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Impact of Drone in Agriculture Sector

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ABSTRACT: In India, drones are becoming a useful tool for agriculture. They can offer real-time information on nutrient levels, soil moisture, and crop health, which can assist farmers in making better management choices. In various Indian states, drones are employed for tasks like crop monitoring, yield estimation, insect management, and soil study. The potential advantages of deploying drones in agriculture are obvious, despite the regulatory issues that need to be resolved. Improved sensor technology, technological integration, more automation, and broader applications are just few of many future possibilities for drone use in agriculture sector at India. Drones are set to play a bigger role in Indian agriculture sector as technology advances.

KEYWORDS: Drone, Agriculture, Tech Agriculture, Agricultural Drones.

I. INTRODUCTION

The global population is projected to reach 9 billion people by the year 2050, and experts predict that at that time, agricultural consumption would also rise. Amount of food using for biofuels, food production must increase by 70% to feed this larger, more urban and wealthier population [1]. The amount of cereal produced annually must increase from the present 2.1 billion tonnes to around 3 billion tonnes, and the amount of meat produced annually must increase about 200 million tonnes to touch 485 million tonnes. The agriculture industry is among the most promising and difficult sector because it relies on weather, soil quality, irrigation water amount, and rate of application. According to this paper, implementing advanced agricultural production methods will enable us to expand food production to the necessary level. Several significant or minor issues could be encountered while using cutting-edge technologies in agriculture like drones. Drones in agricultural practices are primarily employed for irrigation, crop monitoring, soil and field studies, and bird control.

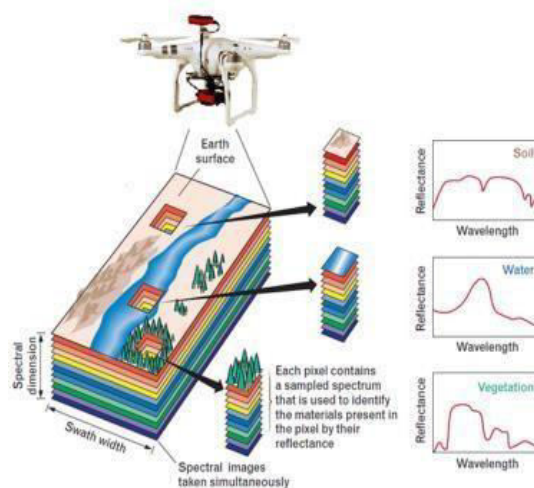
II. LITERATURE SURVEY

Smart buildings, traffic management, waste management, emergency services, water quality monitoring, transportation, and weather monitoring are just a few of the industries that are greatly impacted by the Internet of Things (IoT). The available research states that the Internet of Things (IoT) improves security, user comfort, convenience, efficiency, and scalability by connecting items to the Internet using wireless technologies including Wi-Fi, Bluetooth, and Radio Frequency Identification (RFID). [1] Studies suggest that the integration of sensors and actuators into commonplace products and infrastructure through IoT applications enhances both operational efficiency and quality of life. Research, for instance, demonstrates developments in smart waste management systems that utilize sensors to monitor garbage levels and improve collection routes, as well as smart transportation systems that optimize traffic flow and minimize congestion (Bertolini et al., 2020) (Santos, et al., 2021). Furthermore, it has been demonstrated that IoT applications for weather forecasting and water quality monitoring may supply vital information for disaster preparedness and environmental management.

III. APPLICATIONS OF IOT

A. CROP MONITORING

Drones using cameras and sensors may take high resolution pictures and data of crops, enabling farmers to spot early indicators of crop stress, disease, and pests. Farmers can utilize this information to make more informed decisions about pest control, fertiliser, and irrigation. As shown in the figure 1.



B. LIVESTOCK MONITORING

Farmers may follow the movement of their animals and their grazing habits, along with spot overgrazed or underused areas, by watching them from the air. By doing this, farmers can minimise the impact on the environment while maximizing grazing resources. Farmers are able to respond to possible issues or emergencies more rapidly because to drones' speedy and effective coverage of broad areas.

C. CROP SPRAYING

A contemporary technique for applying insecticides, herbicides, and applying fertilizers to crops using unmanned aerial vehicles is called crop spraying. In comparison to conventional ground-based techniques, this technology offers a number of benefits, including improved accuracy, speed, safety, and accessibility. Using drones, farmers can swiftly and effectively cover enormous areas, using fewer pesticides and having less of an impact on the environment. Regulation limitations and a payload capacity ceiling are two issues with drone-based crop spraying, though. Yet, this technology holds great promise for enhancing crop management, lowering labour costs, and raising agricultural productivity. As depicted in the figure 2.



Figure 2: Crop Spraying

D. PLANTING

Drone planting allude to the use of Unmanned Aerial vehicles (UAVs), drones to scatter seeds or seedlings across wide areas. Compared to conventional planting techniques, this technology offers a many benefits, including enhanced accuracy, efficiency, accessibility, uniformity, and less environmental effect. To achieve more consistent plant growth and larger harvests, drones can plant seeds at a constant depth and spacing.

Drones can also access locations that are challenging to access, including steep hills or flooded fields, enabling more thorough planting. While drone planting technology is still under development, it holds the potential to completely change how we plant crops and manage our property. Drones can be connected with other technology to give farmers data- driven insights into their land, crops, and resource management. As shown in the figure 3.



Figure 3: Planting Crops

E. SOIL AND FIELD ANALYSIS

During the at the start of the crop cycle, drones can offer valuable insights for soil and field study, which is an essential element of crop management. Farmers may more precisely plan seed planting patterns by using drones to provide accurate 3-D maps for early soil analyses. Farmers can identify locations with varied soil types, moisture levels, or nutrient concentrations and modify their planting approach by utilising drones to investigate the soil.

Drones can still offer valuable insights for irrigation and nitrogen management after planting. Farmers may modify their irrigation and fertiliser use to maximise crop growth and reduce waste by using drone-driven soil analysis to monitor soil moisture and nutrient levels.

Overall, drones are instrumental in soil and field analysis, providing farmers with data-driven understanding of their land and crops. By employing drones for soil and crop health monitoring, farmers can enhance their decision-making, optimize resource management, and improve productivity.

IV. DRONE TECHNOLOGY

Drones may carry out many agricultural chores because they are outfitted with a variety of technology. They use GPS to navigate and determine their location, sensors to gather information on soil moisture and crop health, communication systems to relay information to users on the ground, and remote control systems to direct the flight path. The drone's flying time and range are controlled by its battery and propulsion systems, while its flight direction, data collecting, and communication are all managed by software. Drones can be fitted with a variety of sensors, including cameras, thermal imaging sensors, LiDAR sensors, and multispectral sensors, to gather information on the condition of crops, temperature, and other factors.

Overall, this technology fusion enables drones to gather real-time information on crop health, soil moisture, and other significant factors, which can assist farmers in making more educated decisions about crop management. Drones may also come equipped with additional features and technology to enhance their functionality in addition to the ones

already listed. Certain drones, for instance, may be equipped with obstacle avoidance technologies that let them recognise and steer clear of objects like trees or power lines that are in their course of flight. Some people may possess sophisticated image processing capabilities that allow them to evaluate data in real-time and spot trends or anomalies in crop health or soil quality.

Advanced artificial intelligence systems can also be installed in drones, allowing them to make autonomous judgements and modify their flight path and data collecting based on varying environmental conditions. Drones are set to become much more competent and sophisticated as technology advances, allowing them to play a bigger part in future advancements of agriculture.

A. Advantages

Unmanned aerial vehicles offer a more stressful environment, improve decision-making, present a safer alternative, and allow for longer flight times (there is no human weariness in the aircraft). It doesn't necessitate a licenced pilot to fly it; in the long run, unmanned aircraft can stay airborne for up to 30 hours, performing repetitive tasks such as performing a precise, repetitive faster scan of the area day in and day out, night after night, in total darkness or in the fog, and while under computer control.

Unmanned aircraft do geological surveys, thermal or visual imaging of the area, and measurements of the cell, radio, and television coverage over any terrain. Drone operators or pilots can effortlessly switch the controls of the aircraft without causing any operational pause. From further out, the drones' precise accuracy can be improved.

B. Dis-Advantages

- Cost: Drones can be expensive, and the cost of acquiring and maintaining them may be prohibitive for some farmers.
- Technical expertise: The technical knowledge and training needed to operate drones can be hurdle for some farmers.
- Privacy concerns: The utilization of drones can raise privacy concerns, especially if used to observe private property or collect sensitive data.
- Weather conditions: Drones are sensitive to weather conditions such as high winds, rain, and fog, which can limit their operation.
- Battery life: Drones typically have a battery constraint which can restrict their operation time and require frequent recharging.
- Limited payload capacity: Drones have a limited payload capacity, which can restrict the amount of equipment or supplies that they can carry.

Honeycomb AgDrone System: The Honeycomb Company's AgDrone System is thought to be the most advanced drone for agriculture, flying at 400 feet and covering 600–800 acres of land every hour. The drone's wings are made of a

composite of Kevlar Fiber, the same material used in bulletproof jackets, making it resilient, adaptable, and powerful for agriculture in all environments [3]. As depicted in the figure 4.



Figure 4: Honeycomb AgDrone System

- DJI Matrice 100: With dual battery support, which extends flying endurance by about 40 minutes, the DJI Matrice 100 is considered as the Best Quadcopter-based Drone for Agricultural. This drone has unique features like GPS, a flight controller, and DJI Lightbridge, which is a sophisticated flight navigation system that is simple to use in any setting and can perform difficult tasks [3]. As depicted in the figure 5.



Figure 5: DJI Matrice 100

- DJI T600 Inspire 1: Another robust agriculture drone with a carbon fibre finish is the DJI T600 Inspire Quadcopter, which is renowned for its quick charging. It offers intuitive navigational capabilities, individual flight and camera control, and 4K video recording as distinctive features [3]. As shown in the figure 6.



Figure 6: DJI T600 Inspire 1

Agras MG-1- DJI: The Agras MG-1 from DJI is the best octocopter for farmers to use for spraying herbicides, insecticides, or fertilisers across vast tracts of farmland. The MG-1's ability to transport liquid payloads up to 10KG and its capacity to cover an area of 400–6000 m² in under 10 minutes—70 times faster than hand spraying—are its unique features. To maintain airflow to all the drone's components while in flight, the MG-1 includes a totally sealed fuselage and an effective, integrated centrifugal cooling system. For precise fertiliser application in the field, the MG-1 is outfitted with four nozzles. It also has three flight modes: Smart, Manual Plus Mode, and Manual Mode, each of which is customized to the specific needs of the field. Without the utilization of any additional equipment, MG-1 has a Y-type folding structure [3]. As depicted in the figure 7.



Figure 7: Agras MG-1- DJI

- EBEE SQ-SenseFly: The EBEE SQ is a high- performance agricultural drone that has specially created for crop monitoring from planting to harvest to help farmers increase crop productivity. This drone contains a multispectral sensor that can record data across four infrared bands and RGB imagery in just one flight. It is fully integrated, extremely precise, and has these capabilities. This quadcopter drone includes autonomous 3D flight planning and offers a wider coverage than other quadcopters. NVDI maps for crop fields may be created using the drone and Pix4dmapper AG mapping software, and trouble spots can be found while in flight [3]. As shown in the figure 8.



Figure 8: EBEE SQ-SenseFly



Figure 9: SOLO AGCO Edition

V. USE OF DRONES IN INDIA

In India, a diverse range of businesses, including agricultural, are increasingly using drones. Drones are being utilised in agriculture for various tasks, such as crop monitoring, yield mapping, and pest control. In India, where farming accounts for a significant portion of the economy and small-scale farmers are common, the utilization of drone in agriculture is particularly pertinent. Drones are utilised for management of pest in addition to monitoring crop and yield mapping. Pest infestations can be detected and treated using drones with sensors and sprayers, which eliminates the necessity for pesticides and other harmful chemicals.

In general, the utilization of drones in Indian agriculture has the potential to boost efficiency, decrease waste, and improve agricultural yields. To guarantee the safe and responsible use of this technology, there are regulatory difficulties that must be overcome. The government of India has taken steps to control drone use in the nation, including drafting drone usage regulations and establishing a registration procedure for drone operators. As shown in the figure 10.

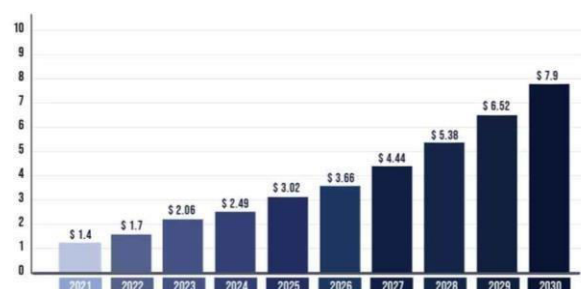


Figure 10: Agriculture Drone Market

A. States that are currently practising

- Maharashtra: The Maharashtra government has launched a pilot project to use drones in agriculture. The project aims to use drones for agricultural crop monitoring, yield estimation, and identifying areas of the farm that require attention.
- Karnataka: The Karnataka government employs drones for crop monitoring and precision agriculture. Drones are being used to capture images of crops and analyse them utilizing machine learning algorithms to identify areas that require attention.
- Tamil Nadu: The Tamil Nadu government is using drones to map and survey agricultural land. Drones are being used to create high-quality images and maps of farmland, which can be used for crop management and planning.
- Gujarat: The Gujarat government is using drones for agricultural monitoring of crop and yield estimation. Drones are being used to gather data on crop growth and health patterns, to help farmers optimize their planting and irrigation practices.
- Punjab: The Punjab government is using drones for crop monitoring, pest control, and yield estimation. Drones are being used to identify pest infestations and spray pesticides, also to gather data on crop health and yield.

VI. LITERATURE SURVEY

- [1] By 2050, it is predicted that there will be 9 billion people on the planet, meaning that the amount of food consumed would likewise rise. Everybody's food needs must be met, and this is of the utmost importance. The most optimistic sector is agriculture. Industry, which is currently faced with a number of issues. The lack of labour for farming is the main issues. Extreme weather conditions, insufficient fertiliser application, infected plants, infections, allergies, and other health issues caused by chemical treatments (pesticides, insecticides and fungicides etc.) or bites from insects or animals are some more issues or challenges. Drones in agriculture are primarily used for crop monitoring, irrigation, field and soil studies and bird control.
- [3] Drones, also known as unmanned aerial vehicles or UAVs, are typically associated with the military, business, and other specialised operations. However, with recent advancements in the fields of sensors and information technology over last two decades, the application of drones has been expanded to include other sectors, such as agriculture. Modern drones are growing smarter by incorporating open-source technology, intelligent sensors, greater integration, longer flight times, criminal detection, and the detection of forest and other disaster zones. The goal of this study paper is to emphasise the value of drones in agriculture and detail the top drones now on the market for agricultural monitoring and observation that will provide better crop quality and shield farms from harm.
- [5] A significant portion of current drone research initiatives involves precision agriculture. Commercial drones are needed in agriculture since the sector is growing; advanced analytics and software work with advanced drone solutions to enable innovations. Drones are a crucial component of precision agriculture in the farming of the future because they provide aerial crop and livestock condition monitoring. The research and application of drones for agriculture, package delivery, and GIS are reviewed in this paper. We look at the ways that drones are utilised, such as for applying pesticides and mapping in agriculture. In the conclusion of the paper, analysis and discussion are offered.

VII. CONCLUSION

In summary, drone is useful tool for Indian agriculture. They may increase efficiency, decrease waste, and raise crop yields. Drones can assist farmers in spotting concerns early and taking corrective action by delivering real-time information on soil moisture, crop health and nutrient levels. Drones is versatile tool for agriculture because they may also be used for soil analysis, insect management, and yield mapping. While there are some legislative issues that need to be resolved in order to guarantee the safe and responsible usage of drones, the benefit of this technology for Indian agriculture are obvious. Drone use for crop management and other purposes is projected to increase as this technology is more generally embraced in Indian states.

FUTURE SCOPE

Drones can be combined with other technologies for produce more sophisticated analytics and insights, such as artificial intelligence and machine learning. As a result, farmers able to improve their crop management techniques and make more data-driven decisions.

- Increased automation: Drones are expected to become more autonomous as drone technology develops. As a result, farmers will be capable to programme drones to survey their fields at predetermined intervals, gather data, and make choices autonomously.
- Increased sensor capabilities: Drones will be capable to gather increasingly more precise information on crop health, soil moisture, and nutrient levels as sensor capabilities continue to advance. This advancement will assist farmers in managing their crops more effectively and increase yields.

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