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## A Survey on Digitization Efforts in Agricultural Applications in India

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**ABSTRACT:** There has been a significant shift in modernizing extension and advisory services in agriculture using digitization efforts. Implementing the digitized tech solutions in agriculture enable reliable management and monitoring of farms. As these update the farmers with complete digital analysis of farms in real-time, they can reduce water and pesticide consumption. It helps in increasing agriculture productivity and lowers crop production cost. Inhibits the soil degradation Lessens less use of pesticides in crop production, guide in effective and efficient use of water resources, Uplifts socio-economic statuses of farmers, Reduces environmental and ecological impacts, Augments worker safety etc. In the present study survey of digitations efforts in India by public private partnership has been explored using secondary data. The web-portals and applications discussed may provide insight into the knowledge.

**KEYWORDS:** agriculture, applications, digitization, information communication technology, portals

### I. INTRODUCTION

Digitization converts analog or fundamental information from text, image, and sound to digital form. The object, image, sound, document or signal can be digitally stored and represented in binary numbers to be processed for other operations. Digitization is significant for information processing, storage and transmission since it allows all kinds of data in all formats to be transmitted with the same efficiency and also can be intermingled [1]. Furthermore, Digital data can be shared, accessed easily and propagated indefinitely, without generation loss, provided it is migrated to new, stable formats as per requirements [2]. This potential has led to massive growth in digitization projects designed to improve access and the rapid growth of the digital preservation field.

One such application area of digitization and digital devices is agricultural practices. Due to massive growth in information and communication technology, thousands of knowledge platforms have been developed during the past decade, resulting in a change in the traditional way of agricultural practices from planning to implementation and harvesting the crop. Digitization helped meet the challenges in agricultural development by providing up-to-date agriculture information, awareness, education. For example, it offers advanced adverse weather information so that farmers can take preventive measures, Real-time / near-real-time products pricing & market information, information dissemination about details of various government schemes [3]. In addition, stakeholders can get information regarding agriculture finance, agriculture clinics, agribusiness platforms, and online farmer communities. Furthermore, Digital technologies involving artificial intelligence, machine learning, remote sensing, big data, blockchain, and IoT devices, are changing agricultural value chains and modernizing operations.

The agriculture sector, presently valued at US\$ 320 billion, is one of the significant contributors to the Indian economy. GDP contribution by the agriculture sector is 17.8%, as recorded in 2019-20[4]. Over the years, the

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government has taken significant steps to help grow the agricultural industry with proven farming technologies and framing supportive policies. The recent digitization efforts in farming technology will further accelerate growth by ensuring higher crop yields improving sustainability by reducing water consumption and agrochemicals.

There has been a significant shift in modernizing extension and advisory services in agriculture using digitization efforts. Digital technologies like surfing the internet, mobile phones and other devices, data analytics, artificial intelligence, digitally-delivered services, and specialized web portals have changed agriculture and marketing systems. As a result, the world's first entirely machine-operated crop sown and tended without human intervention in the field was harvested in 2017; this was a milestone in digital agriculture, also known as smart farming, or e-agriculture.

In the present study, comprehensive surveys of the digitization efforts by the public and private sector have been explored, along with the future scope and outcome of the current platforms.

## II. METHODOLOGY

We followed a systematic investigation approach by exploring secondary data from internet sources, newspapers, peer-reviewed research articles, textbooks, government archives, and libraries.

## III. RESULTS AND DISCUSSION

The primary Information and communication technology (ICT) tools based on digitization for the agricultural sector include personal computers, mobile telephones, web portals, mobile applications, interactive voice recording, IOT based sensor devices, drones for pesticide spray, remote sensing applications and other telecommunication devices. ICT has great potential in delivering agricultural extension services and can enrich rural people with new pieces of information. ICT tools provided by public private partnership can help meet the challenges and opportunities in agricultural development and are explored as mentioned below-

### ICT Steps for farmers empowerment

#### I. Portals

- m-Kisan portal was launched on July 16, 2013; more than one crore farmers use the SMS portal, 20 web-based services are integrated with this portal [5]. This portal provides Buyer-Seller Interface, choice of machine & dealer, Kisan Call Centre, market prices, weather advisories, NeGP-A roll-out, farm-mechanization, micro-irrigation, animal husbandry practices, and fertilizer testing services. After launching the portal, over 50 crore messages and 152 crore SMSs have been sent to farmers throughout the country.

The Ministry of Agriculture & Farmers Welfare has provided major digital applications to encourage technology adoption among farmers: -

- National Agriculture Market (eNAM): - It was launched in April 2016; it is a pan-India electronic trading portal that connects the existing Agricultural Produce Market Committee (APMC) and creates a unified national market for agricultural commodities. eNAM provides a platform to farmers to sell products without the interference of any brokers or mediators on competitive returns from their investment
- Direct Benefit Transfer Central Agri Portal: - Launched in January 2013, the DBT Agri Portal is a unified central portal for agricultural schemes. The portal helps farmers adopt modern farm machinery through government subsidies.
- Soil Health Card portal was developed for soil samples registration, recording soil samples' test results, and generation of Soil Health Card along with fertilizer recommendations. This is a single, generic, uniform, web-based software and can be accessed at [www.soilhealth.dac.gov.in](http://www.soilhealth.dac.gov.in).

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- Fertilizer Quality Control System is a web-based configurable workflow application developed by NIC to process the collected sample, test and generate reports. This application can be accessed at <http://www.fqcs.dac.gov.in>.
  - Participatory Guarantee System certifies organic products, which ensures agriculture production process following standards maintained for organic products quality has been claimed. This is exhibited in the form of a documented logo or a statement. The purpose is to promote the domestic organic products market and enable small/marginal farmers to have easy access to organic certification; an organic farming certification system called Participatory Guarantee System –India is implemented by the Department of Agriculture and Cooperation, Ministry of Agriculture, Government of India. It is cost-effective, farmer-friendly and hassle-free. Moreover, it is outside the framework of a third party system of certification, which is a prerequisite to enter the export market of organic products.
  - It is a quality assurance initiative and locally relevant with the active participation of stakeholders, including producers/farmers, traders and consumers in the certification system. Paramaparagat Krishi Vikas Yojana (PKVY) scheme supports this group certification system. It, in a way, promotes domestic demand for organic produce, trains farmers in document management and adherence to other requirements of the certification process and prepares them to opt for third party certification. For the online operation of this certification system, a web portal: <http://www.pgsindia-ncof.gov.in> has been created [6].
  - Cisco developed an Agricultural Digital Infrastructure (ADI) portal in August 2019. It enhances farming and knowledge sharing. Thus playing a vital role in the data pool. This pilot project for this initiative will take place at Kaithal (Haryana) and Morena (Madhya Pradesh).
  - <https://agricoop.gov.in/>
  - <https://extensionreforms.dacnet.nic.in/>
- The EMS is a Web-enabled online monitoring system for monthly progress report under ATMA Programme.
- <https://www.digitalgreen.org/about-us/>
- Digital Green is a private global development organization that empowers farmers to lift themselves out of poverty by utilizing the collective power of technology and grassroots-level partnerships.

## II. Mobile apps

The link for android applications is provided on farmer's portal [7].

- **Kisan Suvidha**

Kisan Suvidha is a multipurpose mobile app developed to help farmers quickly provide relevant information. For example, farmers can get the current day's weather information for the following five days. Farmers can track dealers, market prices, agro advisories, plant protection, IPM Practices, etc. In addition, unique features like extreme weather alerts and market prices of commodities in the nearest area and the maximum price in the state and India have been added to empower farmers in the best possible manner.

- **PUSA KRISHI**

ZTM&BPD Unit; ICAR-IARI, New Delhi, leads 14 ICAR institutes of North Zone-I. This unit is a strong link between the research community and the outside world to promote agribusiness ventures using technology development and commercialization for corporate to individual farmers. They provide a variety of technologies/products for commercialization.

- **MKISAN APPLICATION**

This platform has been designed and developed by the in-house IT team of DAC with the help of C-DAC Pune. It helps farmers and all other stakeholders obtain advisories and information sent by experts and government officials at different levels through the mkisan portal without registering.

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- ***SHETKARI MASIK ANDROID APP***

This has been one of the most popular monthly magazines in the Agriculture sector since 1965. It is published by the Department of Agriculture, Maharashtra.

- ***FARM-O-PEDIA***

Developed by CDAC, Mumbai, The application is a multilingual Android app targeted at rural Gujarat. The app is helpful for the agricultural community and is available in English and Gujarati languages. The main features of the app are:

1. Get suitable crops as per soil and season
2. Get crop-wise information
3. Check the weather in your area
4. Manage your cattle

- ***BHUVAN HAILSTORM APP***

A mobile application has been developed to capture crop loss due to hailstorms. extension workers can use this app to capture the following parameters:

1. Photograph of the area with latitude and longitude.
2. Name of Crop
3. Date of sowing
4. Date of harvesting
5. Source of irrigation

The captured data will automatically be plotted to Bhuvan Portal, and analysis can be done quickly.

- ***AGRI MARKET***

AgriMarket mobile app updates the market price of crops within 50 km of the device's location. This application automatically captures the person's area using portable GPS and fetches the market price of crops in nearby markets, which falls within the range of 50 km. There is another option to get the cost of any call and yield if a person does not want to use a GPS location.

- ***SIKKIM HORTICULTURE AND CASHCROP ASSISTANCE***

This app is used for submitting online applications for obtaining Departmental assistance by farmers of Sikkim.

- ***SIKKIM ALLOTMENT OF BREEDING BULL***

This app is used for requesting the allotment of breeding bulls under the Animal Husbandry department of the government of Sikkim.

- ***APPLICATION FOR POULTRY***

CDAC, Mumbai, developed it. The government of Himachal Pradesh has introduced Backyard Poultry Scheme under the Centrally Sponsored Scheme, where low input technology birds of coloured strain but disease-resistant type are supplied to the state's farmers. Using this app, an applicant can obtain assistance under Poultry Chick and Backyard Poultry Schemes of Govt. of Himachal Pradesh and apply online.

- ***PASHU POSHAN***

National Dairy Development Board has developed an android application that farmers can use on phones and tablets. With the help of this software, a balanced diet is formulated while optimizing the feed cost considering animal profile like details of cattle or buffalo, age, milk production, milk fat, feeding regime etc. the milk producers are advised to adjust the quantity of locally available feed ingredients offered to their animals along with the mineral mixture.

- ***DIGITAL MANDI INDIA***

This app helps check the latest Indian agricultural commodities Mandi prices from different states and districts. It is easy to use and intuitive; the app enables farmers, traders, and others to know the updated Mandi price.

Its main features are:

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- Browse through various commodity categories
- Browse prices in different states
- Simplified flow to reach the selected commodity's mandi price
- Copy the mandi price of a commodity
- Sync data from the Indian government portal Agmarknet. nic. in

- **MCFC**

This Android-based application, developed by National Remote Sensing Centre, ISRO, is helpful for field data collection for crop assessment using satellite data under the FASAL project of the Ministry of Agriculture. The application can collect Field Photographs (640x480 resolution), GPS coordinates and Field information, such as crop type, condition, date of sowing, soil prototype, etc. Through crowdsourcing, the farmers can also upload pictures depicting the crops, varieties, and soil status through their mobile devices. This information will be extremely useful in creating a national geospatial database of crops. The data can be sent in real-time or later using the Send Later option. All data received through this application reaches ISRO's Bhuvan Server.

- **KARNATAKA BHOOMI**

Bhoomi is the project of online delivery and management of land records in Karnataka.

- **HP SOIL TESTING**

C-DAC has developed this application for the agriculture department of Himachal Pradesh. Using this app, farmers can submit soil health samples of their land to the concerned soil health testing lab of their district / Block.

- **INTELLIGENT ADVISORY SYSTEM FOR FARMERS**

CDAC, Mumbai, developed it. As a result, farmers can get different farming season details, month based atmospheric and ideal conditions for various crops.

- **CROP INFO**

It was developed by Nirantara Livelihood Resources Private Limited, Bangalore, Karnataka. It provides Production Technology of commercially important Horticultural & crops on your smartphone. It includes production aspects, post-harvest technology, processing possibilities and market information. It is specifically developed for students & faculty of Agricultural & Horticultural Universities, Subject Matter Specialists & Extension Officials of Agriculture & Horticultural Departments, Private Sector Professionals, Farmers, and anyone interested in cultivating crops.

### **Future of Digital Agriculture in India**

The application of Digital Agriculture and technological interventions based on remote sensing applications, soil sensors, drone surveying and market insights, etc., permit farmers to gather, visualize and assess crop and soil health conditions at different stages of production in a convenient and cost-effective approach. In addition, they can act as an initial indicator to identify potential challenges and provide options to deal with them promptly.

Artificial Intelligence/Machine Learning algorithms can generate real-time actionable insights to help monitor crop yield, control pests, soil screening, provide actionable data for farmers, and reduce their workload. Blockchain technology offers secure & tamper-proof and precise data about farms, inventories, quick and secure e-commerce transactions and food tracking. Thus, farmers don't have to depend on paperwork or files to record and store important data.

### **Outcome of digitization**

With time, farmer requirements are changing rapidly, and so are the technological innovations in agriculture. It is becoming difficult to measure the impact of particular digitization efforts, although many revolutionized changes are observed as mentioned below-

*Direct outcome:* digitization efforts have made it easy for the rural community to obtain helpful information on precise farming, weather conditions, agronomics and soil science, the temperature of air and soil, rainfall, relative humidity of



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the air, moisture of leaf, moisture of soil, length of the day, speed of the wind and solar radiation from farmers portal, eNAM portal, fertilizer quality control portal and direct benefit transfer Agri portal.

*Indirect outcome:* digital platforms and devices support Agri workers in decision making and involve them in agriculture development. It helps the farmers stay competitive and survive in globalized market changes in the agricultural environment are necessary for the farmers. The internet allows farmers to track real-time prices of Agri commodities and communication with others. Digitization has facilitated rural peoples to exchange ideas and interact to solve their problems. Farmers also receive information and guidance from extension workers and experts regarding scientific practices in crops cultivation and animal husbandry practices. It has reduced the communication gap between agricultural researchers and farmers.

*Capacity-building and empowerment:* Digitization has strengthened the capacities of the rural people and farmers to better represent in negotiating prices in grain markets, land claims, infrastructure etc. It connects farmers to interact with other stakeholders. With the help of the internet and digital devices, the system has become more transparent and accessible to better access to credit and banking and insurance facilities at a reduced cost.

## Implementation of Digitization in Agriculture in India

The gradual acceptance of digitization in farming in India is the prominence of segregated small-holding farms in the country; this complicates the data gathering process. Additionally, limited availability of mechanized tools frequent natural calamities like droughts, floods, excessive monsoon rains, fire etc., have negatively impacted digital agricultural solutions. Thus, a customized approach would be needed to implement digital agriculture to a typical Indian small farm; this can be scaled up and made available to many Indian farms. Following measures could be implemented to make digital agriculture successful in India: -

Low-cost technology: - The average annual income of an Indian farmer is >85000/-. This low income explains the precarious financial circumstances of a typical farmer operating in India. Thus, low-cost technology will be beneficial.

Portable hardware: - due to small farmland holdings and leased farm practices, investing in mobile equipment is better for farmers.

Renting and sharing of agriculture equipment and machinery: - Due to financial resources and small landholding constraints, some digital solution providers offer equipment on a rental and sharing basis instead of outright purchases. A few agricultural technology solution providers like Farmkart (rent4farm), EM3 AgriServices and Tringo already provide rental equipment.

Academic support: - The district administration, research centres and academic institutes regularly interact with farmers through various locally arranged programs and government initiatives. In addition, training facilities provided by extension workers and experts from educational institutes and agricultural organizations help in supporting digital technology usage among farmers.

## Opportunities

- Digital technologies can also help governments improve existing policies, and programmes' efficiency and effectiveness and design better ones. Freely available and high-quality satellite imagery dramatically reduces the monitoring cost of agricultural activities.
- Digitization supports trade in agriculture and food products by connecting private sector suppliers to new markets and enabling new ways for the government sector to monitor and ensure compliance with established standards.
- Digitization can support the goal of achieving more resilient, productive, and sustainable agriculture and food systems, which better meet consumer needs. These benefits come directly via the adoption of technologies by actors in the sector (including service providers) and indirectly via the adoption of technology by governments to deliver better policies [8].

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## IV. CONCLUSION

The above study revealed that government agencies and private industries had developed several tools and technologies for knowledge dissemination, economic activities, business transactions, livestock-related activities for agricultural purposes in the form of web portals, mobile apps, and mobile telephony services. It has also been observed that future actions will be based on portals, mobile apps, and devices using the Internet of Things (IoT), Cloud Computing, Big Data technologies. The future requirements will be the devices applicable for intelligent irrigation, remote sensing technologies, drones to gather data on pest attacks, soil properties monitoring systems, air quality information, crop health information, crop insurance software, and weather conditions. The usage of these technologies and data collected from these portals, devices and apps will enable farmers and agribusinesses to closely monitor crop cultivation, optimize the use of agrochemicals and natural resources, and adapt quickly to climate changes. As a result, ICTs and precision agriculture tools will increase efficiency, reduce costs and increase agricultural productivity to manage natural resources effectively.

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