

# Exploring the Potential of Artificial Intelligence for Smart Agriculture: A Review

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**Abstract** - Agriculture being one of the most essential practices for humans implies that it is necessary to make farming an optimized practice. Most of the farmers accidentally or not may affect farming negatively. As well as there are many factors like pesticides, irrigation, crop breeding, etc that are done in the wrong way that causes farming to be less effective. AI in agriculture can be a boon to us to avoid these and enhance the productivity of agriculture. In this paper, we will summarize different techniques or procedures, and models using Artificial Intelligence, IIOT, Machine learning, and Deep Learning that can help us reduce various farming challenges we face. There are many such techniques that have been proposed worldwide, and we shall see them in this paper.

**Keywords** – Agriculture, IoT, Artificial Intelligence, Artificial Neural Network

## 1. Introduction

Artificial Intelligence (AI) has the ability to convert the agriculture quarter by offering farmers equipment and technology to enhance their efficiency, productivity, and profitability. Precision farming includes the usage of generation to optimize crop manufacturing through reading records on soil health, climate styles, and different environmental elements. AI technologies can examine these records in real-time and offer hints to farmers on the way to optimize their use of inputs along with water and fertilizer, thereby lowering waste and enhancing crop yields. Another place wherein AI is being utilized in agriculture is in crop tracking and management. AI technologies can examine satellite tv for pc imagery and different records reassert to stumble on modifications in crop health, along with modifications in sedation or shape, which can suggest the presence of pests or diseases. Various technologies for example: ANN (Artificial Neural Network) is used to analyze data and look at the future scope. In this paper, we will cover Crop Monitoring, Seed Breeding, Soil Health, and Irrigation using AI. ANN and IOT in Agriculture will help the framers understand new technologies with their benefits and improve yield, quality, and quantity as well.

## 2. Crop Monitoring

Artificial intelligence (AI)-based crop monitoring is a growing area of agricultural research and development. Crop monitoring seeks to boost yields and decrease waste by gathering and analysing data on crop growth and health. Artificial intelligence can aid with image analysis, sensor data analysis, yield prediction, and decision support (AI). AI-based crop monitoring has the potential to completely transform agriculture by giving farmers access to real-time data on crop health and development. This can aid farmers in improving decisions, cutting waste, and increasing yields.

## 3. Seed Breeding

AI is being used to enhance the plant breeding process by examining vast volumes of data on genetics, characteristics, and environmental factors to identify the most promising seed candidates. Modern AI-based technologies today target shrinking breeding time and costs, increase the probability of achieving breeding targets, multiple trait detection, augmenting physical and morphological seed data, rapid results, and secure platforms for systematic data storage. These cost-effective technologies help in better and more accurate selection through seed-by-seed analysis and thereby ensure seed uniformity.[1]

## 4. Soil Health

A soil's ability to operate as a dynamic living system within the confines of a land-use boundary is described as its health and quality. When the soil's ecological production is maintained, the quality of the neighboring human health and the environment are maintained as well. Soil nutrient deficiencies, moisture content, and other types of calamities impact agricultural yield.[2] The soil is adversely affected due to the ongoing farming techniques, and it is becoming difficult to deal with as the demands for food production keep increasing. Various threats to soil health include loss of nutrients, a decrease in fertility levels, soil erosion, changes in soil pH, a loss of organic content, and soil compaction. Soil, being the most important to humans, needs to be preserved. Studies say that almost 70% of the soil in India suffers either from soil acidity or soil alkalinity. Artificial intelligence (AI) can be used to predict and improve soil health. Prediction is done by analyzing factors such as soil type, nutrient level, temperature, moisture, and other environmental variables. The ML algorithm

can be trained to work on big datasets of soil samples and their respective health indicators to develop predictive models. Also, sensors embedded in the soil can be used to analyze data. This data will help optimize crop yield and reduce the use of fertilizers. The improvement of soil can be efficiently done with the help of artificial intelligence tools. Providing insights on the data from prediction can provide the details for further techniques in farming practice, for example, optimal plating tie, monitoring nutrient levels, and soil erosion prediction. Analyzing satellite data to map soil moisture, etc. that affect soil health, AI-powered robots can be used to till the soil, plant crops, and apply fertilizers and pesticides, leading to a reduction in soil compaction.

## 5. Irrigation

Optimizing irrigation by analyzing a number of data sources and making predictions about the water needs of crops can be done by Artificial intelligence. Water optimization, reducing energy, saving money and increase yields is an important task in smart irrigation system. [5] The initial step towards optimizing irrigation is the collection of data. Data like weather conditions, soil moisture, water usage, and crop growth must be taken into consideration. As suggested, this data can be collected from sensors and weather stations. Proceeding with analyzing the data and predicting the water needs of crops. For example, if there is going to be raining for a period of time then irrigation will be needed less or not at all. Based on prediction we must Adjust irrigation, which can be done by adjusting the amount, frequency, and period of irrigation. To improve its preciseness and effectiveness we should continuously keep a check on these systems. So, refinement of the system by updating data sources and corresponding algorithms to evolve with the needs of crops. Lastly, Feedback on these AI-based systems should be taken, these can help with further factors like planning strategies and crop selection for the future. Overall, these can lead to an increase the yield and profit.

## 6. Artificial neural network in Agriculture

A group of algorithms called artificial neural networks (ANNs) are created to find patterns and connections in data. These are commonly used for improving the performance of traditional modeling methods in various fields, such as agriculture, water resources engineering, and civil engineering. They are also commonly used in the development of predictive analytics and the management of farm operations. They frequently appear in farm management decision-support systems and precision agriculture technologies. The authors created a set of artificial neural networks that can identify grain weevils in wheat kernels using various features such as mass, equivalent diameter, humidity, and hardness. They found that the model with the 4:10:1 structure and radial basis function was the most effective solution.[3] Artificial neural networks (ANNs) are increasingly being used in agriculture to solve a range of problems. Artificial neural networks can be used for Crop yield prediction, Disease detection, Pest control, Irrigation management, and Crop classification. Overall, ANNs have the potential to revolutionize agriculture by helping farmers make better decisions and improve yields while reducing costs and environmental impact.

## 7. Smart Agriculture using IoT

With the help of the Internet of Things (IoT), farmers can now get real-time information on the condition of their soil, weather patterns, and other environmental elements that affect crop output. IoT technologies can assist farmers in making informed decisions about when to plant, water, and harvest their crops by combining sensors, analytics, and cloud-based platforms. IoT is made up of linked objects that can access resources from anywhere at any time. In the Internet of Things, each object has three functionalities: awareness, representation, and interaction. The development of prediction models that can foretell weather patterns and other environmental elements that may have an impact on agricultural yield is another application of IoT technologies. IoT algorithms can create models that forecast future agricultural yields with a high level of accuracy by examining previous data on weather patterns and crop yields. By implementing the latest sensing and IoT technologies in agriculture practices, every aspect of traditional farming methods can be fundamentally changed. Currently, seamless integration of wireless sensors and the IoT in smart agriculture can raise agriculture to levels which were previously unimaginable.[4] IoT has the potential to completely transform the agriculture industry by giving farmers access to cutting-edge equipment and technology that will increase crop productivity and decrease waste.

## 8. References

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