

THE TRANSFORMATIVE ROLE OF ARTIFICIAL INTELLIGENCE IN MODERN AGRICULTURE

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ABSTRACT

Objective: To examine the impact and potential of Artificial Intelligence (AI) in revolutionizing traditional agricultural practices to meet the increasing global food demand.

Method: A comprehensive review of the integration of AI technologies in agriculture, focusing on advancements in crop cultivation, real-time monitoring, harvesting, processing, and marketing.

Results: AI has emerged as a pivotal technology in the agricultural sector, addressing challenges such as climate change, population growth, employment concerns, and food safety. Advanced AI-driven systems have been developed to identify crucial factors, including weed detection, yield estimation, crop quality assessment, and other parameters. These innovations have elevated modern agricultural practices, ensuring enhanced productivity and efficiency.

Conclusions: AI holds significant promise in reshaping the future of agriculture. Its potential, combined with machine learning capabilities, presents vast opportunities for the sector's growth. However, the full adoption and integration of AI solutions in agriculture remain a challenge, with the sector still being relatively underserved in terms of AI-driven solutions.

Implications: The strategic implementation of AI in agriculture is paramount for the sector's future sustainability. While some advancements are evident, there is a pressing need for more predictive solutions tailored to real-world challenges faced by farmers. Embracing AI will not only ensure increased productivity but also the long-term viability of the agricultural sector.

Keywords: Artificial Intelligence, Agriculture, Crop Monitoring, Food Demand, Predictive Solutions

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Introduction:

The beginning of human civilization coincides with the rise of agriculture, and here is where the social and economic underpinnings of modern humans may be discovered. The agricultural industry continues to this day to play a foundational role in the global economy. The agricultural industry will only continue to expand as a result of the ever-increasing world population; nonetheless, it will continue to confront a challenge. This issue calls for a creative solution, and the role that artificial intelligence plays in finding that answer will be essential to resolving the issue. The use of artificial intelligence in agriculture is expanding into new and different subfields, which is helping to boost the sector as a whole.

Artificial intelligence (AI): What is it?

It may be said that artificial intelligence is now the most advanced form of human technology. The healthcare, banking, automotive, retail, and manufacturing sectors are just some of the ones that have already felt the effects of AI and automation. Artificial intelligence systems are required to exhibit behaviours that have historically been associated with human intelligence. Reasoning, planning, learning, problem-solving, knowledge representation, and a variety of other activities are included in this category. Because of machine learning, AI is able to undergo constant development.

From the beginning of the artificial intelligence business, technologies that may be used in agriculture have begun to develop and promise a very bright future for the sector. In order to have a better understanding of the function that artificial intelligence plays in agriculture, we are going to take a more in-depth look at these applications.

Agriculture's Traditional Methods Faced with Difficulties:

Before we can evaluate the influence and use of AI in agriculture, we must first understand the obstacles that farmers face while utilising conventional techniques, which are listed below:

- ❖ Several meteorological conditions, such as rainfall, temperature, and humidity, have a vital influence in farming. Because of pollution, the weather might change unexpectedly,

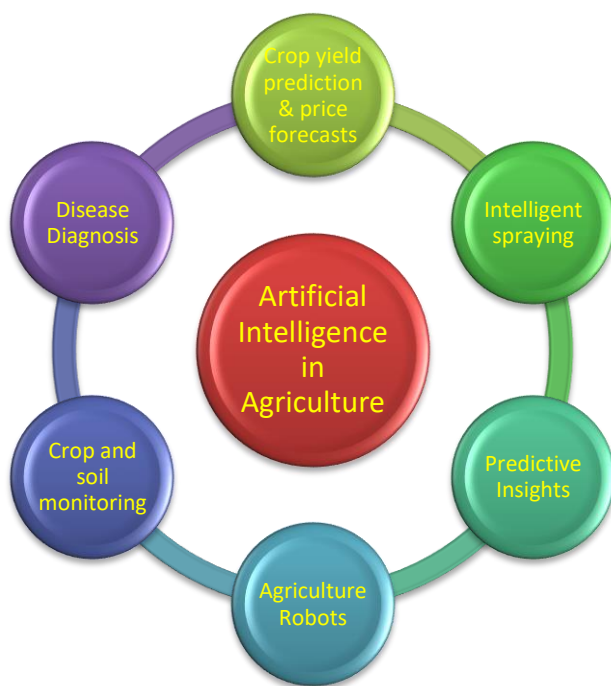




making it difficult for farmers to make informed judgements about harvesting, planting seeds, and preparing soli.

- ❖ For a better crop, the soil must be productive and have the appropriate nutrients, such as nitrogen, phosphorus, and potassium. If these nutrients are not present in sufficient quantities in the soil, low quality crops may result. Traditional methods, however, make it difficult to determine soil quality.
- ❖ Weed control is an essential part of the agricultural lifecycle. Otherwise, it may raise production costs and suck nutrients from the soil. Yet, standard methods of weed identification and prevention are ineffective.

Agricultural Artificial Intelligence Applications:



Farmers would confront several hurdles, just as they would with conventional agricultural practises. AI is being increasingly employed in this field to address these difficulties. Artificial intelligence has been a game changer in agriculture. It benefits farmers in a variety of ways, including increased agricultural productivity, insect management, soil monitoring, and many more. The following are some significant uses of artificial intelligence in agriculture:





Robotics and artificial intelligence:

Robotics and artificial intelligence are inextricably linked. A variety of practical uses are making their way into agriculture. Picking robots, for example, are meant to assist in the harvesting of vegetables. These robots can select produce considerably quicker than humans and at a far higher volume. The Sight & Spray AI technology, on the other hand, is radically transforming crop management. The cameras enable the AI to identify any possible weeds or crop concerns. It may then spray pesticide on the weeds or nourish certain plants. It enables farmers to better manage their crops, resulting in improved yields.

Weather and price forecasting:

As we covered in difficulties, climate change makes it harder for farmers to make the best decisions for harvesting, planting seeds, and soil preparation. Farmers, on the other hand, may use AI weather forecasting to get information on weather analysis and, as a result, prepare for the sort of crop to produce, seeds to sow, and harvesting the crop. Farmers may use price forecasting to acquire a better picture of crop prices in the next weeks, allowing them to maximise profit.

Crop Health Monitoring:

Crop quality is heavily influenced by the type of soil and soil nutrients. Yet, with the rising rate of deforestation, soil quality is deteriorating day by day, and determining it is difficult. AI has developed a new programme called Plantix to address this problem. PEAT created it to discover soil inadequacies such as plant pests and illnesses. Farmers may use this programme to gain ideas on how to apply better fertiliser, which can enhance crop quality. With this software, farmers may shoot photographs of plants and gain information on their quality using AI's image recognition technology.

Spraying with Intelligence:

Weed detection is simple using AI sensors, and it also identifies weed-affected regions. Herbicides may be accurately applied in such regions, reducing herbicide consumption while also saving time and crop. Many AI firms are developing robots with AI and computer vision that can





accurately spray weeds. The deployment of AI sprayers may significantly decrease the quantity of pesticides required on fields, improving crop quality while also saving money.

Diagnose of Disease:

Farmers can readily learn about illnesses thanks to AI forecasts. They may easily identify ailments with right approach and on time using this. It has the potential to save both plant life and farmer time. To do this, photos of plants are first pre-processed using computer vision technologies. This guarantees that plant photos are accurately classified as infected or non-diseased. Upon discovery, the sick portion is clipped and sent to laboratories for further analysis. This approach is also useful for detecting pests, vitamin deficiencies, and other issues.

Smart farming:

The mantra of precision agriculture is "Right location, Right Time, and Right goods." Precision farming is a more precise and controlled method for doing repeated chores that may replace the labor-intensive portion of farming. The detection of plant stress levels is one example of precision agriculture. Using high-resolution photos and diverse sensor data on plants, this may be determined. The sensor data is then used as input for a machine learning model that recognises stress.

Why is it advantageous to use automation and artificial intelligence in agriculture?

Although there are several reasons against the use of automation, some contend that it is displacing vital employment and the importance of human labour in conventional agriculture. Nevertheless, land scarcity limits the amount of food we can produce using conventional farming techniques. Using artificial intelligence and automation would enable present farmers to maximise their assets. Future agricultural production, administration, and sustainability will be enhanced by artificial intelligence. The nature of the majority of these applications also does not completely replace human work. The artificial intelligence may collaborate with the farmer to get optimal outcomes.





Since the global population continues to expand, the agricultural industry must raise its production. Using AI may assist guarantee that the transition to more modern agricultural practises is as efficient and profitable as feasible.

The intelligent farm:

The development of artificial intelligence-based technology has resulted in smarter farms or agricultural models with a high degree of adaptability.

- ❖ Data collection and analysis enables farms to collect, monitor, and evaluate a variety of data points, enabling farmers to make more informed choices. This data analysis facilitates the development of far more intelligent responses to the challenges at hand and improves decision making.
- ❖ Blue River technologies are a California-based start-up company that was founded in 2011. Using AI, computer vision, and robotics technologies, it creates agricultural machinery of the future. This technology recognises individual plants using computer vision, machine learning determines action, and robots execute the action. This allows farmers to reduce expenditures and chemical use.
- ❖ Farmbot is an open-source CNC precision farming equipment and software suite that allows anybody to cultivate crops at home. Farmbot is a \$4000 product that allows anybody to do comprehensive farming on their own, from seed planting to weed identification, with the assistance of a physical robot and an open-source software system. In addition, it includes a webapp that can be accessed on any Smartphone or computer, allowing us to manage farming from anywhere and at any time.
- ❖ Globally, the usage of artificial intelligence in the agricultural business is expanding day by day. Nevertheless, agricultural holdings per farmer in the poorer zone are smaller than in the wealthy region, which is helpful for automated monitoring since it takes a smaller number of sensors with low bandwidth and size to record all agriculture data. The Indian startup Fasal is working in this sector. It employs inexpensive sensors and AI to offer farmers with real-time data and insights. This allows farmers to profit from real-time, actionable information pertinent to the farm's daily operations. The company's gadgets





are simple to install in compact spaces. They are building AI-enabled equipment for precision agriculture that are accessible to all farmers.

- ❖ OneSoil is an application aimed to assist farmers in making better decisions. This application employs an algorithm for machine learning and computer vision for precision agriculture. It remotely monitors the crops, finds issues in the fields, checks the weather prediction, and calculates the nitrogen, phosphorus, and potassium fertiliser rates, among other things.

Difficulties of adopting AI in Agricultural:

Seeing the benefits of AI for sustainable agriculture, it may seem rational for every farmer to use this technology. Nonetheless, there are still certain significant obstacles that everyone is aware o

Lack of knowledge with artificial intelligence machines:

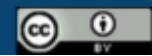
While there are several advantages to employing AI in agriculture, the majority of the global population is unfamiliar with AI-enabled solutions and equipment. To tackle the problems, AI businesses should first give farmers with basic equipment, and then, after the farmers are acquainted with them, provide them with more complex machinery.

Insufficient familiarity with developing technologies:

Using AI and new technologies in agriculture might be problematic for underdeveloped nations. It will be very challenging to promote these technologies in regions where they are not already used. To employ these technologies in such regions, farmers require assistance.

Privacy and safety risks:

As there are now no defined norms and policies governing the use of AI, it may generate a number of legal difficulties. In addition, the usage of software and the internet may lead to additional privacy and security concerns, such as cyber attacks and data breaches. Any of these factors may provide a significant challenge for farm owners and farmers.





Conclusion:

Artificial intelligence will play a crucial role in the future of humanity. It also involves the agriculture sector. The agriculture industry's development ceiling is enormous due to the vast potential of machine learning and continually increasing AI. Adoption of AI solutions will primarily determine the future of AI in agriculture. Despite the fact that some large-scale research is ongoing and certain applications are now on the market, the agricultural business remains neglected. In addition, the development of predictive solutions to address a genuine problem encountered by farmers in agriculture is still in its infancy.

The intelligent use of AI in agriculture would contribute to the future sustainability of the sector!

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