

ICT tools for dissemination of farming system technologies

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The integration of Information and Communication Technology (ICT) tools into agricultural systems is revolutionizing the dissemination of farming technologies. ICT solutions, such as mobile apps, satellite-based tools, and AI-driven platforms, enable timely and accurate decision-making for farmers, enhancing productivity, efficiency, and income. Key initiatives, including the National e-Governance Plan in Agriculture (NeGP-A), Kisan Call Centres, and precision agriculture tools, offer innovative approaches for managing resources, crop health, and market access. These tools empower farmers to adapt to challenges like climate variability, improving livelihoods and fostering sustainable agricultural practices across India.

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AGRICULTURE is the mainstay of Indian economy and serves as a predominant livelihood activity for majority of the households. The challenges that farmers face include unpredictable drought, flood, wind, uneven distribution of rainfall, high temperature etc. These factors influence outbreak of pest, diseases, heat stress to plants, thereby affecting the productivity of the crop which incur losses to the farmers. Also, farmers face low market rate for their produce, lack of market access, low productivity and inefficient resource utilization. With these unpredictable challenges, farmers are unable to manage the farm and hence need timely, relevant and accurate information for increasing productivity, income, quality of the output etc. On the other hand, Information and Communication Technology (ICT) has penetrated in almost all corners of the world, including rural India. The technology helps to disseminate information at the right time so that farmers can take action. This article illustrates different ICT tools usage by farmers and stakeholders for the betterment of agriculture and farmers in particular. ICT comprises of a wide range of converging technologies which includes, mobile phone, internet, the Radio Frequency Identification (RFID), Geographical Information System (GIS), drones, Artificial Intelligence (AI), sensors, satellites, Internet of Things (IoT), cloud computing, etc. Essentially, the goal of ICT is to transfer information

from one point to another. ICT has been applied for 100 years, ever since the popularization of radio in the 1920s. But it is the use of digital technology over the recent years that has the most significant potential to transform agriculture and other sectors.

Application of ICT tools

Key government initiatives to promote digital agricultural strategies include National e-Governance Plan in Agriculture (NeGP-A), Mobile apps deployment, Knowledge Management Portals, Krishi Vigyan Kendra (KVK) Portal, Touch Screen Kiosks, Kisan Call Centres, Agri- Clinics, Common Service Centres, mKisan, Direct Benefit Transfer (DBT) schemes, Kisan TV and various other applications. Private initiatives include digital start-ups in agriculture (such as CropInfo), e- choupal (of ITC), mobile apps (such as Farm Rise by Monsanto), weather systems (such as Skymet), Reuters Market Light, Digital Traceability (such as Source Trace), Direct Market Interventions (such as Naa Panta), etc.

The Agricultural Technology Information Centre (ATIC), Digital Green, Easykrishi, e-SAP from University of Agricultural Sciences, Raichur, IFFCO Kisan Sanchar Limited (IKSL), Kisan Community radio station from University of Agricultural Sciences, Dharwad, and mKisan have significantly impacted the lives of farmers by providing weather-based agro-advisories, digital

market access, and remote monitoring (MANAGE 2019). Additionally, the Meghdoot app, developed by the India Meteorological Department (IMD), Indian Institute of Tropical Meteorology (IITM), and Indian Council of Agricultural Research (ICAR), has revolutionized crop management by providing real-time weather updates, pest alerts, and market prices, leading to significant improvements in crop health and productivity for farmers. On an average, 12,218 agro-advisories per state have been issued through Meghdoot (as of July 26, 2021) since the inception of the app (Dhulipala *et al.* 2021). Similarly, the Damini app, launched by the Ministry of Earth Sciences, has proven instrumental in weather forecasting and risk management, aiding farmers to successfully prepare for a cyclone, thereby minimizing crop damage and preserving livelihoods (Priyanshu and Mrigangko 2024).

Various ICT initiatives taken by ICAR, State Agricultural Universities, departments under Government of India and private initiatives are described below.

Network programme on precision agriculture

The ICAR Network Programme on Precision Agriculture is a programme of national importance cutting across all Subject Matter Division (SMDs) of the Council. For this program, it has partnered with 16 ICAR institutes. This program was launched in 2021. Precision agriculture involves using sensors to track soil health, plant growth, and weather patterns to make informed decisions about using inputs like seeds and water. This is implemented for sustained enhanced input use and production system with safe environment and quality produce to make agriculture a profit-making enterprise. Under this programme, various technologies through ICT tools are developed, some of them are listed below.

Variable rate technology (VRT): It plays a significant role in a specific site application of fertilizer, chemicals, and water at different rates across a field based on field variability. It is a precision agriculture based technology. Variable Rate Application (VRA) system includes data collection, data processing, decision support system and applicator. Conventionally, fertilizers (granular urea) are being manually broadcasted. Division of agricultural engineering, ICAR, IARI, New Delhi has designed and developed the high clearance VRT Robot for fertilizer application as per requirement of the crop at various plant growth stages.

SMART Pond: The SMART Pond, developed under the ICAR Network Project on Precision Agriculture (NePPA), is an intensive fish culture with a production target of 20 tonnes per hectare in a year. The SMART pond contains a range of gadgets like a Mechanical Fish Harvester, a CIFA-SMART PondFeeder, and a Sensor-based Aeration System (ICAR-CIFRI).

riceNxpert: ICAR-NRRI has developed an android based application "riceNxpert" which is available free of cost in the Google play store. This app is used to monitor and recommend N topdressing requirement by analysing 10 photographs of rice leaves. riceNxpert

based N management resulted in 10.4% – 43.6% higher yield compared to farmer's practice in the six farmers' field trials due to right dose and right time of application of nitrogenous fertilizers.

eNAM: Digital market access provides farmers with the latest information on markets and changing consumption patterns, allowing them to have a better plan of crop production based on supply-and-demand factors, increasing market efficiency and facilitating market access. National Agriculture Market (eNAM) is a pan-India electronic trading portal which networks the existing Agricultural Produce Market Committee (APMC) mandis to create a unified national market for agricultural commodities. Small Farmers Agribusiness Consortium (SFAC) is the lead agency for implementing eNAM under the aegis of Ministry of Agriculture and Farmers' Welfare, Government of India. It is integrated with 1389 mandis in 23 states and 4 UT. Benefits from eNAM for a seller/ farmer are transparency in trade through better price discovery, access to more markets & buyers, real time information on prices and arrival in nearby mandis, quick payments which build a healthy financial profile.

AGMARKNET: Under the Marketing Research and Information Network sub-scheme (MRIN), Agricultural Marketing Information Network (AGMARKNET) portal was launched to link important agricultural produce markets, the State Agriculture Marketing Boards and Directorate of Agricultural Marketing across the country. The ICT project was launched by Directorate of Marketing and Inspection (DMI), Ministry of Agriculture, Govt. of India and is being executed with technical assistance of National Informatics Center (NIC). It aims to effectively share market information by gradually connecting all of the wholesale markets of agricultural produce, State Agricultural Marketing Boards/Directorates, and DMI offices.

The portal analyses information drawn from 3700 markets across 28 States and 05 UTs of the country. The weekly arrivals and price trend analysis for important markets in respect of major agricultural commodities transacted are under the purview of this scheme component through AGMARKNET. Mandi arrivals and prices reported on the portal helps in commodity flow mapping and supply chain integration of agricultural produce in the country. Mandi prices are also provided to farmers through DD Kisan channel, Mobile apps and Kisan Call Centres.

Expert system: Under network project of Indian Council of Agricultural Research, the Experts System was developed for agriculture (Paddy, Sugarcane, Banana, Ragi and Coconut) and animal husbandry for the three state in their respective languages, i.e. Tamil Nadu (Tamil), Karnataka (Kannada) and Kerala (Malayalam) to provide timely expert advice with ICT initiatives to farmers. The Expert System was developed to cater to the needs of farmers, extension workers, scientists, and students. Based on this, the three components, viz. Decision Support System, Crop Doctor/Health Adviser and Information System were

developed by Tamil Nadu Agricultural University (TNAU). Information system is web based static information system wherein all the technological information and complementary information about the crop have been loaded. The Decision Support System consists of details about season, variety, soil, water, land preparation, nursery management, cultivation, irrigation, nutrient management, farm implements, post-harvest technology, marketing, institutions and schemes. Crop doctor is a vital component in the expert system, which acts as artificial intelligence. It deals with diagnosing the pest, disease and nutritional disorders affecting the selected crops. For more details visit TNAU portal.

IFFCO-Kisan: With a presence across India, supported by a team of agri-experts and partnerships with national and state agricultural institutions, IFFCO-kisan has built a vast repository of agricultural information. The technology outreach has equipped multiple farms with Internet of Things (IoT) sensors and irrigation automation systems across India. Under precision-based tech stack, they are updated with fully automated, semi-automated and sensor-based technology dissemination for farming and crop health monitoring through remote sensing. Weekly analysis on soil moisture, crop moisture, soil organic carbon, vegetation index through remote sensing is done. IoT Precision tech provides hyperlocal weather insights, automated irrigation, and early pest warnings.

Farmer.CHAT: An AI assistant created by Digital Green to make knowledge accessible to all. Farmer.CHAT is designed to deliver tailored assistance to numerous extension workers providing advice to small-scale farmers. This enables extension professionals and farmers to ask conversational questions in their local language using voice, text, or images to overcome digital literacy barriers and encourage gender equity. This chatbot is multilingual and it overcomes technological literacy barriers with multi-media inputs and response messages including text, audio and video.

AgNext technology: The AI based technology of AgNext classifies agri commodities on its morphological characters. It provides AI enabled instant quality analysis for physical and chemical testing of different agriculture commodities on the spot or at procurement / collection centres or mandi centres. Farmers and buyers can get a digital quality certificate for their produce in a quick time by paying a nominal sum. It also has AI based quality assay machine in chilli. This helps in determining the grade of the chilli and farmer can use this receipt while trading in the market to get higher price for the best quality products. Common Service Centre (CSC) has entered in MOU with AgNext for digital quality assaying technology.

Farmers' portal: The Farmers' Portal of the Department of Agriculture, Co-operation and Farmers' Welfare is a platform for farmers to seek any information related to agriculture. Detailed information on farmers' insurance, agricultural storage, crops, extension activities, seeds, pesticides, farm machineries, etc. are provided at this

portal in addition to the details of fertilizers, market prices, package and practices, programmes, welfare schemes. Block level details related to soil fertility, storage, insurance, training, etc. are available in an interactive map. Users can also download farm friendly handbooks, schemes etc. For more information, visit www.india.gov.in

India observatory has come up with various tools on different aspects. Their objective is to disseminate social, economic and ecological data, tools and analytics to various stakeholders. Their tools include ground water monitoring tool, access datasets on India's diverse social, economic, and ecological parameters with insightful visualizations, GIS Enabled Entitlement Tracking System (GEET). It also has Crop Water Budgeting, a farmer centric android based tool which enables rural communities to input primary information and avail assistance in managing their surface and ground water efficiently without depleting their resources. It generates discussions on water as a collective resource and the need for better governance, create designs for soil and water conservation structures and estimate costs for building them. For more information, visit www.indiaobservatory.org.in.

Aqua one centre: A new initiative of National Fisheries Development Board (NFDB), Hyderabad, is an ICT enabled aquaculture support service that would help in wider dissemination of newer aquaculture technology and innovation to the fish farming community. It will function in tandem with the existing public fisheries extension system. Aqua One Centers will provide Aquaculture support services like pond monitoring, input management, health diagnosis, water analysis, advisory services etc. It would bridge research-extension gap and would make aquaculture support services available to fish farmers, fish seed growers etc. at their doorstep (NFDB bulletin, 2018).

Other apps

Kisaan suvidha: Launched in July 2015, Kisaan Suvidha is India's first mobile application to bring Agricultural Produce Marketing committee (APMC), farmers and agents on one platform/online. The app benefits the farmers, commodity merchants and APMCs. Farmers can see the live auction of any commodity & APMC, price variations- maximum, minimum and average price of any commodity for any day/ month/ year. On the same app, commodity merchants can analyse the ups and downs of all the APMCs in the state and get information of the total cess paid by him. Government bodies can view the total stock of any commodity at an APMC and review village/ taluk/ district wise production. It helps rural communities in accessing government entitlements and schemes that they are eligible for by providing them information about the same on a single platform.

Agrotrace: It is a smart solution for efficient irrigation and fertigation management. The machine measures soil water potential and temperature at various depths, enabling precise monitoring of soil conditions. The

device works on a licensed IoT spectrum. By analysing this data, Agrottrace estimates the current water needs of the soil, ensuring optimal irrigation and fertigation. This leads to better crop yields, resource conservation, and sustainable agricultural practices. With real-time data and advanced analytics, Agrottrace helps farmers make informed decisions, reduce water usage, and improve overall farm productivity.

myScheme: It is a mobile application that brings all the details of Government Schemes into one portal. myScheme platform envisages providing a reliable, secure, trusted schemes to the users. In its initial avatar, myScheme aims to offer a one-stop search and discovery portal where a user can find schemes that she is eligible for.

PM-SURYA GHAR: Muft Bijli Yojana mobile application is a gateway to the Pradhan Mantri Muft Bijli Yojana, the Government of India's national programme on Rooftop Solar systems.

This portal is a centralized platform that simplifies the process of installing rooftop solar systems for households. It allows residents to apply for subsidies for rooftop solar installation including net-metering, estimate generation and savings from rooftop solar, and track the status of their application.

Poshan atlas map: The Poshan Atlas app is a one-of-a-kind engaging, interactive and fun-filled way to embed positive nutrition behaviors among, children, youth, and young audiences.

Bijak Vyapaar: Grain Trade app is India's most trusted grain trading app that connects verified grain traders.

Kissan Khidmat Ghar: Kisan Khidmat Ghars will serve as one-stop service hubs, offering comprehensive support, from input supply to marketing and technological assistance to our farmers. It is a comprehensive mobile application designed to support farmers by providing vital agricultural information, resources, and services in J&K to enhance their farming practices.

AAKRI waste management app: AAKRI is a futuristic environmentally friendly Start-up aimed to address the waste/trash issue concerning the people of Kerala and the environment as a whole. It is a single go-to-point for disposal of every kind of waste that the common man needs to dispose of today. This initiative was conceptualized in 2018, and the idea is very simple "To protect our landfills from plastic and recycle maximum for the environment".

SUMMARY

There are various ICT tools and resources available with different stakeholders, viz. ICAR, State Agriculture Universities, different ministry of Government of India and private stakeholders. Farmers and other stakeholders can access the relevant ICT tools based on their needs. The use of digital tools saves time, money and the energy, helps to increase the efficiency, effectiveness and productiveness of the farm in general and thus aids to increase the income of the farmers in particular.

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