CHAPTER 12

Information & Communication Technology

AN OBLIGATORY & RELIABLE PLATFORM IN AGRICULTURAL INFORMATION DISSEMINATION

***M. Jagan Mohan Reddy**, Professor and Head, Department of Agricultural Extension, College of Agriculture, Professor Jayashankar Telangana State Agricultural University (PJTSAU), Rajendranagar, Hyderabad, Telangana, India*

***K. Madhu Babu**, Professor, Department of Agricultural Extension, College of Agriculture, PJTSAU, Rajendranagar, Hyderabad, Telangana, India*

***B. Rajasekhar**, Subject Matter Specialist, Agricultural Extension, Krishi Vigyan Kendra, Palem, PJTSAU, Nagarkurnool District, Telangana, India*

***Note:** Some of the information in this chapter comes from www.manage.gov.in.*

Introduction

Information and Communication Technology (ICT) is the blending of information technology, communication technology, and computer technology. ICT has become a power tool to disseminate accurate and reliable information with a faster rate to all the stakeholders of agriculture for qualitative decision-making. ICT encompasses various techniques that improve performance, accelerate the growth of any economy, and reduce the drudgery in acquisition and processing of information. In this context, this chapter highlights the importance and applicability of various concepts of ICT and their relevance in agriculture.

ICT consists of all technical means used to handle information and aid communication, including computer and network hardware, communication middleware as well as necessary software. In other words, ICT consists of information technology as well as telephony, broadcast media, all types of audio and video processing and transmission, and network-based control and monitoring functions. The use of ICT in education extends beyond equipping classrooms with computers and an internet connection. There are a wide variety of ICTs currently available to schools and universities that can be implemented to enhance students' overall learning experiences in numerous ways. The universities that have implemented ICTs primarily use these technologies to fulfill the objectives of increasing the networking opportunities, providing distance learning, and supplementing traditional learning.

Agriculture is not an exception in applying the concept of ICT to pass on the information among its stakeholders. The majority of research findings do not reach farmers due to the inadequate and insufficient transfer of technology mechanisms. The spirit of ICT can be applied in the following forms to draw maximum benefit in agriculture.

- Cyber extension (ICT-based initiatives)
- Remote sensing
- Geographical Information System
- E-Governance
- Expert Systems
- Professor Jayashankar Telangana State Agricultural University (PJTSAU) interventions

Cyber Extension

Cyber extension is defined as the "extension over cyber space." It means "using the power of online computer networks with the help of communication channels to deliver content in the form of text, graphics, audio and video either passively or interactively to facilitate dissemination of agricultural technology." Nagarjuna Kumar et al. (2009) observed that among all the users (scientists, extension workers, students, farmers, and others) of the email facility created by the Central Institute for Arid Horticulture, Bikaner, Rajasthan, the majority of the users are farmers (48.35%) followed by students (22.35%).

Major Cyber Extension Initiatives

Cyber Kiosks: Changing Lives

National Institute of Agricultural Extension Management (MANAGE) has established internet connectivity in 24 districts in seven states: Andhra Pradesh, Bihar, Himachal Pradesh, Jharkhand Maharashtra, Odisha and Punjab under the National Agricultural Technology Project. Ten villages have been connected in Andhra Pradesh. MANAGE has selected successful Mutually Aided Co-operative Thrift and Credit Societies (MACTCS), organized by the Development of Women and Children in Rural Areas groups in 10 villages of the Ranga Reddy district. One multimedia computer system with uninterrupted power supply (UPS), UPS only printer, and internet connectivity was provided to each MACTCS. Four members identified by the group were trained in basic computer operations, and internet browsing. Multimedia CDs on agriculture; watershed management; the *vyavasaya panchangam* (a farmers' almanac that consists of varieties and production technology of various agricultural crops); cultivation aspects of major crops such as paddy, cotton, mango and coconut; expert systems on selected crops and rural development; pickle making; child labor; child development; nutrition and health; and other topics were given to all the groups.

ITC–IBD Choupals

ITC–IBD is an international business division of ITC, a large agribusiness company in India. Their core competency lies in establishing strong relationship with farmers. They have innovated a unique network of internet kiosks. These are one-stop shops for farmers called *choupals*. This

concept helped not only in building a strong relationship with the farmers but also to significantly optimize their procurement cost. ITC–IBD has successfully implemented several projects: soya choupal, acqua choupal, and coffee club. There are separate websites for each component.

e-Sagu: ICT-Based Personalized Agriculture

In view of technology and extension gaps in Indian agriculture and to take advantage of the ICT revolution, the International Institute of Information Technology, Hyderabad, Telangana, India, had developed the e-Sagu model of extension system and implemented it for the cotton crop in three villages of Oorugonda, Gudeppad, and Oglapur, covering 749 farmers and 1041 farms during the 2004–05 crop season. The main objective is to build a cost-effective and scalable agricultural expert advice dissemination system to all farmers. The three-tier system consists of farmers as end users, and coordinators as intermediaries to obtain crop status through digital photographs and text, and an information system for communications and digital advice to the farmers. Scientists with the knowledge system prepare the farm advice for the system.

Hooked to the Net: Information Village Research Project

The Information Village Research Project (IVRP), funded by the International Development Research Centre in Canada, was established in 1998 through the M.S. Swaminathan Research Foundation (MSSRF). Under this project, MSSRF funds the equipment and supplies expert guidance while the villagers provide office space and four volunteers to staff a center. The fisher folk of Veerampattinam and seven other villages in and around Pondicherry (Villianur, Thiru-kanchipet, Kizhur, Embalam, Kalitheerthalkuppam, Pillayarkuppam, and Pooranankuppam) all have praise for IVRP. Each village has an information center, with Villianur acting as the hub, connected to the MSSRF Centre via intranet.

Warna Wired Villages

A group of villages in Maharashtra, India, has been the site of a cooperative project meant to improve lives through improvements in agriculture by making knowledge accessible. The “wired villages” have been provided access to and training on using computer networks to disseminate evidence-based information on agriculture to local farmers. Computer booths in each village are manned by a booth operator, and local farmers visit the booths for information relating to crop cultivation, pest management, and marketing. This cooperative movement has been highly successful and was described as follows:

> Ushering in the IT revolution to villages where more than 70% of the Indian population lives is a dream that has come true at Warna Nagar in the Kolhapur district of Maharashtra. The special IT task force set up by the prime minister recommended modernizing the cooperative movement through use of state-of-the-art IT. This led to the “Wired Village” project initiated by the prime minister’s office. The key objective of the project is to demonstrate the effective contribution of an IT infrastructure to the socioeconomic development of a cluster of 70 contiguous villages around

Warna Nagar in the Kolhapur and Sangli districts of Maharashtra (www.indiachi.com, as cited in UNICEF, n.d.).

The project uses IT to increase the efficiency and productivity of the existing cooperative enterprise by setting up a state-of-the-art computer communication network (www.indiachi.com, as cited in UNICEF, n.d.).

Self Employed Women's Association

The Self Employed Women's Association (SEWA; www.sewa.org) was founded in 1972 in Ahmedabad, India, as a union of women working in the informal sector. SEWA has now begun to introduce ICT to its quarter of a million members. It has also developed technology information centers, which are distance-learning classrooms, to provide training to their "barefoot managers," to build capacity of their women organizers and leaders, and to help members strengthen their micro-enterprises (embroidery, agriculture, incense, gum, and salt).

The Akshaya Project

The Akshaya Project was first started in the rural Malappuram district of the state of Kerala and now spread over to seven more districts in the state. It was the first district-wide e-literacy project in India and one of the largest known internet protocol-based wireless networks in the world. In November 2002, the state government of Kerala put into place a project, piloted in Malappuram, that aimed for one person in every family to be computer literate in Kerala. That individual would be familiarized with the basic use of the computer and empowered to access innumerable services that ICT offers. Malappuram is now what is said to be India's first e-literate district. The mission continues to make Kerala the first e-literate state in India.

Remote Sensing

Remote sensing is a technology that provides the means to collect and use geographic data to assist in the development of agriculture. It is the practice of measuring an object or a phenomenon without being in direct contact with it. The prominent tools used in remote sensing are weather satellite collection platforms, ocean and atmospheric observing weather buoy platforms, Magnetic Resonance Imaging (MRI), Positron Emission Tomography (PET), and space probes. A timely, comprehensive, transparent, accurate, and unbiased agricultural monitoring system prevents excessive market speculation and resulting price spikes. Probably the best way for gaining unbiased information over large areas is through satellite-based remote sensing (Atzberger, 2013).

Kinds of Remote Sensing

The phenomenon of remote sensing facilitates the access of remote and adverse locations to ascertain and forecast a catastrophe or havoc that may inflict huge damage on the flora and fauna, which may directly or indirectly ruin the farmer financially. This allows for the development of models and forecasts for alternate cropping and risk management in climate change and for finding coping mechanisms in rainfed agriculture.

Passive sensors detect natural radiation emitted or reflected by the object. *Active sensors* emit energy in order to scan objects and measure the radiation reflected back from the target (for example, radar).

Data Acquisition Techniques in Remote Sensing

Data in remote sensing is acquired through electromagnetic radiation with the help of sensors. The types of sensors used are *analog*, which uses dynamic physical properties (for example, chemical changes) and *digital*, which uses numbers (0s and 1s).

Remote Sensing Software

The software that captures the data through remote sensing is developed by the Environmental Systems Research Institute. The prominent software used in remote sensing are ERDAS, RSI ENVI, IDRISI, GRASS, ERMapper, and AutoDesk.

Geographical Information System

Technology provides the means to collect and use geographic data to assist in the development of agriculture.

The classification of soils based on land capability by integrating remote sensing and Geographical Information System (GIS) technologies helps in estimating soil resources available for different purposes and for appropriate use of soils without deterioration (AbdelRahman et al., 2016).

It is the system for capturing, storing, analyzing, and managing data and associated attributes, which are spatially referenced to Earth. It enables the user to input, manage, manipulate, analyze, and display geographically referenced data using a computerized system. Components of GIS are software, hardware, data, people, and methods.

Use of GIS in combination with remote sensing enhances the decision-making in:

- Processing identification to enable comparison of different acquisitions through time.
- Identifying agricultural and other development problems.
- Evaluating possible technical interventions for conservation or reclamation measures.
- Monitoring soils, water, and land degradation processes.

E-Governance

E-governance refers to the use of ICT applications, to provide access to and deliver information and services to the public faster, cheaper, easier, and more efficiently. *E-government* is the delivery of more convenient, customer-oriented, and cost-effective public services and sharing of information through electronic media. When applied to the agricultural sector, e-governance refers to use of ICTs in delivering governance products and services, which are of use to the agricultural community, including farmers,

livestock breeders, herders, dairy workers, agriculture extension workers, traders, scientists, middlemen, and nongovernmental organization workers working in the field of agriculture and allied sectors.

Amit Wasukar and Yavatmal Mrunal have evolved a new loan concept through e-governance in which:

> To remove bank concept between government and farmer, Government can implement new scheme in which farmer who requested for seeds sack scheme online would be provided with seeds sack from agriculture department without giving money by farmer, But before giving seeds sack to the farmer. Department have to take farmer's land documents as evidence and farmer have to fill agreement with government terms online and have to submit request. (Wasukar & Shidurkar, p. 24)

Benefits of E-Governance

- Faster, easier service
- Convenience, near to home, more services at one place
- Faster processing, shorter wait, shorter queues at government offices
- Less number of trips to government offices
- Better interaction environment, no harassment
- Reduced transport cost
- Avoids wage loss for daily-wage earners
- Better quality service

Expert Systems

Expert systems are mostly based on a specific problem domain and are a traditional application of artificial intelligence. The expert system behaves like a human expert to solve the problem with the help of pre-set conditions in the software application. A wide variety of methods can be used to simulate the performance of the expert, which are (a) the creation of a *knowledgebase*, which uses some knowledge representation formalism to capture the subject matter experts' (SME) knowledge, and (b) a process of gathering that knowledge from the SME and codifying it according to the formalism, which is called *knowledge engineering*.

Expert systems can be one of the most useful tools for accomplishing the task of providing growers with the day-to-day integrated decision support needed to grow their crops.

Components of Expert Systems

- User interface
- Knowledgebase
- Inference mechanism (IF-THEN-ELSE). For example, if the symptom of crop is X, then the nutrition deficiency is Y.

Advantages & Disadvantages of Expert Systems

Advantages

- Ready to use by end user
- Provides consistent answers
- Holds and maintains significant levels of information
- Encourages human expert to clarify and finalize the logic of their decision-making
- Never "forgets" to ask a question, as a human might

Disadvantages

- Lacks common sense
- Cannot make creative responses
- Domain experts not always able to explain their logic and reasoning
- Cannot adopt to changing environments

Cases of Expert Systems in Agriculture

Rice Doctor: National Institute of Agricultural Extension Management has developed an expert system to diagnose pests and diseases for rice crop and suggest preventive or curative measures. It is available as a free mobile phone app, which farmers can download and use as a diagnostic tool. The Rice Doctor (https://bit.ly/35rG2Hu) highlights the use of expert systems focusing the area of agriculture and explicitly rice production by designing a prototype by inserting major pests and diseases of the crop as well as a few pertinent deficiency issues of the crop.

> An Expert System Shell is an interface for strengthening, refining, and maintaining the knowledgebase of an Expert System by directly interacting with it. The expert system shell is a complete development environment for developing and maintaining Knowledge-Based Applications and Expert Systems. It provides a step-by-step methodology for a knowledge engineer that allows the domain experts themselves to be directly involved in structuring and encoding the knowledge through an expert interface. Agriculture being a multidisciplinary science there is a scope of developing multiple expert systems for various crops, disease, insects, irrigation scheduling, fertilizer management and various other issues needed for a sustainable agriculture. There has been no such system or software that supports information management in this area. Developing such a platform for developing multidisciplinary and multi crop expert systems is a new approach that can provide computational convenience to replicate it for multiple crops (Islam, 2013, Abstract).

Table 12-1 gives a few examples of expert systems shown with authors and their usage.

Table 12-1. Examples of expert systems.

Authors	Name of Expert System	Utility
Fermanian et al.	PLANT/tm	Diagnosis of weed in turf
Jones and Haldeman	CHAMBER	Management of environmentally controlled crop research facility
Lemmon	COMAX	Cotton crop management
Palmer	COMAX	Soybean crop variety selection
Shroyer et al.	WHEAT WIZ	Cultivator selection tool

ICT Initiatives of PJTSAU

- **Annapurna Krishi Prasara Seva (AKPS):** AKPS is a communication system that disseminates authenticated information on agriculture and allied aspects from primary sources such as university centers to the end users (farmers). The use of the AKPS in various extension centers of PJTSAU is a new ICT initiative to meet the information needs and expectations of farmers. It has developed as an alternative ICT model under the Interactive Information Dissemination System (IIDS) to meet the information needs of farmers. Timely season-based agro-advisories in the form of short messages in both audio and video are delivered to the registered farmers in the AKPS portal instantly. Farmers also have an opportunity to interact with scientists over a toll-free number to get the answers to field problems. Sowjanya et al. (2018) in their study stated that the majority of the respondents have a moderately favorable attitude (44.16%) toward AKPS agro-advisory service where the messages were partially understandable (41.66%), needful (83.33%), timely (53.33%), saves time and money (83.33%), increase in knowledge (79.16%), increase productivity (83.33%), and information can be adoptable in field conditions (43.33%).
- **YouTube channel:** The PJTSAU YouTube channel is an initiative of PJTSAU that uses and shares videos for agricultural development particularly regarding agricultural development, farmer's success stories, agricultural innovations, extension approaches, events, and guest lectures of eminent personalities for the benefit of farmers, entrepreneurs, and students. The unique components of the PJTSAU YouTube channel are (a) timely and need-based content production, (b) a locally generated video database with scientific and technical expertise, (c) scientist-led instruction for dissemination, and (d) regimented sequencing to initiate a new community. It works with existing Krishi Vigyan Kendras (KVKs), (https://kvk.icar.gov.in/), which are agricultural science centers, and District Agricultural Advisory and Transfer of Technology Centre services of extension systems and aims to amplify their effectiveness. The goal is building a model for the use of ICTs in meeting the knowledge and information requirements of rural families by taking into account the socioeconomic context and gender dimension. Prashanth et al. (2019), as part of their study, an analysis of video modules posted in the PJTSAU YouTube channel, revealed which topics were generating the most interest. They found that viewers mainly sought information on milky mushroom production, brown plant hopper management, bacterial leaf

blight symptoms in paddy, and bacterial leaf blight management, whereas, the least preference was given to chili post harvesting technology and sugarcane early shoot borer.

- **Chenukaburlu:** Chenukaburlu is another innovation in use of media. This radio program caters to the information needs of communities living in surrounding areas. The poorest of the poor or farmers or farm women can be helped by providing them with the most basic information so that they can learn to sustain in their environment by the most efficient use of the resources available to them and henceforth improving their worsening condition. One such ICT strategy is Chenukaburlu, which caters to the needs of the rural community, promoting a bottom-up approach, and providing a voice to the voiceless. The Chenukaburlu is characterized by the active participation of the student community in the process of creating news, information, entertainment, and culturally relevant material, with emphasis on the program using local voices. The success of Chenukaburlu essentially depends on the extent of the students' production quality control over the topics and programming. While radio programs managed by agriculture and home science students broadcast a diverse portfolio of programs, those managed by other institutions are run on very rigid lines, with the content obviously influenced by the expertise in or objective of the educational institution. Prashanth et al. (2019) in their study on Chenukaburlu found that the respondent students mostly broadcasted farm information regarding extension, crop production, food and nutrition followed by central and state developmental programs covering mainly climate change, women entrepreneurship, youth development, weather forecasting, and agricultural marketing aspects.
- **Gyankisan app (under development):** The Gyankisan app is being developed by PJTSAU in collaboration with Western Sydney University, Australia, and River Bridge Ventures, India. Gyankisan is an application, which delivers scientific knowledge as context-specific actionable knowledge to the farming community via a mobile system and thereby empowering them with the right knowledge at the right time. It enables all stakeholders of agriculture to effectively optimize and coordinate their offerings based on both published knowledge and real-time information generated by aggregating farmer actions and transactions.
- **University website:** The university website (https://pjtsau.edu.in/) updates the public on the happenings in the university on research, education, and extension aspects.
- **Online Agro-Advisory bulletins:** Twice a week (every Tuesday and Friday) the university releases Argo-Advisory bulletins to educate farmers on practices to be followed in agriculture based on existing weather condition.
- **Distance education to the farmers:** Started in 1993 for the benefit of farmers through private TV channels like E-TV, distance education has continued with more than 30 news channels.
- **Digital Extension:** The electronic wing of the university has developed many agriculture DVDs in multimedia to alert stakeholders (students, teachers, scientists, extension workers, and farmers) of the access to the information to get easy understanding and quick adoption in the field.
- **Blog:** The Department of Agricultural Extension, College of Agriculture, Rajendranagar, has created a blog (http://www.aecar.in) to document and reveal its activities. The desired audience is undergrad and doctorate students in particular and farmers in general.

Conclusion

The fast-changing scene of liberalization, competition, and globalization combined with a never-before-seen emphasis on quality, timeliness, innovation, customer orientation, and efficiency puts a premium on accurate, super fast, and timely dissemination of information across the globe. The unprecedented developments in computing and communication technology have indeed made such demands translatable into realizable goals. Thus, a large portion of the world population has its stake in information processing. It is time to apply ICT technologies to derive maximum benefit to all stakeholders of agriculture to make Indian agriculture more competitive in the international market.

References

AbdelRahman, M. A. E., Natarajan, A., Hegde, R. (2016, June). Assessment of land suitability and capability by integrating remote sensing and GIS for agriculture in Chamarajanagar district, Karnataka, India. *The Egyptian Journal of Remote Sensing and Space Science*, *19*(1), 125–141.

Atzberger, C. (2013). Advances in remote sensing of agriculture: Context description, existing operational monitoring systems and major information needs. *Remote Sensing*, *5*(2), 949–981.

Islam, S. N. (2013). *ShellAg: Expert system shell for agricultural crops*. (2013). International Conference on Cloud & Ubiquitous Computing & Emerging Technologies, Pune, India, 83–86. https://bit.ly/36DaIVo

Nagarjuna Kumar, R., Meena. S. R., Awasthi, O. P., Samadla D. K., Singh, I. S., Jain, M. K., & Khatri, B. R. (2009). Cyber extension in transfer of technology to farmers. *International Journal of Tropical Agriculture*, 205–210.

Prashanth, P., Laxminarayanama, V., & Laxma, M. A. (2019). Online distance education in agriculture: A case of PJTSAU. *Journal of Pharmacognosy and Phytochemistry*. SP2, 496–500.

Sowjanya, B. L., Banerjee, P. K., Punnarao, P., & Anurag, T. S. (2018, August). Impact of Annapurna Krishi Prasara Seva (AKPS) Agro Advisory services in East Coastal Districts of Andhra Pradesh. *International Journal of Agricultural Science and Research*, *8*(4), 49–58. https://bit.ly/3kslW3V

UNICEF. (n.d.). Warna Wired Villages. *Development practices in India*. http://www.gopio.net/india_development/best_pratices.htm

Wasukar, A., & Shidurkar, M. P. (2015). E-Governance in agriculture. *International Journal of Computer Applications*. National Conference on Recent Trends in Computer Science & Engineering (MEDHA 2015). 22–25. https://research.ijcaonline.org/medha2015/number3/medha8043.pdf