

# DRONE TECHNOLOGY-THE FUTURE OF ARTIFICIAL INTELLIGENCE IN AGRICULTURE SECTOR

## Abstract

Rapid technological development and wide range of applications, artificial intelligence is one of the most important areas of research in computer science. The need for food is increasing along with the population's rapid growth, making the presence of AI in agriculture one of the main areas where it is extremely necessary. Farmers were using traditional methods, but they were insufficient to meet these demands. This led to the introduction of new automated techniques (drone technology). These cutting-edge methods helped feed the world while also opening up employment opportunities for billions of people. Drone technology helps make better use of labour, conserves soil fertility, minimises wasteful use of water, pesticides, and herbicides, increases productivity, and improves quality. The use of drone technology reduces spending on chemicals while saving time, labor, and water. Additionally, it lessens chemical use and prevents human exposure to chemicals. This paper's goal is to examine drone utilisation in agricultural applications. The present state of drone technology for agricultural uses, such as crop health monitoring and farm operations, is discussed in this study. The research report ends by urging more farmers to use drone technology to increase the quality of their agricultural production.

**Keywords:** Artificial Intelligence, Drone Technology, Agriculture, Applications.

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## **I. INTRODUCTION**

Modern technology develops quickly. Agriculture-related production equipment is in greater demand worldwide. The widespread usage of drones in commerce is very beneficial to agriculture. Drone technology was created by combining the advancements in aerial photography and aeronautical engineering. A few of the complex issues that farmers today must deal with include climate change, water quality, soil quality, volatile commodity prices, economic challenges related to productivity and cost-effectiveness, strict regulation, international competition, rising labour costs, population growth, urbanisation, an increasingly degraded environment, and changes in consumer tastes. For solutions, they are using cutting-edge technology. Any tool that will increase production must be given significant consideration. Drones are one of these tools, and they are cheap and simple to use.

## **II. ARTIFICIAL INTELLIGENCE IN AGRICULTURE**

Artificial intelligence (AI), a subfield of computer applications, is focused on the study of intelligent machines that can function like humans. The study of artificial intelligence requires a high level of technological expertise. Artificial intelligence will play an essential role in business and technology, and it will have a greater impact on education in the future. In the agricultural sector, artificial intelligence is now widely applied. Information on pest control techniques, yield maximisation, inappropriate soil treatment, pest control systems, disease management information, and information on farm technology and innovation are just a few of the risks and challenges that the agricultural business must deal with. Agriculture is one of the sectors that artificial intelligence (AI) is revolutionizing. Therefore, incorporating AI into agriculture is transforming food distribution and production. As a result, it is more effective, sustainable, and available. Additionally, AI is displacing conventional agricultural practices with technologies that aid farmers in optimizing crop yields, forecasting weather, and wise resource management. With AI, the agriculture sector is becoming more intelligent, effective, and sustainable. This is essential in a society where food consumption is always rising.

## **III. DRONE**

The study of intelligent computers that can perform human-like tasks is the focus of the branch of computer applications known as artificial intelligence (AI). A farmer may use drones to monitor farms and assess the condition of crops because they come with all the software, sensors, and hardware they might possibly need. An average drone has GPS, sensors, infrared cameras, software, programmable controllers, propulsion and navigation systems, and other components. An aerial drone's camera functions as a security camera. Drones cannot be climbed aboard by a human body because to their size. Both directly by an operator and autonomously are options for how to control them. The drone's camera records in-depth images as it flies over the field. Using a drone to collect data on various agricultural conditions is a cost-effective strategy. Drones are pilotless aircraft designed to collect data more precisely than satellites or commercial planes. Once the drone has captured and processed the data, it is made available to farmers in a way that can be used for management choices. Agriculture drone software will be required to process the data that your drone acquires.

**Agriculture Drones:** Agriculture drone refers to a drone that is utilized for agricultural purposes. Farmers and agriculture service providers are the two categories of professions who might be interested in owning an agriculture drone. Farmers will need to use next-generation technologies to meet new difficulties as the globe changes quickly. Drones can assist farmers in overcoming a variety of obstacles. Agriculture might undergo a transformation because to drone technology. Farmers may boost crop yields, save time, save costs, and act accurately and precisely by having access to a wide pool of data.

Drones can facilitate profitable farming, enhance yield, and enable sustainable farming. They aid farmers in making the best use possible of inputs including pesticides, water, fertilizer, and seeds. Drone technology is used in a variety of agricultural applications, including crop scouting and monitoring, crop volume, prescription map generation, precision spraying, inspection of agricultural infrastructure (including irrigation), field mapping and surveying, crop damage assessment, and insurance claim forensics. Drones for agriculture can be used for spraying, monitoring, assessing droughts, and aerial photography of animal activities. Drone data is an effective tool for helping farmers see their farms. Farmers can evaluate the fertility of their crops using high-resolution drone data, which enables agricultural experts to apply fertilizer more precisely and cut down on waste.

#### IV. APPLICATIONS OF DRONES IN AGRICULTURE

- 1. Crop Monitoring:** Crop surveillance refers to the observation of a crop's growth from the moment the seeds are sown until the crop is ready for harvest. This involves monitoring insect infestations, scheduling the use of fertilisers, and measuring the effects of the weather. Crop surveillance is the only way a farmer can ensure a timely harvest, especially when working with seasonal crops. Any errors now might result in a crop failure. Crop monitoring may be used to comprehend and plan for the future farming season. Drones can help with effective crop surveillance by scanning the area using infrared cameras. The health of the plants there can then be improved by farmers taking immediate action based on the information they get.
- 2. Soil and Fields Analysis:** Drones used in agriculture can analyse soil and fields to design farms more efficiently. They can be used to mount sensors that assess soil fertility, soil nutrient concentration, soil erosivity, topography, and soil conditions.
- 3. Plantation:** Drones can help in tree and agricultural planting, a chore that was formerly done by farmers. With the use of this technology, labour and fuel expenses may be reduced. In the near future, cost-effective drones are expected to take the place of large tractors since they harm the environment and generate hazardous chemicals.
- 4. Livestock Management:** Large cattle can be observed and handled by drones because they have high-resolution infrared cameras built into their sensors, which can quickly recognise ill animals and take immediate action. Drones' influence on precision dairy production will swiftly displace the present norm as a result.
- 5. Crop Spraying:** Agri-drones can be used to spray chemicals because, in contrast to traditional methods, their reservoirs can be swiftly loaded with fertilisers and pesticides

for use on crops. Drone technology thus has the potential to usher in a new era of precision farming.

- 6. Irrigation Management:** Providing enough water to cultivate crops is a difficult undertaking in the majority of drought-prone countries. The water is currently delivered to a field uniformly using the available irrigation techniques. To make the best and most efficient use of the available water resources, it is necessary to supply the water where it is actually needed. Water is a vital component of crop growth; insufficient or excessive amounts might interfere with a plant's ability to develop properly. In a big agricultural area, farmers need to implement adequate irrigation management based on the grown crop. Using thermal cameras, the drone can help farmers make informed decisions for precise irrigation management. The soil moisture stress state and excess water at a specific location in the agricultural field can be captured by the drone. Drone-assisted fieldwork assists in improving water use efficiency and identifying irrigation leaks through regular irrigation monitoring. Drones using sensors, multispectral imaging cameras, and thermal cameras can record the effects of heat and water stress on crops in specific agricultural areas. It allows irrigation to be used on crops according to their requirements. This will ensure that irrigation water is used efficiently and prevent water from being wasted.
- 7. Crop Damage Assessment:** Multispectral and RGB sensors on agricultural drones enable them to detect weeds, illnesses, and pests in field areas. The amount of pesticides needed to eradicate these pests may be precisely calculated using this knowledge, which decreases the farmer's expenditures.
- 8. Verify the Health of the Crop:** Acres of land are needed for the large-scale Endeavour of agriculture. Regular surveys are necessary to monitor the state of the soil and the crop that has been planted. If done manually, it may take days, and even then, mistakes could be made by humans. Drones can finish the same job in a few hours. To gather information on the state of the crop and the soil, drones can employ infrared mapping.
- 9. Avoid Over Use of Chemicals:** Reduced usage of pesticides such as herbicides and insecticides may be made possible by the use of drones. In actuality, these compounds aid crop protection. However, utilizing them too frequently might be harmful. Drones can accurately assess the intensity and breadth of an attack by seeing even the tiniest indicators of insect infestations. Farmers may use this to determine how much pesticide should be used to guarantee that the crops are only protected and not harmed.
- 10. Prepare for Weather Glitches:** A farmer's best friend and worst opponent might both be the weather. Because patterns cannot be accurately predicted, it might be difficult to prepare for any changes in them. Drones can anticipate weather conditions in the future. Storm drones are already being used to produce improved forecasts. By employing this information, farmers may also make better preparations. Using forewarning of storms or a shortage of rain, one may plan the crop to be planted that would be optimal for the season as well as how to care for planted crops later on.

Drones with integrated thermal cameras can identify animals both during the day and at night, alerting farmers. Therefore, farmers using drones can prevent agricultural damage brought on by outside animals. The birds may flee the field after a few drone flights.

- 11. Tracking Livestock:** Farmers can follow the movements of their animals in addition to their crops thanks to the drone survey. Animal recuperation and disease or damage detection are made easier by thermal sensor technology. This task is well suited for drones to perform, which significantly boosts the growth of vegetation.
- 12. Plant Establishment:** It is evident that there used to be a labor shortage during crop-sowing activities. With utmost accuracy and in a very short amount of time, drone technology can solve this problem by planting crops throughout a big field. Seeds are planted and nutrients are sprayed on the agricultural land using drone planting devices in a predetermined manner. In addition to lowering costs, it has been shown that the deployment of drone technology improves crop management consistency and effectiveness. Some inventors have created add-ons for drone systems that allow them to fire pods containing seeds and plant fertilizers into already prepared soil. Real-time meteorological conditions can be detected by drones, and farmers can analyse the data they collect to create a plan for risk reduction in preparation. Planning various agricultural activities and judicious resource allocation might be aided by advance knowledge. In disaster management, the risk is decreased by using real-time data acquired from the ground by drones to anticipate future catastrophic occurrences. Drone-based data collection is more flexible, timely, accurate, and less expensive than satellite-based Remote Sensing (RS). Through accurate prediction and necessary adjustments, this drone-enabled data helps to increase agricultural output and supply chain management.
- 13. Pest Management:** Locust attacks on crops are posing additional difficulties for farmers in addition to their inherent vulnerability. The cultivated crop that the army of locusts decimated caused the catastrophe and the financial loss for the farming community. Many Indian states are employing drones to spray insecticides to eradicate the locust, a process that would otherwise be very impossible to complete by hand.
- 14. Agricultural product transportation:** In accordance with the requirements of the farmer, drones can also transport agricultural products from one place to another. The drones may park in a field and be utilized for activities like spraying, monitoring, and transferring freight. They are capable of a wide range of functions.

## V. BENEFITS OF DRONE TECHNOLOGY

- 1. Increased Output:** By carefully planning irrigation, monitoring crop health, learning more about soil health, and reacting to environmental changes, the farmer may increase output capacity.
- 2. Effective and Flexible Techniques:** The usage of drones gives farmers regular crop updates and helps to advance agricultural methods. They are able to distribute resources effectively and change course as the weather does.

3. **Greater Farmer Safety:** It is safer and more feasible for farmers to use drones to spray pesticides in hard-to-reach terrain, polluted places, higher crops, and power lines. Farmers can also lessen soil pollution and chemical contamination by forgoing spraying crops.
4. **Less Wastage of Resources |:** Resource waste is reduced since agri-drones enable the best possible use of all resources, including seeds, water, fertilizer, and pesticides.
5. **5.99% Accuracy Rate:** The drone survey aids farmers in mapping the soil, calculating the exact area of the field, and dividing up the various crops.
6. **Helpful for Insurance Claims:** Farmers utilize the information obtained by drones to file crop insurance claims in the event of damage. Even if they are insured, they nevertheless analyze the risks and losses related to the land.
7. **Evidence for Insurance Businesses:** The agricultural insurance sectors employ agri-drones to swiftly obtain accurate data. They keep track of the damage done in order to accurately calculate the cash compensation to be awarded to the farmers.

## VI. CHALLENGES IN ADOPTION OF DRONES IN AGRICULTURE

The application of drone technology in agriculture is impeded by a number of issues. For adoption to be successful, these issues must be resolved. These challenges include:

1. **Internet Connectivity Issue / Internet Access:** Drone operation is complicated by the poor internet access.
2. **Weather Dependency:** Drones function better and more effectively than human labor under normal weather conditions. However, it is not advisable to fly drones in adverse weather due to the increased danger of falling or less accurate operation.
3. **Knowledge and Skill:** Utilizing new technology is intriguing, but flying a drone frequently requires the right skill set and knowledge.
4. **Regulatory Uncertainty:** The laws governing drone use are still being created. If criteria are established for allowed chemicals, drones for spraying pesticides in agricultural fields will become more popular faster.
5. **High Cost:** The cost of drone technology, training, and use in agriculture is higher. Small-scale manufacturing is done at significant fixed costs. A village businessperson cannot afford to buy or rent one and utilize it for farm applications or surveys.
6. **Limited Flight Time and Range:** Drone flights frequently last 20 to 60 minutes because of their heavier payloads. As a result, the quantity of field coverage per charge is reduced and the cost of operating the drone is increased.

7. Expansion of the UAV business in India, in addition to technical expertise and cost. Agri-drones are available for purchase by farmers; however upkeep costs for battery technology are high.
8. **Techno-Economic Feasibility:** The techno-economic feasibility of drone applications may limit their spread in India, since the majority of farmers are small-scale and ownership of land is dispersed.
9. **Safety and User-Friendliness:** Due to safety concerns, drones cannot be deployed in public without prior government authorization. Serious concerns over privacy, safety, and criminality.
10. **Dependency on Imports:** Due to limited startup funding, insurance coverage, and spending on drone research and development, there is a significant reliance on imported drone parts.
11. **Privacy issue:** Many people worry that their privacy would be violated if unmanned aerial vehicles (UAVs) are used for tracking and spying. The absence of clearly defined operational and technical rules for the safe operation of UAVs is a major challenge. There is the possibility for misuse to transfer information unlawfully and to violate people's privacy.

## VII. INITIATIVES TO APPLICATION OF DRONE TECHNOLOGY IN INDIAN AGRICULTURE

Although drone technology in Indian agriculture is still in its infancy, the government is making an effort to encourage the use of drones by collaborating with farmers, academics, the private sector, and agri-tech start-ups in order to reap the potential benefits of this technology. In an effort to hasten the implementation of such cutting-edge digital technology in agriculture, the government is attempting to provide policy support through the NeGP-A and Union budget 2022–23. 'Kisan Drones' for the use of drone technology in agricultural tasks like crop assessment, digitalization of land data, and application of nutrients and insecticides. By increasing efficiency and accuracy, programs like Kisan Drones can completely change the agriculture industry. It would also encourage the convenience of conducting business in the farming industry and draw young, educated individuals to the field. The 'Drone Shakti' and Drone-As-A-Service (DrAAS) will be made a reality by promoting and assisting entrepreneurs that deal with the use of drones in various industries. The Indian government launched the online "Digital Sky Platform" platform for drone registration and use in India in order to encourage domestic drone development and acceptance. The two task forces were specifically created by the national government to design and manufacture aircraft and drones in the nation. This program will encourage the advancement of domestic drone technology and its use in a variety of fields, including agriculture.

The Union government has established the Production Linked Incentive (PLI) program for drone makers, and it has been suggested that any value-added drone technology be rewarded with 20% incentives. By supporting drone technology development and use in India, this program hopes to make a difference. The cost of drones is the biggest obstacle to

farmers embracing this practical technology. Since 86% of Indian farmers are small or marginal farmers, new technology must be reasonably priced and accessible to them in order for it to be embraced as broadly as possible. Attempts to address this issue have been made by both the public and private sectors. The International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) has been given permission by the central government to deploy drone technology into Indian communities and utilise it for agricultural research. Initiatives of the national government, such as the Pradhan Mantri Fasal Beema Yojana (PMFBY), used cutting-edge technologies, such as remote sensing and drone technology, to identify fraud, false claims, and anomalies.

## VIII. CONCLUSION

Drones help agriculture perform better overall, encourage farmers to use precision farming techniques, and give farmers the chance to switch from farming to a technology-intensive vocation. It would help to reduce human mistake and inefficiency in present agricultural practices by providing accurate and reliable information on the status on agricultural fields. The drone serving as "an eye in the sky" will usher in the next agricultural revolution. Software, sensors, cameras, and various analytical tools work together to automatically record data and images, translate them into usable information, and then evaluate those insights. This greatly reduces the possibility of human error. Drone technology may assist farmers in making decisions in two ways, and it can also replace human labor by doing various chores in the field more accurately and quickly. The use of drones in agriculture is being hampered by a number of issues. To effectively accept and utilize drone technology's potential for revolutionizing India's agriculture industry and millions of farmers' lives, these difficulties must be overcome

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