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# Role of Information Technology in Agriculture to Improve Farmer Livelihood: A Review

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**ABSTRACT**

*ICT acts as a provider of major opportunities to rural livelihoods and contributes towards poverty reduction. Productivity of rural areas can be enhanced by usage of ICT. Application of new and contemporary information and communication technologies (ICTs) for agricultural development in the India has been advancing quite rapidly over the last decade. ICT is changing all the spheres of human lives. Agriculture is an important sector with the majority of the rural population in developing countries depending on it. The agriculture sector faces major challenges of enhancing production in a situation of declining natural resources necessary for production. The growing demand for agricultural products, however, also offers opportunities for producers to sustain and improve their livelihoods. Information and Communication Technologies (ICT) act as a key agent in agriculture sector in addressing these challenges and enriching the livelihoods of the poor rural population which depends on agricultural produce. ICT can be used effectively in extension education for transfer of technologies by using, internet access, mailing systems, servers, tele-conferencing interactive video, videoconferencing, wireless, computer systems; local area and wide area network (LAN and WAN), dial access, television and digital equipments etc.*

***Keyword:*** *ICT, Agriculture, farmer, livelihood and ICT tools.*

## INTRODUCTION

### ICT Concept and origin

ICT (information and communications technology or technologies) is an umbrella term that includes any communication device or application, encompassing radio, television, cellular phones, computer, network, hardware and software, satellite systems and so on, as well as the various services and applications associated with them, such as videoconferencing and distance learning. ICTs are often spoken in a particular context, such as ICTs in education, healthcare or libraries. The phrase Information and Communication Technology has been used by academic researchers since the 1980s and the term ICT became popular after it was used in a report to the UK government by Dennis Stevenson in 1997 in the revised National Curriculum for England, Wales and Northern Ireland in 2000.

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Butin 2012, the Royal Society recommended that the term ICT should no longer be used in British schools "as it has attracted too many negative connotations", and with effect from 2014 the National Curriculum was changed to use the word computing reflecting the addition of computer programming to the curriculum. A leading group of universities consider ICT to be a soft subject and advise students against studying A-level ICT, preferring instead A-level Computer Science. Variations of the phrase have spread worldwide, with the United Nations creating a "United Nations Information and Communication Technologies Task Force" and an internal "Office of Information and Communications Technology".

**Information and communication technology (ICT)**

Information and communication technology or ICT, is defined as the combination of informatics technology with other related technologies, specifically communication technology. In this, these three definitions have been collapsed into a single, all encompassing, definition of ICT. This definition implies that ICT will be used, applied and integrated in activities of working and learning on the basis of conceptual understanding and methods of informatics.

**Aims**

Information and communication technology (ICT) has become, within a very short time, one of the basic building blocks of modern society. Many countries now regard understanding ICT and mastering the basic skills and concepts of ICT as part of the core of education, alongside reading, writing and numeracy. Agriculture is a major sector, which is vital for the survival of modern man. Plants are the producers in the food chain, and without them, the life cycle would just not be possible. Agricultural produce, though highly perishable compared to other food sources, is essential for survival. Crops are used to produce several food sources by themselves or through by-products such as bread, powders, organic additives to other goods and the like (Byerlee et al., 2009). The produce from agriculture drives trade from one country to another, brings income for farmers, makes productive use of otherwise idle land, and brings food on the table. It is such an important part of everyone daily life, although it may not be seen as a direct factor since the produce goes a long way before reaching the hands of everyone who benefits from it. Because of its importance to society, it is but a must to evolve with the times and adjust to meet the needs of modern people (Banu, 2015). By adapting and making use of IT to help improve agricultural progress, everyone benefits from the union of these sectors. Upon first glance, it may be challenging to see how IT and agriculture sectors may work together being completely different. Agriculture has been around since men first learned to tend to his own crops and not depend on what just grows where he goes. IT, on the other hand, is a much younger advancement that man has developed (Donner, 2006). The main phases of the agriculture industry include crop cultivation, water management, fertilizer application, fertilization, pest management, harvesting, post-harvest handling, transport of food products, packaging, food preservation, food processing, value addition, quality management, food safety, food storage, and food marketing (Dunaway, 2002). Since IT encompasses a lot of disciplines, it can also be successfully integrated to many different sectors to help them become more efficient and productive. It may take some getting used to, but when IT is successfully integrated to agriculture, it helps a great deal and can definitely contribute to positive changes that farmers can prove with the growth of their output.

**How sustainable agriculture can be achieved**

Sustainable agriculture can be achieved when the farmers are supplied with adequate, appropriate, accurate and timely information. Agricultural information has a key role in facilitating the participation of people relating to sustainable development (Jain, et al., 2011). Globally, the emerging concept of e-agriculture incorporates the sophisticated use

of innovative information and communication technologies (ICT). ICTs have the potential to revolutionize the agricultural sector due to their affordability, accessibility, and adaptability. This technology empowers different stakeholders involved in the value chain to perform tasks quickly, efficiently, and with greater ease and accuracy. ICTs can help farmers improve local economies and the quality of life by making informed decisions. These ICT tools can be our new arsenal in the fight against hunger and in feeding the billions. ICTs for Improved Prediction and monitoring of environmental and soil conditions can make farming more profitable and sustainable and can lead to increased productivity, significant profits and savings. In this regard, ICTs can be useful for various purposes including land use planning, crop forecasting and early warning systems. In addition to that, ICT tools can enable farmers to exploit their farming potential by getting timely, accurate and relevant information on sustainable agricultural practices, water management, pest and disease control, soil testing and post-harvest management techniques. Information Sharing Information and knowledge play a key role in enhancing sustainable agricultural development and addressing food security. ICTs can provide farmers with useful and beneficial information, such as new farming techniques, weather reports, and crop prices. This is also referred to as e-agriculture and the following are some practical examples of this use of ICTs (Jat et al., 2017).

**Rural Radio:** Radio is a relatively inexpensive communication medium and has fairly wide coverage. It can provide farmers with information about farming conditions. These radios do not only aim at modifying agricultural methods but they also aim at changing the state of mind through profound behavior modifications.

**Mobile Phones:** The use of mobile phones to distribute food market information offers great advantages for consumers and food producers. Farmers can use mobile phones to receive text messages with market information on commodities (market price, supply, and demand).

**Tele-centers:** Community telecenters in rural areas with access to the Internet, telephone and fax services can play a vital role to make relevant information available to the farmers. Farmers can use these services to enhance communication with potential buyers and to access information on improved farming techniques.

**ICTs and Agri-Markets:** With the help of ICTs farmers can get information on the location of profitable agri-markets, enquiring about who is paying the highest price and even contact their potential buyers to sell their products online. They can also benefit from mobile banking and government credit programs with reduced transaction costs. Apart from this, there are more-specialized applications, esp. software, for supply chain and financial management that can increase the accuracy of the farm operations.

ICT-enabled marketing and access to markets plays a major role, especially for information on market prices and demand. ICT-enhanced marketing and certification strengthen the capacity of small-scale producers to increase revenue by improving their position on local and international markets.

**Impact of ICT on Research and Extension**

The impact of ICT in agricultural research is quite significant. This is taking place through three means. The first one has to do with the changing nature of agricultural information systems, which is having a profound impact on how research results are communicated and disseminated. With the development of web-based information systems the possibility of accessing databases and information on-line has increased dramatically, with the concomitant problems that is generating from the point of view of the confidentiality of the information and of the economics of information management (economic value of information). The rapid expansion of web publishing is dramatically changing the way people access information and leading to the development of meta databases, based on virtually braries that provide direct access to

the publication, wherever it is located, as long as the publication is accessible through the web. Secondly, the very significant advances that are being made in software applications related to agricultural research techniques, coupled with advances in other areas of science, such as molecular biology, is accelerating the research process enormously and making it much more efficient. This is one of the areas in which NARS can seriously fall behind, compared to IARCs to ARIs and obviously to the private sector. Access to research software is one of the important dimensions through which the ICT technology gap can be avoided or reduced. But the most important impact on research is being generated by a third factor. The presence of new actors in agricultural research (such as the private sector, NGOs and universities), the changing composition of the scientific fields related to agricultural research (increasing importance of molecular biology and ICT as compared with agronomy and veterinary), the changing nature of networking, the possibility of working jointly with researchers in different institutional locations by interacting with them in real time, the possibility of developing virtual communities of scholars working on the same topic but dispersed in space, and the increasing importance of knowledge systems and learning systems that are based on interactive knowledge development processes and thus on a different concept on how knowledge is generated and managed in this new environment, is leading to profound changes in the research world. The social organization of science is changing, given changes that are appearing in the organizational structure of research (how research is organized), as well as changes in the relationship between research, education and extension. The traditional linear relationship among these three functions is being replaced by dynamic interactive processes, based on knowledge systems that combine these three key functions in different and innovative ways. Given the importance of this change, it will be analyzed in a separate section where it will be argued that we are confronting the emergence of a new paradigm for agricultural research for development.

**Implementation**

Broad areas of ICT implementation: ICT-based extension advisory methods are relevant in areas such as pre-production, production, post-harvest and marketing, financial services (credit, payment, savings, insurance), and gathering and distributing of climate and other data. The list belowindicates which ICTs to use to achieve five broad aims:

I. **Offering localised and customised information, advisory, and other services:** Farmer call centres, mobile apps, radio, TV.

II. **Helping to create, document, store, retrieve, share, and manage information:** Web portals, crop-specific portals, knowledge banks, expert systems, agricultural information management systems.

III. **Enabling collaboration, sharing, and partnerships for innovation among extension actors:** Social media, discussion groups.

IV. **Enabling farmers and others to 'gain a voice':** Community radio, tele-centres, videos, virtual communities of practice and social media.

V. **Facilitating capacity development of farmers, extension professionals, and other AIS actors:** E-learning mechanisms (open distance learning, learning object repositories, massive open online courses, and other e-learning mechanisms), training by using ICTs, survey and monitoring tools, and applications.

**Implementation steps of ICT-enabled Extension and Advisory Services:** appropriateness of ICTs depends on the situation and their use is most successful as a catalyst of development. To use them effectively, a series of logical steps needs to be followed (Figure 1). While the steps may be indicative of the logical delivery of ICT projects, they are not absolute in any terms, but depend on the situation and best judgements of the extension organisation,

based on detailed need assessment surveys of clientele and other stakeholders.

**1. Needs assessment:** Extension and Advisory Services is most useful and applicable when the information and services provided are localised and needs based. So for ICT projects to be successful, the first and foremost action of the host organisation should be a needs assessment of the target community.

**2. Benchmark survey:** Standards or points of reference are very important for ICT-enabled services to meet their objectives and this makes benchmark surveys a necessity. They are also useful as standards of monitoring and evaluation.

**3. Content development:** Localised and customised content needs to be developed, based on the results of the needs assessment and benchmark surveys to avoid blanket recommendations.

**4. ICT selection, development, and testing:** Based on localised needs, content, and target groups, the appropriate ICT tool needs to be selected, developed and pilot-tested for determination of suitability.

**5. Awareness programmes and registration:** One major drawback in ICT projects is lack of awareness of target users of the project's existence or benefits. To solve that, innovative campaigns need to be conducted to make the intended audience aware of the projects. This is especially important in the case of subscription-based services, as the users need to register to receive the benefits.

**6. Extension, advisory, and other services:** Based on demand and needs of the users, the services are to be provided to the targeted groups.

**7. Partnership and integration of services:** Depending on the needs of the project and the services provided, stakeholders need to collaborate to determine which services can be integrated to avoid duplication and provide quality service to the users.

**8. Monitoring and stabilisation:** Continuous monitoring is an important function, especially in the pilot phase, to determine the suitability of the project for target users and modifications should be made accordingly to the services offered to ultimately scale up the project in a profitable manner.

**9. Impact assessment:** This remains one of the most important steps in implementation of ICT projects, as the impact ultimately determines the degree of success of the project in bringing about the desired changes in the target group, as well as the factors deciding its long-term sustainability.

**Bridge the Communication Gap**

ICTs can help bridge the communication gap to improve the interaction between farmers and agri scientists and researcher to better identify farmers' specific problems. Researchers can get critical agricultural information like the incidence of pests, disease and crop-yields using mobile based applications. Data collection is faster than traditional methods more people can be interviewed in less time using minimum resources. Investing in technology and building ICT skills of farmers help to ensure food security for the poorest populations and consistent food production for local and global markets and can also help to achieve the goals for a sustainable development model. Advanced Technology in Agriculture and Food Processing, Robotics and Automation in Agriculture and Food sector Energy-Efficient and Environment-Friendly (EEEF) Devices for farm operations to compensate for the growing shortage of farm labour. Developments in Bio-Technology and other Frontier Sciences. Precision farming. A combination of Systems-Research Tools relating to Information Technology, Geographic Information Systems (GIS), Global Positioning Systems (GPS), Remote Sensing (RS), and climate-smart resource management technologies. Smart sensors and new delivery systems to help combat viruses and pathogens. High-Performance Computing (HPC) for manipulation of very large data sets, particularly those related to agricultural genomics, proteomics, geo-informatics and climate change. Smart Knowledge Agriculture Corridor. An effective regulatory approval process for new technologies, which allow farmers to gain access to the latest

technological advancements, to be put in place. This Vision Document clearly perceives the need for a regulatory process for new technologies so as to allow farmers to gain access to latest technological advancements, and also the fusion of technologies for achieving higher level productivity in food and agriculture systems.

**National Policy on ICT in Agricultural Extension**

National policy framework for agricultural extension (2000) stated that information technology revolution is unfolding and has very high visibility. Harnessing information technology for agricultural extension will receive high point in the policy agenda. Extensive use of modern information technology will be promoted for communication between researchers, extension workers and their farmer clients to transfer technologies and information more cost effectively. Further, it emphasised IT application in marketing, wider use of electronic mass media for agricultural extension, farmer participation in IT programmes and support to the state government for using IT in agricultural extension, promoting IT based information kiosks and capacity building for use of IT (DoA&C, 2000). National policy for farmers (2007) indicated that the potential of ICT would be harnessed by establishing Gyan Chaupels (Knowledge centres) in villages. Further, the Common Service Centres (CSCs) of the Department of Information Technology, Ministry of Communications and Information Technology, Government of India and those set up by the state governments and private initiative programmes will be evolved for inclusive broad-based development. Last mile and last person connectivity would be facilitated with the help of technologies such as broadband internet, community radio or internet-mobile phone synergies (NPFF, 2007). Document of ICAR Framework for Technology Development and Delivery System in Agriculture (2008) outlined the need for the construction of Agri – India knowledge portal – A single electronic gateway to be developed through a peer review process with the help of 15 content accreditation centres from 15 agro-climatic regions of the country. Each accreditation centres will be coordinate with other Agricultural Universities and agricultural institutions in their region for development of content in regional language as well as in English and also do its validation, which will be collected in the central data warehouse integrated in the knowledge portal. The portal will also serve as a platform for facilitation of interaction among researchers and extension personnel in the KVKs through high speed server intranet (ICAR-FFTDDSA, 2008). National e-Governance Plan indicated that the typical services envisaged in Agriculture as a Mission Mode Projects (MMP) to provide information to the farmers on seeds, fertilizers, pesticides, Govt. Schemes, Soil recommendations, Crop management, Weather and marketing of agriculture produce. Several projects such as ASHA in Assam, KISSAN and e-Krishi in Kerala and Krishi Maratha Vahini in Karnataka have been initiated by the Department of Agriculture and Cooperation (DoA&C), Government of India (Jat et al., 2017). To spearhead implementation of Mission mode project (MMP) in Agriculture, DoA&C has adopted twin strategy through AGRISNET & two portals AGMARKNET & DACNET (Mathur et al., 2009).

## CONCLUSION

People only have to open their minds to the endless possibilities that technological advancement can bring to agriculture. Instead of being locked away with the traditional strategies for planting, why not get involved in new and improved methods of farming. Today's society can benefit from agricultural advancements and live sustainable lives by improving the production, harvest methods, and distribution of agricultural goods. All of these effects and more are possible through the successful merge of IT and agriculture which is why farmers are getting more and more encouraged to take part in this positive change. There is a great potential for the use of ICTs

for agriculture and rural development in India. India is fortunate to have developed an ICT policy, which indicates the government's commitment to support ICT programmes in the rural areas. What is required now is policy implementation with emphasis on the provision of information to the rural areas. One of the ways of improving access to ICT in the rural areas in India is through the promotion of community ICT Centers. This has the advantage of mass usage, maintenance, the security of both service and equipment and the easier collection of charges. Individual communities should be assisted to build their own knowledge centres where indigenous knowledge is combined with exogenous knowledge to improve livelihoods. The government alone cannot carry out this programme. Support is needed from various non -governmental organisations, corporate bodies and individuals in this area. In all these, the urban-rural disparity in the distribution of ICTs which has created a localized digital and information divide must be tackled and dealt with decisively if the rural areas in India's are to take full advantage of these technologies to enhance their socio economic development.

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