

How AI Is Transforming Modern Agriculture

**Theertha M.S¹,
Samiksha Ahire²,
Majjari Swapna³,
Vishal Gupta⁴,
R. G Khude⁵**

¹Ph.D Scholar, Department of Soil and Water Conservation Engineering, Indian Agricultural Research Institute, New Delhi.

²Ph.D Scholar, Department of Soil Science, Mahatma Phule Krishi Vidyapeeth, Rahuri.

³Assistant Professor, Department of Entomology, SBVR Agricultural College, Badvel.

⁴Ph.D Scholar, Department of Soil and Water Conservation Engineering, Indian Agricultural Research Institute, New Delhi.

⁵Ph.D Scholar, Department of Soil and Water Conservation Engineering, Indian Agricultural Research Institute, New Delhi.

INTRODUCTION

Agriculture is undergoing a major technological transformation with the integration of Artificial Intelligence (AI) and digital technologies. With the global population expected to reach nearly 9.7 billion by 2050, food production must increase significantly to meet rising demand. At the same time, farmers face numerous challenges such as climate change, declining soil fertility, water scarcity, pest outbreaks, and labor shortages. Artificial Intelligence has emerged as a powerful tool to address these challenges and improve the efficiency, sustainability, and profitability of modern agriculture.

Artificial Intelligence refers to the ability of machines and computer systems to perform tasks that normally require human intelligence, such as learning, analyzing data, recognizing patterns, and making decisions. In agriculture, AI technologies analyze large volumes of data collected from satellites, sensors, drones, weather stations, and farm machinery to provide accurate and timely recommendations to farmers.



*Corresponding Author
Theertha M.S*

Available online at
www.sunshineagriculture.vitalbiotech.org

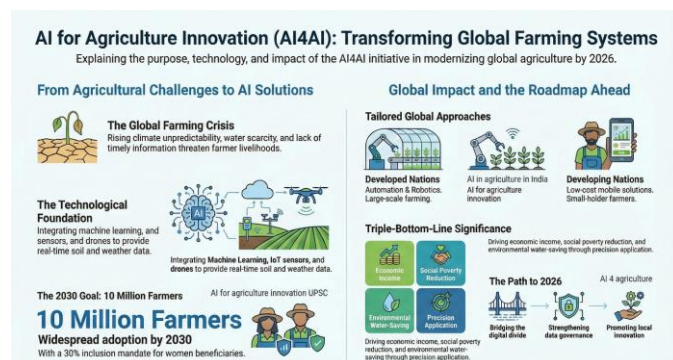
Article History

Received: 5. 4.2026

Revised: 10. 4.2026

Accepted: 15. 4.2026

This article is published under the terms of the [Creative Commons Attribution License 4.0](https://creativecommons.org/licenses/by/4.0/).

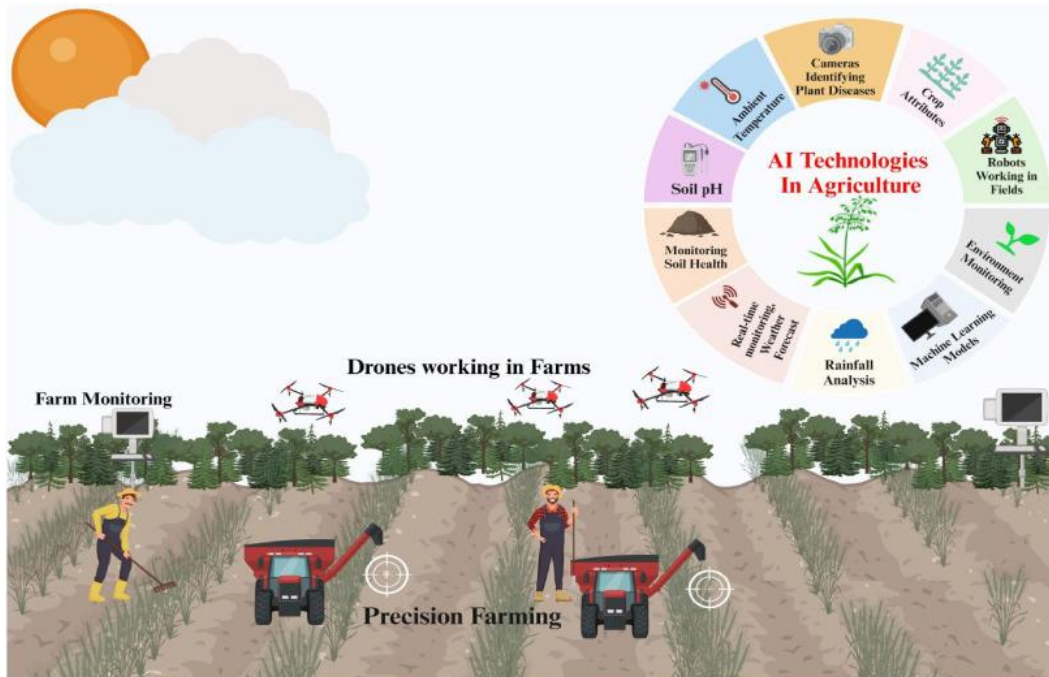


AI-Based Precision Agriculture

One of the most significant contributions of AI in agriculture is the development of precision agriculture. Precision agriculture involves the use of advanced technologies to manage crops and soil conditions with high accuracy. AI systems analyze data related to soil moisture, nutrient status, weather conditions, and crop growth to determine the exact amount of water, fertilizer, and pesticides required by crops.

This approach helps farmers optimize resource use, reduce input costs, and improve crop productivity. For example, AI-powered irrigation systems can automatically adjust

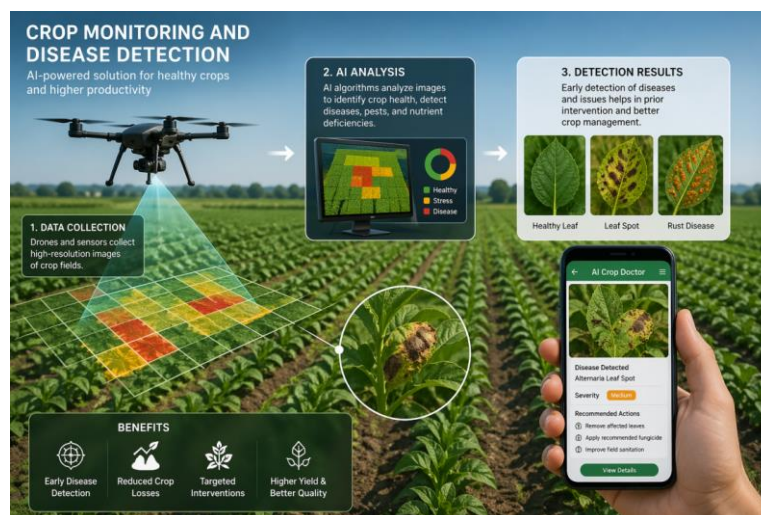
water supply based on soil moisture levels and weather forecasts, thereby conserving water and preventing over-irrigation.



Crop Monitoring and Disease Detection

AI technologies combined with computer vision and machine learning are increasingly used for monitoring crop health. Drones and satellite imagery collect high-resolution

images of crop fields, which are then analyzed by AI algorithms to detect early signs of plant diseases, pest infestations, or nutrient deficiencies.



Early detection allows farmers to take timely corrective measures, preventing large-scale crop losses. AI-based mobile applications can

even identify plant diseases from photographs taken by farmers using smartphones and

provide immediate recommendations for treatment.

Smart Pest and Weed Management

Traditional pest and weed control methods often involve excessive use of chemical pesticides and herbicides, which can harm the environment and human health. AI-based systems enable targeted pest and weed management by identifying specific areas of infestation within a field. Autonomous robots equipped with AI technologies can detect and remove weeds mechanically or apply herbicides only where necessary. This reduces chemical usage, lowers production costs, and promotes environmentally sustainable farming practices.

AI in Soil and Nutrient Management

Soil health is a critical factor influencing agricultural productivity. AI tools analyze soil data collected through sensors and laboratory testing to evaluate soil fertility, pH levels, and nutrient availability. Based on this information, AI systems generate customized fertilizer recommendations for different crops and locations. Such data-driven nutrient management practices improve fertilizer efficiency, enhance soil health, and minimize

environmental pollution caused by excessive fertilizer application.

Weather Prediction and Climate Risk Management

Climate variability and extreme weather events pose significant risks to agricultural production. AI models analyze historical climate data and real-time weather information to generate accurate forecasts and predict potential climate risks. These predictive models help farmers make informed decisions regarding crop selection, planting time, irrigation scheduling, and harvesting. Early warnings about droughts, floods, or storms enable farmers to take preventive measures and reduce crop losses.

Autonomous Machinery and Robotics

AI has also enabled the development of autonomous agricultural machinery such as self-driving tractors, robotic harvesters, and automated planting machines. These machines can perform tasks such as planting, spraying, harvesting, and field monitoring with high precision and minimal human intervention. Autonomous machinery helps address the growing shortage of agricultural labor while improving operational efficiency and reducing production costs.



Supply Chain Optimization and Market Intelligence

AI technologies are not limited to crop production; they also play an important role in improving the agricultural supply chain. AI

systems analyze market trends, transportation logistics, storage conditions, and consumer demand to optimize the distribution of agricultural products. Farmers can receive real-time information about market prices,

demand forecasts, and optimal selling times, which helps them maximize profits and reduce post-harvest losses.

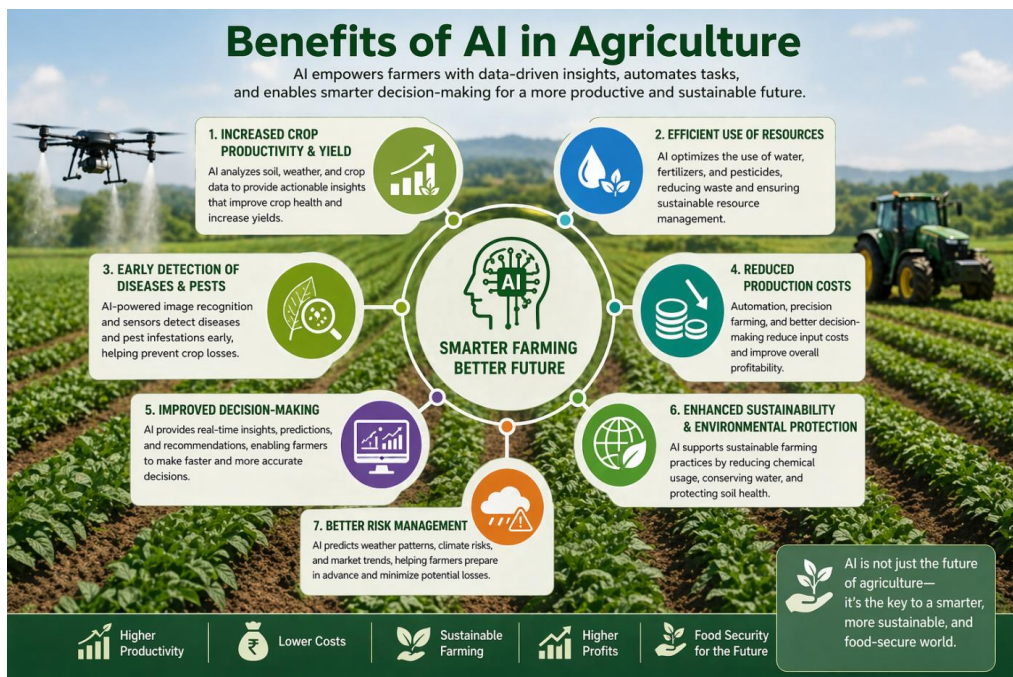


Benefits of AI in Agriculture

The adoption of Artificial Intelligence in agriculture offers several important benefits:

- Increased crop productivity and yield
- Efficient use of water, fertilizers, and pesticides

- Early detection of diseases and pests
- Reduced production costs
- Improved decision-making for farmers
- Enhanced sustainability and environmental protection



Challenges and Limitations

Despite its potential, the adoption of AI in agriculture faces several challenges. Many small and marginal farmers have limited access to advanced technologies due to high initial costs and inadequate infrastructure. Lack of digital literacy and poor internet connectivity in rural areas also restrict the widespread use of AI tools. Additionally, there is a need for large datasets and continuous research to improve the accuracy and reliability of AI models.

CONCLUSION

Artificial Intelligence is rapidly transforming modern agriculture by enabling data-driven farming practices and improving efficiency across the entire agricultural value chain. From precision farming and disease detection to autonomous machinery and market

intelligence, AI technologies help farmers make informed decisions and optimize the use of resources such as water, fertilizers, and pesticides. By analyzing large amounts of data collected from sensors, drones, satellites, and weather stations, AI can monitor crop health, predict pest outbreaks, and recommend timely management practices that improve productivity and reduce losses. AI also plays an important role in post-harvest management and agricultural supply chains. Advanced data analytics can forecast market demand, track price trends, and improve storage and transportation systems, helping farmers sell their produce at better prices while minimizing post-harvest losses. These technologies ultimately contribute to higher efficiency, better profitability, and improved food distribution systems.