

# (A No. 142) Role of Technology in Modern Farming: AI, Drones & Digital Agriculture

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## Abstract

Agriculture is undergoing a technological transformation across the world, and India is emerging as a major hub for digital farming. With challenges such as declining soil fertility, labor shortages, climate variability, and low profitability, modern farming techniques involving Artificial Intelligence (AI), drones, satellites, Internet of Things (IoT), and data analytics are providing new opportunities to enhance productivity and sustainability. Government initiatives like Digital Agriculture Mission 2021, PM-KISAN, agricultural startups, and Kisan Drone Scheme are bridging the gap between traditional and modern agriculture. This article focuses on the role of technology in Indian agriculture and its potential to improve input use efficiency, climate resilience, market access, and farmer income.

## 1. Introduction

Indian agriculture has historically relied on traditional practices, but increasing environmental stress, shrinking landholdings, and market volatility demand a shift toward smart and data-driven agriculture. The introduction of drones, AI-based advisory tools, soil sensors, precision irrigation, and satellite imagery-based crop monitoring has modernized farming practices. This transformation is known as “**Digital Agriculture**”, which aims to make farming more efficient, profitable, and sustainable.

## 2. Major Technologies Used in Modern Farming

### 2.1 Artificial Intelligence

AI helps predict weather, diagnose crop diseases, analyze soil conditions, and provide real-time advisory to farmers. Mobile-based apps using AI models allow for quick pest diagnosis by simply taking a picture of the affected crop.

### 2.2 Drones in Agriculture

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Drones are used for:

- Spraying fertilizers and pesticides
- Crop health monitoring
- Yield estimation
- Mapping of affected areas during floods or droughts

The **Kisan Drone Scheme** provides subsidies to custom hiring centers and FPOs for drone usage.

### 2.3 Internet of Things (IoT) and Sensors

Soil sensors measure moisture, pH, and nutrients. They help in precision irrigation and fertilizer application. IoT-based automated irrigation reduces water use significantly.

### 2.4 GPS & GIS Mapping

These tools help farmers plan sowing, irrigation, and harvesting based on location-specific data. GIS helps identify water-stressed or nutrient-deficient zones.

## 2.5 Satellite-Based Crop Monitoring

High-resolution satellite imagery allows real-time tracking of crop growth, drought conditions, pest attack zones, and flood damage.

## 3. Government Initiatives & Policies

Initiative	Purpose
Digital Agriculture Mission 2021	Promote data-driven farming
PM-KISAN	Financial support using digital platforms
e-NAM	Digital market for farmers
Kisan Drone Scheme	Drone subsidy
Agri-Stack	Unified farmer database
Soil Health Card	Digital nutrient management

These initiatives aim to make agriculture knowledge-based instead of input-based.

## 4. Role of Agri-Startups & FPOs

Over 3000 agri-startups in India are solving problems related to input supply, market linkage, climate advisory, precision agriculture, and soil health. Many startups provide mobile-based solutions for weather forecasting, crop advisory, and pest detection. Farmer Producer Organizations (FPOs) help small farmers access technology and digital platforms collectively.

## 5. Precision Farming: A Game Changer

Precision farming improves input use efficiency and reduces cultivation costs.

**Key components include:**

- Variable rate fertilizer application
- Remote sensing-based crop health monitoring

- Weather-based irrigation scheduling
- Robotic weed management

Studies show that precision farming can **increase profitability by 15–25%** and reduce water usage by nearly **40%**.

## 6. Big Data & Farmer Advisory

Digital platforms collect data on soil, crops, weather, markets, and pests. AI-based advisory systems analyze this data and send personalized messages or voice calls to farmers in local languages. This makes advisory services more inclusive and scalable.

## 7. Challenges in Technology Adoption

Challenge	Impact
High initial cost	Limits adoption among small farmers
Lack of training	Reduces effectiveness
Poor rural internet connectivity	Affects digital tools
Data privacy concerns	Need for regulation

Without farmer education and infrastructure improvement, technology alone cannot transform agriculture.

## 8. Future Policy Directions

1. Low-interest loans for agri-tech adoption
2. Drone rental centers in every block
3. District-level AI advisory centers
4. Strengthening digital extension system
5. Govt.–startup–farmer partnerships
6. Rural digital infrastructure
7. Crop insurance linked with satellite data
8. Carbon credit market through technology
9. GIS-based village planning
10. Legal framework for data protection

## 9. Conclusion

Technology is reshaping Indian agriculture and providing solutions to age-old problems of productivity, climate vulnerability, and profitability. AI, drones, satellite data, and IoT-based precision farming have the potential to reduce input cost, improve output quality, and secure farmer income. However, technology must be made inclusive through training, financing, infrastructure development, and farmer awareness. The future of Indian agriculture depends on how effectively policy and technology are integrated with farmers' real needs. Sustainable development will come when technology becomes affordable, accessible, and farmer-friendly.

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