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Advanced Study of Accuracy Farming Procedures with Artificial Intelligence

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Abstract

The idea of smart farming is being revolutionized worldwide by precision agriculture. To grow healthier crops, control pests, monitor soil and growing conditions, analyze data for farmers, and improve other management tasks in the food supply chain, the agriculture industry is turning to AI technology. The secret to generating the highest crop production is smart and precision agriculture. Globally, the majority of the agrarian society is illiterate and ignorant about intelligent farming. Our study serves as a link between computer scientists and researchers in the agriculture field. This study focuses on crop suggestions that take into account chemical and climatic factors. The nutrients that should be added to the soil to improve its quality are recommended by AI to farmers. A crop's health is monitored by an AI-powered system known as a health monitoring system, which also tells farmers what nutrients to add to improve the quality and

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quantity of the crop's production. Numerous sectors have been changed by AI and machine learning (ML), and the agriculture industry is also seeing the same trend. To make it simpler to monitor farmers' crop and soil health, businesses are creating a number of technologies. The most effective AI-based solutions for ensuring crop health are hyperspectral imaging and 3D laser scanning. For analysis, these AI-driven devices gather more detailed information on the health of the crops. The necessity for AI in agriculture was examined in this research. We provide a quick overview of the AI in Agriculture process and a few criteria that AI monitors in agriculture.

Keywords— Artificial Intelligence, precision agriculture, Agriculture, Farming, Information, Machine learning.

I. INTRODUCTION

Over the years, technology has changed how farming is done, and the agricultural sector has been impacted by it in a variety of ways. In many nations throughout the world, agriculture is a major source of income, and as the world's population rises—from 7.5 billion to 9.7 billion people, according to UN estimates—there will be increased strain on the planet's resources because only an additional 4% of the land will be cultivated by 2050. Farmers will thus have to work harder with fewer resources. The same report estimates that to feed an additional two billion people, food output must rise by 60%. Traditional approaches, nevertheless, are unable to meet this enormous need. Farmers and agro-businesses are being forced by this to seek out newer. Efforts and research are underway to improve the quality and quantity of agricultural products by making them "connected" and "intelligent" through "smart farming.

Agriculture is one industry where AI is still a developing technology. A new level has been reached in modern agriculture thanks to technology and machinery powered by AI. Real-time monitoring, harvesting, processing, and selling of crops have all improved because of this technology. Currently, crops are managed, monitored, and data about crops is collected using robots and sensors. Different high-tech computer-based systems are used to identify essential characteristics like weed identification, yield detection, crop quality, and many other procedures identify essential characteristics like weed identification, yield detection, crop quality, and many other procedures, different high-tech computer-based systems are used. Using drones with AI technology, farmers can keep an eye on the health of their crops. A report on the health of the farm is compiled once experts have looked through the photographs the drone has taken. This aids in pest management for farms. The most time-consuming and physically taxing farm jobs are now sometimes carried out by agricultural robots, according to some farmers. These machines may lighten the workload of workers and help farms save money on physical labor-intensive essay's main goal is to examine the many ways in which AI is used in agriculture.

1. Artificial Intelligence

The goal of the multidisciplinary field of research known as artificial intelligence is to develop robots that can mimic human cognition and behaviors, such as learning and problem-solving, to imitate human intelligence. AI technology is increasingly being used by research scientists and extension workers to address issues with farm production. By supporting them in selecting appropriate crop kinds, implementing better soil and nutrient management methods, managing pests and diseases, calculating crop production, and forecasting commodity prices, AI technology may help farmers raise yields. To solve

agricultural problems, AI makes use of deep learning, robotics, the Internet of Things, image processing, artificial neural networks, wireless sensor networks (WSN), machine learning, and other cutting-edge techniques. These AI technologies can now help farmers monitor a variety of things that come from their fields in real time, such as the weather, temperature, water use, and more.

2. Need for AI in agriculture

Agriculture is a labor-intensive industry, and with population growth and an increased need for agricultural produce, automation is becoming more and more crucial. In terms of components, technology, and applications, AI greatly benefits farmers. Crop quality and availability are guaranteed through enhanced farm and crop management systems and predictive analytics. Businesses use satellite images and meteorological data to calculate agricultural acreage and monitor crop health. Big data, AI, and ML technologies may be used by businesses to forecast prices, estimate tomato output and yield, and spot pest and disease infestations. They may provide farmers advice on supply and demand, the best crop kinds to plant for profit, the use of pesticides, and anticipated price trends. Given that AI greatly decreases the lack of skilled workers, it will be a powerful tool for organizations to deal with the expanding complexity of modern agriculture. Urbanization is accelerating at the same time that the world's population is expanding. Consumer habits are changing as disposable income rises. Since farmers are under a lot of pressure to meet the rising demand, they need a strategy to enhance output. Feeding more people will be necessary. Due to the restricted availability of fertile soil, farming will also require creativity. We must come up with methods to help farmers reduce their risks or, at the very least, manage them. One of the most intriguing possibilities is the global use of AI in agriculture. Several food producers are currently having trouble managing

the hazards and threats that pests and other diseases offer to their crops. Because of climate change, these dangers are exacerbated.

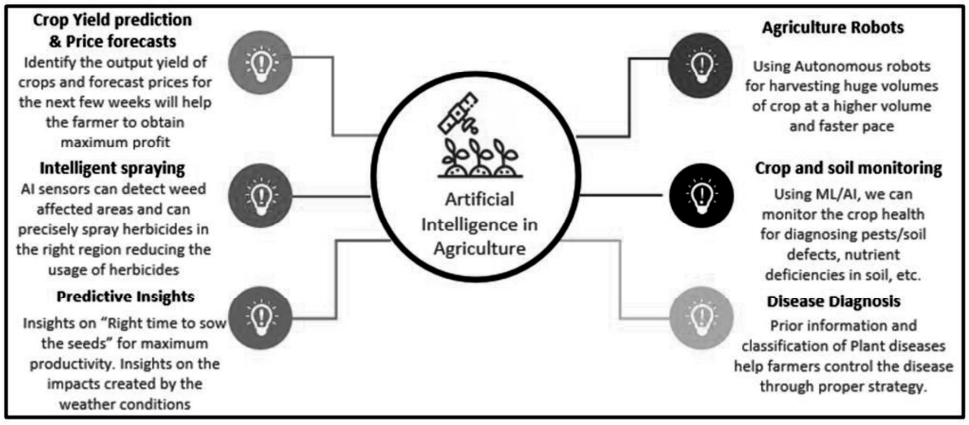


Fig 1 : Steps in Crop yield prediction

3. Research objectives

As a result, new technologies are frequently perceived as being complex and excessively expensive. This is because agriculture technology suppliers sometimes fall short of providing appropriate justification for why their solutions are beneficial and how they should be used. Although AI has potential benefits, technology providers still need to put up a lot of work to help farmers apply it effectively. 38,39 Agriculture involves the bulk of manual processes and stages. By augmenting present technologies, AI might help with even the most routine and difficult tasks. Because agriculture requires so much effort, there is a general lack of workers. Farmers can handle this problem using automation. Driverless tractors, intelligent irrigation and fertilization systems, smart spraying, vertical farming software, and harvesting robots powered by artificial intelligence (AI) are just a few tools that farmers may use to perform the task. driving agricultural equipment.

4. Process of Artificial Intelligence in agriculture

1. Data collection: The first step in applying artificial intelligence to agriculture is data collection. Agricultural

information such as crop yields, weather trends, soil quality, and other environmental elements may be included.

2. Data analysis: After gathering the essential data, analysis comes next. To achieve this, patterns in the data may be found using algorithms or machine learning approaches, which can then be used to provide insightful conclusions.
3. Prediction: After evaluating the data, AI may be used to forecast future crop yields and other agricultural results. Farmers may be able to better plan and run their farms as a result.
4. Automation: Automation is a significant component of AI in agriculture. This involves automating activities like planting, harvesting, and pest management. This may be beneficial.
5. Implementation: Last but not least, AI-based solutions must be put into action in the agriculture industry. This may entail utilizing drones and robots to automate particular jobs or AI-based systems to monitor crop conditions and offer farming advice.

Every stage of plant growth requires thorough monitoring of horticultural methods. Agriculture AI systems can continuously monitor the nutrient levels in the soil and compare them to the clerestories that have historically produced the highest yields on the particular crop using data from precision agricultural software, soil sensors, soil analysis drones, or even smartphone photographs. The application of different doses and types of fertilizers can harm the environment; therefore, AI can use datasets to assess these effects and determine the dosage that will have the fewest negative effects while maximizing productivity. These will support ecologically sustainable farming.

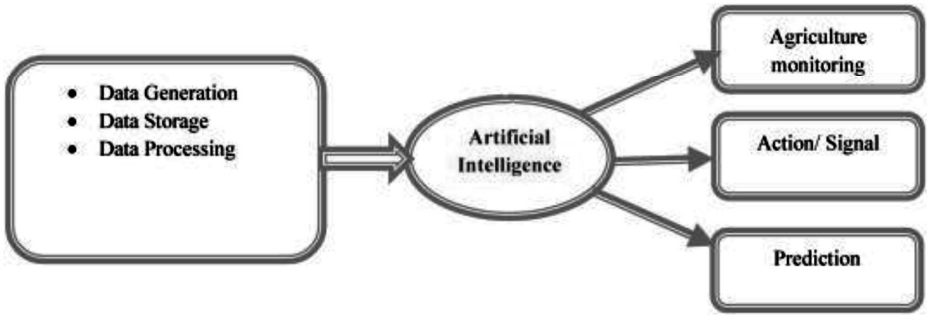


Fig2: The graphic illustrates the use of AI in agriculture

The amount of pollution and the unpredictability of the weather have both increased noticeably over time. Due to climate change, farmers are having difficulty determining when to plant seeds, which is where AI comes in. The influence of seasonal sunshine, wind, and rain on agricultural planting cycles may be easily understood with the use of artificial intelligence (AI). The analysis and planning of when to plant seeds will benefit from weather predictions for farmers. The advancement of computer vision, mechatronics, AI, and ML has made it feasible to utilize remote sensing technologies to identify and manage plants, weeds, pests, and diseases. Furthermore, it presents a once-in-a-lifetime possibility to create smart seeding methods for precise fertilization. AI solutions might help farmers produce higher-quality, faster-to-market products while minimizing waste.

AI helps with pest control by identifying the main plant on the farm. by deciding which pesticides and in what quantities they can be used. Furthermore, it uses drone technology to quickly spray herbicides over fields. Predictive analytics may be used to estimate precipitation and evapotranspiration. ML models may be trained to offer significant insights regarding soil moisture, temperature, and general condition when paired with soil samples and other data. Data may be used by farmers to irrigate their crops more effectively, which is good for both the environment and their bottom lines. As a result of such systems' ability to autonomously monitor agricultural

conditions, agriculture becomes more resourceful and labor-efficient. Identifying and controlling field variability makes it possible to provide the crop with exactly what it needs. Crops are improved with precision responsiveness to farming demands.

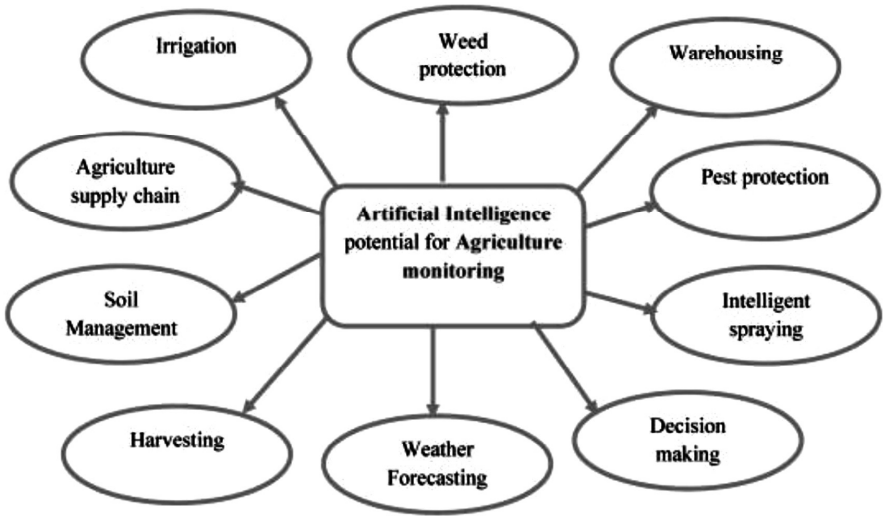
The agriculture industry has experienced a workforce deficit as the globe has moved from a rural to an urban lifestyle. Workers are needed on traditional farms to do a variety of jobs, including planting seeds, watering the land, harvesting crops, pulling weeds, and more. AI helps to solve these issues by offering automated solutions. Self-driving bots are being developed by several businesses to manage labor-intensive agricultural procedures. These agricultural robots are a complement to human labor and can provide work with improved quality, cheaper prices, and increased production. Applications of AI in agriculture include disease prediction, calculations of soil retention, crop development modelling, assessments of pesticide and nutrient loss, and fertility of hen eggs. To ensure that agricultural decision-making is as efficient and sophisticated as possible, many people think employing AI is crucial.

5. Agriculture parameters monitored by artificial intelligence

Since agriculture requires a lot of labor, a labor shortage is not unexpected. Automation, though, may be able to aid with this issue. Auto-driving tractors, intelligent irrigation, spraying, and fertilizing systems, as well as AI-based harvesting robots, are a few examples. It could be challenging for software companies to explain the full AI system to farmers.

For field harvesting, health monitoring, pest management, and deficit diagnosis in agriculture, AI is applied. ML and AI are replacing antiquated forecasting and intelligence techniques in the agriculture sector. AI brings cutting-edge technology to the farm, increasing the sector's adaptability. Even the fertility and hydration of the soil may now be monitored

thanks to biosensors. Raw data is gathered utilizing a variety of approaches as opposed to employing fundamental linear regression models. Neural networks can calculate and forecast the future. Some Agriculture parameters monitored by AI are shown in the image.



6. Some Agriculture parameters are monitored by Artificial Intelligence.

Every day, farms generate thousands of data points on temperature, soil, water use, weather, and other variables. These data are used in real-time by AI and ML models to gain insightful knowledge about things like when to sow seeds, which crops to choose, which hybrid seeds to choose for greater yields, etc. By improving the harvest's overall accuracy and quality, AI systems aid precision agriculture. Artificial intelligence (AI) technology aids in the early detection of pests, illnesses, and nutritional deficiencies in farms. AI sensors can recognize and target weeds before choosing the best herbicide to apply in the area. As a result, using herbicides is decreased, saving money. Robots using computer vision and AI have been developed by many tech companies to correctly and efficiently monitor weeds.

These cutting-edge agricultural technologies help gather the information that farmers can use to monitor and improve their

crops. Additionally, it is regularly updated with changing ecological and environmental elements. Emerging agricultural technologies suggest that technical development is crucial to the agriculture industry in the present. The aims of agricultural sustainability are facilitated by the use of innovative agricultural technologies. Various sectors are using AI technology to boost production and efficiency. AI in agriculture is helping farmers become more efficient and less harmful to the environment. To alter the total result, the agriculture sector embraced AI wholeheartedly. The production and operation of agricultural, food, and bio-system engineering processes are optimized using this technology, which is also frequently utilized to address other issues facing the farming sector.

To aid with crop production, data may be gathered through sensors, drones, and satellites. AI in farming may then be used to analyze the data, enabling farmers to make better decisions. Phenotyping may employ AI to examine the biomass and traits of a plant. AI technology may be enhanced to determine the precise causes of these illnesses by examining changes in plant biomass and external influences to find common patterns across affected crops. Finding contaminants and pests in crops can help farmers improve their total production. Water management in agriculture influences the hydrological, climatological, and agronomic balance.

The most sophisticated machine learning (ML)-based applications to date are connected to daily, weekly, or monthly evapotranspiration calculation, which permits more efficient use of irrigation systems. The enormous potential of AI will accelerate the pace of disruption and fundamentally alter the process by which our food is transported from farm to plate. A digital revolution is now taking place in agriculture. New agricultural regions' potential will be unlocked by AI, and these

new businesses will require workers. AI is making controlled farming of both new products like insects and enduring ones like leafy greens more viable and accessible. This technology can help farmers overcome several problems, including pests, water scarcity, and climate change. With a wealth of data at hand, AI uses ML, Deep Learning, and other techniques to produce insightful forecasts that may help farmers make knowledgeable agricultural decisions. Humans are unable to examine vast volumes of data with such accuracy as AI can. Robots powered by AI are being used by many farmers to complete jobs that once needed human labor. The majority of individuals avoid working in agriculture as a profession due to rising urbanization. As a result, there is now less manpower available for agricultural chores.

7. Artificial Intelligence applications in agriculture

The application of AI in agriculture can lead to several technological developments. This involves, among other things, data analytics, consultancy services, the internet of things, and the usage of cameras and other sensors. When AI in agriculture becomes proficient enough, it will be able to analyze a variety of data sources, including weather, soil, crop performance, and temperature, to offer superior predictive insights. This study examined the hazards associated with applying ML models to maximize yields in agriculture, including interoperability, safety and security, data dependability, and unexpected socio-ecological effects. By promptly recognizing plant diseases and effectively distributing agrochemicals, AI in agriculture may be utilized to enhance crop management and productivity. Rapid plant phenotyping, agricultural monitoring, evaluation of soil composition, weather forecasting, and yield prediction may all be aided by machine learning. IoT, AI, and other technology advancements are being embraced by more farmers to improve the production of their land.

1. **Monitoring of Crops and Soil:** Artificial intelligence may be used to monitor crops and soil in real time and offer information on the fertility of the soil, the availability of water and nutrients, and other elements that influence crop health. Then, by using this information, farming methods may be improved, leading to higher yields.

2. **Irrigation System Automation:** AI may be used to automate irrigation systems, which require less manual work and conserves water. Intelligent irrigation systems can be configured to alter their water consumption in response to the weather, the moisture content of the soil, and other factors.

3. **Automated Pesticide Application:** Applying pesticides, herbicides, and fungicides automatically is possible with the use of artificial intelligence (AI). This lessens the need for human effort and guarantees that the crops are receiving the proper quantity of pesticide application.

4. **Agricultural Disease Detection:** AI may be used to spot insect infestations and crop illnesses before they become major issues. AI can identify symptoms of illness or pests and inform farmers so they may take appropriate action by utilizing picture recognition and other data.

5. **Precision Farming:** Precision farming is a potential use for AI. AI may assist farmers in optimizing their agricultural operations and boosting yields by evaluating data on the types of soil, weather patterns, crop health, and other variables.

8. Conclusion

To forecast weather, analyze crop sustainability, and assess farms for the presence of diseases or pests and insufficient plant nutrition, AI-enabled technologies use data such as temperature, precipitation, wind speed, and solar radiation along with ML algorithms and images captured by satellites

and drones. Farmers that have access to Wi-Fi may utilize AI applications to get an AI-tailored farm plan. Farmers can meet the world's need for more food while increasing productivity and profits through AI-driven solutions that preserve irreplaceable natural resources. To determine which parts of their crops require irrigation, fertilizer, or pesticide application, farmers may utilize AI to gain real-time insights from their farms. Agronomic innovations like vertical farming might enhance food output while consuming fewer resources. As a result, Herbicide use decreases, harvest quality improves, earnings rise, and considerable cost savings are obtained as a consequence. AI tools gather data on the irrigation systems that are required for the crops as well as high-resolution aerial pictures. AI helps with the identification of soil problems like blockages and leaks. The bad state of the soil is evaluated and rated; AI helps raise farm yield. Yield management, AI-enabled production, and automated and autonomous farming activities all increase the net output from the field. Production, packaging, and sorting of food are improved by AI-assisted picking, packing, and sorting. The ability to better understand agricultural data insights relating to temperature, precipitation, wind speed, and sun radiation benefits farmers. Farmers' issues, such as reduced yields due to plant and insect infestations and climate change, may be resolved through AI solutions. AI will be used in agriculture to improve the entire agriculture process.

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