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CROP MANAGEMENT USING ARTIFICIAL INTELLIGENCE: A LITERATURE SURVEY

C.V. SriRam Kasyap*1, Dr. Shikha Tiwari*2

*1Affiliation Amity University, Chhattisgarh, India.

*2Asst. Prof., Affiliation Amity University, Chhattisgarh, India.

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ABSTRACT

Recently, artificial intelligence (AI) has been widely used in farming. The agriculture sector is turning to AI technology to develop healthier crops, manage pests, monitor soil and growth conditions, analyse data for farmers, and improve other food supply chain management tasks. It makes it difficult for farmers to figure out the best time to plant seeds. AI assists farmers in selecting the best seed for a given weather circumstance. It also supplies weather forecast data. AI-powered solutions will assist farmers in producing more with fewer resources, increasing crop quality, and shortening product time to market. AI assists in understanding soil properties. AI assists farmers by recommending which fertilizers to apply to improve soil quality.

AI can assist farmers in determining the best time to plant their seeds. Intelligent equipment can compute seed spacing and maximum planting depth. A health monitoring system is an AI-powered system that supplies farmers with information on the health of their crops as well as the nutrients that must be applied to improve yield quality and quantity. This research collects and analyses significant papers on artificial intelligence for agriculture. Farmers may now use AI to have access to advanced data and analytics tools that will promote better farming, increase efficiency, and minimize waste in biofuel and food production while minimizing negative environmental impacts.AI and Machine Learning (ML) has altered several industries, and AI wave has now reached agriculture. Several technologies are being developed by companies to aid farmers in monitoring crop and soil health.

These AI-powered solutions collect more precise data on crop health in greater volume for analysis. This article investigated AI and its application in agriculture. The process of AI in agriculture is described, as well as various agricultural metrics tracked by AI. Finally, we highlighted and analysed the important uses of artificial intelligence in agriculture.

This paper provides an overview of the uses of AI in soil management, crop management, weed control, and disease management. A significant emphasis is placed on the application's strengths and limitations and the methods for employing expert systems for increased productivity

Keywords: Agriculture, Artificial intelligence, Precision Farming, AI in Agriculture, Applications of AI in Agriculture, Information.

I. INTRODUCTION

Agriculture is the foundation of any economy's long-term viability. It is important for long-term economic growth and structural transformation; however, this varies by country. The global population is growing, expected to reach 10 billion by 2050, putting pressure on agriculture to produce more food. Two options to address food shortages have emerged: using more land for large-scale farming or using technology to enhance productivity on existing farmland.

Agricultural operations were previously limited to food and crop production. However, in the last two decades, it has evolved to include crop and livestock processing, production, marketing, and distribution. Agricultural activities currently serve as the primary source of livelihood, increasing GDP, serving as a source of national commerce, lowering unemployment, supplying raw materials for manufacturing in other industries, and overall developing the economy.

With the global geometric population increasing, agricultural methods must undergo scrutiny to supply innovative means to sustain and enhance agricultural activity. Other technological breakthroughs, such as big data analytics, robotics, the Internet of things, the supply of cheap sensors and cameras, technology for drones,

and even wide-scale internet access on geographically separated fields, will enable the application of AI to agriculture. Efforts and research are currently being made to increase agricultural product quality and quantity by making them "connected" and "intelligent" through "smart farming." To increase production, pesticides are sprayed over farming fields in open-air or greenhouse settings. Farmers can also employ ML as part of precision agriculture management, which involves applying agrichemicals based on time, location, and affected crops. To enhance crop prices and prevent waste, farmers must reliably detect and classify crop quality traits. Data can be used by machines to detect and reveal new features that contribute considerably to crop quality.

AI systems will be able to provide predictive insights into which crop to plant each year and when the optimal dates to sow and harvest are in a specific area by analysing soil management data sources such as temperature, weather, soil analysis, moisture, and historic crop performance, thus improving crop yields and reducing the use of water, fertilizers, and pesticides. The impact on natural ecosystems can be decreased, and worker safety can be improved, which will keep food prices low and ensure that food production keeps up with the growing population. To enhance crop prices and prevent waste, farmers must reliably detect and classify crop quality traits. Data can be used by machines to detect and reveal new features that contribute considerably to crop quality. Water management in agriculture has a substantial impact on agronomic, climatological, and hydrological balance. Evapotranspiration can be estimated daily, weekly, or monthly using ML-based applications, allowing irrigation systems to be used more successfully. Furthermore, accurate daily dew point temperature forecasting aids in the identification of expected meteorological occurrences as well as the assessment of evapotranspiration and evaporation. Farmers are increasingly using AI and ML models to boost production, and the food-tech sector has profited the most. Robots and sensors are being utilized to maintain and monitor crops, as well as collect crop-related data. There is an increasing chance for ML to be employed in digital agriculture. ML is a risk-free approach to enhancing agricultural yield while minimizing environmental effects. Farmers can gain a better understanding of crops, their DNA, and potential diseases by gathering agricultural data. AI is quickly evolving. With increases in the computational role and growing cloud penetration, more areas of the global economy have begun to reap the benefits of AI. Agriculture is one industry that has already begun to reap the benefits of AI. Whether it's weed control, estimating the ideal time to harvest crops, monitor soil and crop health, or predicting yield in advance. AI and machine learning have been assessed as development tools in a variety of industries during the earlier decade. Still, it's only lately that it has been apparent that AI can be used to ameliorate agrarian decision- timber. Farmers, in illustration, may be able to make better judgments because of AI technology, performing with advanced effectiveness in agrarian and best affairs. Several factors contribute to the agrarian sector's desire to incorporate AI technology for better decision- timber. The irrefutable increase in available data and the ease with which it may be penetrated is at the van. In husbandry, AI and ML-powered surveillance systems give perceptivity to cover crops, descry pests, and diagnose soil excrescencies, allowing growers to plant seeds at the ideal time for maximum yield. Weeds pose a trouble to numerous agrarian conditionings. They reduce ranch affairs, overrun crops, suffocate ranges, and, in rare situations, detriment to creatures.

AI detectors can describe weed infestations and recommend the stylish pesticide to use in that area. AI systems can read rainfall patterns, estimate crop health, and describe ails, pests, and shaky factory nutrition. growers can use AI-powered drones to cover the health of their crops. Experts estimate the drone photos and produce a report on the ranch's health. This assists growers with pest operation. Some growers are decreasingly espousing agrarian robots to handle the most time-consuming and physically delicate ranch duties. These robots can help growers save plutocrats on physical labour and minimize worker workloads. According to the United Nations Food and Agriculture Organization, the world population will exceed 9 billion by 2050. Rapid population increase, dwindling cropland, depleting natural coffers, irregular climate change, and altering request requirements are forcing a paradigm shift in the agrarian product system. The new agrarian system must be more productive in the product, effective in operation, flexible to climate change, and long-term in nature.

Artificial intelligence (AI) has the implicit to handle the issues of this new paradigm. The Agricultural Research Service (ARS) of the United States Department of Agriculture (USDA) is the world's premier agrarian exploration association, with over 2,000 scientists conducting agrarian exploration in further than 90 locales

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across the United States and three foreign countries. ARS performs exploration in crop product and protection, best product and protection, natural coffers and sustainable husbandry, food nutrition and food safety, and food nutrition and food safety. ARS has set up a virtual Centre of Excellence (COE) to give strategic leadership on the operation of AI in agrarian exploration to harness the power of arising technologies and transfigure agrarian exploration. The primary thing of this exploration is to probe the numerous uses of AI in husbandry.

II. REVIEW OF LITERATURE SURVEY

1. Artificial Intelligence:

Artificial Intelligence (AI) is a software technology that allows machines to perform human-like tasks. AI has become increasingly popular in different applications, from commercial to consumer and embedded firmware. Today, AI is being widely used to solve complex problems and develop intelligent solutions. In agriculture, AI has significant potential to revolutionize farming by utilizing data acquired through Wireless Sensor Networks (WSN) technology. This data can help farmers make more informed decisions about their crops and land's applications including data collection, accounting, and analysis that can be used to monitor farmland and automate farming activities. By using sensors to assess parameters such as humidity, wetness, atmospheric pressure, and pH levels in water or soil, AI-powered systems can help optimize the use of natural resources such as water and soil quality. By enhancing AI using machine learning algorithms, we can enable intelligence in automation, which can help farmers save time and resources.

AI is widely used in various applications, including mobile face recognition and self-driving cars. However, in the agricultural sector, AI is still in its early stages, and it has a lot of untapped potentials. AI is useful in precision agriculture, which involves using data to optimize various farming activities such as watering, crop rotation, harvesting, crop selection, planting, and pest management.

In conclusion, AI is a promising technology that can help farmers optimize their farming activities and conserve natural resources. With the help of AI, farmers can make more informed decisions and increase their yields while reducing their environmental footprint.

2. Precision Farming:

Precision agriculture is a farming management strategy based on observing, measuring, and responding to temporal and spatial variability to improve agricultural production sustainability. AI's impact on agriculture begins with precision farming, a technique that involves using data-driven insights to optimize various aspects of crop management. AI algorithms analyse data from satellite imagery, sensors, and other sources to provide farmers with real-time information about soil health, crop conditions, and weather patterns. This enables farmers to make informed decisions, such as precisely timing irrigation, applying fertilizers, and managing pest control. As a result, resources are utilized more efficiently, reducing waste and increasing overall yield.

3. AI in Agriculture:

Despite producing enough food to feed the world's population, nearly one billion people still suffer from hunger and malnutrition because of food wastage, climate change, and other factors. Moreover, with the global population projected to reach 9.7 billion by 2050, the pressure is mounting on the agricultural industry to produce more food while using fewer resources and reducing its environmental impact. Fortunately, the integration of artificial intelligence (AI) in agriculture has the potential to transform food systems and help address the global food crises. By analysing data from various sources, AI can help farmers make data-driven decisions, optimize resource usage, and reduce environmental impact.

For example, the World Economic Forum has reported that AI integration in agriculture could bring about a 60% decrease in pesticide usage and a 50% reduction in water usage.

However, existing technologies are unable to meet this massive need. This is pushing farmers and agro-businesses to develop innovative ways to improve output while reducing waste. As a result, Artificial Intelligence (AI) is gradually developing as a component of the agricultural industry's technological advancement. The objective is to boost global food production by 50% by 2050 to feed an additional two billion people. AI-powered solutions will not only help farmers improve efficiency, but will also increase crop yield, and quality, and ensure a faster time to market. These advancements enabled farmers to produce a substantial number of improved agricultural yields. In contrast, efforts to get the highest possible output from distinct

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types of soil are still ongoing, and there are significant losses due to food particularly during and after harvest when production is not closely monitored and managed. The sector requires a shrewd and exact answer, which modern technologies provide. Thus, such monitoring might be achieved by integrating appropriate electronic sensing devices that record data in soil, environment, or crops. The data can provide helpful information about what the crop requires. To make the most use of soil in a certain region, regulate crop care, and maximize output after harvest. Informed judgments must be made about allocating resources. Sensors have been developed and used to assist in establishing the quality of a wide range of agricultural goods, including fruits. As a result, AI is seen as a data-driven clarification with several benefits. The strategy may assist in reducing the loss of fruits and vegetables throughout the supply chain from the farm. Keeping all these challenges in mind, AI provides agriculture automation.

4. Optimizing AI for agriculture:

The benefits of AI in agriculture are clear, but it cannot work without other existing digital technologies such as big data, sensors, and software. Similarly, other technologies need AI to work well. In the case of big data, the data itself is not particularly useful. What matters is how it is handled and implemented.

Big data for informed decision-making: By combining AI and big data analytics, farmers receive recommendations based on accurate, real-time information to improve productivity and reduce costs.

IoT sensors for collecting and analysing data: IoT sensors, along with other supporting technologies (AI drone, GIS, and other tools), can monitor, measure, and store training data on various metrics in real time. By combining these devices with AI, farmers can quickly obtain accurate information. Minimizing manual labour through intelligent automation.

Robotics: The combination of AI and autonomous tractors and IoT can help solve the common problem of labour shortage. Robotics is also important. Agricultural robots are already used for manual tasks such as fruit and vegetable harvesting. Robots are advantageous in agricultural work because they can work for longer periods, increase accuracy, and reduce the chance of errors.

5. Research Motives:

Agriculture technology suppliers sometimes lack clear explanations of their products' benefits and use, leading to perceptions of confusion and high costs. Despite its potential benefits, technology companies must still make significant efforts to help farmers in deploying AI effectively. Agriculture relies heavily on manual operations and techniques. AI can improve present technologies and help with even the most difficult and mundane tasks. Agriculture relies heavily on labour, leading to significant shortages. Automation can assist farmers with this issue. Farmers may use technologies such as autonomous tractors, intelligent irrigation and fertilization systems, smart spraying, vertical farming software, and AI-based harvesting robots to fulfill their tasks.

RM1: to study AI and its need in Agriculture. RM2: to study the process of AI adoption in Agriculture.

6. Developing AI for agriculture:

AI's ability to solve agricultural problems is largely dependent on the quality of available data. AI is viewed as a promising technology that might revolutionize agricultural solutions. Obtaining necessary information at the farmer level is particularly challenging. Combining image classification algorithms with distant and local sensing data can improve farm machinery performance, including weed control, early disease detection, crop harvesting, and grading.AI solutions can provide constant monitoring of high-value goods, ensuring their safety and security at all times. In the field of horticulture, every stage of plant growth requires comprehensive monitoring. Precision agricultural software, soil sensors, soil analysis drones, or even smartphone photographs can be used to gather information, which can then be analysed by AI systems. By continually monitoring the nutrient levels in the soil and comparing them to historical data on crops that have produced the highest yields, AI can provide insights that can help maximize production. Additionally, AI can analyse datasets to determine the environmental impact of applying different types and dosages of fertilizers. This information can help farmers choose the most effective fertilizer while minimizing any negative effects on the environment. Ultimately, these AI-powered solutions can help farmers operate in an environmentally friendly and sustainable manner

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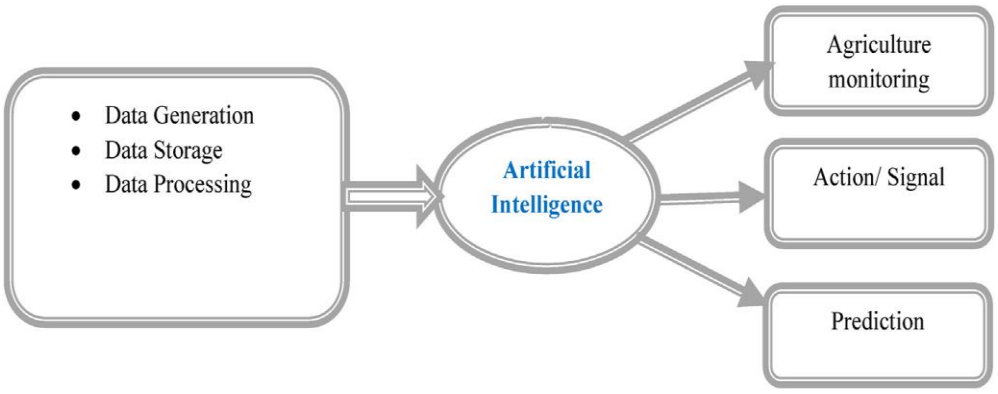

Fig 1. demonstrates AI usage in agriculture.

Pollution and unpredictable weather patterns have increased over time. Climate change makes it difficult for farmers to determine when to plant seeds, making AI a valuable tool. AI makes it simple to grasp how weather, seasonal sunlight, wind, and rain affect agricultural planting cycles. Weather predictions can help farmers plan and plant seeds more effectively. Advancements in computer vision, mechatronics, AI, and machine learning have enabled remote sensing for plant, weed, pest, and disease management. Additionally, it provides a unique opportunity to create precise planting procedures for optimal fertilization.

AI tools can help farmers to reduce waste, improve product quality, and ensure faster market access. The use of automated tractors for planting and harvesting is becoming increasingly popular. These tractors are equipped with GPS technology and can operate without a driver. Drones are also being used to collect data and monitor the health of farms and crops from a distance. This information is then relayed to farmers for analysis and decision-making.

7. AI monitors agricultural metrics:

Agriculture's significance and relevance are not unfamiliar to any of us. Aside from feeding us all, it facilitated the first settlements and the shift from a nomadic to a sedentary existence, which resulted in our contemporary civilization. Although there has been a lot of IoT technology and innovation developed in recent years, there is still plenty of potential for development.

The expanding use of artificial intelligence, along with climate change, population expansion, a scarcity of agricultural labour, and food security concerns, has pushed the agricultural industry to explore ever more inventive techniques to increase yields.

The image above illustrates that robots can play a key part in control, but it is envisaged that humans' roles in analysis and planning will be increasingly supplemented by machines, resulting in a nearly autonomous cycle. According to a Markets and Markets report published in 2019, the agricultural AI industry is expected to grow from $519 million in 2019 to $2.6 billion in 2025.

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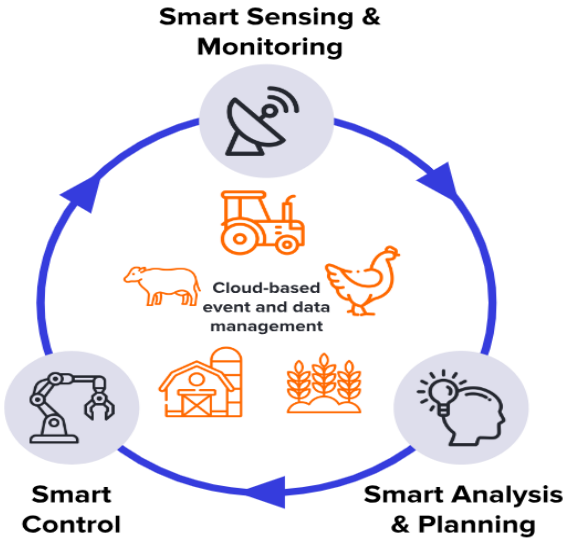
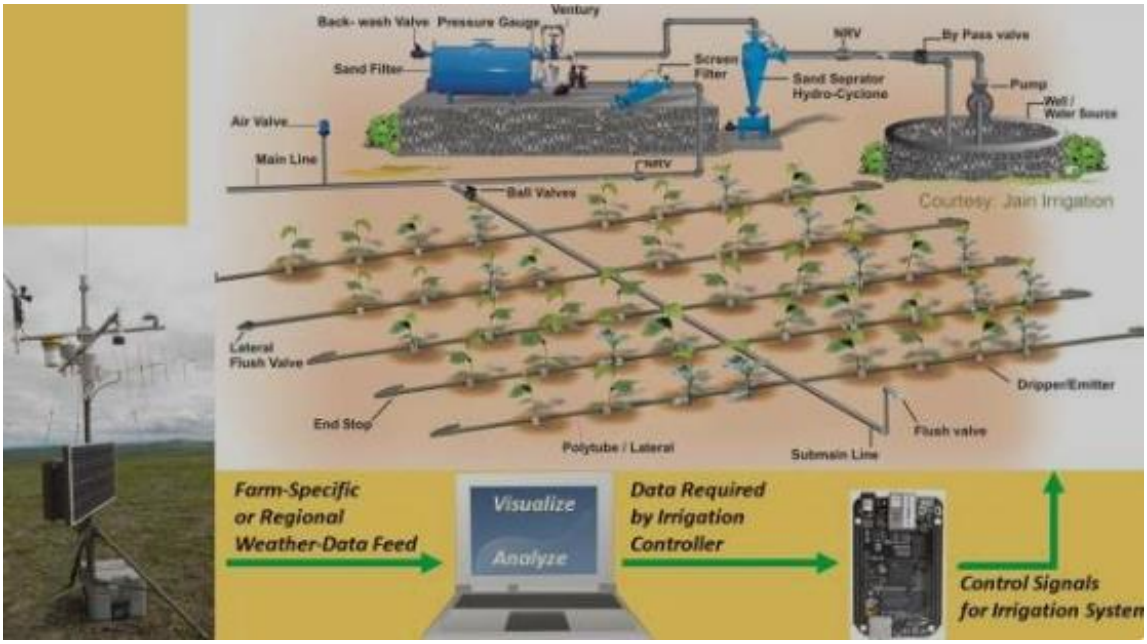


(a). Automated irrigation system:

Agriculture absorbs 85% of the world's available freshwater, and this figure is constantly growing as the world's population grows and food demand rises. When dealing with open-space agriculture, it is typical to encounter extremely inefficient irrigation systems, resulting in water waste rather than soil hydration. By scattering sensors measuring temperature, humidity, pH, and soil moisture throughout the fields, it is feasible to precisely water just the areas that require irrigation in an automated way.



The sensor data connected with each field segment is designed to activate a valve in that precise area of the field. Aside from this, plant evapotranspiration is influenced by a variety of climatic characteristics such as humidity, wind speed, sun radiation, and even crop aspects such as growth stage, plant density, soil conditions, and pests.

(b). Leaf disease detection:

It is anticipated that diseases account for a significant portion of agricultural output losses. The most common method of pest and disease control is to spray insecticides equally throughout the cropping area. This approach, while effective, has a high financial and environmental cost.

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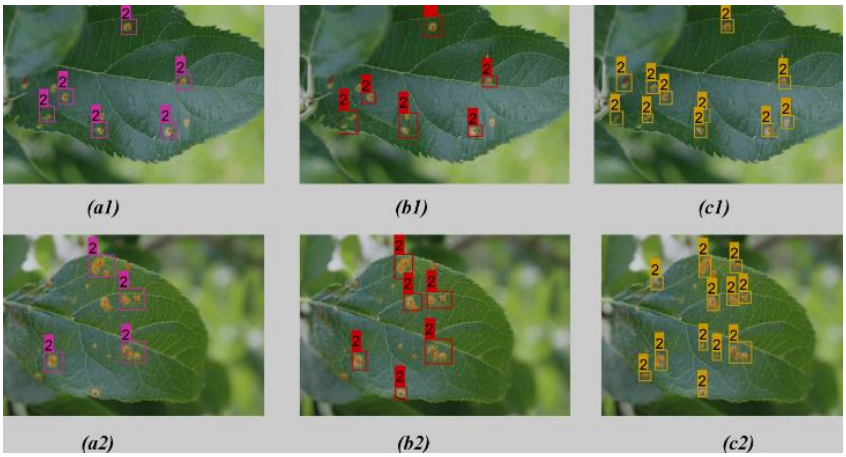
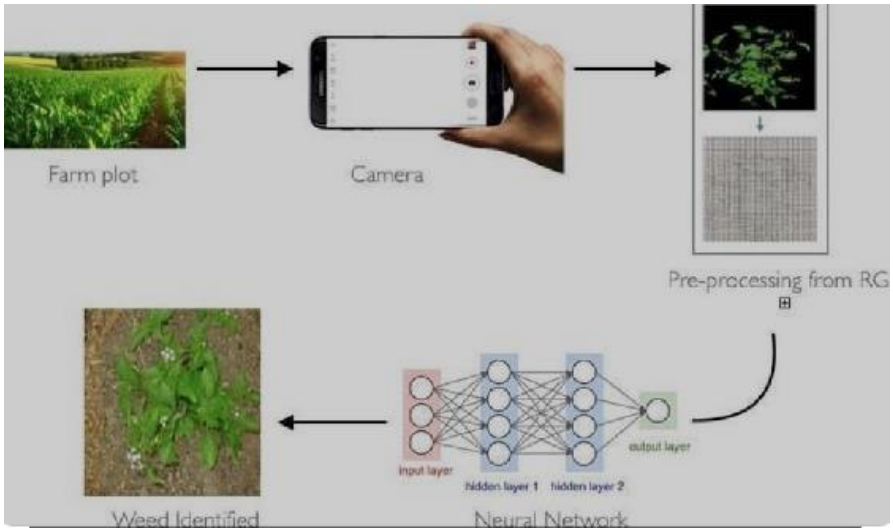


Traditionally, disease identification has been done manually by examining the colour of the leaves and the presence of spots. However, it has been used by computer vision systems to segment afflicted leaf sections and determine whether they are related to a disease or not. Companies employ drone-based aerial photography to monitor agricultural health and advise farmers on when and where to apply pesticides.

(c). Weed Detection:

Weed identification and management is another major issue in agriculture. Weeds, according to many growers, are the greatest serious hazard to agricultural productivity. Weed detection accuracy is critical considering the difficulties of distinguishing across crops. According to a study done in India, the competition between crops and undesirable weeds costs more than $11 billion. As a result, eliminating these weeds from the fields is critical to preventing space from being filled and affecting crop development.



To create a system with this use case, it is first important to distinguish between crops and weeds, and as we all know, computer vision is an effective tool for doing so the undesired guests can then be removed using micro sprays or lasers.

(d). Drone-related use cases:

Drones have helped to increase the popularity of aerial crop monitoring. With recent improvements and falling technological prices, more research has been performed with practical applications. These unmanned aircraft are used to monitor agricultural health, irrigation equipment, herds, and animals, identify weeds, and respond to calamities. Aside from that, their digital imaging systems can provide field elevation data, which may subsequently be utilized to determine drainage patterns and wet/dry regions. Farm management may also be utilized to ensure that everything runs well through real-time operation monitoring. Drones utilizing Computer Vision methods for product spraying and fertilization can achieve more precision than traditional tractors and are a safer choice for workers because they do not have to spray the plants manually and in proximity.

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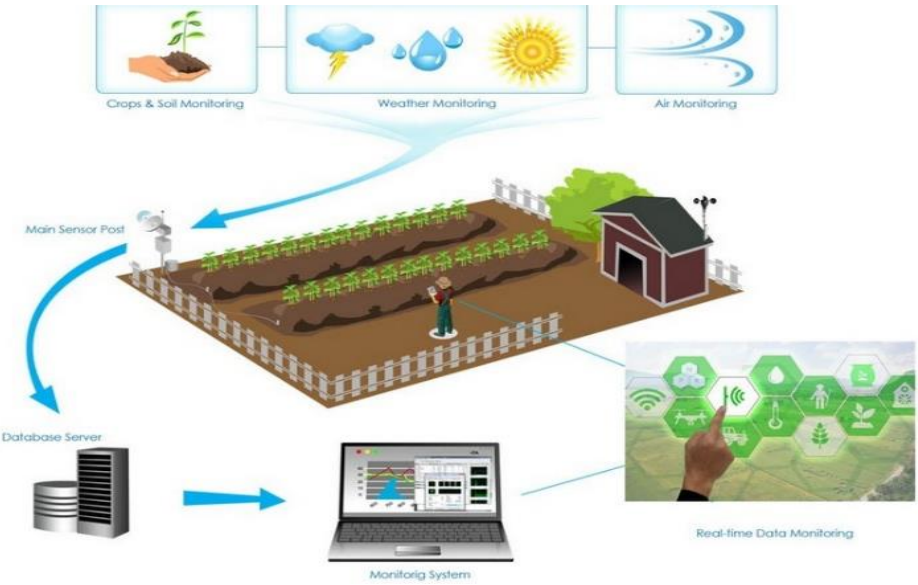
New sensors installed on drones, with high-tech cameras serving as the client's eyes on the ground, and ideal techniques for survey, data collecting, and analysis are constantly created and tested, but this is nothing new. Satellites have been used for more than a decade to examine big croplands and forests, but their precision and flexibility cannot compete with drones. Below are instances of drone usage.

(e). Increase farmer profitability:

AI improves food production and farmer profitability's poses a major danger to crop health. AI systems can identify insects landing on fields using satellite photography. AI can alert farmers to the pest's location via cell phones. Farmers can swiftly reduce pests and protect their crops. AI will enable farmers to increase agricultural yields while using less water. In drought-prone areas, farmers must preserve resources and money.



Many workers are concerned that AI will someday replace them. AI and digital agents are expected to hold several future occupations. AI is not projected to eliminate more employment than it generates**.** Agriculture, although being the oldest occupation, has become increasingly important due to food insecurity. AI technology supports sustainable food production. AI technologies are utilized to identify pests, predict optimal sowing times, and anticipate crop pricing.

(f). Autonomous Farming Equipment:

The integration of AI into farming equipment has led to the development of autonomous tractors, harvesters, and other machinery. These autonomous systems can navigate through fields using GPS and sensors,

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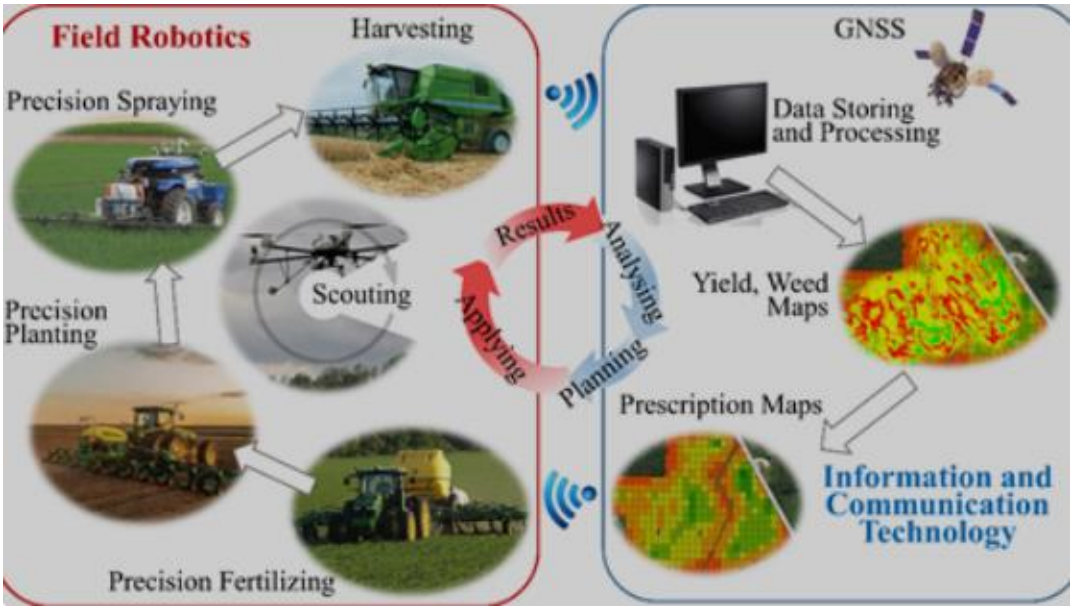
performing tasks with precision and efficiency. This is not only reducing the need for manual labour but also enhances the accuracy and speed of various farming operations.



(g). Climate Prediction and Adaptation:

AI is helping farmers adapt to changing climatic conditions by providing accurate climate predictions and recommendations. Machine learning algorithms analyse historical weather patterns to predict future climate patterns, helping farmers anticipate shifts in temperature, precipitation, and other factors. Armed with this information, farmers can adjust their planting schedules, crop choices, and cultivation practices to optimize yields and mitigate the impact of climate change.

(h). Supply Chain Optimization:

AI is playing a crucial role in optimizing the entire agricultural supply chain. From predictive analytics to demand forecasting, AI helps streamline the distribution process, ensuring that crops reach markets efficiently and minimizing waste. Smart logistics powered by AI also enable better inventory management, reducing post-harvest losses and improving overall supply chain resilience.

(i). Chatbots for Farmers:

Chatbots can be used as an interface between farmers and their customers or distributors. Farmers can use these conversational agents to answer questions about products or services offered, order supplies, and check inventory levels. Chatbots are also useful for managing databases of information about crops and soil conditions. The chatbots use personalized natural language processing and machine learning algorithms to understand farmer's queries and provide real-time insights on weather, market prices, and other agricultural information.

III. DISCUSSION

AI technology is widely used in agriculture to manage crops efficiently. It includes deep learning, computer vision, and machine learning. AI applications in agriculture provide farmers with precise and regulated agricultural advice, including water management, crop rotation, timely harvesting, and insect attacks. To enhance precision farming, computer vision technologies, drone data, and IoT alerts are integrated and analysed to deliver timely notifications. AI can predict the weather, analyse crop sustainability, detect diseases and pests, and transform agricultural practices. AI technology is widely used across various industries including healthcare, manufacturing, automotive, finance, and agriculture to overcome conventional hurdles and boost production and efficiency.

Deep learning, an AI function that processes data similarly to the human brain and generates patterns for decision-making, is becoming increasingly popular. It is being used to handle several agricultural concerns, such as disease detection, plant classification, and crop management. For instance, businesses are developing

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and programming self-driving robots to do agricultural tasks like soil analysis, weed control, seed planting, and harvesting more efficiently than humans.

Innovative approaches for large-scale data analysis and image processing are also covered by AI. Computer vision and deep learning algorithms are being developed to understand data from drones and other software technologies. Machine learning algorithms are being used to anticipate and monitor the impact of weather and climate change on agricultural productivity.

AI applications in agriculture provide farmers with precise and regulated agricultural advice, including water management, crop rotation, timely harvesting, crop type, optimal planting, insect attacks, and nutrition management. By accurately anticipating crop growth based on farm data and external influences like weather information, AI can detect and manage pest illnesses more efficiently. AI in agriculture enables farmers, even small enterprises, to easily interact with merchants globally.

To enhance precision farming, computer vision technologies, drone data, and IoT alerts are integrated and analysed to deliver timely notifications. Drone photos can help diagnose agricultural diseases more efficiently. Despite the potential benefits of AI in agriculture, many farms currently lack access to advanced machine-learning technologies which require large R&D expenditures and regular maintenance to function properly.

To answer real-world challenges, it's important to consider that most farmers have tiny landholdings and limited resources. Extension professionals should encourage farmers to see agriculture as a business and employ AI technologies to boost revenues sustainably. Farmers should be encouraged to use existing AI models and get proper demos and training on how to use certain AI-based technologies.

AI can boost agricultural growth and improve IT infrastructure. New data opportunities have led to the growth of AI and related technologies. Satellites and remote sensors can continuously collect data across a vast region, monitoring soil quality, humidity, temperature, and plant health. By providing farmers with statistical data, remote sensors can guide their operations, and adding more inputs and statistical data will improve the algorithm's accuracy in predicting various outcomes.

AI can predict the weather, analyse crop sustainability, and detect diseases, pests, and poor plant nutrition using temperature, precipitation, wind speed, solar radiation, and images from satellites and drones. It can transform agricultural practices and improve the livelihoods of farmers, especially in underdeveloped nations.

IV. FUTURE SCOPE

Artificial Intelligence (AI) has immense potential to revolutionize the agriculture sector by improving crop yields, reducing waste, and increasing efficiency. According to a report by Market and Markets, the market size for AI in agriculture is expected to grow from $2.35 billion in 2020 to $10.83 billion by 2025 at a Compound Annual Growth Rate (CAGR) of 35.6% during the forecast period.

AI technology enables farmers to collect and analyse large amounts of data, leading to informed decision-making and improved crop yields. By monitoring soil conditions, crop growth, and climate changes, farmers can detect diseases early and take necessary preventive measures before a crop is destroyed. AI also aids in forecasting weather changes, allowing farmers to plan their activities better and take advantage of the optimal planting season.

In addition, AI can help farmers optimize the amount of fertilizer and water used on their crops, leading to a more sustainable and environmentally friendly practice. This optimization reduces the risk of soil and water contamination, which is an increasing concern today.

However, most farmers worldwide, particularly smallholder farmers, lack the necessary resources to implement these technologies. Smallholder farmers have limited access to technical training, making it difficult for them to operate AI systems effectively. Many also lack the financial resources needed to purchase the equipment and software required for AI-based farming.

To bridge this divide, initiatives must provide access to training and funding for smallholder farmers to implement AI-based farming practices. This will ensure the adoption of AI in agriculture is inclusive, considering the needs and limitations of smallholder farmers, who make up a significant portion of the global agricultural workforce. With this, farmers at all levels can benefit from emerging technologies that secure our food system’s future.

V. CONCLUSION

This paper's survey mainly focuses on AI technologies that are capable of using data such as temperature, precipitation, wind speed, and solar radiation, along with machine learning algorithms and images from satellites and drones, to predict the weather, analyse crop sustainability, and evaluate farms for diseases, pests, and inadequate plant nutrition. Farmers who have access to Wi-Fi can use AI applications to get personalized agricultural plans.

AI-driven solutions can help farmers increase productivity and profitability while preserving natural resources. It provides real-time insights into fields and identifies areas for irrigation, fertilization, and pesticide treatment. Vertical agriculture boosts food output and quality while reducing herbicide usage, costs, and resource depletion.

AI technology captures high-resolution photos and irrigation data, identifies soil concerns, and assesses and ranks soil quality to enhance farm output. Automated farming, AI-enabled production, yield management, and AI-assisted picking, packing, and sorting improve food production and storage.

With the help of AI, farmers can better understand agricultural data such as temperature, precipitation, wind speed, and sun radiation. AI technologies can also help farmers address issues like climate change and bug and weed infestations, which in turn reduce harvests. Artificial intelligence will continue to enhance the agricultural process

VI. REFERENCES

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