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Indian Agriculture: Shifting from Traditional Technologies towards Digital Technologies for Sustainable Development

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Abstract

Indian agriculture has undergone a significant transformation over the past few decades, moving gradually from traditional methods towards the adoption of modern and digital technologies. Traditional agriculture depended on human labor, animal power, and basic irrigation systems. However, the rapid growth of information and communication technologies (ICT), mobile networks, and government initiatives has accelerated the digital shift. Today, tools such as mobile-based advisory services, digital soil health cards, precision farming, satellite mapping, and e-market platforms like e-NAM are helping farmers make better decisions and improve productivity. The Government of India, through policies like the Digital Agriculture Mission (2021–2025), is promoting digital innovation and data-driven farming practices. This paper explores how digital transformation is enhancing the efficiency, transparency, and sustainability of the agricultural sector in India while highlighting the challenges and opportunities ahead.

Keywords: *Indian agriculture; Technological shift; Digital agriculture; sustainable development; Govt. policies*

1. Introduction

Agriculture has always been the backbone of the Indian economy, providing livelihoods to more than 50% of the population. Traditionally, Indian agriculture relied on manual labour, bullock carts, and conventional irrigation systems. While these methods served well for centuries, the growing population, limited resources, and climate variability demanded a shift towards more efficient, scientific, and technology-driven approaches. The introduction of digital tools, mobile connectivity, and innovative government policies has opened a new era known as 'Digital

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Agriculture.' It aims to enhance productivity, reduce losses, and empower farmers with real-time data and market access.

2. Transition from Traditional to Digital Agriculture

Initially, farmers adopted improved seeds, chemical fertilizers, and mechanization during the Green Revolution. The next major phase began with the spread of information and communication technologies (ICT). Mobile phones, internet connectivity, and rural broadband made it possible for farmers to access weather forecasts, market prices, and crop advisory services. Gradually, new innovations such as satellite-based crop monitoring, drone usage, and AI-based pest management started gaining ground. Farmer Producer Organizations (FPOs) have also adopted digital platforms to link farmers directly with markets and buyers, reducing dependence on middlemen. The Green Revolution, heralded by Dr. M. S. Swaminathan (Swaminathan, 2010), introduced HYV seeds, fertilizers, irrigation expansion, and mechanization, laying the foundation for scientific agriculture. Today, digital innovations such as precision farming, remote sensing, mobile advisory services, and e-markets like e-NAM continue this transformation

3. Role of Mechanization in the Digital Era

Mechanization remains central to modern agriculture. Precision seeders, combine harvesters, and sensor-based irrigation systems improve efficiency (Patel & Singh, 2018). Drone sprayers and automated machinery reduce labour needs and increase accuracy. Custom Hiring Centers (CHCs) enable access to costly equipment for small farmers (Kumar, 2021).

4. Major Digital Technologies in Use

Several digital technologies are transforming Indian agriculture today. Some key examples include:

- eNAM (Electronic National Agriculture Market): An online trading platform that connects agricultural markets across India, enabling farmers to get better prices and wider market access.
- Kisan Call Centre (KCC): Provides advisory services to farmers in their local language through toll-free numbers.
- Digital Agriculture Mission (2021–2025): Promotes the use of advanced technologies such as artificial intelligence, blockchain, drones, and remote sensing in agriculture.
- Soil Health Card Scheme: Offers farmers digital soil test results and fertilizer recommendations.
- Agri-startups and private platforms like Ninjacart and DeHaat: Facilitate supply chain efficiency, credit access, and input delivery through apps.
- Drone and satellite technology: Used for crop mapping, pest detection, and precision spraying, reducing costs and improving yields.

5. Government and Private Sector Role

Both the government and private sector have played a crucial role in promoting digital agriculture. The Government of India has launched several initiatives such as the Agri Stack, Pradhan Mantri Fasal Bima Yojana (PMFBY), and Digital Agriculture Mission (Ministry of Agriculture, 2021). Agri-startups are working in terms of supporting market, credit, and logistics (Sharma, 2020). These initiatives aim to integrate farmer databases, insurance, and subsidy systems digitally. Similarly, private firms and start-ups are building user-friendly apps and online marketplaces to help farmers sell produce directly, access information, and make data-driven decisions. Weather apps and AI-based advisory tools are going to play a very pivotal role. (Rao & Reddy, 2019). Collaborations between government

institutions like ICAR and private technology firms are creating new models of agri-innovation and rural entrepreneurship.

6. Benefits and Challenges

Digital agriculture offers numerous benefits including higher productivity, transparency, efficient input use, and reduced transaction costs. It also improves farmers' access to markets, finance, and information. However, there are still challenges such as limited digital literacy, poor internet connectivity in rural areas, high cost of digital tools, and data privacy concerns. Addressing these barriers through inclusive policies and capacity building is essential for achieving full-scale digital transformation in agriculture.

7. Conclusion

The digital transformation of Indian agriculture is not just a technological change but a developmental revolution. By integrating traditional wisdom with modern tools, India can achieve sustainable agricultural growth and rural prosperity. Strengthening digital infrastructure, training farmers, and ensuring affordable access to digital tools will be key to success. With continued government support and private innovation, India's agriculture sector can become more resilient, productive, and globally competitive.

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