

Artificial Intelligence [AI] for Agriculture -A study

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Abstract: Artificial intelligence (AI) has the potential to completely transform India's rural development by boosting production, encouraging creativity, and raising millions of people's standards of living. AI has the potential to become a catalyst for equitable and sustainable development, helping rural India realise its full potential in the twenty-first century through smart investments, capacity building, and community participation. The ambitions of millions of rural residents will be realised as the country moves closer to its vision of a Digital India and AI is incorporated into policies for rural development. AI in agriculture is being used by an Indian agritech project to preserve livelihoods, reduce climate change, and guarantee food security. Governments, businesses, philanthropists, innovators, and farmers may work together to develop national frameworks for digital agriculture initiatives that will advance sustainability, inclusivity, efficiency, and better nutrition on a global scale.

Keywords: Artificial Intelligence, Machine Learning, Bigdata, agritech, Precise farming, food security

I. INTRODUCTION

Globalization and industrialization have led to significant technological advancements, including automation and computerized production systems. This has led to a focus on information handling, processing, storage, and dissemination, with computers now capable of simulating human activities. AI trends are exploring intelligent human behavior, including reasoning, sensory capabilities, and mechanical capabilities. Farmers face concerns about fluctuating crop prices, which can be addressed by businesses using climate information and satellite photos to determine acreage and track crop health. A German start-up has created a multilingual app for diagnosing diseases and pests in fruits and vegetables that employs AI and machine learning to identify approximately 385 different forms of crop infections and diseases. AI technology is also being applied in the agriculture industry.

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Artificial Intelligence (AI) is transforming various sectors, including agriculture, healthcare, education, and infrastructure in India. AI-powered solutions provide farmers with valuable insights into crop health, weather patterns, soil quality, and market demand. Telemedicine platforms, diagnostic tools, and predictive analytics can bridge the gap between rural communities and healthcare professionals, enabling early disease detection and timely intervention. AI-powered educational tools can personalize learning experiences, cater to diverse learning styles, and provide access to quality resources in remote areas. Efficient infrastructure is essential for economic growth and improving living standards in rural areas. AI-driven solutions can optimize planning, enhance transportation networks, and streamline public service delivery. However, challenges such as limited internet connectivity, digital literacy, and affordability of technology infrastructure need to be addressed. However, with supportive government policies, public-private partnerships, and grassroots initiatives, these challenges can be overcome. Initiatives like the National AI Mission and Digital India program aim to promote innovation, research, and skill development in AI, creating an enabling environment for rural development.

Massive volumes of data, such as weather patterns, crop health, and soil conditions, can be analysed by AI algorithms to give farmers real-time insights and advice. In addition to increasing yields, this promotes sustainable farming techniques by utilising less water and fertiliser. Artificial intelligence is in Favour of Rural and Agricultural Development In order to increase productivity, efficiency, and sustainability in the agricultural and rural development sectors, artificial intelligence (AI) technologies are being used. Higher yields and better living conditions for rural populations can result from farmers using AI to assist in decision-making about crop management, animal care, and resource allocation. Predictive analytics for crop yields and weather forecasting, drones for agricultural practice monitoring and optimisation, and smart sensors for soil health and water management are a few potential uses of AI in agriculture and rural development. Agriculture is crucial for economic growth, and automation is a growing concern. As population increases, demand for food and employment rises New automated approaches are introduced because traditional methods are not sufficient. Agriculture has undergone a revolution thanks to artificial intelligence, which shields agricultural productivity from challenges with food security, employment, population increase, and climate change.

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India's smallholder farmers now have easier access to AI tools through the AI for Agriculture Innovation programme, which will increase their revenue and farming efficiency. With the use of AI-based quality testing, bot advisory services, and a digital marketplace that links buyers and sellers, the project revolutionised the growing of chilies in the Khammam district. Farmers who took part said that their revenue had doubled. But these farmers also have to deal with decreased harvests, shifting climatic trends, unpredictable monsoons, droughts, and pest infestations. Additionally, they deal with 40% waste in the areas of access to markets, logistics, warehousing, and supply chain. Many farmers still cannot afford new technologies like drones, digital market access, and precision farming. A comprehensive, scalable strategy that incorporates financial inclusion and climatic resilience is needed to address these issues. For farmers like Krishna, the complexities of market supply and volatile pricing further compound the difficulties. Therefore, by producing enormous volumes of data, AI is being adopted to enhance government efficiency and provide public services. Nonetheless, it is important to recognise the benefits of these technology. Developed nations with advanced technology make investments in technology development to provide more competent, transparent, and service-oriented digital public services. Another important component of these digital services is agriculture, where ministries are putting e-government frameworks into place for sustainable management, and stakeholder participation. AI-driven initiatives like AI4AI are helping farmers in India tackle climate change, pestilence, and financial burdens. The "Saagu Baagu" project, which doubled earnings for 7,000 Chilli farmers, is expanding to potentially impact 500,000 farmers across five value chains.

Objectives

Agriculture technology vendors often struggle to explain the benefits and application of their solutions, leading to confusion and high costs. AI can enhance manual tasks and address labor shortages in the labor-intensive sector. Automation can help farmers with autonomous harvesting robots, intelligent irrigation systems, intelligent spraying, vertical farming software, and driverless tractors. Compared to human labour, AI-driven farm equipment is faster, more productive, and more efficient. To guarantee that AI is used in agriculture in a responsible manner, more study is required.

- The study aims to explore the embracing of AI in agriculture,
- It monitoring of agri parameters, and its major tools in the sector.
- To offer suggestions

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Limitations: The absence of straightforward answers, as well as farmers' limited time and digital proficiency, present obstacles to the broad application of AI in agriculture. Artificial Intelligence must be incorporated into current systems and infrastructure in order to be used in agriculture. AI could lead the way in agriculture becoming semi-autonomous as awareness grows. However, obtaining large amounts of data, particularly crop-specific data, is challenging.

Artificial Intelligence's Impact on Agriculture

Artificial intelligence (AI) is revolutionizing agriculture by simplifying farming and increasing profitability for farmers. By 2025, it is anticipated that the global AI market would reach \$1.1 billion, with AI driving advancements in agricultural productivity, supply chain constraints, and market accessibility. Global agriculture is predicted to benefit \$4 billion from AI by 2026. AI-powered solutions can raise agricultural go-to-market, quality, and efficiency. AI can also create vibrant, inclusive, and sustainable rural economies by diagnosing plant diseases and pest infestations in real-time, tracking weather patterns, and monitoring crop and soil health. India can leverage AI's transformational power to support rural economies in becoming more inclusive, productive, resilient, and sustainable.

II. PROCESS OF AI IN TO AGRICULTURE

Agriculture is being transformed by artificial intelligence (AI), which combines sensing data with picture categorization algorithms. Artificial intelligence (AI) systems can track soil nutrient levels, assess environmental effects, and assist farmers in adopting more eco-friendly practices. AI has also been applied to problems like weather uncertainty and pollution. With the help of drone technology and artificial intelligence (AI), automated tractors may operate without a driver by employing GPS technology. ML models help farmers irrigate crops more effectively by giving them insights regarding the temperature, moisture content, and general state of the soil. With self-driving bots bringing more production and reduced costs, artificial intelligence is also assisting in addressing the labour crisis in the agricultural industry. In industries including sales, medical, architectural, marketing, and finance, advanced technologies like AI, ML, and IoT are being employed more and more.

III. AI APPLICATIONS IN AGRICULTURE

Artificial Intelligence (AI) is revolutionizing the agricultural industry through various technological advancements, including internet of things, data analytics, camera and sensor utilisation, and consulting services. By analysing a variety of data sources, including weather,

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soil, crop performance, and temperature, AI can generate more accurate prediction insights. Quickly detecting plant diseases and effectively using agrochemicals can enhance crop management and productivity. Quick plant phenotyping, agricultural monitoring, analysing soil composition, predicting the weather, and yield prediction are all made easier using machine learning.

Weather forecasting and other agricultural circumstances including crop cycle, groundwater, soil quality, and plant disease identification are made easier with the help of AI technology. Multispectral images captured by drones or satellites, along with sensors in the soil and plants, enable the monitoring of crop health. With the use of this data, AI solutions can identify whether more complex unsupervised machine learning algorithms are being used, which would increase output while reducing crop loss. AI systems may also search for unauthorised individuals, wild animals, and birds that could damage crops by watching security camera or drone footage.

The agriculture sector has to embrace AI and ML technologies to combat food insecurity and maintain the sustainability of high-quality food production over the long run. The goal of smart farming, a novel idea that blends conventional farming with cutting-edge innovations like the Internet of Things, is to maximise agricultural output quality while limiting human involvement. Aside from using weather and satellite imagery to track crop health, AI startups and firms may also leverage big data, AI, and ML to build models that identify pests and diseases and provide real-time analysis to improve crop health.

By evaluating soil quality in real-time, increasing net-use efficiency, improving water use efficiency, and lowering the quantity of agri-inputs required for crop cultivation, generative AI—a novel and reasonably priced technology—can greatly boost farmers' output. Drones with AI capabilities can be used by farmers to gather information on insect populations, crop disease, and crop health in their fields. This information can then be sent to them for precision farming.

All industrial sectors, including agriculture, have been enchanted by AI, which has opened up new opportunities for farmers and other industry players to develop and flourish. Artificial intelligence (AI) has become widely used in agriculture as a result of technological and

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computing advancements as well as public confidence in machine learning. Big Data and AI in rural farming are areas that the Indian government is interested in since data is "key to targeted development." Artificial intelligence (AI) technologies are being used for pest diagnosis, seed timing prediction, and produce pricing estimation. AI can significantly benefit agriculture in six key areas: IoT-driven growth, soil testing, image-based insight generation, crop disease detection, optimal agri product mixture, and crop health monitoring. Cognitive IoT solutions can sense large amounts of data daily, improving yield. Soil testing uses proximity sensing and remote sensing technologies to characterize soil, while image-based insight generation aids in field analysis and crop monitoring. Optimal agri product mixtures are achieved by recommending based on factors like soil condition, weather, seed type, and infestation. Remote sensing techniques and 3D laser scanning revolutionize crop monitoring. In India, an AI-sowing app has increased crop yield by up to 30%.

IV. CONCLUSION

Artificial Intelligence (AI) is revolutionizing agriculture by addressing issues like manpower shortages and improving farming practices. It can reduce resource consumption, improve farmers' lives, and automate processes, leading to better quality and reduced resource consumption. However, farmers often view AI as a digital tool, unable to see its practical application in real-world situations. Technology providers should focus on enhancing tools, addressing farmers' concerns, and communicating machine learning's potential to reduce manual labor.

RECOMMENDATIONS

AI technologies are revolutionizing agriculture by providing innovative solutions like pest control, weather prediction, and farm work assistance. Companies are developing robots capable of picking crops, harvesting, and checking crop quality.

AI algorithms use satellite photos and historical data to detect insects, automating farming and improving crop output. Future developments will enhance AI-based goods and services, addressing food supply challenges and horticulture research.

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