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Application of Information and Communication Technology for Dissemination of Agricultural Information among Farmers: Challenges and Opportunities

Riti Thapar Kapoor
Assistant Professor Amity Institute of Biotechnology Amity University, Noida - 201313 Uttar Pradesh, India. E.mail: rkapoor@amity.edu

Abstract

Agriculture is the backbone of India's economy as two-third of the population live in rural areas and directly or indirectly depend on agriculture for their livelihood. India's food production has improved significantly during the last three decades due to all-round efforts but Indian agriculture is still facing a multitude of problems to maximize productivity to feed the continuously increasing population. Access to information and improved communication is a prerequisite for sustainable agricultural development. The use of information and communication technology (ICT) is an important pillar of agriculture extension and different sources and channels of agriculture information can play important role to meet the requirement. The use of modern information technology needs to be promoted for communication among scientists, extension workers and farmers to transfer the information and new technologies in a cost effective manner. An increased access to the scientific knowledge and information through information technology will help people specially the rural communities in making informed decisions and solving their problems by applying scientific methods. The present paper deals with the constraints and work out strategy for making information and communication technology effective for farmers. Information and communication technology is the backbone of modern development in almost all the sectors which can enhance agricultural and rural development by the transformation of the rural communities. Hence efforts should be made for increased and improved investment in ICT infrastructure and capacity development through the proper implementation of ICT policy.

Keywords: Agriculture, Dissemination, Farmers, Information and communication technology (ICT)

1. Introduction

Agriculture is the backbone of Indian economy as it contributes nearly one fifth of the gross domestic product (GDP) in India and provides livelihood to approximately 70% of the rural population (Narayana Gowda, 2013). The population of India has already been crossed 1.27 billion and is still increasing alarmingly that put a great pressure on the food grain production. India achieved a remarkable success in food grain production from 51 million tonnes in 1951-1952 to 263.2 million tonnes in 2013-2014 due to significant efforts in agriculture such as modernization of agriculture techniques, utilization of seeds of improved varieties, application of fertilizers and pesticides, better cultivation methods and use of modern farm equipments etc (Ayyappan, 2013). However Indian agriculture is still facing a multitude of problems to maximize productivity to feed the continuously increasing population (Brahmanand et al. 2013). Agriculture apart from providing food security has tremendous potential to fuel the economic growth of the country and has maximum cascading impact on other sectors. Hence the growth in the agricultural sector is essential for national growth (Nerker et al. 2013). Rapid industrialization, climate change, deforestation, loss of biodiversity and environmental pollution have become matter of serious concern. Increase in the global atmospheric concentration of carbon dioxide and other greenhouse gases beyond their natural level caused by anthropogenic activities are responsible for increase in the average

temperature of the earth i.e. global warming (Gautam and Sharma, 2012). Such climatic changes will adversely affect the entire agricultural production system through direct or indirect effects on crops and livestock.

The climate change predictions have projected the reduction in crop yield 4.5-9% due to climate change by 2039 but the long run predictions provide a scarier picture with 25% reduction in the crop yield by 2099 (Mahato, 2014). The Intergovernmental Panel on Climate Change (IPCC) in its fourth assessment report indicated that developing countries are more vulnerable to climate change because they largely depend on climate-sensitive sectors. The change in climate conditions will adversely affect farmer's income and purchasing power (Singh, 2012). The yield of several crops such as wheat, rice and pulses in India is significantly low as compared to the crop yield in other countries (Laxmipathi Gowda et al. 2013). Most of the farmers fail to get the required crop production due to several reasons such as change in weather pattern, low rainfall, lack of irrigation facilities, improper, excessive and untimely application of pesticides, use of adulterated seeds and non-availability of required capital.

The use of information and communication technology is important in the current scenario of a rapidly changing world as it has been recognized as an essential mechanism for delivering the information and advice to the farmers for modern farming procedures (Jones, 1997). According to Stueart (1999) growth in information services is a significant factor for the economic well-being of the countries and it is major indicator of success and failure of the economics of developing countries. Timely access to information is one of the important factor in economic recovery and growth. A report of International Development Research Center states that the most vital difference between developed and developing countries or rich and poor countries is the knowledge gap – the capacity to generate, acquire, disseminate and use of the scientific and technical knowledge. Arreymbi and Agbor (2008) reported a statement which was given by the Malaysian Prime Minister Mahathir Mohammed who said, "…it can be no accident that there is today no wealthy developed country that is information poor and no information rich country that is poor and underdeveloped.

In developed countries, precision farming or satellite farming is popular which extensively uses different tools of information technology such as geographical information system and remote sensing to increase the agricultural output (Goswami et al. 2012). This approach is useful for the large tracts of land but it is capital intensive. Geographical Information System (GIS) can provide useful information about the current and future risks of climate change and can be used in designing and implementing adaptation programmes (Yang et al. 2013). Geographical Information System (GIS) and Remote Sensing (RS) have also been proved to be an efficient and effective tool for spatial analysis and management of natural resources (Sinha, 2013). Unfortunately in our country implementation of GIS technologies at the village level and empowering the farmers to use them for local level planning and monitoring agriculture for its sustainability is lacking (Narayana Reddy and Rao, 2009).

Effective utilization of information technology has potential to make the rural communities prosperous as it disseminates the requisite information in user friendly form, easy to access with cost-effective ways (Dhaka and Chayal, 2010). To meet the needs of farmers and rural people engaged in farming, the present communication system has to be geared. Facilities should be generated so that information and expert advice can spread far and wide into the villages and remote areas. Such connectivity will have a positive impact on opening up rural markets, boost up the income levels of the rural people and improve their standards of living thereby transforming the rural sector. The present paper deals with the constraints in dissemination of agricultural information and a solution to bridge the information gap between experts and end users by exploiting different tools of information and communication technology.

2. Role of Information and Communication Technology in Dissemination of Agricultural Information

Science and technology plays a vital role in the development of various sections of the society. During the last two decades progress in Information and Communication Technology (ICT) is affecting all spheres of our life. It has been predicted by the experts that our poverty line will no longer be measured in the terms of money but it will be in terms of information (Hersberger, 2002). Herbert Marshall McLuhan was a famous Canadian philosopher and he gave his concepts on communication theory and public intellectual. McLuhan is also known for coining the term global village and for predicting the idea of world wide web (www) almost thirty years before it was invented. He said that due to information revolution, the world will become very small and it can be described as global village (Mukherjee-Das, 2014) and information technology will become as important as our basic requirements such as food, clothes and shelter. Information technology consists of three main

technologies such as computer technology, communication technology and information management technology (Aina, 2004).

Information and communication technology (ICT) is an umbrella term that includes computer hardware and software, digital broadcast and telecommunication technologies as well as digital information repositories online or offline and also includes social networking aspects on the web besides online file sharing system (Zahedi and Zahedi, 2012). It also includes the television, radio, mobile phones, satellite system and the policies that govern the widespread use of these media resources (Shinde and Dhiman, 2008). Database and data warehousing technologies can be used to store and retrieve large amount of information which can be coupled with internet technology to deliver information to the needy (Afolabi, 2012). The Indian farmer requires timely and reliable sources of information inputs for taking decisions but at present, the farmer depends on trickling down of decision inputs from conventional sources which are slow and unreliable (Mathur and Goyal, 2014). Recent developments in information technology enable the maintenance of huge information (text, image, audio and video) repositories with negligible down-time and stored information can be quickly extracted by millions of users simultaneously. Information technology offers a great opportunity to facilitate the flow of information and technology services delivery especially to the farmers (Maningas, 2006). Now-a-days agriculture is becoming highly science driven and technology intensive but on the other hand the existing extension system has become expensive, less effective, time consuming and fails to meet the expectations of the farmers.

The present era is also known as era of information. Information and communication technology can be useful in improving the linkages between the research and extension system as it is an important pillar of agriculture extension (Zijp, 1994). Effective communication from different sources and channels provides knowledge to rural people to modify their behaviour in the ways that provide sustainable benefits to them and to the society. Different sources of information technology can help in rural development by disseminating a broad range of information needed by rural community. The use of information technology needs to be promoted among scientists, extension workers and farmers to transfer technologies and information in a cost effective manner (Ommani and Chizari, 2008).

3. Objectives of Development of Information and Communication Technology in Agriculture Sector

The potential of information technology in the agriculture sector can be assessed broadly under two heads: (a) as a tool for direct contribution to agricultural productivity (b) as an indirect tool for empowering farmers to take informed decisions which will have positive impact on agriculture and allied activities (Allahyari and Chizari, 2010). The main objectives of information technology in support of agricultural and rural development fall into five main areas such as:

1. Dissemination of scientific advice and technical education to the farmers.
2. Transfer of technology and its application for benefit of the society.
3. Development of entrepreneurial skills as well as economic development of agricultural producers.
4. Small and medium enterprises development in rural areas (Rahman et al. 2005).
5. Rural development.

4. Types of Expert Advice Required by the Farmers

Information and communication technologies are facilitating faster sharing of information and acting as a key agent for changing the agrarian situation and lives of farmers by improving access to information and knowledge (Dhaliwal et al. 2011). The efforts of government and non- governmental organizations are underway to reduce the urban and rural digital divide through the development of information technology. It has been observed that farmers are anxious to get quick and authentic information in the changing scenario of agriculture at global level (Mwakaje, 2010). The technologies like mobile, internet, teletext and microcomputers should necessarily be used for communication with farmers and rural communities. The broad information inputs required by farmers in the current scenario can be classified as:

1. Information about the improved high yielding varieties and hybrid seeds.
2. Type and methods of sowing, spacing, season and appropriate time of seed sowing.
3. Seed treatment, timely cultivation and inter-cultivation methods.
4. Awareness database which can provide weather related information such as low and high temperature, high relative humidity, waterlogged condition, rainfall, hailstorm and drought situation.
5. Methods of application of fertilizers, dosage and time of application.
6. Identification of deficiency symptoms in crops and remedial measures of nutrient-deficient symptoms of crops.

7. Crop improvement practices by the application of micro-nutrients such as zinc, iron, magnesium and gypsum and other cultural practices etc.
8. Identification of pest damage in crops and remedial measures against the pests and worms.
9. Improved methods on integrated pest management.
10. Advanced techniques and methods of pesticide application.
11. Decision support system that facilitates farmers to make a proper SWOT analysis to take appropriate decisions.
12. Information about small and medium scale enterprises.
13. Improved methods of animal husbandry, mushroom cultivation, bee keeping, fisheries and poultry farming etc.
14. Market related information on crops and information about the government schemes of agriculture loan and other facilities to the farmers (Ferroni and Zhou, 2012).

5. Constraints for Effective Dissemination of Agricultural Information

Communication is a basic need of all human beings and it is a web that holds a society together (Singh et al. 2008). Dissemination of the required and recent agricultural information to reach over 119 million farmers which are spread in more than six lakh villages at the different geographical locations in India is very difficult and challenging task (Chauhan, 2010). Unfortunately in our country there are many constraints for dissemination of agricultural information to the rural people. The new technologies in order to reach the farming community from research laboratories require a well organized and efficient extension mechanism of technology transfer (Singh, 2012). Transfer of technology to farmers is not a one time exercise because new technologies are being constantly evolved (Chauhan, 2010). A continuous flow of information about the new technologies in an appropriate manner is essential to provide quick benefit to the farmers (Krishna Reddy and Ankaiah, 2005). Less than one-third of the technologies generated by ICAR Institutes and Agricultural Universities in India have been transferred to the farmer's field due to the lack of an appropriate extension facilities. Hence the research challenge is to identify the effective means to provide quality and timely technical advice to all the needed farmers by using the time of available experts efficiently. The present extension work is already under pressure due to wide ratio between extension workers and farmers i.e. 1:1000. Most of the time of the extension worker is spent for administrative work and travel to the villages and remote areas. Under these situation, it is not possible for the extension worker to serve all the farmers for their problems. It has been observed that the extension workers who work for the welfare of the farmers do not have access to latest information which hinders their ability to serve the farming community effectively. It is important that the extension workers should decide the effective communication sources before development of any system for the higher adoption at a farmer's level (Parihar et al. 2010).

The extension work in the rural areas through satellite based communication is not impossible but it requires collaborative efforts from administration and different organizations. The literacy level of the farmer's and rural people also plays an influential role in the extent of the utilization of available ICT resources (Qaisar et al. 2011). The government and non-governmental organizations should provide appropriate opportunities of formal and informal education to decrease the illiteracy level in rural areas. Another constraint in the development of villages is the problem of electricity. Reliable connectivity is a prerequisite for a successful penetration of helpline services in the rural areas. In India out of 5.93 lakh inhabited villages, less than 4.8 lakh villages have electricity and in most of the rural areas, power supply is not available for long hours and this problem reduces the usefulness of the intended helpline services (Gulati, 2009). Thus illiteracy, lack of electricity, poor connectivity, less number of extension workers, lack of awareness in farmers and incomprehensible technical information provided through helpline services have been perceived as constraints in effective on-line information dissemination to the rural people (Tiwari et al. 2014).

6. Strategies for Effective Dissemination of Agricultural Information through Information Technology

Studies have shown that villagers are willing to know information about agriculture, weather, e-marketing, e-health services and different government schemes related with the welfare of the rural communities etc. Mass media resources such as radio and television offer effective channels for communicating agricultural information and other messages which can increase knowledge of the intended audience (Kumari et al. 2014). The Doordarshan channel telecasts many programmes like choupal, krishi dharshan and navankur etc. in which useful information about the agriculture is given to the farmers. Kisan call center service has been recently launched by the Directorate of Extension, Department of Agriculture and Cooperation which offers expert advice on

agriculture related problems to the farmers. Kisan mobile sandesh (KMS) is becoming the largest ICT initiative in Chhattisgarh state providing farm advisory services to the farmers. The kisan mobile sandesh (KMS) delivers real-time agricultural information to improve farmer's decision making ability so that they may enable to increase the productivity of their crops and getting improved price recovery in a globally competitive agrarian economy (Parganiha et al. 2012).

In a private sector, Bharti-Iffco's joint venture is a good example where mobile handsets are provided with value added services such as free daily voice messages on weather forecast, farming techniques, animal husbandry, rural health initiatives and market prices for the crops. The study of National Sample Survey Organization (NSSO) reveals that approximately 70% of the farmers do not know about the government's minimum support price scheme. Internet is a rich source and fastest way of exchanging information in short time and it must be used by the farming community for their betterment. High speed broadband connectivity for rural areas is a vital component of growth in agriculture sector. Broadcast media have the ability to disseminate information to large audiences efficiently but there is an urgent need that relevant content should be available in local languages then it will be meaningful for the rural people. There is no doubt that broadband enabled services can play major role in unleashing the economic potential of rural India as it can provide several opportunities such as youth employment, increase in crop productivity and promote export. According to the report of World Bank, every 10% increase in high speed internet connections, there is 1.3% increase in economic growth. Some companies such as Reuter's and Connect are providing weather forecast, expert advisory services and information on the market prices of the crops to the farmers. Another noteworthy effort is done by Swaminathan foundation which demonstrated the beneficial economic impact of providing information to fisherman on wave heights in sea, wind velocity and location of fish on their mobile phones. Many IT companies such as Microsoft, Oracle, IBM and India's Centre for Development of Advanced Computing are working for the development of vernacular software translators including operating system, messenger and keyboards. The rural business process outsourcing (BPO) is a great opportunity for business to reduce the cost and revitalize the rural economy. A hundred seat rural BPO can bring fifty lakhs into the rural economy which may help in mainstreaming of rural India into the knowledge economy but the main challenge for operating BPO in villages is electricity and telecommunications (Pathak and Pathak, 2013).

7. Agricultural Services that can be Provided to the Farmers by Using Information and Communication Technology

Timely and relevant technical information about the agriculture related issues should be provided to the farmers. This is possible only with the combination of extension teaching methods along with the different tools of information technology.

The agriculture programmes should be broadcasted at morning time, day time and evening or frequently broadcasted in similar way as news is broadcasted through different media resources such as radio and television.

Establishment of a well equipped agriculture information center in the villages in which different magazines, newspapers and other printed material related to agriculture information can be provided to the farmers.

Preparation of directory of frequently asked questions and making them available to the helpline agents in local languages both in the printed form and soft copy is also essential.

Capacity building programmes for the farmers through education and training is essential for increasing the productivity in agriculture.

The publicity of different extension activities like exhibition, farmer's fair, workshops, seminars and trainings etc. should be done well in advance through the media resources like newspaper, radio and television before starting the activities.

Basic education and training in the computer subject should be provided to the rural people so that the problem of computer illiteracy can be solved. User-friendly software, graphic interfaces and pictorial information can encourage more use of information technology in rural areas.

Availability of competent experts in kisan call center during working hours should be ensured so that questions asked by the farmers can be attended.

Online services for information, education, training, monitoring, consultation, transaction and processing should be given to the rural people. Creation of databases with details of the resources available in local villages and site-specific information system is also useful for rural development etc.

Provision of early warning system about diseases/ pest problems in crops and their control measures should be introduced in the farmer's field.

Proper orientation should be given to the farmers about the procedure of accessing the on-line information services through the helpline centers.

The facility of land records and online registration services should be provided to the farmers.

Wasteland management is an important issue, helpline services must provide more information on this aspect.

In each state, agriculture department should establish independent cells for distance education for training of rural youth for imparting short-term courses on new technologies in agriculture and allied sciences to improve farming.

The accessibility of toll free phone numbers should be checked regularly, this effort will help in proper functioning of the helpline services.

Location specific problems should be prioritized and technological intervention should be formulated to make the helpline services more effective in solving the problem of a particular region.

Empowerment of small and marginal farmers with suitable technical knowledge for cultivation of improved crops should be encouraged.

Information about the crop price, market opportunities, rural development programmes and crop insurances should be given to the farmers.

It is recommended that while recruiting personnel for ICT programmes, the officers should be selected to work as the interface between ICT and farmers must be graduates preferably in agriculture background, this will ensure effective delivery of services.

Promotion of agribusiness through development of agribusiness centers in villages is essential for rural development. These centers can provide the knowledge to the farmers on various issues such as post harvest technology including processing, product standardization, grading, value addition, storage, packaging, transportation and distribution etc.

Establishment of agro-clinics (information shops) by the trained agricultural graduates in the rural areas can act as single window for all the informations. It may provide advisory services on crops and livestock to the farmers at the block and district level.

Development of seed bank in the villages by producing good quality seeds and planting materials of important crop varieties and hybrids through the appropriate training to the farmers to meet the requirements of village cluster and nearby areas.

Development of water bank in rural areas by harvesting rain water and efficient water management techniques.

Development of manure bank in the villages by utilizing cattle dung and other biomass for improving the soil health.

Development of villagers cooperative bank, which should be completely owned and managed by the rural people with risk mitigation fund for helping the rural communities under unforeseen adverse situation.

Government should create Traditional Knowledge Digital Libraries (TKDL) in villages for the collection of the various types of local knowledge so that it can be shared more widely.

Improved agricultural production is the major weapon in the fight against hunger, improving rural livelihood and increasing economic growth. Before the establishment of ICT projects in a region, rapid rural appraisals should be done to assess the type of information is required by the farmers or rural people. Government should reorient their policies in order to harness ICT's potential for contributing to agricultural development.

8. ICT Initiatives for Agricultural Development in India

Many government and non-governmental organizations are trying to establish internet connectivity to make best use of satellite based communication technology in the villages (Chauhan and Thakor, 2004). Some ICT projects are working successfully in different parts of India such as Agmarknet, E-sagu and Gender resource center projects have been initiated by the central government and several other projects have been started by the state governments such as Gyandoot project in Madhya Pradesh (Dwivedi and Bharti, 2010), Warana wired village project in Maharashtra, information village project of M. S. Swaminathan Research Foundation (MSSRF) in Pondicherry, iKisan project of the Nagarjuna group of companies in Andhra Pradesh, automated milk collection center of Amul dairy cooperatives in Gujarat, land record computerization project in Karnataka, computer-aided online registration department in Andhra Pradesh and knowledge network for grass root innovations in Gujarat. A few non-government organizations (NGOs) have also initiated ICT projects such as: Tarahaat.com in Uttar Pradesh and Punjab, Mahitiz-samuha and Voices - Madhyam communications in Karnataka and Life Lines project etc. Many agricultural websites have been developed which can provide significant information to the farmers such as khetiwadi.com, kisan.net, krishiworld.com, nic.in/agrico, pravara.com, agrinto.com, nabard.org, agriwatch.com, ciks.org/agri.html, agri.mah.nic.in, haritgyan.com, krishiworld.net, itc's soyachoupal.com and acquachoupal.com etc (Qaisar et al. 2011).

9. Conclusion and Recommendations

There is continuously increasing realization about the potentialities of information and communication technology in dissemination of agricultural information among the farmers. A good source of communication directly affects the technology adoption process and without a suitable source or channel, it is not possible to convince farmers and rural people for the adoption of any new method or technology. Awareness generation among the rural people about the various services of information and communication technology is the first step to be considered to increase farmer's participation in ICT related programmes. Proper training in the use of ICT modules should be given to the staff / officers working directly with the farmers. Information and communication technology can play a major role in facilitating the process of transformation of rural India to meet the challenges and to remove the fast growing digital divide between rural and urban areas. There is still a lot of work to be done by policy makers to understand and act on this issue because the satellite-based extension through the use of internet facility still has a long way to go to be user friendly for rural people. There is an urgent need of networking among the various organizations for sharing the information resources. The government should gear up their central and state level efforts to provide all types of mobile and internet enabled education, health and information services to the rural communities in the rural areas. If cyber connectivity will be made available to all the Indian villages and other remote areas, the positive change in the face of rural development will be possible. The connectivity through information and communication technology will ensure that India will become knowledge and economic superpower in the twenty first century. Information and communication technology is the backbone of modern development in almost all the sectors. The application of ICT in agriculture sector can enhance agricultural and rural development by the transformation of the rural communities.

The central and state government should take necessary steps to start more ICT information service centres with adequate facilities by preparing useful and realistic information needed to the farmers to reduce the existing problems in agriculture sector.

The basic requirements for successful implementation of rural ICTs initiatives are electricity, hardware, appropriate software, telephony, network connectivity. Hence, there should be increased and improved investment in ICT infrastructure and capacity development by the government.

There should be a well established national ICT policy and involvement of all ICT stakeholders in setting of the ICT R & D priorities is required.

There is an urgent need of networking among the various organizations for sharing the information resources. There should be focus on ICT training for teachers, researchers, extension workers and farmers for its practical implementations.

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