriculture is increasingly important. E-Agriculture is an emerging field focusing on the enhancement of agricultural and rural development through improved information and communication processes. More specifically, e-Agriculture involves the conceptualization, design, development, evaluation and application of innovative ways to use information and communication technologies (ICT) in the rural domain, with a primary focus on agriculture. E-Agriculture is a relatively new term and we fully expect its scope to change and evolve as our understanding of the area grows.

E-Agriculture is one of the action lines identified in the declaration and plan of action of the World Summit on the Information Society (WSIS). The "Tunis Agenda for the Information Society," published on 18 November 2005, emphasizes the leading facilitating roles that UN agencies need to play in the implementation of the Geneva Plan of Action. The Food and Agriculture Organization of the United Nations (FAO) has been assigned the responsibility of organizing activities related to the action line under C.7 ICT Applications on E-Agriculture (Wikipedia, 2010).

The main phases of the agriculture industry are: Crop cultivation, Water management, Fertilizer Application, Fertigation, Pest management, Harvesting, Post harvest handling, Transporting of food/food products, Packaging, Food preservation, Food processing/value addition, Food quality management, Food safety, Food storage, Food marketing.

All stakeholders of agriculture industry need information and knowledge about these phases to manage them efficiently. Any system applied for getting information and knowledge for making decisions in any industry should deliver accurate, complete, concise information in time or on time. The information provided by the system must be in user-friendly form, easy to access, cost-effective and well protected from unauthorized accesses.

Information and Communication Technology (ICT) can play a significant role in maintaining the above mentioned properties of information as it consists of three main technologies. They are: Computer Technology, Communication Technology and Information Management Technology. These technologies are applied for processing, exchanging and managing data, information and knowledge. The tools provided by ICT are having ability to:

- i. Record text, drawings, photographs, audio, video, process descriptions, and other information in digital formats,
- ii. Produce exact duplicates of such information at significantly lower cost,
- iii. Transfer information and knowledge rapidly over large distances through communications networks.
- iv. Develop standardized algorithms to large quantities of information relatively rapidly.
- v. Achieve greater interactivity in communicating, evaluating, producing and sharing useful information and knowledge.

The main focus of this section is to elaborate how the achievements of ICT can be applied in Agriculture sector and its development. The main applications of ICT in Agriculture sector include: Office Automation, Knowledge Management System, E-learning, E-commerce, ICT for managing Agricultural Resources and Services, Computer Aided Manufacturing (CAM), Computer Aided Design (CAD), RFIDs, Wireless Technologies, GPS, GIS, and Computer controlled devices (Automated systems).

The office automation is application of computers, computer networks, telephone networks, and other office automation tool such as photocopy machines, scanners, printers, cleaning equipments, electronic security systems to increase the productivity of organizations.

There are many government, private and non-government organizations that are involving in agriculture sector and rural development. They all have to work together to give better services to farming community. Therefore, application of office automation is one of the solutions to enhance the efficiency and interconnectivity of the employees work in all above mentioned organizations.

Many computer applications such as MS Office, Internet Explorer, Open Office and other tailor made office automation software packages are providing unlimited potential to organizations and individuals to fulfill their day to day data processing requirements to give an efficient service to their customers. Large agri-business organizations are now using SAP AG ERP software solutions to automate their business processes.

Future prospects of the Agri-Industry depend on adoption and deployment of new tools and technologies to cut down cost and improve efficiency. E-commerce has become a reality. Globalization is putting pressure for international quality at lowest possible cost with rocket speed and best customer services. The only option is to enable your business process with IT. With legal framework in place, e-commerce provides for better security than normal business transactions. Procurement, recruitment, disposal, communication and marketing are the important areas where e-business can be tried and adopted in agriculture.

IX. CONCLUSION

Among the three necessities of existence are clothing, food, and shelter. Food is the only one of the three that is necessary for survival. The topic of food security has gained international attention, particularly in recent years. Therefore, it is impossible to overstate the significance of agriculture. Like every other industry, agriculture requires ongoing research to stay up to date with technological advancements and meet the ever-increasing demand for its produce, especially in light of the recent eco-friendly green globe movement. The most environmentally friendly resources available, agricultural goods, have been under increased pressure as a result (e.g. usage of cereals in fuel production). Every area of the economy has benefited from ICT. ICT has not yet had a significant, pervasive impact on agriculture as an economic sector. In light of this, this article offers guidelines regarding the potential benefits and challenges of ICT for agriculture, should it be implemented.

X. RECOMMENDATIONS

This study recommends the following:

- i. Government should provide at least one ICT centre in every local government headquarter. This ICT centre should have computers equipped with IT such as email and the World Wide Web, for ready access to farmers.
- ii. Government should provide training and support staff in each of these ICT centres.
- iii. Government should educate farmers on the role/benefits of ICT in agriculture so as to boost user's trust on ICT.

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