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Page: 01-09

DIGITAL TRANSFORMATION IN INDIAN AGRICULTURE: EMERGING TECHNOLOGIES AND THEIR INFLUENCE ON CONTEMPORARY FARM MANAGEMENT

***¹Dr. S. Selvarani, ²Dr. A R. Chitra Juliet Mangeshkar**

¹Adjunct Faculty, Department of Corporate Secretaryship, Alagappa University,
Karaikudi.

²Head & Assistant Professor, Department of Commerce, Seethalakshmi Achi College For
Women, Pallathur.

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***Corresponding Author: Dr. S. Selvarani**

Adjunct Faculty, Department of Corporate Secretaryship, Alagappa University,
Karaikudi.

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ABSTRACT

Indian farming is undergoing a major shift from conventional methods to technology-driven practices. The present investigation is based exclusively on secondary sources published between 2020 and 2026. The Government of India introduced Digital Agriculture Mission during 2024 with a financial allocation of Rs. 2817 crore to develop Digital Public Infrastructure. According to Press Information Bureau February 2026, more than 7.63 crore digital farmer identities have been created, including 1.93 crore for women cultivators, and 23.5 crore land parcels have been mapped through mobile-based crop survey. Modern tools such as Artificial Intelligence, Internet of Things, drone technology, precision farming, remote sensing and Geographic Information System are reshaping farm operations. The AI-enabled Kisan e-Mitra platform has resolved 93 lakh farmer questions with a daily capacity of 8000 queries in eleven languages. Similarly, AI-supported monsoon prediction experiment during Kharif 2025 benefited 3.88 crore growers across thirteen states. This paper discusses two aspects - development of new-age technologies in farm management and managerial benefits and obstacles. Findings indicate 20 to 30 percent improvement in productivity and scope for premium branding through Geographical Indication, especially in Tamil Nadu. The paper concludes that success depends on cultivators' capability to choose suitable innovation, interpret information, distribute resources, handle risk and apply data for decision making.

KEYWORDS: *Digital Farming, AgriStack, Farm Management, AgriTech, Artificial Intelligence, Precision Agriculture, Kisan e-Mitra.*

INTRODUCTION

Agriculture continues to be the backbone of India, engaging more than half of the population. Yet, conventional management suffers from low yield, climate vulnerability, small land holdings and limited market linkage. To address these issues, the Ministry of Agriculture launched Digital Agriculture Mission. The mission creates core platforms such as AgriStack for farmer registry, Krishi Decision Support System for analytics, Soil Profile Mapping and Pest Surveillance. Research Problem of this study is: How are emerging agricultural technologies transforming farm management in India, and what managerial opportunities and challenges arise from this transformation?

Based on this, objectives are framed as:

Objectives:

1. To examine the development of emerging agricultural technologies and their role in modern farm management in India.
2. To analyse the managerial implications and challenges associated with digital transformation in Indian agriculture.

Scope covers AI and Machine Learning, IoT and sensors, agri-drones, precision farming and remote sensing with GIS. The study period is 2020 to 2026.

Table 1: Growth of Digital Agriculture Infrastructure in India. (2024-2026)

Parameter	Status as of Feb 2026	Source
Total Farmer IDs Generated	7.63 crore	PIB, 2026
Women Farmer ID	1.93 crore	PIB, 2026
Crop Plots Digitally Surveyed	23.5 crore plots	PIB, 2026
Districts Covered under Digital Crop Survey	492 districts (Rabi 2024-25)	MoA&FW, 2026
Queries Answered by Kisan e-Mitra AI	93 lakh queries, 8000/day	PIB, 2026
Farmers Benefited by AI Monsoon Forecast	3.88 crore (13 States)	AgriBazaar, 2026
Crops under Pest Surveillance System	66 crops, 432 pest types	PIB, 2026

Source: Compiled by Author from PIB (2026), MoA&FW (2026) and AgriBazaar (2026)

Table 1 reveals rapid expansion of digital agriculture infrastructure between 2024 and 2026. A total of 7.63 crore Farmer IDs have been generated including 1.93 crore women farmers, indicating inclusive digital coverage. The digital crop survey covering 23.5 crore

plots across 492 districts and Kisan e-Mitra resolving 93 lakh queries demonstrate large-scale operationalization of Digital Agriculture Mission. AI-based monsoon forecasting benefiting 3.88 crore farmers across 13 States highlights the shift from intuition-based to data-driven decision making in farm management.

Literature Survey

Literature reveals rapid digitalization.

PIB (2026) documented progress of AgriStack and noted that mobile crop survey covered 492 districts. National Pest Surveillance now extends to 66 crops and 432 pest varieties supporting 10,000 field staff.

AgriBazaar (2026) observed that satellite intelligence has improved farm visibility and AI monsoon forecast influenced sowing choices of 31 to 52 percent sampled growers.

Academic studies by Bhatt (2023) reported productivity enhancement of 20-30 percent through IoT advisories.

Industry reports from Ken Research (2025) valued Indian AgriTech at USD 4 billion with 20 percent annual growth. AgFunder (2025) found investment in Indian agri-food tech rose 215 percent against global decline.

Recent news in Hindu BusinessLine (Oct 2026) highlighted Tamil Nadu's initiative to obtain GI status for nine local products such as Panruti Jackfruit, Chettikulam Onion, Puliyanakudi Lime and Thooyamalli rice, indicating branding opportunity through Intellectual Property.

Gap identified:

Despite extensive literature on agricultural technologies in isolation, there is a significant dearth of empirical studies that integrate technological advancement with managerial decision-making frameworks, particularly from a commerce and corporate governance perspective. Existing works largely focus on technical efficiency, while managerial dimensions such as resource allocation, risk management, IPR-based branding through GI, and data-driven decision-making capability of farmers remain underexplored, especially in the context of Alagappa University's commerce curriculum and Tamil Nadu's agrarian economy.

Contribution of the Author

This article contributes by compiling latest official data of 2026 and linking it with management concepts. A comparative framework of traditional versus digital farming is presented. Further, the author connects digital agriculture with IPR dimension, particularly

Geographical Indication, which is important for Corporate Secretaryship discipline. The interpretation of how data-driven decision making improves resource allocation is the author's original contribution.

RESULT AND DISCUSSION

Objective 1 - To examine the development of emerging agricultural technologies and their role in modern farm management in India.

AI and Machine Learning: Platforms like YES-TECH, CROPIC and PMFBY Chatbot use AI to speed up insurance claims. Budget 2026-27 proposal of Bharat-VISTAAR aims to integrate all agri portals into one multilingual AI.

IoT and Sensors: Firms like Fasal and CropIn deploy soil and weather sensors providing real-time alerts. This reduces water usage and fertilizer waste.

Drones: Namo Drone Didi scheme empowers self-help groups. Spraying which earlier required one full day now completes within thirty minutes per acre, reducing labour cost and health hazards.

Precision Farming and GIS: Satellite images identify crop health, acreage and stress without physical visit. Soil health map enables site-specific nutrient application, cutting input cost by around 15 percent.

Digital Markets: e-NAM connects over 1000 mandis. Farmer ID linked with land records ensures hassle-free access to PM-KISAN and Kisan Credit Card.

Table 2: Transformation in Farm Management.

Parameter	Traditional Management	Digital Management
Decision	Based on experience	Based on AI, Satellite data
Advisory	VAO visit	Kisan e-Mitra - 24x7 AI
Pest Control	After attack	AI early warning
Marketing	Local middleman	e-NAM pan-India
Risk Management	Crop failure	AI Monsoon forecast
Land Records	Manual Patta	Farmer ID + AgriStack
Crop Monitoring	Eye observation	Satellite + IoT sensors

Source: Author's own compilation based on literature review and secondary data

Table 2 illustrates the paradigm shift in farm management due to digital transformation. Traditional farm management which relied on farmer's experience, physical visits of extension officers and uniform input application is replaced by AI and satellite-based advisory, 24x7 access through Kisan e-Mitra in local languages and site-specific precision application. Predictive risk management through AI monsoon forecast covering 3.88 crore

farmers and direct market linkage through e-NAM has improved evidence-based planning, resource allocation efficiency and data-driven decision making, which are the core managerial functions identified in the present study.

In my observation as a Professor of Alagappa University, the development of these technologies is not merely technical upgradation but a complete paradigm shift in farm management. The farmer's ability to select appropriate technology according to landholding size, crop pattern and financial capacity is the determining factor for success. For Tamil Nadu's dryland regions like Karaikudi, low-cost IoT sensors combined with Tamil-language AI advisory will be more suitable than high-cost drone technology.

Table 3: Emerging Technologies and Their Role in Farm Management.

Technology	Key Application in India	Role in Farm Management	Example / Scheme
Artificial Intelligence	Advisory, Insurance claim, Monsoon forecast	Decision-making & Risk management	Kisan e-Mitra, Bharat-VISTAAR, YES-TECH
IoT & Smart Sensors	Soil moisture, Weather monitoring	Resource allocation & Water saving	Fasal, CropIn startups
Agricultural Drones	Pesticide spraying, Crop mapping	Operational efficiency & Labour saving	Namo Drone Didi
Remote Sensing & GIS	Soil fertility map, Crop health monitoring	Planning & Precision farming	Krishi DSS, Digital Crop Survey
e-NAM & AgriStack	Price discovery, Digital credit	Marketing & Financial management	e-NAM, e-KCC

Source: Compiled by Author based on PIB (2026), NITI Aayog (2024) and AgriBazaar (2026)

Table 3 presents the mapping of five major emerging technologies with their managerial roles. Artificial Intelligence and Machine Learning through platforms like Kisan e-Mitra and Bharat-VISTAAR transform decision-making and risk management by providing personalized advisory in 11 languages. IoT and smart sensors enable precise resource allocation and reduce input wastage by 30 percent. Agri-drones under Nam0 Drone Didi scheme enhance operational efficiency by reducing spraying time from one day to 30 minutes per acre and addressing labour shortage. Remote Sensing and GIS through Krishi DSS and Digital Crop Survey support planning and evaluation with soil fertility maps, reducing fertilizer cost by 15 percent. e-NAM and AgriStack ensure transparent marketing

and financial management through pan-India price discovery and digital credit access via 7.63 crore Farmer IDs. Collectively, these technologies improve farmer's ability to select appropriate technology, process information, allocate resources and make data-driven decisions, which are essential managerial competencies in modern farm management.

**FLOWCHART: DIGITAL AGRICULTURE MISSION 2024
— FRAMEWORK**

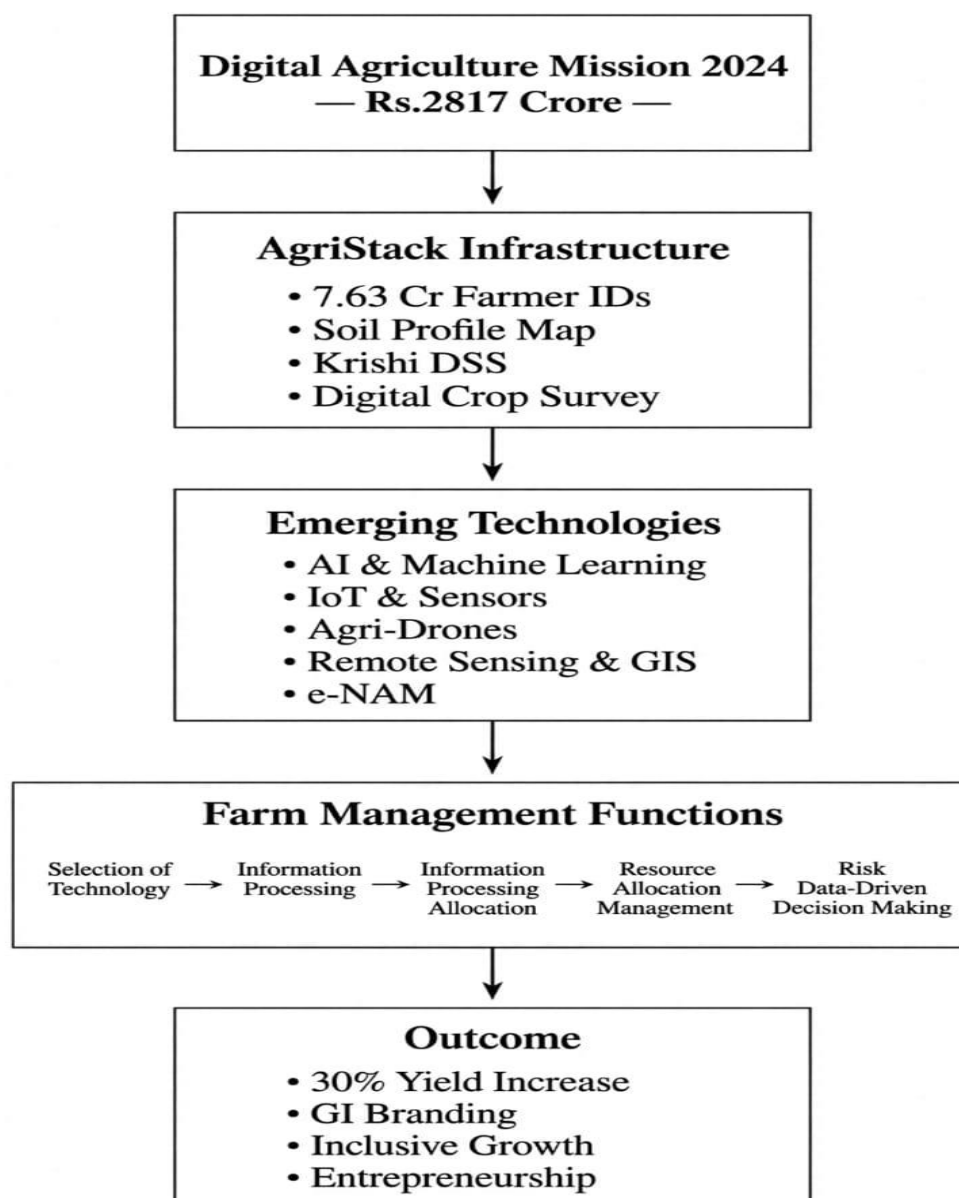


Figure 1. Flowchart illustrating the Digital Agriculture Mission 2024 framework and expected outcomes.

Figure 1: Conceptual Framework of Digital Transformation in Farm Management - From Digital Agriculture Mission to Sustainable Outcomes.

Source: Author's compilation based on PIB (2026)

This flowchart illustrates that Rs.2817 crore Digital Agriculture Mission builds AgriStack (7.63 Cr IDs), which enables 5 emerging technologies, which improves 5 farm management functions, resulting in 30% yield increase and GI branding.

Objective 2: To analyse the managerial implications and challenges associated with digital transformation in Indian agriculture

A. Managerial Opportunities

The secondary data analysis reveals five major managerial opportunities emerging from digital transformation:

1. **Evidence-Based Planning and Risk Management:** Traditional farming relied on intuition and past experience. Digital tools like AI monsoon forecasting, which reached 3.88 crore farmers in Kharif 2025, enable data-driven sowing decisions. According to AgriBazaar (2026), 31 to 52 percent of farmers changed their sowing schedule based on AI advisory, reducing crop failure risk significantly.
2. **Productivity Gain and Input Saving:** Precision agriculture and IoT-based soil sensors help in site-specific application of water and fertilizer. Studies indicate 20 to 30 percent increase in yield and 15 percent reduction in input cost. Drones under Nam0 Drone Didi scheme reduce spraying time from one full day to 30 minutes per acre.
3. **Premium Market through GI Protection:** Digital documentation and traceability support Geographical Indication registration. Tamil Nadu's recent initiatives for nine products including Panruti Jackfruit, Chettikulam Small Onion, Puliyan kudi Acid Lime, and Thooyamalli Rice demonstrate how IPR-based branding can fetch premium prices. Established GI products like Erode Turmeric and Srivilliputtur Palkova already earn 20 to 40 percent higher market value.
4. **Inclusive Growth and Financial Inclusion:** As per PIB (2026), 1.93 crore women farmers have received digital Farmer IDs. AgriStack linkage with land records enables hassle-free access to PM-KISAN, e-KCC and digital credit, promoting gender-inclusive financial access.
5. **Agri-Entrepreneurship and Startup Ecosystem:** India now hosts more than 2000 AgriTech startups as reported by NITI Aayog (2024). Bharat-VISTAAR announced in Union Budget 2026-27 integrates AgriStack with ICAR knowledge, creating new opportunities for agripreneurs in advisory, drone services and market linkage.

B. Managerial Challenges

Despite opportunities, several challenges persist:

1. **Low Digital Literacy:** According to Census data, 86 percent of Indian farmers are small and marginal. Their ability to understand, process and apply digital information remains limited, affecting technology adoption.
2. **High Initial Investment:** IoT devices cost between Rs. 20,000 to Rs. 50,000 per unit, drones cost over Rs. 5 lakhs. This is unaffordable for smallholders without subsidy.
3. **Data Privacy Concerns:** Farmer ID linked with Aadhaar and land records raises concerns about data misuse and privacy breach. Clear data protection policy is still evolving.
4. **Infrastructure Deficit:** Rural internet penetration is below 60 percent and power supply is irregular, limiting real-time use of digital platforms like Kisan e-Mitra.
5. **Resistance to Change and Technology Selection:** Many farmers hesitate to shift from traditional methods due to fear of failure. Most importantly, farmer's ability to select appropriate technology suitable for their crop, land size and financial capacity is still very low.

In my observation as a Professor of Alagappa University, Karaikudi, the adoption rate will increase significantly if training programs are conducted in Tamil and other local languages. For districts like Karaikudi, Sivagangai and other dryland regions of Tamil Nadu, localized demonstration in mother tongue, coupled with practical exposure through Agricultural Extension Centres, will bridge the digital divide and improve farmer's capability to select appropriate technology, allocate resources efficiently and use resulting data for decision-making.

CONCLUSION

Analysis of secondary sources confirms that Indian agriculture is shifting from intuition-based to information-based management. With 7.63 crore digital identities and 23.5 crore plots mapped, India has created strong digital public infrastructure. Modern farm management now depends on farmer's ability to choose right innovation, manage risk and utilize data for informed choices. Integration of IPR like GI tags with digital branding will help Tamil Nadu farmers obtain premium prices and achieve goal of Viksit Bharat 2047.

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