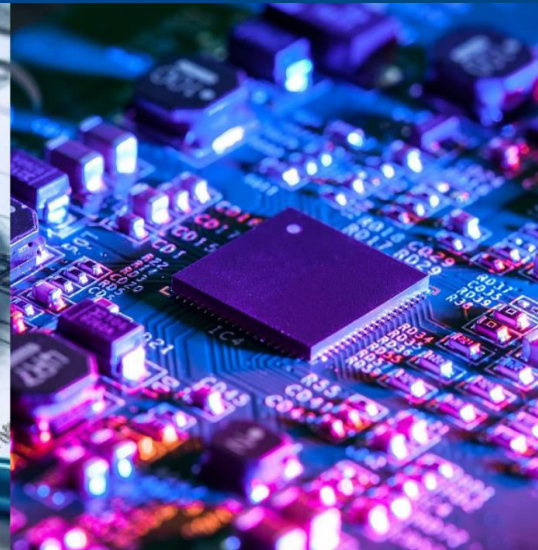
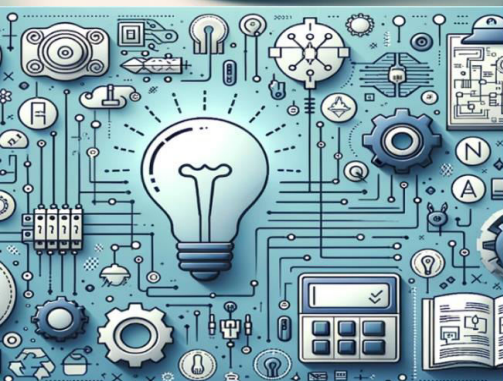




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Impact of Artificial intelligence in advancement of agriculture

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ABSTRACT: The developments in the field of science, like Artificial Intelligence and Robotics, can be most helpful in the domain of social problems like agriculture or in increase cultivation in order to assist meet the food needs of ever increasing world population so as to avoid famine. A.I can give introduce advanced and rational answers concerning overly expensive agricultural labor, and the increasing cost of farming purchases and also the risk of crop failure because of unpredictable disease, rainfall, climate change, and soil degradation, fertility alongside variable market prices for agricultural produce. To better the socio-economic conditions of Indian agriculture, Artificial Intelligence has the potential to design sophisticated farming systems meant for to optimize yield and minimize the losses suffered by farmers. Through Artificial Intelligence platforms, a lot of data can be gathered from government and public sites, or active feeder monitoring could be enabled using IoT (internet of things). With modern technology tools, it is possible to unmask various unknown challenges facing farmers in the agriculture sector using artificial intelligence apps and IoT.

KEYWORDS: Artificial, intelligence, advancement

I. INTRODUCTION

Agriculture is the main sector of the Indian frugality as it contributes 18 percent in India's gross domestic product (GDP) and offers employment openings to roughly 50 percent of the youth in the country. According to the US Environmental Protection Agency (EPA), the agrarian sector contributes an estimated \$ 330 billion in periodic profit to the frugality. (Madhusudhan, 2015) (14) likewise, India is the largest patron of beats, cereals, and spices, and the second largest patron of vegetables and fruits in the world. Notwithstanding some of the agrarian problems, India husbandry has traditionally plodded with a imperishable thunderstorm reliance, subsistence position yields, and low overall productivity. Issues like climate change, rapid-fire population growth, and food security are shifting the paradigm towards further sustainable crop protection and yield enhancing inventions (Kumar and Joshiba, 2019) (1). critical Need to meet the rising demand for foliage and food along with the growing rate of consumption is attributed as one of the major factors driving robotics development in husbandry (Smith, 2019) (28). Enhanced food consumption drives growers to increase husbandry exertion, which increases the demand for robotization in husbandry tasks. I must highlight that not all writers have the same skills. Some can focus on one format of writing and excel in it while some can handle multiple formats at once. In my case, I have to admit that I rely on a format or style of writing that I feel most confident in. In such a scenario, the integration of new technologies such as AI can assist Indian farmers in crop selection and risk reduction. So far AI is emerging as a constituent of the technological advancement of the industry. The achievement was that AI can ascertain a disease with 98% precision, AI provides growers with a weapon against the cereal-starved pests, The sensors monitoring the fruit's progress to ripeness, modulating the light to hasten or slow the rate of ripening. This type of farming requires AI technology. Soffar predicted crop market time will be faster due to improved quality powered by AI solutions (Soffar, 2019) [29]. The domain of Artificial Intelligence has temperature, precipitation, wind, solar radiation and time- comparison-of-historical data sourced for all over the agriculture world. It is true that AI will not make farmers redundant, But the use of AI in farming will change the methods of farming, processing, and selling staple crops by making it easier for the farmers. The government has formed a committee to examine the role of digital technology and its impact on transforming and modernizing rural India's agriculture. Technologies like Artificial Intelligence, Big Data Analytic, Block chain Technology etc.



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II. CONCEPT

Artificial Artificial Intelligence (AI): “Artificial” “AI” combines two words “artificial” and “intelligence” that deals with branch of computing technology such as information and computer technology, robots or automatic electronic devices designed to perform tasks that typically require human intelligence to accomplish such as identifying objects visually, understanding spoken language, making choices, or translating from one language to another. (Russel, 2016) [23]. AI includes computer vision, data mining, deep learning, image processing and includes a neural networks (Kale, 2019) [11]. In agriculture, climate change, food security, and population growth have served as drivers and concern for increases protective measures for both advanced protective perceptions for improving crop yield have advanced the technology incorporated into the industry. “With the growth of the computer, it may be defined that Artificial Intelligence is a program capable of modifying itself to carry out functions amid real- time scenarios and situations or engagement by thought processes of a human being. Fascinatingly, constant monitoring is not needed” (Maher, 2018) [15].

In India Artificial Intelligence was first piloted for crop cutting and yield estimation in Pradhan Mantri Fasal Bima Yojana. The pilot project focused on reducing the farming expenditure while improving productivity across the region. The Government is of the view that Pradhan Mantri Fasal Bima Yojana is of great use and would help scale AI in agri-tech.

recent years, many tech companies and startups have come up with smart farming solutions to help Ifarmers. These solutions mainly fall into three groups.

Predicting Weather and Crop Conditions:

Some companies use AI and satellite images to help farmers understand the weather and the health of their crops.

- A Where is a company from the U.S. that uses data from satellites to predict the weather, check how crops are doing, and spot any signs of pests or diseases early on.
- Farm Shots, another American company, looks at pictures taken from satellites and drones to see if crops are healthy. They help farmers spot problems like pests, diseases, or lack of nutrients before it’s too late.

Checking Soil and Plant Health:

- PEAT, a company from Berlin, has made an app called Plantix. This app uses pictures of plants and soil to tell farmers if their crops are sick, if the soil is missing nutrients, or if there are any other issues. It helps farmers fix problems quickly and avoid bigger losses.

So, in simple terms, these technologies help farmers by giving them important information at the right time—whether it’s about the weather, crop health, or soil conditions—so they can make better decisions and get better results from their farms.

See & Spray

This is a smart system that uses AI and cameras to detect weeds and apply herbicide only where it’s needed. Instead of spraying chemicals all over the field, it targets only the infected areas. This reduces waste, saves money, and helps manage weeds more effectively while protecting healthy crops.

Harvest CROO Robotics

Strawberry farmers in places like California and Florida often struggle to find enough workers during harvest season. Harvest CROO Robotics created a robot that can pick and pack strawberries. In just one day, this robot can harvest up to 8 acres—doing the work of about 30 human workers. This kind of machine helps prevent revenue losses caused by labor shortages.

Blue River Technology

Blue River developed a robot version of the See & Spray system to help cotton farmers fight weeds. It uses computer

vision to detect and target weeds accurately, which reduces the overuse of herbicides. This also helps prevent weeds from becoming resistant to chemicals, which is a growing problem in farming.



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III. AI AND ROBOTS FOR HARVESTING

In many developed countries, machines and robots are now being used to pick fruits like apples and tomatoes with the same care and precision as human workers. These robots have helped increase harvests by around 3–4%. Some advanced systems can also detect plant diseases like sudden death syndrome in soybeans and report the location and severity of the issue.

Companies Supporting Small Farmers in India

Some innovative companies are working hard to improve the lives of small farmers in India by using advanced technologies. One such company is Intello Labs.

1. Intello Labs

Intello Labs is using deep learning and image recognition technology to help farmers better understand their crops and improve the quality of their produce. Their tools are especially helpful for small-scale farmers who may not have access to expensive lab testing or expert advice.

Here's how Intello Labs is making a difference:

- **Crop Health Monitoring**

Farmers can simply take a photo of their crops using a smartphone. The system then analyzes the image and gives information about the crop's health throughout its growing period, as well as the quality of the final harvested product. This helps farmers gain a better understanding of the entire crop life cycle in a simple, visual way.

- **Product Grading and Quality Check**

The company also offers an automated tool for grading fruits, grains, and vegetables. By analyzing the color, size, and shape of the product in a photo, it instantly classifies the quality— saving time and removing the need for manual checks.

- **Pest and Disease Alerts**

If a farmer notices something unusual on their plants, they can snap a photo and get a diagnosis. The tool can identify pests, diseases, and weeds, and even recommend solutions on how to treat or stop the issue from spreading.

Microsoft India: Microsoft India has taken significant steps in supporting Indian farmers through artificial intelligence. Recognizing the challenges small farmers face—especially unpredictable rainfall and the risk of drought—Microsoft partnered with ICRISAT (International Crops Research

Institute for the Semi-Arid Tropics) to create an AI-powered Sowing App. This app helps farmers make smarter decisions about when to plant their crops, which is one of the most crucial factors affecting agricultural success.

The AI Sowing App works by analyzing weather patterns, soil conditions, and historical data using machine learning and Microsoft's Cortana Intelligence Suite. What makes it especially helpful is its simplicity. Farmers don't need expensive equipment or advanced smartphones to use it. In fact, the system is designed so that all a farmer needs is a basic phone that can receive text messages. The app sends timely messages telling farmers the best time to sow seeds. This not only improves the chances of a healthy crop but also helps reduce the risk of wasted effort, seed, and resources caused by planting at the wrong time.

To further support farmers, especially in managing crop diseases and pests, Microsoft joined hands with United Phosphorous Limited (UPL), India's largest agrochemical company. Together, they developed the Pest Risk Prediction App, which uses AI to monitor and predict the likelihood of pest attacks. This app takes into account the current stage of the crop and weather conditions to determine when pests are most likely to appear. If the risk is high, farmers receive an alert in advance.

Gobasco: The Intelligent Agri Supply Chain

Location: Uttar Pradesh, India

Focus: Using AI and advanced technology to modernize agriculture and support farmers



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- **Quality Maintenance**
 - Uses computer vision and AI for automatic grading and sorting of fruits and vegetables
 - Helps ensure produce meets international agri- commodity standards
 - Enables reliable trading across regional and international markets
 - Supports fair pricing for farmers by maintaining consistent quality
- **Credit Risk Management**
 - Solves the issue of credit defaults in the agricultural supply chain
 - Uses crowd-sourced data, algorithms, and analytics to assess and manage risk
 - Ensures low-risk operations, increasing trust between farmers, lenders, and buyers
- **Agri-Mapping**
 - Combines satellite image analysis with crowd- sourced information
 - Creates real-time agricultural maps with 1 square kilometer resolution
 - Helps monitor crops, forecast markets, and support planning and decision-making

Gramophone: Image Recognition for Soil Science

Based in Madhya Pradesh, India

- Uses image recognition combined with soil science to provide farmers with timely information and the right agricultural inputs to improve yields.

Major AI-Based Agricultural Schemes and Apps

- **Kisan Suvidha Mobile Application:** Provides farmers with critical information on weather, market prices, plant protection, input dealers (seeds, pesticides, fertilizers), farm machinery, extreme weather alerts, soil health cards, cold storages, and veterinary centers. Helps farmers make informed decisions on when and where to sell produce for better prices.
- **Farm Machinery Package App:** Offers localized information about available farm machinery according to state, agro-climatic zones, districts, cropping patterns, and power sources.
- **My Ciphert Mobile Application:** Provides accurate information on post-harvest technologies, products, and machinery developed by the Indian Council of Agricultural Research (ICAR).
- **Compilation of 100+ ICAR Mobile Apps** Includes apps covering crops, horticulture, veterinary care, dairy, poultry, fisheries, natural resource management, and more, delivering market prices, weather info, advisory services, and farming best practices.
- **mKisan Portal**

Sends crop-related advisories to registered farmers through SMS.

- **e-National Agriculture Market (e-NAM)** An online electronic trading platform to facilitate transparent buying and selling of agricultural produce.
- **Soil Health Card Scheme** Provides farmers with soil health cards every two years, informing them about soil nutrient status and recommending appropriate fertilizer dosages to improve productivity and soil fertility.

IV. APPLICATION OF AI IN AGRICULTURE

1. **Drone Mapping and Field Monitoring** Farmers use drones to fly over their fields and create detailed maps and 3-D models. These help identify which areas need watering, fertilizing, or pest control.
2. **Precision Farming:** Farmers use GPS, sensors, and smart devices to monitor soil, weather, crops, and livestock closely. This helps them make precise decisions about planting, watering, and harvesting.
3. **Smart Irrigation and Water Management** Sensors track soil moisture in real-time so farmers can water crops only when needed, saving water and money.
4. **Livestock Tracking and Health Monitoring** Collars and cameras help farmers keep an eye on their animals remotely, monitoring health, location, and breeding.
5. **Crop and Machinery Sensors:** Sensors attached to farm machines and plants collect information to improve farming practices and machine efficiency.
6. **Eco-Friendly Pest Control**
Using natural pheromones, farmers can disrupt pest reproduction without relying on harmful chemicals.
7. **Connected Machinery and Farm Robots** Tractors and robots with built-in software help farmers manage planting,



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fertilizing, and harvesting by providing recommendations and tracking machine maintenance.

Same-Day Aerial Maps and 3D Field Models: A company called Drone Deploy, based in San Francisco, has created software that lets anyone fly a small drone and analyze the pictures it takes using a computer or smartphone. This tool is useful for industries like farming, building, inspections, and insurance. With just one click, users can send drones on a pre-planned flight to capture aerial photos and create 3D maps of fields on the same day. This helps farmers quickly see which parts of their crops need care, estimate harvest sizes, and keep accurate records to compare over time.

Another small drone called SenseFly eBee helps farmers check their fields faster and with fewer mistakes. It flies by itself, takes pictures, including special images to check plant health, and lands on its own. After the flight, it quickly produces crop maps, spots problem areas, and helps plan treatments. It can even coordinate with tractors to apply those treatments the same day.

Precision Agriculture: Thanks to cheaper sensors and better technology like GPS, tablets, and smart devices, precision farming has become easier for many farmers. This approach uses advanced tools to gather detailed information about things like water levels, weather changes, soil quality, and the health of crops and animals. It helps farmers make smarter decisions by using real-time data collected from the

farm environment. Precision farming uses Internet of Things (IoT) devices and communication technologies to keep track of farm conditions, protect the environment, and increase profits. For example, smart irrigation systems improve watering efficiency to save water and reduce waste. Drones and ground sensors help monitor fields and animals by collecting important data over large areas.

Water Conservation and Irrigation: New technologies can measure soil moisture and water availability instantly, allowing farmers to manage water use better. This helps reduce water waste, boost crop growth, and increase farm productivity.

Monitoring Livestock: Farmers use collars and cameras on their animals to keep track of their health, location, and behavior from their phones or computers at home. Tags on animals can send information about things like health status and breeding activity, making it easier to manage livestock remotely.

Sensors on Crops and Farm Machines: Sensors attached to farming equipment like tractors and harvesters collect data about crops and soil. This technology helps farmers gather more detailed information to improve how they grow and manage their fields. These sensors also benefit the entire agricultural industry by providing valuable insights for better farming practices.

Eco-Friendly Pesticides: The farming industry is working on safer and cheaper alternatives to chemical pesticides. One method uses natural chemicals called pheromones, which some animals produce to influence others' behavior. These are used to disrupt the mating of pests that damage fruit, reducing the need for harmful chemicals.

Connected Tractors and the Future of Agricultural Robots: Modern tractors have software that tracks how long machines are used and when they need maintenance. This helps farmers keep their equipment in good shape and improve productivity. Data collected from these machines can also help farmers decide the best crops to plant, how much fertilizer to use, and the optimal time to harvest.

V. ADVANTAGES OF AI

Artificial intelligence (AI) is making farming smarter and more efficient by helping farmers manage their land and resources better. By using sensors and soil sampling, AI collects valuable data about the soil, crops, and weather conditions. This information is stored and analyzed to help farmers understand the strengths and weaknesses of their fields, which supports healthier crop growth and prevents weak or defective plants. AI technology allows farmers to get more produce from limited resources by detecting issues early, such as identifying pest swarms or diseases before they spread widely like tomatoes will be ripe, so they can plan the harvest at the perfect time. Machine learning algorithms recommend the best seeds to plant and provide advice on irrigation, fertilization, and water management, which saves resources and increases yields. Additionally, AI can automatically adjust farm machines based on field conditions, making equipment like planters and harvesters more efficient.



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AI improves weather forecasting, helping farmers prepare for changing weather patterns that could affect their crops. It also aids in quick identification of pests and diseases, allowing for precise spraying of herbicides or pesticides only where needed, reducing chemical use and preventing resistance. AI-powered systems predict when machinery needs maintenance or is likely to break down, helping avoid costly repairs and downtime.

In livestock farming, smart collars track animals' health and behavior, such as signaling when a cow is ready for milking, which can be automated to save time and labor. Robots equipped with AI and computer vision can precisely identify and spray weeds, minimizing chemical waste and improving crop safety.

Moreover, AI supports plant breeding and crop management by analyzing field data and satellite images to improve crop varieties and farming methods. Overall, AI helps farmers address major challenges like climate change, pest infestations, and reduced crop yields by providing timely and actionable insights that improve productivity and sustainability.

VI. DISADVANTAGES OF AI IN AGRICULTURE

While artificial intelligence offers many benefits to agriculture, it also brings some significant challenges. One major concern is the impact on employment. Agriculture is a huge industry that supports over 1.5 billion people worldwide, which is about 20% of the global population. With AI and automation gradually taking over repetitive and routine tasks, there is a real risk that many farm workers could lose their jobs in the coming decades. Smart robots and machines are increasingly capable of performing both simple and complex tasks in the fields, which may make certain human roles unnecessary.

Another disadvantage is the high cost of advanced technologies like drones. These tools, while very useful, are often expensive and mostly accessible only to governments, research institutions, or large agricultural businesses. This makes it difficult for many smaller farmers, especially in developing countries, to afford or benefit from these innovations. Funding and investment from governments and organizations will be essential to make these technologies more widely available and affordable. Without proper support, the gap between large, tech-savvy farms and smaller traditional farms may continue to grow.

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