

Review Article

Role of Information and Communication Technology in Agriculture

Insha Javeed^{1*}, Sumati Narayan¹, Ajaz A. Malik¹, Anil Kumar¹, Rihana Rahman²,
Shemoo Nisar³, Afroza Akhter¹, Sayed Azrah Indrabi¹ and Amreena Sultan¹

¹Department of Vegetable Science, ²Department of Soil Science,

³Department of Fruit Science, Sher-e-Kashmir University of Agricultural Sciences and
Technology of Kashmir, Shalimar, Srinagar-190025, Jammu and Kashmir, India

**Corresponding author*

ABSTRACT

Information and Communication Technology (ICT) can be defined as a basket of technologies which assist or support in storage, processing of data/information or dissemination /communication of data. The application of 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. ICT are most natural allies to facilitate the outreach of agri-extension system in the country. Despite large, well- educated, well- trained and well organized agricultural extension manpower, around 60% of farmers in the country still remain unreached, not served by any extension agency. The major source of information is radio and television. Approximately 45% ICT projects of whole World have been implemented in India and also maximum no. of information Kiosks has been employed in rural India. It was found that majority of the ICT projects in agriculture were put into action in socio- economically developed states of South and North India, while deprived states are not benefitted by ICT initiatives. Some of the e-Agriculture initiatives in India include e- Extension, Agrinet, Digital green, e- Sagu, Agmarknet, iKisan, Village Knowledge Centers, Kisan Call Centers, SMS Portal/mKisan portal. The e-Agriculture disseminates useful information through Decision Support System (DSS) and Expert system (ES). Moreover ICT help in finalising decision making at the right time, to discover best solutions and efficient systems for water management and irrigation to harvest maximum yield.

Keywords

ICT, Agriculture,
initiatives, DSS,
ES

Introduction

The agricultural sector in India is currently passing through a difficult phase. India is moving towards an agricultural emergency due to lack of attention, insufficient land reforms, defective land management, non-providing of fair prices to farmers for their crops, inadequate investment in irrigational

and agricultural infrastructure in India, etc. India's food production and productivity is declining while its food consumption is increasing. The position has further been worsened due to use of food grains to meet the demands of bio fuels. Even the solution of import of food grains would be troublesome, as India does not have ports and logistical systems for large-scale food imports.

ICT or Information and Communications

Technology in simple terms, can be defined as the basket of technologies, which assist or support in storage, processing of Data/Information, or in dissemination/communication of Data/Information, or both. ICT thus includes technologies such as desktop and laptop computers, software, peripherals and connection to the Internet that are intended to fulfill information processing and communication functions.

ICTs explicitly include the field of electronic communication, in addition to IT. The term IT is defined as “the study, design, development, implementation, support or management of computer-based information systems, particularly software applications and computer hardware.” IT deals with the use of electronic computers and computer software to convert, store, protect, process, transmit and retrieve information, securely. The relevance of ICTs for Agricultural Development in general and for Agricultural Extension in particular is extremely high for a country like India.

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. All stakeholders of agriculture production system need information and knowledge about these phases to manage them efficiently.

ICTs are most natural allies to facilitate the outreach of Agricultural Extension system in the country. Despite large, well-educated,

well-trained and well-organized Agricultural extension manpower, around 60% of farmers in the country still remain un-reached, not served by any extension agency or functionary. Of the 40%, who have some access to Agricultural Information, the major sources of this information are Radio and Television. The telephone has just started to make its presence felt on this scenario. Internet supporting Information-Kiosks are also serving the farming community, in many parts of the country. Hence ICTs are highly relevant for Agricultural Extension scientists, researchers, functionaries and organizations. The various applications of ICTs, have been discussed in sections below, which have a relevance in agricultural research, education and extension (Singh and Kumar, 2015) (Fig. 1).

Potential of ICT in agriculture

The potential of ICT in agricultural sector can be used on two ways:

Directly, where ICT is used as a tool that contributes directly to productivity of agricultural production

Indirectly, where ICT is used as a tool that provides information to farmers for making quality decisions in efficient management of their enterprises.

Direct contribution of ICT to agricultural production - Precise farming that is popular in developed countries is based on intensive use of ICT and it contributes directly to agricultural productivity. In order to increase agricultural production, techniques of remote sensors with support of satellite technology, geographic information systems (GIS), agronomics and soil science are applied. ICT supports farmers to track and react to weather condition changes on daily basis. Meteorological stations on field supplied with

solar energy can be connected to computers of farmers in order to send information on current temperature of air and soil, rainfall, relative humidity of air, moisture of leaf, moisture of soil, length of day, speed of wind and solar radiation. All these techniques and technologies of precise farming require great capital investments which are payable for big farms. They are appropriate for corporate farming while they are less suitable and efficient for small enterprises and farms.

Indirect contribution of ICT to agricultural production - Indirect benefits of ICT are manifested in enabling of farmers for decision making and should be realized in the future development of agriculture. Farmers need timely and reliable sources of information that is explained in previous section of paper. Presently, farmers depend on conventional sources of information that are unreliable and do not give timely information.

Changes in the agricultural environment that farmers face make information not only useful but necessary for them to stay competitive and survive on globalized market. However, efforts on providing of the information will be wasteful if farmers are not able to use ICT. In order farmers to use internet services for searching useful information and communication, elementary computing literacy is required. Through internet, they can track prices and communicate with colleagues around world as often as they want. They can exchange ideas, ask questions and get answers on specific themes. Of specific importance is receiving advices from researchers and agronomists on cultivation of crops and animals. ICT influences on reduction of gap between agricultural researchers and farmers that leads to high developed agriculture having enormous contribution to national economy and society (Milovanovic, 2014).

ICTs and farmers' advisory services

The most widely used and available tools of farmers' advisory services are- telephone based Tele Advisory Services, the mobile based Agri Advisory services, television and radio based mass media programmes, web based online Agri Advisory services, video-conferencing, Online Agri video.

Channel, besides traditional media like, printed literature, newspapers, and farmer's exhibition/fair etc. Most of the agricultural institutes and organizations have their own telephone based advisory services for farmers which provide telephone based Agri advisory services through a dedicated telephone number to provide real-time information and advisory.

The on-line phone based expert advice service, Kisan Call Centres (KCC), launched by the Ministry of Agriculture, Government of India is available for all within the country since January 2004. A toll-free telephone number "1800-180-1551" has been provided that is operational on all days from 6.00 am to 10.00 pm.

Beyond these hours the calls are attended in the Interactive Voice Response System (IVRS) mode. The mobile based Agri Advisory services offers text, voice and video content based Agri information services through mobile phones. Mobile phones are becoming an essential device for all types of users irrespective of the age group. In India mobile technology has unleashed a paradigm shift in the communication medium to reach out to the masses. Community radio is one of the important tools of ICT that offer farmers and the people a voice and help development of the community. Community radio is owned and operated by a community or members of a community (Singh and Kumar. 2015)

Farmers' access to different ICT based

media

There were 9 selected ICT based media included in the interview schedule and were asked to the respondent farmers to give their responses regarding their access to those media for receiving and providing agricultural information. Data presented in below graph indicates the frustrating scenario that none of them had adequate access to any of the selected ICT media. Findings revealed that half of the farmers (50%) had limited access to cell phone for getting agricultural information and still a significant portion (18%) do not have access to cell phone. However, around one-third (31%) of them had moderate access to cell phone which is relatively better compared to other ICT based media. This is due to the reason that they can afford it to some extent. On the other hand, scenario of farmers' access to smart phone was quite different. Highest majority (84%) of the farmers do not have access to smart phone. However, in the case of FM radio it was a bit better compared to smart phone and more than one third (38%) of the farmers had limited access to FM radio. It was similar to smart phone that only 4% of them had moderate access to FM radio and still more than half (59%) of them do not have any access to FM radio (Khalak *et al.*, 2018).

The ICT based Model for Information Dissemination

The information is vital for development of agriculture and well being of the rural masses. The fact has been well recognised in the form of a number of initiatives taken to disseminate information on agriculture and related aspects by government, non-government, private and co-operatives. However, the optimum utilisation of the system and the information disseminated will depend on a number of factors like literacy level, understanding of ICT, extent of

telecommunication infrastructure, level of awareness of the farmers, information need of the farmers, etc. Any approach incorporating these factors will have maximum impact. Since few research findings are available to support any particular approach, an attempt has been made to identify the important factors for an ideal ICT model for information dissemination considering the above given factors.

Delivery mechanism

The rural India characterised by poor literacy and poor infrastructure poses the biggest challenge in finding the correct and effective mechanism for delivery of information to the end user. Under such conditions, mobile phones which are used by sizeable rural population can provide an efficient and effective platform for delivering of information. The penetration of mobile in rural areas has increased in the recent past. The tele-density in rural India was reported to have reached 31.18 per cent by the end of year 2010.

A study on fisheries sector in Kerala suggests that mobile phone coverage alone led to significant market efficiencies with reduction in waste and the difference in prices across markets. The study also reported an increase of 9 per cent in fishermen's profits and decline of 4 per cent in consumer prices (Jensen, 2007). Another innovation that has been utilised successfully in some of the approaches to deliver information is introduction of Sanchalak - the facilitator.

Mostly the Sanchalak is an educated and progressive farmer from the community itself. This linkage already having the faith of the locals can effectively compensate for the low level of literacy and lack of IT exposure of the farmers.

Two-way process

Single directional flow of information has been the problem with many of the government extension programmes. An efficient information system should be a two-way process. The content of information to be delivered by the system should be developed after thorough assessment of the information needs of the farmers.

Integration of various departments

There are a number of departments operating in isolation to serve the varying and different needs of the farmers. The integration of all these departments will help in economic utilisation of resources and help rapid dissemination of information for its optimum utilisation.

Window for Queries

Agriculture is a kind of profession where practically farmers come across a new problem every day. The information dissemination system should have provision for interaction with subject matter experts to resolve farmers' specific queries.

Customized information

Different farmers cultivate different crops with different technology and thus, the system should be in a position to serve the specific requirement of the farming community.

Integrated approach

An integrated approach using different mediums like phone, films, digital photos, internet, television, radio, local facilitators, etc. according to the needs and level of understanding of the end user would yield better results.

User friendly information

The information should be provided in an easily understandable format preferably in local language (Shalendra *et al.*, 2011).

Major components used for ICT initiatives in India

Major components which are used in our country for providing ICT services to the farmers are web portals, mobile applications on android phone, SMS and voice messages on simple phones, information kiosks, videos and video conferencing with the experts. Agriculture experts are the key component in the whole process of disseminating information to the farmers.

The ICT components may disseminate relevant, real, customized information to the farmers at appropriate time. Hence, ICTs provide a forum to reach masses easily and to make global and local information easily accessible to the stakeholders. Information dissemination in agriculture is cost effective, time saving and speedy through ICT (Chandrashekara, 2001). Mobile telephony has emerged as the foremost choice of the majority of the urban and rural people (Ansari and Panday, 2011). Mobile phones were found as the most widely accessed tool among the farmers for communication and for accessing agriculture-related information particularly for the marketing of produce (Chhachhar *et al.*, 2014). Researchers also reported that mobile phones were the most used ICT tool and highly accessible by the farmers (Rebekka and Saravanan, 2015). It was found in a comparative study that the livestock farmers of Uttar Pradesh, who were using ICT-based information made significantly better decisions on various livestock practices as compared to ICT non-users (Jabir, 2011). Further, few studies reported that the ICT based initiatives helped

farmers of Madhya Pradesh, Uttar Pradesh and Tamil Nadu of India, in reducing transaction cost while acquiring information and doing transactions in input and output markets (Adhiguru and Devi, 2012).

ICT Initiatives for Agriculture in India

Approximately 45 per cent ICT projects of the whole world have been implemented in India and also maximum number of information kiosks has been employed in rural India (Manzar, 2004). Nevertheless, it was found that majority of the ICT projects in agriculture were put into action in socio-economically developed states of South and North India (Paul *et al.*, 2004), while deprived states are not benefitted by ICT initiatives. Some of the e-Agriculture initiatives in India are indicated below:

e-Extension (e- Soil Health card Programme)

The Deptt. Of Agriculture, Gujarat State is one of the ambitious programmes which aims to analyse the soil of all the villages of the state & proposes to provide online guidance to farmers on their soil health condition, fertilizer usage and alternative cropping pattern. (Singh *et al.*,2015)

e-Choupal

ITC's Agri Business Division launched "e-Choupal" in June 2000 in which village internet kiosks managed by farmers - called sanchalaks -themselves, enable the agricultural community access ready information in their local language on the weather & market prices, disseminate knowledge on scientific farm practices & risk management, facilitate the sale of farm inputs (now with embedded knowledge) and purchase farm produce from the farmers'

doorsteps (decision making is now information-based) (Singh *et al.*, 2015).

Agrisnet

It is a comprehensive web portal to broadcast relevant information to farmers, which was initiated and funded by the Ministry of Agriculture, Government of India. The AGRISNET serves farming community by disseminating information and providing services through use of Information & Communication Technology (ICT). It has following goals:

Providing information to the farmers on quality of the inputs and its availability; Disseminating information of various government schemes and recommending fertilizers after soil testing; Providing information on latest technologies for increasing productivity in agriculture

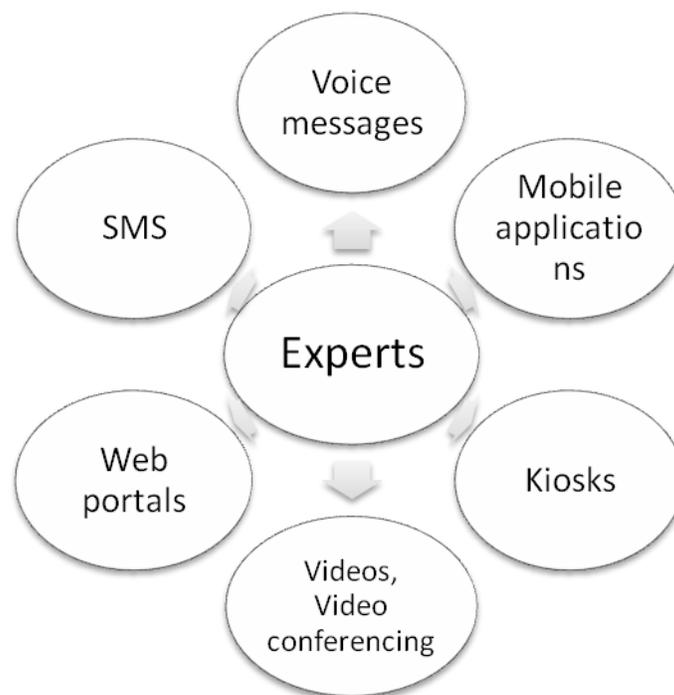
Digital green

Digital Green is an international organization, which works with the participatory approach by engaging rural community to improve their livelihood using digital platform. Interactive and self explanatory videos are prepared for farmers by progressive farmers with the assistance of experts. These videos are shown to the farmers at individual level or in groups. The videos are prepared concentrating the requirements and welfare of the rural masses.

e-Sagu

The eSagu system was developed in 2004. eSagu provides customized solution to the farmer's problems and advise them from sowing to harvesting. Farmers send their farm condition in the form of digital photographs and videos, which were analyzed by the agricultural scientists and experts.

Fig.1



After that, they suggest the right things to do to the farmers even small and marginal farmers are also getting advantage by this. The expert advice is conveyed to the concerned farmer within short time. The queries of illiterate farmers are dealt with the help of educated coordinators at village level. The farm situation or problem is communicated to the agricultural experts and they transmit accurate information to the farmers.

Warana “Wired Village” project

The Warana “Wired Village” project was instigated in 1998 by the Prime Minister’s Office Information Technology (IT) Task Force with the objective of providing agricultural information and services to farmers for increasing productivity. The information is transmitted to the farmers in local language about prices of agricultural outputs, employment schemes from the government of Maharashtra and educational opportunities. The information is

disseminated through information kiosks with the help of operators, who are the main linkage between the farmers and the agricultural connoisseurs.

IKSL IFFCO Kisan Sanchar Ltd

IFFCO Kisan was started in 2012. It delivers relevant information and custom-made solutions to the concerned farmers through voice messages on mobile phones. The farmers can also communicate directly to the agricultural experts on explicit themes via ‘phone-in’ programmes.

Agmarknet

Agricultural Marketing Information Network (AGMARKNET) was commenced in March, 2000 by Ministry of Agriculture, Government of India with the aim of empowering decision-making ability of the farmers regarding selling of their produce. This portal was developed to pace up the agricultural marketing system through broadcasting

information about influx of agricultural commodities in the market and their prices to producers, consumers, traders, and policy makers transparently and quickly.

iKisan

iKisan is a web portal for transmitting information to the farmers about wide-ranging issues related to agriculture such as crop cultivation, weather forecast, agricultural inputs availability and quality, agriculture related financing institutions, soil quality and market updates.

Digital Mandi

Digital Mandi is an electronic trading platform for facilitating farmers and traders to sell and procure agricultural produce beyond the geographical and temporal limitations effortlessly. Various financial institutions also participate in online trading of agricultural output to remove cash crisis.

eArik

The eArik project was initiated in 2007 and it aims to disseminate climate smart agricultural practices and to achieve food security. It is an integrated platform to enhance the accessibility of agricultural information and technology in north-eastern India. It delivers agricultural specialist advice on crop cultivation, crop management and marketing. Farmers can also obtain information direct from the portal but field workers help farmers to access ICT -based information or to consult with other agricultural experts.

Akashganaga

This ICT project makes possible the milk collection, fat testing, and payment timely and user friendly manner. It augments the

income generation of dairy farmers through incorporation of advanced technology.

aAQuA (Almost All Questions Answered)

aAQUA is a multilingual online system that facilitates farmers by advising them, solving their problems and answering their questions related to agriculture. Farmers have to register on aAQUA platform online or telephonically. After that, they can post their queries on the portal, for which they get answers shortly.

Fisher Friend Mobile Advisory KCC

The Fisher Friend Programme (FFP) of M S Swaminathan Research Foundation was launched in 2009 to protect fisher folk from occupational hazards and to empower their livelihoods. The relevant information on wave height, wind speed and direction, potential fishing zones, relevant news, government schemes and market price is provided to fishermen in local language. The FFP covers marginalized coastal communities in Tamil Nadu, Puducherry, Andhra Pradesh, Kerala, and Odisha, and is operational in English, Tamil, Telugu, Malayalam, Odiya languages.

Reuters Market light

Reuters Market Light (RML) was initiated in October, 2007 to deliver customized information to the registered farmers via mobile-SMS. It disseminates information in eight local languages in 13 states (RML.2010).

SMS Portal/mKisan Portal

This portal is designed aiming to serve farmers in three ways. To disseminate information about diverse agricultural activities,

To provide seasonal advisories and to provide various services directly to farmers through SMSs in their local languages

The SMS Portal endows with a platform for amalgamation of service delivery under different sectors viz. Agriculture, Horticulture, Animal Husbandry and Fisheries.

Mahindara Kisan Mitra

This portal provides information to the farmers on price of commodities, weather forecast, crop advisories, loans, insurance, cold storage and warehouses along with success stories of progressive farmers.

Kisan Call Centers (KCCs)

KCCs were commenced on January 21, 2004 by the Department of Agricultural and Co-operation with the main intend of endowing extension services to the farming community in the local languages. The queries of farmers are tackled by agricultural graduates on help line, toll free number in their local language. The agricultural scientists also visit the field in person to get an idea about complex agricultural problems to resolve them.

Village Knowledge Centers (VKCs)

Village knowledge centers of MS Swaminathan research foundation, initiated in 1998 in Pondichery as a gateway of technical information related to agricultural inputs, price of outputs, crop rotation, use of fertilizers and pesticides. Information is disseminated through public address system.

AgRonXT

AgroNxt platform is multitasking platform for the farmers where farmers can get inputs, agriculture advice, weather condition etc.

AgroNxt thrives to contribute to agriculture industry by delivering farmers usable, reliable and timely information that maximizes farm profitability. It assists upholding the agricultural productivity and sustainability.

Agriculture is one of the indispensable sectors in our country. It is well known fact that ICT can revolutionize agriculture in many ways. ICT projects are yet to make any breakthrough in agricultural information dissemination and other areas. Deployment of ICTs needs to be stressed more. ICT for agricultural projects needs to be compared and evaluated precisely. It is need of hour to obtain apposite information through ICTs and to deploy advanced ICTs in agriculture. Having reviewed and analyzed current ICT based information service models, the following suggestions that are relevant to government organizations and ICT developers can be provided for future development and research:

Evaluation of the effectiveness of existing strategies and policies to run ICT projects in agriculture based on the feedback of grass root level workers/officers working directly with farmers in rural regions.

Transforming agriculture sector into the modern digital agriculture to further improve social and economical benefits. Improving the digital access by farmers with technological advances and skills improvement.

Adopting more advanced ICT tools in agriculture such as GPS, GIS, RFID, Remote sensing, Smart device for precision agriculture, sustainability, environment, food safety, etc.

Analyzing and managing big data in agriculture.

References

- Adhiguru, P and Devi, S.V.2012. ICT in Indian Agriculture: Learning's and way ahead. *International Journal of Extension Education*.8:1-4.
- Ansari, M.A. and Pandey, N. 2011. Assessing the potential and use of mobile phones by the farmers in Uttarakhand (India): A special project report.
- Bahera, 2015. E-governance Mediated Agriculture for Sustainable life in India. *Procedia Computer Science*. 48:623-629.
- Chandrashekara, P.2001. "Private Extension: Indian Way, Private Extension: Indian Experiences", National Institute of Agriculture Extension Management, Hyderabad, p. 25.
- Chhachhar, A.R., Querestic, B.,Khushk, G.M. and Ahmed, S. 2014. Impact of ICTs in Agriculture Development. *Journal of Basic and Applied Scientific Research*. 4(1): 281-288.
- Deshmukh.P, 2015. ICT: A path towards rural empowerment through telecommunication, E-governance and E- agriculture. *Journal of Management and Research*. 42(2): 47-54.
- Jabir, A. 2011. Use of quality information for decision -making among livestock Farmers: Role of ICT. *Livestock Research for Rural Development*. 23 (3).
- Khalak, A., Sarker, A.M and Nasir Uddin, M. 2018. Farmers access to ICT based media in receiving farm information. *American Journal of Rural Development*. 6(1):14-20.
- Manzar, O. 2004. Adversity to Success the World's Best e-Content and Creativity Experience. The Country Paper INDIA, Global ICT Summit. Digital Empowerment Foundation, Hong Kong.
- Milovanovic, S. 2014. The role and potential of information technology in agricultural improvement. *Economics of Agriculture*. 61(2):471-485.
- Paul, J., Katz, R. and Gallagher, S.2004. Lessons from the Field: An Overview of the Current Usage of Information and Communication Technologies for Development.
- Rebekka S., Saravanan, R.2015. Access and Usage of ICTs for Agriculture and Rural Development by the tribal farmers in Meghalaya State of North-East India. *Journal of Agriculture Information*. 6(3): 24-41.
- RML (Reuters Market Light).2010. Transforming the Indian Farming Community through Access to Intelligent information. Brochure.
- Shalender, S., Gummagolmath, K. and Sharma, P. 2011. ICT Initiatives in Indian Agriculture-An Overview. *Indian Journal of Agricultural Economics*. 66(3).
- Singh.K.M and Kumar. A. 2015. Role of Information and Communication Technology in Indian Agriculture: An Overview. *SSRN Electronic Journal*.
- Singh, S., Ahlawat, S and Sanwal, S.2017. Role of ICT in Agriculture: Policy implications. *Oriental Journal of Computer Science and Technology*. 10(3): 691-697.