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Full Length Research Paper

ICT's Contribution to Closing the Knowledge Gap in Rural Farming

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Mobile applications, internet-based platforms, and communication systems are just a few of the many instruments that fall under the umbrella of information and communication technology (ICT), which helps farmers overcome important obstacles like poor training, limited market access, and climate resilience. A key factor in making agriculture a more efficient, sustainable, and productive industry is information and communication technology, or ICT. ICT tools, such as internet platforms, communication systems, and mobile applications, facilitate real-time information access, improve decision-making, and support sustainable farming methods. In order to demonstrate the value of ICT tools in agriculture, the current study highlights successful ICT initiatives in India, including e-NAM, e-Sagu, AGRISNET, and AGMARKNET, as well as mobile apps like Kisan Suvidha and Pusa Krishi, Kisan 2.0, and others that offer crucial information on weather, crop management, and market prices. Farmers may make data-driven decisions with the use of mobile applications like Kisan Suvidha, Pusa Krishi, and Farm-o-Pedia, which offer actionable insights on weather forecasts, crop health, and market prices. ICT adoption is hampered by issues like inadequate infrastructure, exorbitant pricing, and low levels of digital literacy, despite its benefits. In order to fully utilize ICT in Indian agriculture and guarantee fair and sustainable growth, these issues must be resolved.

Key words: Agricultural productivity, e-agriculture, ICT, Rural development, Sustainable farming system.

INTRODUCTION

The phrase "information and communication technology" (ICT) encompasses a wide range of technologies used for information gathering, storing, processing, and sharing. ICT in agriculture refers to a broad range of instruments, including both conventional techniques like radio and television broadcasting and digital systems like computers, smartphones, satellite communications, and internet-based applications. Real-time information availability is one of ICT's most important contributions. Through web platforms, SMS services, and mobile apps, farmers may access vital information about crop management practices, pest infestations, soil conditions, and weather forecasts. Making well-informed judgments is facilitated by this prompt access, which raises output and lowers losses.

By improving information availability, the main objective of ICT use in agriculture is to increase farming methods' efficacy and efficiency. ICT is a potent instrument that gives farmers instant access to critical information including soil conditions, market pricing, weather forecasts, and pest management strategies. By strengthening their capacity for making decisions, boosting farm management, and encouraging sustainable farming methods, it gives farmers more influence. In today's world, information and communication technology, or ICT, is essential for promoting global connectivity, increasing efficiency, and stimulating creativity.

Because it facilitates immediate communication, efficient operations, and access to a wealth of information resources, it is crucial in the fields of education, healthcare, business, and governance. ICT greatly contributes to social and economic growth by enabling telemedicine, e-commerce, remote learning, and digital inclusion. But there are difficulties in putting it into practice. Opportunities for underprivileged groups are restricted by the digital gap, which is defined by unequal access to technology. Significant hazards also come from data privacy issues,

cyber security threats, and the quickening rate of technological obsolescence. Reliance on ICT can also result in environmental problems including energy use and electrical waste. To ensure that the advantages of ICT are maximized while limiting its drawbacks, overcoming these obstacles calls for sustainable practices, strong security measures, and fair access (Nehra et al., 2018; Sharma et al. 2019 & Sharma et al., 2017) [8, 12, 13].

Methodology

Abstracts and citations were located through a search of the many online and offline publications in order to extract pertinent material on the various functions of ICT in agriculture. The primary source of secondary data used in this paper is various published papers, journals, books, etc. The data gathered from these sources was combined to meet the review manuscript's predetermined goals. Ultimately, this page was prepared by compiling all relevant facts.

Results and Discussion

Tools of ICT in agriculture

1. Informative tool: Applications that offer a lot of information in several formats, such text, images, music, or video, are known as informative tools. The internet, network drive, internet systems, homepage, etc. are examples of instructive tools.

2. Situating tool: A system that places students in an environment where a scenario and its context are present is known as a situating tool. CD-ROM is an example of a locating tool.

3. Constructive tool: A general-purpose tool that may be used to change data, create one's own knowledge, or show pupils' comprehension is called a constructive tool. Adobe Photoshop, PowerPoint, and Microsoft Word are a few examples of constructive technologies.

4. Communicative tool: Communicative tools are systems that facilitate communication between students and teachers or between students outside of the classroom. Email, SMS, and other forms of communication are examples of tools.

5. Collaborative tool: Real-time tasks are typically the focus of ICT collaborative tools. Online collaborative projects are becoming a viable alternative for distributed group work due to the advancement of new collaboration tools. Discussion boards are an example of a collaborative technology (Singh et al., 2014) [10].

Role of ICT in agriculture

By providing data to research and development projects, ICTs can be effectively used to gather and disseminate fast and accurate news about weather, inputs, markets, and pricing, enabling the adoption of contemporary agricultural technologies and improving production in a sustainable way. The use of ICT in agriculture, or e-agriculture, fosters a cross-sectoral, multi-stakeholder, people-centric platform that will unite all parties involved, particularly farmers, and allow them to share resources, good practices, and timely and pertinent information. It makes it simple to disseminate information using ICTs like TVs, radios, and cell phones. Additionally, this will encourage the blending of technology with knowledge, culture, and multimedia. Collecting, storing, and maintaining data and information to give farmers real-time information about integrated crop management, input availability, dosage, irrigation, soil quality, fish culture, livestock, poultry, and other topics at the community level are among the urgent needs of ICT in e-agriculture. For a demand-driven, decentralized, and localized extension program with appropriate management and effective delivery, the current information channels are strengthened and new ones are created. facilitating market access while providing the knowledge and instruction required to support, encourage, and improve rural farm and non-farm businesses both domestically and globally. Increase the ability of farmers and extension agents by using ICTs, local and pertinent multimedia content, and distance learning. Organize or bring farmers together on a national level to facilitate information sharing and to guarantee their participation in the creation of policies. The involvement of women in agriculture is also acknowledged and promoted by ICT tools (Chowhan and Ghosh, 2020; Devi and Sharma, 2022; Sharma et al., 2023) [2, 3, 11].

ICT projects for agriculture and rural development:

Agrisnet is a comprehensive website that was started and supported by the Indian government's Ministry of Agriculture to provide farmers with pertinent information. Using information and communication technology (ICT), AGRISNET provides services and disseminates information to the farming community. Its objectives are to inform farmers about the availability and quality of inputs, to spread knowledge about various government programs, to suggest fertilizers following soil testing, and to provide information on the newest technologies for boosting agricultural productivity.

Agmarknet: The Ministry of Agriculture, Government of India, launched the Agricultural Marketing Information Network (AGMARKNET) in March 2000 with the goal of enabling farmers to make decisions about the sale of their produce. This portal was created to speed up the agricultural marketing system by promptly and transparently informing producers, consumers, traders, and policymakers on the arrival of agricultural commodities on the market and their prices.

The Department of Agriculture and Cooperation established Kisan Call Centers (KCCs) on January 21, 2004 with the

primary goal of providing extension services to the farming community in their native tongues. Agricultural graduates answer farmers' questions in their native tongue on a support line or toll-free number. In order to get insight into complicated agricultural issues and find solutions, the agricultural experts also make in-person field visits.

E-Chaupal: e-Chaupal was introduced in June 2000 and consists of village internet kiosks run by farmers, known as sanchalaks themselves. Agricultural e-Choupal allows the community to obtain up-to-date information in their native language about market prices and weather, spreads knowledge about scientific farming methods and risk management, and makes it easier to buy farm produce from farmers directly and sell farm inputs (decision information-based).

E-NAM: On April 14, 2016, the National Agriculture Market, or e-NAM, was launched. To unite all national agricultural markets, the e-NAM site links the current APMC (Agriculture Produce Marketing Committee). Among other things, this covers product arrivals, quality and pricing, purchase and sell offers, the ability to reply to trade offers, and the direct deposit of electronic payments into farmers' accounts.

E-sagu: Created in 2004, the e-Sagu system offers farmers personalized solutions to their issues and guidance from planting to harvesting. Digital photos and videos that farmers provide on the state of their farms are examined by agricultural scientists and specialists. The concerned farmer receives the professional advise quickly. At the village level, educated coordinators assist in answering the questions of illiterate farmers.

E-Arik: The e-Arik initiative was started in 2007 with the goal of achieving food security and spreading climate-smart agriculture techniques. It is a comprehensive platform designed to improve northeastern India's access to agricultural technologies and information. It provides expert agricultural advise on crop management, marketing, and cultivation. Although field personnel assist farmers in accessing ICT-based information or consulting with other agricultural specialists, farmers can also get information directly via the portal.

E-Velalnmai: In Tamil Nadu, the e-Velanmai initiative was started in 2013. According to Dutta and Anand (2023) [4], "Velanmai" means "agriculture" combined with "personal and ICT based, demand driven, participatory and sustainable extension approach to provide appropriate and timely agro advisory services by scientists to the registered farmers using ICT tools (Internet, Tablet, Mobile Phone etc.) on a regular and need-based basis.

Mobile apps used for agriculture in India

Kisan Suvidha: This app was released in 2016 and offers data on the current weather, five-day forecasts, commodity and agricultural prices in the closest town, and information about machinery, seeds, fertilizer, and other items. The app is more generally accessible because it may be used in multiple languages.

Upaj: This innovative farming software, which was released in 2021, transforms agriculture by tackling the difficulties that farmers encounter. By providing accurate weather forecasts, up-to-date agricultural news and expert insights, exclusive farming tips, comprehensive agronomy solutions like crop safety, smart satellite mapping, pest management, soil testing, and reasonably priced crop insurance, it makes farming easier.

Farm-o-pedia: Developed by CDAC (Centre for Development of Advanced Computing), Mumbai on 27 Feb, 2014. The application is a multilingual Android application targeted for rural Gujarat. The main functionalities of the app are to get crop wise information, check weather in particular area and get suitable crops as per soil and season.

Bhuvan hailstorm: CDAC (Centre for Development of Advanced Computing), located in Mumbai, created Farm-o-pedia on February 27, 2014. It is a bilingual Android app designed for Gujarat's rural areas. The app's primary features include crop-specific information, local weather forecasting, and crop selection based on soil and season.

Bhuvan hailstorm: On January 15, 2016, CDAC, Mumbai, created a mobile application to record crop losses brought on by hailstorms. The following parameters can be recorded by this mobile app: field photo, crop name, sowing date, and anticipated harvest date. The Bhuvan Portal will automatically plot this collected data, making analysis simple.

Pusa Krishi: In 2016, the Pusa Krishi app was released. Its goal is to assist farmers in learning about technology created by the Indian Agriculture Research Institute (IARI) that will increase their profits. Additionally, the app offers details on new crop types created by the Indian Council of Agriculture Research (ICAR).

IFFCO Kisan: IFFCO Kisan is in charge of this app, which was introduced in 2015. With information tailored to their needs, it seeks to assist Indian farmers in making well-informed decisions. A range of useful modules, such as weather, market prices, agricultural advise, and an agriculture information library, are available to the user in the chosen language in the form of text, images, audio, and videos.

Kisaan 2.0: In February 2019, this app was released. In India, e-agricultural and smartphone-based agriculture are expected to benefit from KISAAN 2.0 (Krishi Integrated Solution for Agri Apps Navigation). It was created with the intention of making farming easier for Indian farmers. Indian farmers can access agricultural knowledge about crops, horticulture, livestock, fisheries, natural resource management, agricultural engineering, agricultural education, and agricultural extension through the KISAAN 2.0 app, which offers a single interface in multiple Indian languages (Ibrahim et al., 2020) [5].

India's position in ICT use

- Second biggest software exporter globally.
- 45% of the world ICT projects implemented in India
- There were 751.5 million internet users in India till January 2024.
- India's internet penetration rate stood at 52.4 percent of the total population at the start of 2024 (Saravanan R, 2020) [9].
- There were 1.12 billion cellular mobile connections in India at the start of 2024.
- Mobile connections in India were equivalent to 78 percent of the total population in January 2024.
- According to Anonymous (2024), 32.2 percent of the population, or 462.0 million people, used social media in January 2024 [1].

Benefits of ICT in Agriculture

Saves Money: Farmers can save money by utilizing contemporary agricultural technology. Modern technology help farmers operate considerably more swiftly, efficiently, and with less effort. Tasks that once required a large number of people and a lot of time can now be completed quickly and affordably thanks to modern technology.

Productivity is increased: A variety of modern technical techniques and equipment can readily raise farmers' production. Tractors, robotic lettuce harvesters, automatic in-row weeders, carrot harvesters, and separators are just a few of the modern equipment used in agriculture to increase productivity.

Modern technology simplifies transportation: Farmers can now travel much more easily thanks to modern technology. With the use of tractors and trucks, they can easily transport the harvests from one place to another.

Modern technology lessens farmers' efforts: The major goal of modern technology is to make it easier for individuals to work by minimizing their labour-intensive activities. The agricultural efforts of farmers are significantly reduced by modern technologies. The main objective of modern technology is to facilitate human labor by reducing labor-intensive tasks. Modern technologies drastically cut farmers' farming efforts.

Improving access to information: ICT can assist in providing farmers and extension agents with a variety of information and resources, including market pricing, weather forecasts, and crop management best practices.

Agricultural databases: Information and communications technologies (ICTs) can be used to build and maintain databases of information, including agricultural yield statistics, soil mapping, and weather data. Farmers, extension agents, and researchers can use these datasets to assist guide their decisions.

Video and multimedia content: Farmers can obtain information in an interesting and easily accessible way by using ICTs like smartphones and tablets to produce and distribute video and multimedia content, such as webinars, podcasts, and instructional videos.

SMS and mobile apps: In places with poor internet connectivity, ICTs can also be utilized to deliver timely and pertinent information to farmers' cell phones via mobile apps or SMS.

Enhancing communication and collaboration: Extension agents, farmers, and other stakeholders can communicate and work together more easily when using ICT tools like social media and cell phones. This can facilitate the adoption of new technologies and processes and enhance the exchange of knowledge and experience.

Supporting distance education and training: Using platforms like online courses, webinars, and video conferencing, ICT can be utilized to provide extension services remotely, hence supporting distance education and training. In places with few or difficult-to-reach extension workers, this can be especially helpful (Javeed et al., 2020) [6].

Obstacles to ICT expansion in agriculture

Farmer's lack of education: It can be difficult for most farmers to understand how modern technology is employed in farming because they have not had any formal education.

Reduce soil fertility: One of the main disadvantages of

agricultural technology is that it reduces soil fertility. Overuse of technology damages and reduces the fertility of the soil in the fields. Fertilizers and herbicides may increase productivity, but they can progressively reduce soil fertility

High Cost of Maintenance: The high maintenance costs associated with agricultural technology are one of its disadvantages. Farmers find it especially difficult to maintain technology since they cannot afford the high maintenance costs of modern technical machinery and equipment.

Environment-related harm: The high maintenance costs associated with agricultural technology are one of its disadvantages. Farmers find it especially difficult to maintain technology since they cannot afford the high maintenance costs of modern technical machinery and equipment.

Infrastructure Deficiencies in Rural Areas: Farmers' access to and use of ICT tools is restricted by poor ICT infrastructure development, including unreliable internet connectivity, limited electrical supplies, and inadequate cell network coverage in rural areas.

Limited Availability of Localized Content: Real-time, region-specific, customized, and region-specific data on weather, soil conditions, pest control, and market prices are often absent from ICT applications used in agriculture, which diminishes their usefulness and relevance for nearby farmers.

Weak Policy Support and Institutional Frameworks: The broad adoption of ICT solutions is hampered by a lack of clear policies supporting ICT in agriculture, insufficient funding, and a lack of cooperation between public and commercial sectors as well as research institutes.

Data Privacy and Security Concerns: Adoption rates may be hampered by farmers' reluctance to use ICT tools because they are worried about corporations or other stakeholders misusing their personal or farm-related data.

Gender and Social Inequalities: Due to gender biases, limited mobility, and unequal opportunities, women and socially underprivileged groups in rural areas frequently have limited access to ICT tools, which exacerbates the digital divide in agriculture (Mahant et al. 2012) [7].

Conclusion

ICT is essential for delivering timely and accurate agricultural information, which boosts farmers' productivity, food production, and market prices. India's agriculture industry may gain a lot from removing barriers and increasing ICT use. Through effective farm management, ICT may enhance farming technologies and farm management. Better pricing and marketing exposure, lower agricultural hazards, and increased revenue are all made possible by ICT. ICT will become more important in the private sector in areas including market intelligence, agribusiness, and information. It is helping farmers make better choices regarding commodities and crops for the future. It's critical that farmers receive accurate information at the appropriate time. Through timely access to information, tools, and resources, ICT empowers farmers and increases productivity and efficiency. ICT connects farmers in rural areas to global agricultural innovations, from supply chain management and market access to weather forecasting and precision farming. It guarantees better decision-making, encourages sustainable activities, and boosts climate change resilience. In contemporary agriculture, ICT is a vital enabler that promotes inclusivity and innovation. We can solve issues with food security, promote rural development, and build a more sustainable and just agricultural ecosystem by incorporating technology into farming methods. However, ongoing investments in infrastructure, capacity-building, and fair access to technology—especially for small-scale and vulnerable farmers—are necessary for ICT to reach its full potential.

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