

# *The Future of Farming: Artificial Intelligence in Indian Agriculture*

**Dr. Muhammed Irshad M\***

*Research Associate, Agro Economic Research Centre, (Ministry of Agriculture and Farmers Welfare)  
(Government of India), Visva Bharati*

**Corresponding Author**

Dr. Muhammed Irshad M

Email: 07737312101@visva-bharati.ac.in



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## **ABSTRACT**

Agriculture in India plays a crucial role in the country's economy, providing nearly 70 % of rural employment and contributing a significant share to the national GDP. However, the agricultural sector faces several challenges such as climate change, price volatility, pest and disease outbreaks, and the lack of effective decision support systems. In this context, Artificial Intelligence (AI) tools have become increasingly important, as they can help address many of these challenges through various AI models that can predict and manage potential risks in advance. In this way, AI is becoming a key player in Indian agriculture, and its importance is expected to grow even further in the future.

## **INTRODUCTION**

Indian agriculture is entering a new technological era. Traditionally, farming in India has relied heavily on the experience and knowledge of farmers, along with favourable weather conditions and market opportunities (Dev, S. M., 2012). However, in recent years, the agricultural sector has been facing increasing challenges such as climate variability, unpredictable rainfall patterns,

market price fluctuations, and the rising demand for food due to population growth (Kotir, J. H., 2011). These factors have made agricultural decision-making more complex and uncertain for farmers.

In response to these challenges, farmers and agricultural institutions are gradually turning to advanced technologies to improve

productivity and reduce risks. Among these emerging technologies, Artificial Intelligence (AI) is gaining significant attention. AI has the ability to analyse large volumes of data related to weather, soil conditions, crop health, and market trends, enabling more accurate predictions and better farm management practices (Titirmare *et al.*, 2024). As a result, AI is emerging as a powerful tool that can transform the way crops are grown, monitored, and marketed, paving the way for a more efficient and sustainable agricultural system in India.

### **Why Indian Agriculture Needs AI**

Indian farmers operate in a highly uncertain environment. Several factors make agricultural production and income unpredictable.

#### **1. Climate Variability**

Agriculture is highly dependent on weather conditions. Changes in rainfall patterns, increasing temperatures, and extreme events such as droughts and floods can significantly affect crop growth and productivity. Climate variability makes it difficult for farmers to plan their planting and harvesting activities effectively.

#### **2. Price Fluctuations**

Agricultural prices often change rapidly due to variations in supply and demand. A bumper harvest may lead to a sudden fall in prices, while shortages can cause sharp increases (Irshad *et al.*, 2024). Such fluctuations create uncertainty for farmers, making it difficult for them to decide when to sell their produce.

#### **3. Pest and Disease Outbreaks**

Crop pests and diseases can cause significant damage if not detected and controlled early (Irshad *et al.*, 2023). Farmers often struggle to identify these problems at an early stage,

which can lead to large yield losses and increased production costs.

#### **4. Lack of Timely Information**

Access to reliable and timely information on weather forecasts, market prices, and crop management practices is limited in many rural areas. Without this information, farmers may not be able to make informed decisions regarding crop selection, irrigation, fertilization, and marketing.

#### **5. Market Uncertainty**

Farmers frequently face uncertainty regarding where and how to sell their produce. Issues such as limited market access, transportation challenges, and the presence of intermediaries often reduce the share of profits that farmers receive.

Artificial Intelligence techniques can address many of the challenges faced by farmers. By analysing large amounts of data from weather stations, satellites, markets, and farm sensors, AI can provide useful insights that help farmers make better decisions.

#### **Managing Climate Variability**

AI can analyse historical climate data and real-time weather information to produce more accurate and localized weather forecasts. These forecasts help farmers decide the best time for sowing, irrigation, and harvesting, thereby reducing losses caused by unexpected weather changes.

#### **Predicting Price Fluctuations**

AI models can study past market prices, supply patterns, and demand trends to forecast future agricultural prices. With these predictions, farmers can plan when to sell their produce and avoid selling during periods of low prices. This helps them improve their income and reduce market risks.

### **Early Detection of Pest and Disease Outbreaks**

AI-powered image recognition systems can detect crop diseases and pest attacks through photos taken by smartphones or drones. Early identification allows farmers to take quick preventive measures, reducing damage to crops and minimizing the use of pesticides.

### **Providing Timely Agricultural Advice**

AI-based digital platforms can deliver personalized recommendations to farmers based on soil conditions, weather forecasts, and crop requirements. These advisory systems help farmers make informed decisions regarding fertilizer use, irrigation scheduling, and crop management.

### **Reducing Market Uncertainty**

AI can analyse data from different agricultural markets to identify price trends and demand patterns. This information helps farmers choose the right markets and plan better marketing strategies.

### **Challenges in Adopting AI**

Despite its significant potential, the adoption of Artificial Intelligence in agriculture faces several practical challenges. In many rural areas, digital infrastructure such as reliable internet connectivity and access to smart devices remains limited, making it difficult for farmers to use AI-based tools and platforms effectively. In addition, awareness about advanced technologies is still low among many farmers, which restricts the widespread use of digital advisory systems. Another important challenge is the limited availability of high-quality agricultural data, including detailed information on soil conditions, crop health, and local market trends, which is essential for developing accurate AI models. Furthermore, the high cost of advanced technologies and equipment can discourage

small and marginal farmers from adopting AI-driven solutions. Addressing these challenges through better infrastructure, training programs, and supportive government initiatives will be crucial for realizing the full potential of AI in agriculture.

### **Way Forward**

The future of agriculture is likely to be increasingly shaped by Artificial Intelligence and other digital technologies. In the coming years, AI-based decision support systems will help farmers make better choices regarding crop selection, irrigation scheduling, fertilizer application, and pest management. These systems will combine and analyse multiple sources of information, including weather forecasts, soil conditions, and market price data, to provide accurate and timely recommendations. The integration of such diverse datasets will enable farmers to plan their activities more efficiently and reduce production risks. In addition, the adoption of smart farming technologies such as sensors, drones, automated irrigation systems, and satellite monitoring will further enhance farm management practices. With continued technological development and supportive policies, AI has the potential to significantly improve agricultural productivity, environmental sustainability, and farmer income, paving the way for a more resilient and data-driven agricultural sector.

### **CONCLUSIONS**

Artificial Intelligence is poised to play a transformative role in the future of Indian agriculture. While technology cannot replace the knowledge and experience of farmers, it can significantly empower them with timely information, accurate predictions, and smarter decision-making tools. By integrating data from weather patterns, soil conditions, and agricultural markets, AI can help farmers manage risks more effectively and improve

farm productivity. However, to fully realize these benefits, it is essential to strengthen digital infrastructure, promote farmer awareness, and support innovation through appropriate policies and investments. With the right ecosystem in place, AI can contribute to building a more sustainable, resilient, and profitable agricultural system in India, ultimately improving the livelihoods of millions of farmers.

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