

## DIGITALIZATION OF AGRICULTURE IN INDIA: CHALLENGES AND HOPES

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### ABSTRACT

*If we want pro-poor growth and real development, high agricultural growth and rising incomes for farmers are essential and digitization is an important variable for fast growth in this sector. In rural sector e-Agriculture focuses on agriculture by using information and communication technology for better conceptualization, design, development, evaluation and innovation. Critical data pertaining to agriculture can be generated, processed, transmitted, disseminated, sorted, archived and retrieved through mobile phones. Some apps are available and more can be developed to address farmers' specific needs. Mobile devices and the internet facility keep the farmers updated with relevant information related to farming. All this requires great revolution in research technology development, agricultural extension services and a major network of marketing, storage and distribution. The research is descriptive in nature. The study is conceptual and based on secondary data collected from company websites, newspapers and journals. The scope of the study is restricted to agricultural sector only.*

**Keywords:** M-agriculture, Mobile devices, Internet of things

### INTRODUCTION

In India high agriculture growth is needed for overall growth of the economy and also to provide employment and food security to majority population. Growth may be higher during the previous two decades, but inclusive growth in terms of focus on agriculture has been missing. If we want pro-poor growth and real development, high agricultural growth and rising incomes for farmers are essential and digitization is an important variable for fast growth in this sector. According to Dr. APJ Abdul Kalam to provide good nutrition and plenty of food to all Indians, food grains production need to be enhanced to 360 million tons by 2020 so that along with sufficient domestic consumption have sufficient margin for

food exports and aid other countries. All this requires great revolution in research technology development, agricultural extension services and a major network of marketing, storage and distribution. The research is descriptive in nature. The study is conceptual and based on secondary data collected from company websites, newspapers and journals. The scope of the study is restricted to agricultural sector only.

### SCOPE FOR DIGITIZATION IN INDIA

To meet the challenges of climate change use of ICT in agriculture is necessary than optional and can prove prommissable to improve the conditions of small holder farmers. E-agriculture opens up opportunities for non- traditional

players in the agriculture value chain. It provides reliable data for research and policy-making, and the fill the current information gap. Better data will allow government as well as non-government organisations to design farmer-friendly policies and planned interventions. It also brings transparency in agricultural supply chains, removing the huge inequality that exists and guaranteeing adequate income to the farmers.

Digitisation of agriculture or e-agriculture is seen as an emerging field focused on enhancing agricultural and rural development through improved information and communication processes. "E-agriculture is a multi-stakeholder process that involves bringing together many different ministries and departments as well as private sector players such as insurance, banking and mobile network operators. Countries have been experimenting with the use of technology for agriculture for a long time, however due to a lack of multi-stakeholder based approach in sustaining these initiatives, we see that many of these initiatives/solutions haven't moved from the pilot or experimenting phase," says Gerard Sylvester, regional knowledge and information management officer, FAO.. ICT Development Index (IDI) 2015, published by UN International Telecommunications Union, measures the level of information and communication technology access. It ranked India a low 131 out of 167 nations. This is reflective of the poor access of the population to ICT services. Although India has made tremendous progress in raising its telecom density, the country remains far behind when it comes to providing internet access. The report noted that 43.4% of the global population has access to internet. In contrast, only 18% Indians have access to the internet. With higher level of ICT workers become more efficient and their productivity increases as a result income increases at high rate. The digitization of agricultural sector can play a significant role in increasing employment opportunities, improving the standard of living in the agricultural sector and reducing the risk and uncertainties that our farmers have to deal presently. Both private and government sector should complement each other in providing latest information and

communication technologies to empower rural population.(Anand Abhishek and Sharma Deepti)

Technology is key in increasing growth through providing better services and innovative delivery models. Crop health can be measured from pest infestation levels to moisture readings of the crop to satellite imagery of the warehouses. Mobile telephony is connected to satellites and data delivered to centralized servers which is instrumental in converting grain into monetized assets. This type of high-tech intervention will allow financial institutions to use agri-crop as the primary collateral helpful in promoting financial inclusion. Technology can increase crop protection curtailment of food wastage and increasing credit availability to the stake holders of the agri-value chain. Likewise software and technology has revolutionized other sectors, agriculture, warehousing and agri-finance is all set to evolve. (<https://economictimes.indiatimes.com>) Digital farming provides real time flow of data from the fields to the company office with regard to day to day farming operations. This enables to take care of entire value chain, right from sowing to harvesting through agribusiness. With the help of digital system advice can be given to farmers and field staff attached to them can ensure best practices on their fields. Through digital monitoring fields are digitally managed by giving the right course correction advice and taking regular updates on the health of the farm through pictures. The digitisation is going to change the agricultural practices in various means such as remote sensing of plots through satellite systems with precision as close to 5X5 meter resolution can help identify the pest or disease affected areas of the plot. This can be done through Big Data Analytics, with indicators like Normalized Difference Vegetation Index (NDVI), Red Edge Index etc. It will be immensely helpful in weed and pest management. The digitisation of agricultural practice provides traceability across the entire supply chain. It also helps farmers to connect with the buyers and initiate sale by availing online market place, it gives farmer more independence and option to choose a buyer. Digitisation boosts income and also lowers

cost by optimally using chemicals and fertilizers and managing bottlenecks. The production process can be traced through pictures and farmer can give end to end traceability. It is more useful to organic farmers to validate their claims.

Globally Internet of Things(IoT) is being adopted by countries in spaces such as retail, consumer wearables , commerce and smart infrastructure. Currently India has comparatively small market for IoT but it aims to grab atleast 20 percent market share in next five years. Efforts of Indian government in face of Digital India highlight the role of IoT and loud technologies to step forward in digital revolution for growth in India. In 2016-17 Union Budget, the government promised an outlay of Rs 7296 crores as part of its AMRUT mission to build 100 smart cities, and its success is dependent on adaptive use of sensors, smart devices, and connectivity, cloud and Big Data technologies. In urban infrastructure development IoT implementation is useful but on other hand it is interesting to evaluate the impact of IoT and rural technologies on penetration of welfare services in rural areas where almost 70 percent of country's population reside, as per the census of India 2011 Provisional Population Totals of Rural Urban Distribution. Telemedicine network for e-healthcare services delivery is transforming accessibility in remote parts of the country. In telemedicine centers interaction of doctor patient in which patient's health records are automatically wired to doctors for reference. In coming decade India has growing opportunity in the agriculture sector for improving lives making India a true leader in agriculture IoT by revolutionizing the way farmers plant, fertilize and harvest in the next decade. Advancement from chipmakers is making the computer and connectivity hardware and software technologies more affordable. Almost 50 percent of the population is employed in agricultural sector and it will increase overall growth of the country and this sector should avail the benefits of the huge potential of IoT driven solutions for improving supply chains and farm practices which will enhance yield and higher monetization of the sector. Precision Farming

techniques using field sensors to monitor farming operations should be used by large number of farmers. Farmers in Brazil use unmanned tools such as drones, to collect, analyze and transmit real-time crop intelligence to regulate use of chemicals, irrigate dry fields to generate sustainable and high yielding results. The information can be transmitted to their mobile handsets. Farmers can use this informed real time data based decisions for utilization of their resources and overall performance of their yield. In dairy industry technology has been reported to be used in some parts of Europe namely Voluntary Milking Systems (VMS) in which cows voluntarily approach robots for milking up to four times a day, in accordance to their biological needs. Agri-Robotics is being used in developing countries for activities ranging from surveillance to basic farming activities like tilling, ploughing etc. Private and public investments in smart agriculture is being aggressively used but in India their full scale adoption is low as its cost is high therefore, not viable to small and medium farmers. According to NSSO for 2012-13, these costs amount to 30 percent of the total output that an average farm household obtains from a crop, thus reducing their profitability margins. Thus, IoT device and solution providers should innovate and promote low-cost sustainable solutions to reduce costs and low cost sensors should be widely available with ubiquitous connectivity through cellular NB-IoT , having optimized power consumption built on power efficient sensors and processors so that maintenance problem can be dealt with. According to NASSCOM, there are about 28 IoT start ups in India, out of them 40 focus on smart agriculture. Innovations can increase smart irrigation, agri-drones, robotics harvesting, produce monitoring and agri-sensors. In arid and semi-arid regions smart irrigation technology can ensure efficient use of water resources based on the humidity of the soil, the needs of the crop and weather patterns, the right type of sensors and connectivity will optimally use scarce resources. Drones can be used to dispense fertilizer and pesticides over acres of farmland in a very efficient manner through wireless connectivity and precise positioning smart sensor technology is

helpful in monitoring produce quality, wind and light conditions, soil temperature, acidity and mineral content. Start ups are being set which combine such sensors to provide real time feedback to farmers for appropriate action. Governments should create an environment for startups vital for the country. In the IoT draft policy of Indian government its scope for agriculture sector has been outlined and is providing incentives to capture investor interest although much needs to be done with regard to cost reduction, awareness about use of IoT. ([www.indiatimes.com](http://www.indiatimes.com))

Farmers' income can be increased and positive effects on agriculture seen through emergence of farm technologies with well connected robust information communication technology (ICT). Technology in Indian agriculture is helpful in overcoming productivity stagnation, strengthening market linkages and improving farm management. Farmers can also be modernized by adopting technology driven production practices ensuring uniform annual returns to farmers, reduced risk of crop failure and increased yields. Digital technology can be applied in remote sensing via satellites, geographic information systems, crop and soil health monitoring and livestock and farm management. At pre-harvest stage through digital technology can assist in crop and input selection and helpful in providing and getting credit and insurance. During on-farm stage weather advise and disease and pest related help can be provided. During post-harvest stage real time data in both domestic and export markets can be estimated. For improving food quality to meet competition technology can provide farmer friendly solutions by promoting data generation as well as the advanced analytics which favour them to make smart decisions about farming and to economise use of inputs and labor. The eco-system for technology and digital solutions in agriculture sector is expanding at an impressive rate as this sector is attracting large conglomerates, leading IT companies, investors and young innovations in India. In India an estimated 34 ventures received US\$295 million investments in 2016 in the country.

ITCs e-Chaupal has proved to be comprehensive digital knowledge hub for farmers which has 6,100 installations covering 35,000 villages serving 4 million farmers (<http://www.itcportal.com/business/agri-business/agri-commodities> and rural services) It was launched in 2000 benefiting farmers doing business through their network and producing ripple effect on the public sector managed food grain management system leading to upgradation.

Tata Consultancy Services (TCS) offers personalized advisory services in voice and visual formats through communication device such as mobile phones through its mKRISHI platform. Prevalence of mobile phones in rural sector has increased, therefore several mobile based applications by government departments, entrepreneurs and the private sector is being developed. With mobiles farmers can connect with other farmers and traders and utilize their mobile phones for information on input availability or market prices and allow them in getting competing prices and choose the best one and availing information about, selecting seed varieties appropriate to a particular farm, adopt best activation practices, bear weather risks and coping with plant diseases.

A large number of young entrepreneurs have used digital technology for reducing the time duration of crop cycles, economizing water and energy, reducing the use of agro chemicals, automation to improve farm management, strengthening farmer market linkages, and improving cold chain logistics for high value addition.

The eKgaon One Village One World Network is leveraging mobile communication technology to encourage the sustainable development of Self Help Groups (SHG) and small farmers across India. The platform has over 9,00,000 women and 3,00,000 farmers spread across villages in India (<https://.ekgaon.co.in/ekg/indexphp>). Agnext, an Indian start up has developed drones apart from other digital technologies for creating integrated hyper local farm data collection crop analytics platform. ([www.wipo.int/edocs/pubdocs](http://www.wipo.int/edocs/pubdocs)) Seth

## Ankur and Ganguly Kaveri Digital Technologies Transforming Indian Agriculture.

Digital India was launched on July 1, 2015 to create digital infrastructure for empowering rural communities, enabling digital delivery of services and promoting digital literacy. Digital agriculture can be defined as ICT and data ecosystems to support the development and delivery of timely, targeted localised information and services for profitable and sustainable agriculture through providing safe, nutritious and affordable food for all. Rural connectivity can be enhanced by providing low cost data and access to information. As a result rural youth will realise their full potential, profits of farmers can be increased by better access to markets and rural businesses through value addition. The project has three core components, viz. digital infrastructure, digital services and digital literacy. Mobile phone is the preferred delivery medium with focus on mGovernance and mServices. The mAgriculture and mGramBazar, out of the seven components covered under mServices, directly impact agricultural extension and marketing services.

The project will benefit small farmers. It seeks to

- I. transform rural India into a digitally-empowered knowledge economy
- II. provide universal phone connectivity and access to broadband in 250,000 villages
- III. extend timely services to farmers through information technology and its tools
- IV. enhance efficiency in agricultural governance through digital literacy and electronic delivery of services. This article briefly highlights government's initiatives and suggests the need for harnessing potential of digital India for agricultural development.

Agriculture is getting more and more digital and its future lies in leveraging real time analytics and automated systems. In global economy in past few decades digital technologies have transformed virtually each sector including agriculture. New digital technologies accelerate agricultural growth. Both the Central and State Governments should adopt different steps to increase investment in agriculture research and to create an environment for promoting agriculture business through policy initiatives such as:

- The Government wants to promote virtual agricultural market by providing common electronic platforms to farmers for selling their produce to buyers all over country. National Agriculture Market online trade portal has been created.
- Rashtriya Krishi Vikas Yojna encourages states to allocate more funds to agriculture and allied sector by undertaking appropriate growth oriented projects.
- Direct Benefit Transfer system and unique identification number, Aadhar, to support the transfer of government subsidies to citizens; these platforms can also be used for government interventions with regard to soil health, Prime Minister Krishi Sinchai Yojna, national markets and weather indexed insurance.
- Different Institutions related to agriculture sector such, as State Government's department of agriculture, State agricultural universities, Krishi Vigyan Kendras, regional research institutions, farmer producer organizations, corporate/industrial/business houses and multinational companies engaged in manufacturing/production and distribution of farm inputs, farm equipment and machinery, rural financial institutions, insurance companies can contribute their professional knowledge to develop digital

ecosystem for agriculture and make it available for farmers.

- Modern equipment and improvised machines can enhance production and storage.
- Kisan call centers provide services to farmers where they can directly interact with the executives for their queries. They are provided information through mobile phones with regard to suitable techniques needed to maintain the fertility of the soil to increase production is showing positive results. Information communication technology can change the face of agriculture sector by raising crop productivity and profitability per unit area and resources. The mobile connectivity in terms of service users is increasing at fast rate. IAMAI study showed 80% people in rural areas use teledensity for communication, 67% for online services, 65% for e-commerce and 60% for social networking.

In rural sector e-Agriculture focuses on agriculture by using information and communication technology for better conceptualization, design, development, evaluation and innovation. Critical data pertaining to agriculture can be generated, processed, transmitted, disseminated, sorted, archived and retrieved through mobile phones. Some apps are available and more can be developed to address farmers' specific needs. Mobile devices and the internet facility keep the farmers updated with relevant information related to farming. The Government has set up three portals such as farmer portal, Kisan call centre and m-kisan portal to help farmers take informed decisions in various agro climate conditions for better farming. E-Governance program provides soil health card software has been standardized and web based software developed to provide integrated nutrient management through soil test crops. National E-Governance plan in Agriculture provides information to farmers through multiple channels such as common service

centre. Internet Kiosks and SMSs. 12 identified clusters of services provide information on weather, soil health, seeds, nutrients, pests, irrigation, crops, good agricultural practices, farm machinery, marketing infrastructure, farm commodity prices, arrivals, procurement points, electronic certification for export and import, drought relief and management, livestock, fisheries management, training monitoring implementation and evaluation of schemes. NABARD has also designed agricultural portals for farmers. The entrepreneurs with start-ups are exploring opportunities in the field of automation, cloud integration and communication. This trend is a positive indication for government sector and private sector jointly working through digitization to revolutionise agriculture by transforming its structure and reshaping it with the modern equipment and techniques.

Limitations of digitization of Indian agriculture relate to development and upgradation of agricultural content timely, ownership issues of public and government generated data, inadequate public private partnership, awareness and training of farmers in the remote areas, monitoring of instructions to farmers, expenses related to automated systems, robotics, and other equipment and expertise for modernized machines. (Ganguly Sonali and Patra Sujeet Prakash )

GEOSYS's satellite based remote sensing combines the historical records with the real time observations and helps in predicting problems even before the real symptoms appear. Precision agriculture through drones equipped with sensors that take images of crops and apply fertilizers or pesticides according to requirement. Geo-tagging helps to trace the farm produce detecting places from where the raw materials are bought and customers want to know the details of the raw materials used in the final product. Likewise, various techniques can merge field data with crop/weather/soil data useful both to the farmers and agribusinesses as well. Agribusinesses associated with agricultural equipment manufacturers are capital intensive but prove to be

highly beneficial if updated regularly. Sensors fitted irrigation delivery equipments deliver water after analyzing the soil moisture, crop and weather conditions, AGRIVI app helps in planning, monitoring and tracking the input status, expenses, weather, extent of pest attacking risk. For simple and efficient management of all types of agridigital map Module Map can be used. Mobile Platforms such as digital mobile apps and connected farmer system is very successful, through connecting farmers in a single mobile by virtual aggregation and agribusinesses can identify patterns, efficiencies and best practices by registering farmers, managing contracts, provide extension services, make payments, extend farmer loans and provide SMS receipts. Agribusiness should take up on priority basis: (Reddy Prameela)

- To make up with competition alliances and joint ventures should be consolidated.
- Without compromising quality reduce cost.
- Through upstream and downstream upgradation optimize vertical integration.
- Upstream upgradation includes measures to strengthen R&D and develop new products in accordance with consumer's taste. The design and shelf life of the product is equally important and should fit well into their life style.
- Downstream upgradation requires measures to digitalize agriculture and improve infrastructure by providing raw material uninterrupted and qualitative.
- Sales should be extended internationally and efficiently provided in present markets.

Digitalization can be helpful in tracking produce from farm to the table and in this chain reduce wastage and improve food safety. Technology can be helpful in detecting pathogens and allergens before reaching consumers. Helpful in marketing by addressing price discovery issue and solve present problem of lack of transparency in wholesale market. It can be helpful in bringing farmers in touch

with profitable customers and help in building sustainable partnership to improve farming productivity. Holistic digital platform will increase availability, affordability, consumer awareness, quality, safety and access to food. (Mukerjee Debashish)

Digitization will improve rural connectivity and will be key in providing low cost data and access to information and will empower rural youth to realise their full potential, farmers to increase their profitability by accessing equitable markets and rural businesses to offer value added services. Spatial Data Infrastructure and low cost smart phones and tablets to support bi-directional flow of data and information to rural consumers. Advanced agriculture industries help farmers manage their production and market risks through the application of spatial/temporal data bases that are cloud enabled and integrated through Application Programming Interfaces (APLs). This enables rich and dynamic data ecosystem providing advanced analytics to inform farmers regarding best economic options to maximise profitability and minimise risk. Remote sensing provides large data resource to support the development of derived weather products (radar), improved hydrology and watershed management, soil health, crop coverage and crop health estimates among other application. Africa, Brazil and China have successful business models using mobile phones to increase value chain efficiency for appropriate inputs and credits. Same can be applied in India to double farmer's income. Digital Agriculture can use social media platforms for improving human capital and capacity. Digital Green uses participatory videos in which farmers explain best management practices to other farmers. Farmers are better related if someone relating to them explains build livelihood under similar circumstances. Digital agriculture will facilitate the achievement of Sustainable Development Goals before 2030 and help the objectives of the National Food Security Act efficiently, effectively and in equitable manner so that everybody can access safe, nutritious and affordable food. (Bergvinson David)

Startup India launched in 2016 aims to boost startups across sectors by providing handholding services, access to funding and incubation and is of great significances for the agriculture sector.

## CONCLUSION

Digital transformation will provide access to finance through exposure and awareness due to digitization, forecasts on climate change enables right decisions, accessibility of farm equipment and new technology, inputs for better soil fertility and soil structure, access to markets, access to information, small holdings utilization and enables predictive analysis. It requires planning, capacity building, identification of right stakeholders, mechanisms for governance and monitoring and provide buyers and sellers one platform. This technology platform will reduce costs, improve productivity and quality, improve prices, reduce risks and reate sustainable ecosystem. Digital technologies offer the potential to achieve the necessary conditions for scale, with distributed low cost and customised delivery, creating a unique opportunity for private enterprise and innovation to thrive. High and inclusive growth can be well promoted with digitization. For India, at a time when national, regional and international research institutes have already developed technologies, farmers need motivation and encouragement to adopt these proven yield-enhancing, cost-efficient and environment-friendly technologies. Finally digitization will change the scene of Indian agriculture in future and guarantee higher income to farmers and reduce distress.

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