

## AGRICULTURE 4.0: INDIA TOWARDS AGRITECH

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### ABSTRACT

*While agricultural and supply chain inefficiencies persist, keeping farmers small and marginal, the country is catching up with global trends in both consumption (organic, healthy, and convenient) and concerns for sustainability. There is an immediate need for disruption in the industry led by technology, as it has the ability to solve scale difficulties, minimize knowledge asymmetry, and enable for supply chain disintermediation to make farming more profitable, inclusive, and egalitarian. Despite being one of the world's top five agricultural economies, India's agriculture is at a critical crossroads. This sector has a number of issues, including low yields in major crops relative to global averages, limited market access, low produce pricing, and limited water availability which can be resolved by technology. The study through review of published articles, government policies and expert pieces tries to examine the stand of India on adoption of digital agriculture and various government initiatives in this direction. The study identifies various obstacles to digital agriculture and shows the need to go for agriculture 4.0 and barriers to it prevailing in the country. The future of digital agriculture and key game changing technologies are also discussed in the study.*

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**Keywords:** Agriculture 4.0, Information Technology, Digitalization, India, Farmers.

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### Introduction

The agriculture sector is one of the most important industries in the Indian economy, with a current worth of US\$ 370 billion. Over the years, the government has taken significant initiatives to assist and improve the agriculture sector, including the use of proven farming technologies and supportive regulations. In some ways, the Government of India's push to attain the objective of Doubling Farmer's Income (DFI) by 2022 embodies the necessity to pursue all conceivable methods of enhancing agricultural productivity and profitability of farmers. The current advancement of digital technology in farming will accelerate growth by ensuring higher crop yields and improving sustainability by reducing water consumption and pesticide use. Artificial intelligence (AI) and machine learning (ML), remote sensing, big data, block chain, and Internet of Things (IoT) are revolutionizing agricultural value chains and modernizing processes. While other countries, including the Netherlands, the United States, Australia, and Israel, have effectively adopted and utilized digital solutions to revolutionize agriculture, India is still in its early stages for such technological agricultural adoption. The Public-Private Partnership (PPP) mechanism is expected to foster future adoption of digital agriculture in India.

### Research Methodology

The study is based on published research articles, government policies, and expert pieces from the last five years in order to capture the most recent changes on each subject and parameter.

Other published works are also explored with keywords such as agriculture 4.0, information technology in agriculture, artificial intelligence in agriculture, internet of things in farming and others. The search included all articles ranging from exploratory, qualitative, and quantitative studies.

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### **Agriculture 4.0: The Core Concept**

In conjunction with Oliver Wyman, the World Government Summit released a report titled Agriculture 4.0 – The Future of Farming Technology for the 2018 edition of the worldwide event. The research tackles the four major developments putting pressure on agriculture to fulfill future demands: demographics, natural resource scarcity, climate change, and food waste. Agriculture 4.0 encompasses the advancement of precision farming and refers to all agricultural actions that are based on a precise and accurate analysis of data and information acquired and transferred using advanced tools and technology. This refers to the tools and techniques that allow for the synergistic use of a variety of digital 4.0 technologies, allowing for the automatic collecting, integration, and analysis of data gathered from the field, sensors, or other third-party sources. The goal of these technologies is to provide farmers with the most comprehensive and precise help possible in their decision-making process regarding their activity and relationships with other stakeholders in the supply chain. It refers to the use of Internet of Things (IoT), Big Data, Artificial Intelligence, and Robotics to extend, accelerate, and improve the efficiency of operations affecting the entire production chain.

### **Digital Agriculture in India: Status Quo**

Our country is among the top two in agricultural production globally, but we still have a long way to go in terms of adopting new techniques for increasing per hectare productivity. The explosion of digital progress can be seen in nearly every other area of the Indian economy, but it is still a long-held desire for agriculture. India has a mechanization level of 40%, but developing countries such as China and Brazil have mechanization levels of 65 and 75 percent, respectively. This demonstrates our steadfast reliance on conventional ways, as well as the significant gap that must be closed in terms of farm machinery use and agricultural mechanization.

### **Why should India go for Agriculture 4.0?**

The Covid-19 pandemic has generated a need to accelerate the establishment of digital agriculture in India. Digital transformation offers enormous potential to address trans-disciplinary challenges in agriculture at several spatial and temporal scales. It will immediately benefit and boost the agriculture sector, which now accounts for 18% of India's GDP. Further technology will play an important role as it will increase productivity, lower production cost and provide farmers with customized solutions based on crop sowing date, variety sown, harvest date, soil health, disease outbreaks, pest control measures, water availability, projected weather conditions, and market prices. Farmers will be able to make quick, timely, and educated decisions on quality crop production by implementing intelligent software, ICT, mobile technologies and devices, IoT, data analytics, artificial intelligence, digitally delivered services, apps, etc. In brief, pre-harvest and post-harvest management systems will give farmers with useful information into optimizing productivity and mitigating the influence of uncontrollable variables. Digital agriculture will bolster various issues like constraining soil degradation, decreased chemical application, efficient use of water resources etc. Another crucial influence of Digital Agriculture will be on democratizing market pricing and compressing transaction costs, allowing farmers to collect a larger percentage of the marketable value of their produce.

### **Key Initiatives Taken for Agriculture 4.0**

- **Digital Agriculture Mission**

In September 2021, the Union Minister of Agriculture and Farmers Welfare established the Digital Agriculture Mission 2021–2025 to advance digital agriculture through experimental projects. The mission's purpose is to support initiatives that employ drones and robots and are based on emerging technologies such as artificial intelligence (AI), blockchain, remote sensing, and geographic information systems (GIS). Pilot projects were approved in ten states of the country during the previous fiscal year (2020-21).

- **National eGovernance Plan for Agriculture (NeGPA)**

The National eGovernance Plan for Agriculture (NeGPA) has been updated to accommodate new and developing digital agriculture technology and release funds to the States/UTs only for projects involving the use of modern information technologies such as Artificial Intelligence & Machine Learning, Block Chain Technology, Internet of Things, Robotics, and so on, as well as for the customization / migration of web & mobile applications already developed by the States to the platform to be developed using the digital technologies mentioned above. As part of the NeGPA effort, the Department created the Farmers Portal ([www.farmer.gov.in](http://www.farmer.gov.in)) to disseminate information on many agricultural topics such as seed variety, storage warehouse, pests and plant diseases, best agricultural practices, watershed, mandi data, and so on.

- **Mobile Applications for Farmers**

Various mobile applications including Kisan Suvidha, e-NAM (National Agriculture Market), Farm Mech' App, Farm Safety App, Water Balance Simulation Model for Roof Water Harvesting (Mobile App) etc. have also been created to help farmers get information on crucial aspects such as weather, market pricing, plant protection, agro-advisory, extreme weather warnings, and input dealers (of seed, pesticide, fertilizer, farm machinery), soil health card, cold storage and godowns, soil testing laboratories, veterinary centers and diagnostic labs, crop insurance premium calculator, and the government scheme. This software, which was released in 2016, has received over 13 lakh downloads.

- **India Digital Eco-system for Agriculture (IDEA)**

The Ministry of Agriculture & Farmers Welfare's Digital Agriculture Division is also in the midst of developing IDEA – India Digital Eco-system for Agriculture. The framework that will lay out the architecture for the federated farmers' database is being constructed by combining publicly available data from multiple initiatives and tying it to digitized land records. The IDEA would help to construct the country's Agri-stack architecture, which would serve as a foundation for the development of innovative agri-focused solutions employing emerging technologies in order to successfully contribute to the creation of a better ecosystem for agriculture in India.. This Ecosystem will assist the government in making more effective plans to increase the income of farmers in particular and the overall efficiency of the agriculture sector.

- **Cross-industrial Collaborations**

NITI Aayog and IBM have collaborated to build an AI-based crop yield prediction model for predictive insights that aid to increase crop productivity, soil quality, agricultural input control, and disease outbreak early warning. To provide farmers with precise and timely advice, data will be obtained from ISRO, the existing soil health card database, the Indian Meteorological Department's weather prediction, and other sources. This Agricultural Digital Infrastructure (ADI) is likely to play a critical role in the data pool that the Department of Agriculture will build as part of the National Agri Stack. This initiative's pilot experiment will take place in Kaithal (Haryana) and Morena (Chile) (Madhya Pradesh).

### **Impediment to Agriculture 4.0 in India**

Though the internet penetration in India stood at 45% in January 2021 but despite the availability, the country is underperforming in the use of digital agriculture technologies. There are still obstacles to digital agriculture in India. Agriculture is an important component of the Indian economy, yet it continues to face structural challenges. Some of the challenges to realizing the full potential of digital technologies in agriculture in rural areas are mentioned below:

- **Still Dependence on Traditional means of Agriculture and Conventional Wisdom**

Indian agriculture still has conventional wisdom preeminence which is a great obstacle in the way of digital agriculture. Farmers' choices for crops or fertilizers are still far from proper research evading optimum practices based on fundamentals such as soil, climate, water availability, etc. Pesticides and chemicals are still used to control plant viruses and pests. There are few options for mitigating the adverse effects of chemicals.

- **Availability, Connectivity and Affordability**

The farm lands in India are located in the remote areas which are underdeveloped and lack the necessary infrastructure crucial to support the introduction of hybrid technology. Because of such disadvantage of location farmers are unable to adopt new technologies even if they are interested to do so. Due to such location disadvantage many farmers are deprived of availability of technological up-gradation. Along with availability the issue of connectivity prevails in various rural regions in the country where network coverage is limited. Although the country has the world's second fastest-growing mobile market, it lags behind in terms of internet connectivity. India has a population share of roughly 16-17 percent of the world's population however it only has about 10% of the world's internet population. Furthermore, when only fixed broadband is considered, penetration is considerably lower in comparison to other countries. This is compounded by the low rate of internet access in rural areas. Though 4G has become the most prevalent mobile network in the country but connectivity to rural areas is still an issue of concern.

Another prominent obstacle in adopting digital agriculture is inability to afford advanced technology by the farmers. Many rural households choose not to invest in an electric connection because of various reasons which include the seasonal nature of agricultural revenue, a lack of consistent income,

high electricity bills, and unexpected household expenditures. Though a few adopt and implement some form of technologies but they are unable to keep up with the huge maintenance and implementation costs consequently discouraging others also.

- **Low Level of Digital Literacy and Lack of Awareness**

According to a March 2021 Niti Aayog report fewer than four in ten (38 percent) of Indian families are digitally literate. This number is even smaller in rural areas, at 25%. The use of digital technology necessitates fundamental literacy and numeracy, as well as specific technical knowledge and computer skills. Farmers who lack such skills will be left behind in an increasingly digitally-driven society. Because the majority of farmers are uneducated, their knowledge of upcoming technology is limited. They are unfamiliar with the various modern technologies that are available. A big impediment to employing digital technologies is a lack of awareness and basic literacy.

- **Inadequate Policy Framework for Digital Strategies**

One of the driving causes behind digitalization is government laws and frameworks. These conditions foster the development of competitive digital markets and e-services. Given the different needs of farming in India, measures or interventions to cater to the greater farming community are critical. Poor governance and implementation of the relevant projects/programs results in significant disparities in technology adoption, yield, and revenue. India must guarantee that evidence-based agri-tech policies are developed in order to prevent potential problems. Agriculture research spending in India has been pitifully low, especially when compared to countries like China and Brazil. Since 2001, India's agricultural R&D spending has been roughly 0.50 percent of agricultural GDP. Also, there has been very little published research on government digitalization policies.

- **Inadequate Financial Assistance**

Farmers in India are disadvantaged because they do not receive the financial assistance required to make farming profitable. The truth is that the price of digital inputs is rising and the risks are also increasing as a result of climate change-related extreme weather. Most of the farmers are smallholders and belong to lower castes, their access to credit is constrained either by outright refusal of credit to such groups/people or by costly access due to higher interest rates imposed or unfavorable repayment terms. This renders their farming business unviable this discouraging them to adopt digital technologies. Some government-sponsored insurance systems were designed to stabilise farmers' incomes and keep them farming, but enrollments have been limited due to a variety of circumstances, including costly premiums and a lack of encouragement by insurance companies. Farmers must be compensated for both the greater expense of growing food and the increased risk of crop loss in this manner. Farmers with landholdings of less than a hectare primarily borrow from informal sources of credit such as moneylenders, Informal sources of credit are typically offered at higher rates of interests, and may not have proper documentation.

#### **Future of Digital Agriculture in India: Way Forward**

While a data revolution is unavoidable in agriculture, given its socio-political complexities, reliance on mere technological fixes and agri-business investments to improve farmers' livelihoods cannot be considered as digital metamorphosis. For India to bring revolutionary digital transformations massive efforts are required to develop farmer capacities at least until educated new farmers replace the existing under-educated small and medium farmers. The government should try to enhance farmer capacity through a mixed strategy, preferably by building the capacities of individual farmers or coping with the new circumstances by establishing support networks, such as FPOs and other farmer groups where technical assistance is accessible. India has the opportunity to emerge as an IT giant and revolutionize the agriculture sector by taking on global trends of quantum computing, AI, big data, and other emerging technologies. While the green revolution increased agricultural production, the next significant step in Indian farming must be the IT revolution.

#### **Findings of the Study**

The study establishes that although initiatives to digitalize Indian agriculture have begun, digital technology adoption is still in its early stages and there is a long way ahead to compete with global economies. The country's prominence of segregated small-holder farms, which makes data collection difficult, limited percolation of mechanization tools, lack of awareness and digital literacy, and other factors have all worked against the deployment of digital technologies in agriculture, slowing the wave of agriculture 4.0 in India. If these issues are taken care of through effective Public Private Partnership (PPP) model, strategic policy framework, adopting technologies like quantum computing, AI, big data, IoT and other techniques like urban farming, precision farming, nanotechnology, etc. then India can also emerge as an IT giant and revolutionize the farming industry.

### Suggestions

The key reason for India's sluggish adoption of digital farming is the country's prevalence of disjointed small-holder farms, which hampers data collection. As a result, a tailored approach would be necessary to implement digital agriculture on a typical small Indian farm. Low-cost technology, plug-and-play portable hardware, renting and sharing platforms for agricultural equipment and machinery, and academic help to teach farmers in digital adoption might all be included in the proposals. Affordable access to any capital-intensive technology in a country dominated by smallholders necessitates financial and institutional innovations that decrease CapEx requirements, ensure high capacity utilization, and generate competitive rental markets.

The government should try to enhance farmer capacity through a mixed strategy, preferably by building the capacities of individual farmers or coping with the new circumstances by establishing support networks, such as FPOs and other farmer groups where technical assistance is accessible. Farmers who do not have access to such services should be provided with digitized agricultural infrastructure and literacy by the Indian government. Farmers' comments should be solicited on a regular basis to determine whether the project is beneficial to them. Public-private collaboration for digital agriculture services is an important demand to assist and develop the agristart-up ecosystem and bring innovation to smallholder farmers. Establishing an agricultural digital ecosystem must include long-term factors such as interoperability, data governance, data quality, data standards, security, and privacy, in addition to stimulating innovation. Adoption of a decentralized, federated architecture that offers autonomy to service providers and all other actors while still ensuring interoperability is also a crucial demand.

### Conclusion

In today's economy, digitization is the future of many sectors including agriculture. The final mile in digitization is the ease of use, accessibility and popularization of benefits to farmers who quickly understand and appreciate the assistance. Emerging technology must be utilized as a solution to all of our farmlands' fundamental difficulties; as a result, it will help to double farmers' income and increase crop yield. With the goal of becoming globally competitive, profitable and sustainable, India is embracing new-age technologies and innovation to assist farmers, cut production costs, grade better quality and minimize distress sales. The government should spend time and money sharing the benefits of digitization and the Indian private sector should join forces to benefit the country's premier software companies. In the next years, 'digitized farmers' will make a substantial contribution to realize the dream of 'AtmanirbharBharat', or self-sufficient India. Technology is evolving at rapid pace and the Indian government, in collaboration with agtech companies can build effective smart agro value chains by digitally empowering farmers and giving them with opportunities for wealth creation as we progress as a nation. The predominant challenge for government is to make digital technologies both cost-effective and affordable. Achieving this with laying greater emphasis on rural internet access is critical to attaining Digital India's aims and goals.

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