



## **A Comprehensive Study on the Integration of AI Technology in Farming Methods**

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### **ABSTRACT :**

India is an agrarian country. Numerous obstacles face agriculture such as insect and disease infestation, poor soil management, and insufficient irrigation and drainage, among others. These lead to serious agricultural losses and environmental hazards due to excessive pesticide use. Numerous studies have been carried out to address these problems. A thorough literature review of artificial intelligence techniques' applications in agriculture are presented in this research. One of the most practical ways to combat food insecurity and adjust to the demands of an expanding population is by using artificial intelligence in agriculture. Artificial intelligence, with its rigorous learning capabilities, has emerged as a crucial approach for addressing several issues relating to agriculture. This paper discusses how artificial intelligence techniques are employed to encounter the challenges in agriculture. Three major AI techniques are discussed throughout the paper. AI for weeding, AI driverless tractors, and AI remote sensing crop health monitoring. It has the potential to revolutionize technology and boost agriculture, in order to feed the world's growing population.

**Key words:** Artificial Intelligence, technology, agriculture.

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### **Introduction :**

Artificial Intelligence becomes involved in more and more facets of our life and facilitates the creation of priceless services. Artificial Intelligence is one of the fields of science and technology. It's focused on building machines that are as clever as humans in terms of learning and reasoning. Artificial Intelligence is widely used in different businesses. In addition to saving time and money, automating operations that don't need human intervention which can lower the possibility of human error.

Agriculture is vital to India's economy. The nation contains the second-largest area of fertile land in the world, and half of the population make their living from agriculture. India is a major producer of rice, wheat, cotton, sugar and dairy products, making its agricultural system vital to the rest of the globe.

Farmers in India fight against financial pressures, pestilence and climate change. AI promises a broad revolution with cutting-edge methods that will reinterpret agriculture's conventional patterns and boundaries. At a time when the world has to produce more food with less resources, artificial intelligence will propel an agricultural revolution.

To assist farmers, India's Ministry of Agriculture and Farmers Welfare has used Artificial Intelligence approaches to handle numerous agricultural difficulties. Some of the initiatives are 'Kisane- Mitra', an AI- powered Chabot that helps farmers with their queries. National Pest Surveillance System to combat the loss of products due to climate change. This technology uses artificial intelligence and machine learning to detect crop concerns, allowing for timely action and healthier harvests. AI-powered analytics use field images for crop health evaluation and monitor satellite, weather, and soil moisture information for rice and wheat crops. It is the concept that might potentially alter today's agriculture to a 'yield more with less inputs'.

In 2020–2021 and 2021–2022, the Indian government sent INR 1756.3 crores and INR 2422.7 crores to the states to help them implement innovative technologies in agriculture, such as drones, AI block chain, remote sensing, and geographic information system. The Indian Agricultural Research Institute was also given INR 7302.50 crores in 2020–2021 and INR 7908.18 crores in 2021–2022 by the government to conduct research and development in agriculture for the development of new technologies, their demonstration at farmers' fields, and the development of farmers' capacity to adopt new technologies.

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### **Review of Literature :**

(Liu, 2020), explores how artificial intelligence is being used in the farming and agricultural sectors. The agricultural production system is being forced into a new paradigm by fast population expansion, declining acreage, depleting natural resources, unpredictable climate change, and changing consumer demands. The output of the new agricultural system must increase, as must its operational efficiency, climate change resilience, and sustainability for coming generations. The issues of this new paradigm may be addressed using artificial intelligence.

(Eli-Chukwu, 2019), the agricultural industry has recently demonstrated the use of artificial intelligence. To optimize its yield, the industry must overcome several obstacles, including

Low output, disease and pest infestation, inadequate soil treatment, the need for big data, and a knowledge gap between farmers and technology. The key ideas of artificial intelligence in agriculture are its cost-effectiveness, precision high performance, and flexibility. An overview of artificial intelligence's uses in crop, weed, disease, and soil management is provided in this study. Particular attention is paid to the application's advantages and disadvantages as well as how to use expert systems to increase productivity.

(Zha, 2020), shares one of the most practical ways to combat food insecurity and adjust to the demands of an expanding population is through the use of AI in agriculture. An overview of AI's use in agronomic fields is given in this article, along with developments in laboratories for research. The analysis begins by outlining two areas in which artificial intelligence may be crucial: weed and soil management. Three issues must be resolved for AI-based technology to gain traction in markets. Despite highlighting the challenges of implementing machines and algorithms that have been proven, agricultural robots that are aimed at various facets of the agriculture industry have advanced significantly in recent years.

(Sharma et al., 2022), says the economy is significantly influenced by agriculture. Globally, agricultural automation is a relatively recent development and a major source of concern. Artificial intelligence has brought about changes in agriculture. The main problem with this is the various ways AI is being used in agriculture, including weeding, irrigation, and spraying with various sensors or other methods that are installed in drones and robots. These methods conserve soil fertility, reduce the use of water, pesticides, and herbicides, and aid in the efficient use of labor, all of which contribute to higher yield and quality. Drones are used for a variety of crop monitoring and spraying techniques. In this study, we also explore uses of AI to address farming difficulties and how AI should be integrated with other technologies.

(Wakchaure et al., 2023), concentrates on expert systems, agriculturally developed robots, and sensors technology for data collection and transmission. None of the literature discusses the employment of AI methods and robots in cultivation, monitoring, and harvesting in order to comprehend their value to the agricultural industry and to compare each in real time according to its popularity and usefulness. This study compares the three key stages of agriculture that is cultivation, monitoring, and harvesting. It draws attention to the research gaps in the development of intelligent autonomous agricultural systems.

(Sood et al., 2022), this paper aims to give a thorough overview of the academic development of artificial intelligence in agriculture and to draw attention to the opportunities and difficulties associated with implementing AI-based advancements in agricultural systems and procedures. To determine the current state of development in this field, the authors performed a bibliometric analysis of the body of existing literature on AI in agriculture. In order to determine the elements impacting the adoption of AI in agriculture, the authors have put forth a framework based on two widely accepted theories, the unified theory of acceptance and use of technology and diffusion of innovation.

(Jha et al., 2019), examines IOT, wireless communications, machine learning, artificial intelligence, and deep learning are some of the automation techniques covered in this paper. Some crop diseases, poor storage management, pesticide control, weed control, irrigation, and water management are some of the issues that are plaguing the agricultural sector. All of these issues can be resolved using the various methods that were previously mentioned. Deciphering issues like the use of harmful pesticides, controlled irrigation, pollution control, and environmental effects in agricultural practices is urgently needed today. Farming practices that are automated have been shown to improve soil fertility and yield more benefits from the soil. This paper provides a concise overview of the current automation implementation by surveying the work of numerous researchers.

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## Research Methodology :

This paper discusses how artificial intelligence techniques are employed to encounter the challenges in agriculture. AI has the potential to revolutionize technology and boost agriculture, in order to feed the world's growing population.

The objective of this paper is to comprehend how artificial intelligence techniques are implemented in the field of agriculture. Three major AI techniques are discussed throughout the paper. AI for weeding, AI driverless tractors, and AI remote sensing crop health monitoring.

### *AI for weeding*

The first AI technique is AI for weeding. A major obstacle to agricultural productivity is invasive weeds. Herbicides are widely used since it is difficult for farmers to manually identify and remove every weed. However, this approach degrades farms and causes widespread environmental damage. The need for accurate crop-weed separation is growing as a result of agricultural improvements. Research institutes and agricultural groups are collaborating to improve the accuracy of weed detection in order to tackle this difficulty. They are currently using a variety of cutting-edge technological techniques to incorporate artificial intelligence concepts into their operations. The goal of this action is to greatly increase weed detection accuracy.

AI – Powered Weed Detection Technologies uses machine vision systems. This uses image filtering techniques to identify weeds in vegetable crops, have become a popular and efficient method in recent years.

The advent of weed detecting robots, which constitute a noteworthy breakthrough in precision agriculture, is one noteworthy achievement in this field. Robots that identify weeds are made to easily integrate with current farming systems. Coordinated weed management techniques are made possible by their ability to communicate with other farm machines and equipment. This integration guarantees a comprehensive strategy to weed management while optimizing resource utilization (Sahota, 2023).

**AI driverless tractors**

AI, self-driving tractors, and the Internet of Things could help address one of the most pressing problems facing farming: a labor crisis. These technologies may also be less costly since they are more accurate and generate fewer errors. Precision farming is made possible by the convergence of AI, IoT, and self-driving tractors.

AI driverless tractors are approximately half the size of traditional tractors, driverless tractors are equipped with sensors, radar, and ultrasonic technology that can identify objects and stop the vehicle.

**AI remote sensing crop health monitoring**

Crop health monitoring has become a crucial activity in today's agricultural world. Farmers and agricultural specialists may now closely monitor their crops and guaranteeing ideal growth and prompt intervention. This thorough manual examines the many facets of crop health monitoring and how it is transforming the farming sector.

The dynamic and diverse discipline of crop health monitoring blends research, technology, and real-world farming expertise. For modern farmers, it's a vital tool that helps them produce healthier crops, increase yields, and support sustainable agriculture.

To assess the ripeness of the green fruits, photos of various crops are taken under white or UV-A light. Before delivering them to the market, farmers can arrange them in distinct stacks according to the crop or fruit category, creating varying levels of readiness.

Building crop metrics over thousands of acres requires the use of remote sensing techniques, hyper spectral photography, and 3D laser scanning. It has the power to fundamentally alter how farmers monitor their farmlands in terms of both time and effort. Crops will also be monitored using this technology during their whole lifecycle, with reports generated in the event of irregularities.

Crop health monitoring may be quite beneficial if you understand it and put it into practice, regardless of how big or small your farm is. Adopting this strategy is a leap towards wealthy and sustainable future, not just a step toward improved farming.

**Findings :**

1. AI in agriculture will advance to the point where it can analyze a variety of data sources, including weather, soil, crop performance, and temperature, to generate more accurate forecast predictions.
2. AI can be applied in agriculture to enhance crop management and productivity.
3. Yield prediction, weather forecasting, soil composition analysis, and agricultural monitoring can be beneficiary with machine learning in Agriculture.

**Conclusion :**

AI technologies save farmers time and enable them to cultivate the best crop each season by analyzing land, soil, crop health. AI-based forecasts allow for the timely recommendation of suitable pesticides, crops, and locations prior to widespread disease occurrence. There is a great chance for the agriculture sector to take advantage of the new technology of chat boats to help farmers with all of their questions and provide pertinent requirements to their fields, as there is a large area in agriculture that is still unexplored for the introduction of automatic response systems.

**Limitations of the study :**

Even though artificial intelligence has a lot of potential applications in agriculture, most farmers worldwide are still unfamiliar with sophisticated machine learning systems. Farming is exposed to several environmental influences, such as weather, soil conditions, and insect prevalence.

In order to train machines and generate accurate predictions, AI systems also require a large amount of data, while time series is difficult to obtain in case of large agricultural land.

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