

Applications Of Ai Based Technologies For Crop Yield In Smart Agriculture

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ABSTRACT

Traditional farming is transformed into technology based farming to increase the crop yield by introducing tools and systems that enhance efficiency, productivity, and sustainability. With advancements like precision agriculture, farmers can use GPS, sensors, and drones to monitor soil health, optimize irrigation, and manage crops more effectively. Artificial intelligence (AI) and machine learning provides predictive insights for weather, pest control, and crop yield, helping farmers make data-driven decisions. The integration of IoT devices automates processes like irrigation and livestock management, while block chain ensures transparency in the food supply chain. Overall, technology is enabling smarter, more sustainable farming practices, reducing costs, and growing output. We can be establish a infrastructure through which, we can provide the expensive AI tools like GPS, sensors, drones, etc. for the convenience of farmers which cannot afford these AI technology tools. This paper is focus on how to help to increase the crop yield by using AI tools. In Traditional farming due to uncertainty of weather, water irrigation problem, pest control issues farmer so to overcome this crucial problem farmer utilized and gets help from the technology oriented platforms. So In this paper we studied the number of technologies based tools which will help to the farmer to increase the crop yield but AI tools in Indian agriculture is more efficient and provides farmers additional profit like increased crop yields..

Keywords — Agriculture, Crop, Artificial Intelligence, Block chain, Machine learning, GPS.

I. INTRODUCTION

Modern agriculture benefits immensely from tools like Precision agriculture, AI & Machine learning, Block chain technology, as they enable smarter and more efficient farming practices

A. AI (Artificial Intelligence): AI helps farmers by analyzing vast amounts of data to predict weather patterns, optimize planting schedules, detect plant diseases through image recognition, and enhance pest control. AI-driven automation also improves tasks like harvesting and sorting, reducing labor costs.[4]

B. IoT (Internet of Things): IoT devices, like soil sensors and smart irrigation systems, monitor environmental conditions in real time, ensuring optimal water and resource use. Farmers can track soil moisture, temperature, and crop growth remotely, enabling precise control over farming activities.

C. Big Data: Big Data analytics processes large datasets from sensors, satellites, and market trends to help farmers make informed decisions about crop selection, timing, and pricing. This data-driven approach improves yield prediction, resource management, and overall farm profitability. Together, these technologies help maximize productivity, minimize waste, and promote sustainable agricultural practices.

II. Artificial Intelligence

The Artificial intelligence tools for smart farming involves data collection methods and compilation from various sensors, drones, and satellites imaginary, followed by AI algorithms based on machine learning that process this data to generate functional outputs. These outputs update automated decisions and performance, such as focused fertilization, irrigation, and pest control using AI tools using other programmed systems, well equipped resources which will improve crop yields.[9] Following figure 1 shows the Collaborative Artificial intelligence tools for smart Crop Yield Agriculture.

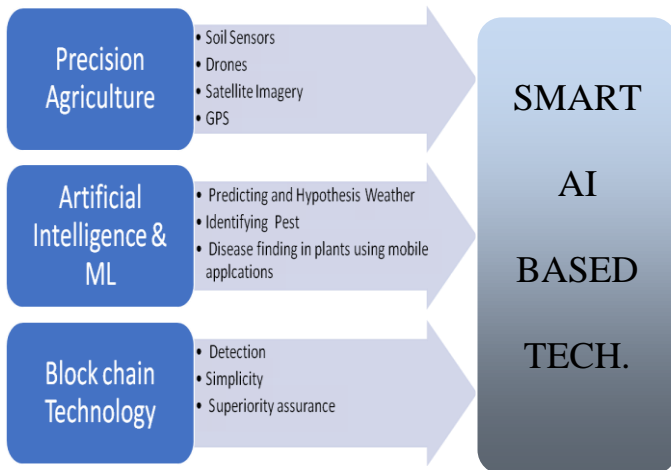


Fig 1. Collaborative Artificial Intelligence technologies for smart crop yield agriculture.

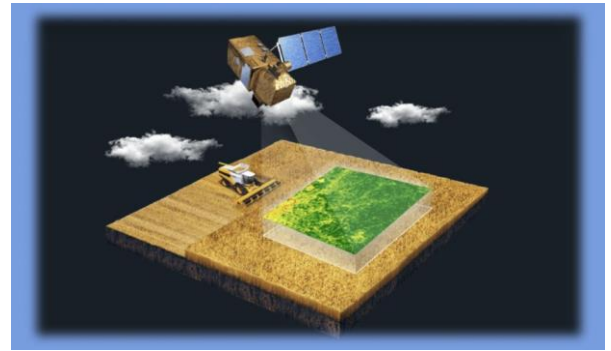


Fig 2 : Satellite Imagery (Source: <https://www.policycircle.org>)

III Artificial Intelligence Tools Used

A. Precision Agriculture:

Sensors, drones, and satellite imagery play a crucial role in modern agriculture by helping farmers optimize crop yields, reduce waste, and save resources [9]

- **Sensors:** Ground-based sensors monitor soil moisture, temperature, and nutrient levels in real time, allowing farmers to apply water, fertilizers, and pesticides only where needed. This targeted approach minimizes waste and ensures crops get the right resources at the right time.
- **Drones:** Drones provide aerial views of fields, capturing high-resolution images that detect crop health, pest infestations, and irrigation issues. Farmers can quickly assess large areas, identify problems early, and take action to prevent crop loss, improving overall yields.
- **Satellite Imagery:** Satellite data offers a broader view of large-scale farms, tracking long-term trends in soil conditions, crop growth, and weather patterns. This helps in planning and optimizing planting strategies, reducing overuse of resources, and promoting sustainable farming. Following fig.2 shows the satellite farm imagery system.

By leveraging these technologies, farmers can make data-driven decisions that enhance productivity while conserving water, energy, and inputs.

In India, precision farming tools are increasingly being adopted to improve agricultural productivity and resource efficiency. Some of the key tools include:

- **Soil Sensors:** Used to monitor soil moisture, temperature, and nutrient levels in real time, helping farmers optimize irrigation and fertilization practices, reducing water and fertilizer waste.[5]
- **GPS-:** GPS technology is used in tractors and other farm equipment to ensure precise planting, weeding, and harvesting, reducing overlap and improving accuracy in large fields.

B AI and Machine Learning in Agriculture:

AI plays a vital role in modern agriculture by improving the accuracy and efficiency of various tasks:

- **Predicting and Hypothesis Weather**
AI models analyze vast datasets from weather stations, satellites, and historical climate records to predict localized weather conditions. This helps farmers make informed decisions on planting, irrigation, and harvesting, minimizing the risk of crop loss due to adverse weather conditions.[7]
- **Identifying Pests:** AI-powered systems use data from sensors, cameras, and field observations to identify pest activity early. Machine learning

algorithms analyse patterns in pest behaviour and environmental factors, allowing for timely intervention with targeted pest control measures, reducing damage and pesticide use. Following fig.3 shows one example of identifying pests.



Fig. 3 : Identifying Pests (Source <https://india.mongabay.com>)

- **Disease finding in plants using mobile applications :**

AI-based image recognition tools analyze images of plants to detect diseases at early stages. By comparing the visual symptoms of leaves, stems, or fruits with large databases, AI identifies diseases such as blights, mould, or rusts. Farmers can receive real-time alerts via mobile apps or systems, enabling quick and precise treatment to prevent disease spread and crop loss.

Together, these AI applications enhance productivity and protect crops from environmental risks, pests, and diseases.

- **Mobile Apps and Platforms:**

Several Indian start-ups and agricultural platforms provide farmers with data on weather, crop health, and market prices. Apps like Kisan Suvidha, Pusa Krishi and AgriMarket help farmers make informed decisions about crop management and resource use. These tools help Indian farmers reduce input costs, conserve resources, and improve yields, promoting sustainable and profitable farming practices.

1. **Machine learning can optimize the supply chain:** Machine learning (ML) can significantly optimize the agricultural supply chain by analyzing large datasets and improving efficiency at various stages:[3]

2. **Demand Forecasting:** ML algorithms analyze historical sales data, market trends, and external factors like weather conditions to predict future demand for agricultural products. This helps farmers and distributors plan production and inventory, reducing wastage and avoiding overproduction.

3. **Inventory Management:** ML models track inventory levels in real-time, predicting when stocks are likely to run low or become overstocked. This allows for more efficient storage, minimizing spoilage of perishable goods and ensuring timely restocking.

4. **Logistics Optimization:** ML can optimize transport routes and schedules based on factors such as traffic conditions, fuel consumption, and delivery times. This reduces transportation costs, enhances efficiency, and ensures timely delivery of produce.

5. **Quality Control:** ML-based image recognition and sensor data analysis can assess the quality of crops during sorting and packaging, ensuring that only high-quality products reach consumers. This improves customer satisfaction and reduces returns.

6. **Pricing Strategies:** ML helps in analyzing market fluctuations and consumer behavior, allowing producers and sellers to set competitive prices that maximize profitability while meeting demand. By optimizing these aspects of the supply chain, machine learning enhances efficiency, reduces costs, and ensures smoother farm-to-market operations.

C) *Block chain in Agriculture*

Block chain ensures transparency and traceability in the food supply chain by creating a decentralized and immutable digital ledger where every transaction is recorded. Here's how it works in the context of India's food supply chain, from farm to fork.[4]

1. **Tractability:** Each stage of food production, from farming to processing to distribution, is logged in the block chain with a unique, time-stamped record. This ensures that any item can be traced back to its

source, allowing for the quick identification of issues like contamination or fraud.

2. Transparency: Since block chain data is accessible to all authorized participants (farmers, suppliers, retailers, and consumers), it ensures transparency. Everyone in the supply chain can view the history and movement of the products, leading to more informed purchasing decisions and greater trust in the quality and authenticity of food products.

3. Preventing deception: By using block chain, tampering with records or misrepresenting information about food quality or origin becomes nearly impossible, reducing the chances of fraud and adulteration in the Indian market.

This system helps both consumers and regulators in India ensure that food products are safe, authentic, and of high quality, boosting trust and improving overall efficiency.

IV. Comparative Study Of AI Based Smart Technologies

A comparative study table of AI based technologies: Precision Agriculture, Artificial Intelligence (AI), and Blockchain Technologies in an agricultural perspective shown here:

Comparative Study Table Of AI Based Smart Technologies

Sr No.	Key Highlights	Precision Agriculture	Blockchain Technology	Artificial Intelligence
01	Properties	Use of data to utilized for farming management level to enhance.	A blockchain is a joint, digital record book handler. It acts as an unchangeable, secure chain of data links.	Artificial Intelligence is replicates human intelligence inside machine and allowing them to study, solve issues and make conclusion.
02	Objective	Uses of technologies to handle crops with high precision level.	Blockchain technologies can create path all types of plants information and generate record of the plant.	Artificial Intelligence in agriculture is to increase crop yield, improve sustainability and enhance farmer growth.
03	Applications	Precision agriculture mapping for soil and crop health, detect pest infestations and IoT sensors monitor soil moisture levels.	As per the plant record it will identify the crop growth, increase the efficiency for crop yield and improved the crop quality.	Artificial intelligence uses technology oriented tools for soil health and crop monitoring which improves the resources and reduces cost to improve yield.
04	Technologies	Sensors, GPS, drones	QR codes, Data Base Management System, IoT.	Machine learning, Satellite, computer vision, drones.
05	Procedure of Data	Precision agriculture Collect the data from sensors, soil samples and land mapping levels from drones.	Blockchain technology involves a well structured data approach to integrate with crop records.	AI accumulate high-quality datasets from sensors, drones, and satellites, which are then interpreted to develop the machine learning models
06	Compatible Relationship	Collaborative work with IoT, Sensors and Artificial intelligence systems.	Collaborative handle data records.	Supportive role with the help of precision agriculture and block chain database records.
07	Advantages	Increased crop yields, reduced expenses, and enhanced environmental green living.	Increased the transparency working system in farm and improve supply chain for farmers.	Increased crop productivity and optimized crop management levels.

V. Importance of Artificial Intelligence Technologies

Recently we know about the farmer suicide cases day to day increased in India due to continuous way of adapting traditional farming. Which will purely depends upon the season wise monsoon and on weather condition. So crop yield is not increased for farmer due to traditional way of farming. So to overcomes this crucial problem farmer utilized and get help from the technology oriented platforms. So In this paper we studied the number of technologies based tools which will help the farmer to increase the crop yield but AI tools in Indian agriculture provides farmers additional profit like increased crop yields, supply effectiveness through AI and under attack pest management, minimum labor costs, prior disease identification, identify the soil health by sensor data for crop yield and mobile based applications system provides predicting and hypothesis weather which may affect to crop. Also AI tools more efficiently help us to farmer for

disease finding in crop using this mobile application based for more regenerative agriculture.

VI. Conclusion

In this paper artificial intelligence technologies helps for the smart agriculture for the soil management, disease detection of plants, identifying pests, weather forecasting. Technologies like AI and machine learning and blockchain, work together to transform farming practices in India, boosting productivity, reducing environmental impact, and ensuring sustainability. According to the AI applications, we can earn more money by the healthy farming using AI technologies, but if have a small farm or haven't idea about these AI tools like Drone, Sensors and GPS-guided Machinery, then we can have a solution, that is, if someone or government establish an organization which gives these AI tools as per demand with recommended charges. This can provide the facility to all farmers who want to take these tools of AI for their farming

work efficiency. This study presented a comparative analysis of AI technologies are helpful for farmers to increase the crop yield. These technologies also help to the farmer for prediction and taking decision of weather forecasting, soil testing and effective use of pesticides. Adapting the traditional way farming farmer are suicide that's why we make a comparative study for these technologies and recommend to use these technologies for increase crop yield and farmer suicide attempt is reduced.

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