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# Revolutionizing Agriculture with Drone Technology

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**SUMMARY**

The world population has increased daily and is projected to reach 9 billion people by 2050 so agricultural consumption will also increase. There is an extreme need to fulfill the food demands of every person. The agriculture sector is the most promising, dealing with many problems now a day's one of the main problems is labor unavailability for farming. Other problems or difficulties are extreme weather events, inadequate amount and inefficient application of fertilizer, infection, diseases, allergies, and other health problems due to chemical application (fungicide, pesticide, insecticide, etc.) or insect/ animal bites. Using advanced technologies such as drones in agriculture offers the potential for facing several major or minor challenges. The major applications of drones in agriculture are irrigation, crop monitoring, soil and field analysis, and bird control. The population is increasing tremendously and with this increase the demand for food. The traditional methods which were used by the farmers were not sufficient enough to fulfil these requirements. Thus, new automated methods (Drone technology) were introduced. These new methods satisfied the food requirements and also provided employment opportunities to billions of people. Drones' technologies save the excess use of water, pesticides, and herbicides, maintain the fertility of the soil, and also help in the efficient use of manpower elevate productivity, and improve the quality. The objective of this paper is to review the usage of Drones in agriculture applications. Based on the literature, we found that a lot of agriculture applications can be done by using Drones.

## INTRODUCTION

As much as India depends upon agriculture, still it is far short of adopting the latest technologies to get good farms. Developed countries have already started the use of UAVs in their precision agriculture photogrammetry and remote sensing. It is very fast and it could reduce the workload of a farmer. In general, UAVs are equipped with cameras and sensors for crop monitoring and sprayers for pesticide spraying. In the past, a variety of UAV models ran on military and civilian applications. Technical analysis of UAVs in precision agriculture is to analyse their applicability in agriculture operations like crop monitoring crop height Estimations pesticide Spraying and soil and field analysis. However, their hardware implementations are purely dependent on critical aspects like weight, range of flight, payload, configuration, and costs.

Drones have long been thought of as expensive toys. One area that has seen little attention from drones, perhaps to its detriment, is the agricultural sector. Drones can fly autonomously with dedicated software which allows making a flight plan and deploying the system with GPS and feeding in various parameters such as speed, altitude, ROI (Region of Interest), geo-fence, and fail-safe modes. Drones are preferred over full-size aircraft due to major factors like the combination of high spatial resolution and fast turnaround capabilities together with low operation cost and ease of trigger. These features are required in precision agriculture where large areas are monitored and analyses are carried out in minimum time. Using aerial vehicles is possible due to the miniaturization of compact cameras and other sensors like infrared and sonar.

The Japanese were the first to successfully apply UAS technology to agricultural chemical spraying applications in the 1980's and crop dusting in the 1990's. As of 2001 1,220 units of Yamaha unmanned helicopters had been sold and were in use in Japan. Over 2,000 Yamaha RMAX unmanned hellos spray about 2.5 million acres a year, covering about 40% of the country's rice paddies in Japan. The U.S. is behind Japan in UAV agricultural applications, and advocates have to navigate through a minefield of privacy and legal issues to legally implement them into society. Although the use of UAVs in agriculture has been steadily increasing, such growth is hindered by many technical challenges that still need to be overcome. Among those applications, stress detection and quantification is arguably the one that has received the greatest amount of attention, most likely due to the potential positive impact that early stress detection can have on agricultural activity. As a consequence, a large amount of data has been generated and a wide variety of strategies have been proposed, making it difficult to keep track of the current state of the art on the subject and the main challenges yet to be overcome. In this context, the objective of this article is to provide a comprehensive overview of the application of drones (UAVs) in agriculture to monitor and assess plant stresses such as drought, diseases, nutrition deficiencies, pests, weeds, etc.

Crop monitoring for insects, nutrients, disease, water stress, and overall plant health is an important aspect of precision agriculture operations. This has been carried out by examination from the air or on the ground traditionally, but these methods are limited by cost of operation and availability. Imagery created using light aircraft usually has higher resolution, is cheaper, and more up-to-date, but it is still relatively expensive per acre. Small UAVs or UAS can be used to acquire temporal/spatial data with a resolution of centimetres and can fly consistently with repeatability of route and altitude to continuously cover the crop's fields. The acquisition of the images by UAVs is manageable and not as influenced by cloud cover. As indicated, UAS has been used in many areas of agriculture, although they still have many limitations and challenges to overcome. This paper summarizes major UAS applications and technologies for agriculture and discusses the challenges of using UAS in an agricultural context.

**Basic Principle - How do drones work?**

The 4 propellers of a drone or quadcopter are fixed and vertically orientated. Each propeller has a variable and independent speed which allows a full range of movements. The core components of a drone are as follows:

**Chassis:** the skeleton of the drone to which all componentry is fixed. The chassis design is a trade-off between strength (especially when additional weights such as cameras are attached) and additional weight, which will require longer propellers and stronger motors to lift.

**Propellers:** principally affect the load the drone can carry the speed it can fly and the speed it can manoeuvre. The length can be modified; longer propellers can achieve greater lift at a lower rpm but take longer to speed up/slow down. Shorter propellers can change speed quicker and thus are more manoeuvrable; however, they require a higher rotational speed to achieve the same power as longer blades. This causes excess motor strain and thus reduces motor life span. A more aggressive pitch will allow quicker movement but reduced hovering efficiency.

**Motors:** 1 per propeller, drone motors are rated in “kV” units which equates to the number of revolutions per minute it can achieve when a voltage of 1 volt is supplied to the motor with no load. A faster motor spin will give more flight power but requires more power from the battery resulting in a decreased flight time.

**Electronic Speed Controller (ESC):** provides a controlled current to each motor to produce the correct spin speed and direction.

**Flight Controller:** the onboard computer that interprets incoming signals sent from the pilot and sends corresponding inputs to the ESC to control the quadcopter.

**Radio Receiver:** receives the control signals from the pilot.

**Battery:** lithium polymer batteries are generally used due to their high-power density and ability to recharge.

**Agricultural applications of drones.**

**Soil and field analysis:** Drones can be instrumental at the start of the crop cycle. They produce precise 3-D maps for early soil analysis, useful in planning seed planting patterns. After planting, drone-driven soil analysis provides data for irrigation and nitrogen-level management.

**Planting:** Startups have created drone planting systems that achieve an uptake rate of 75 percent and decrease planting costs by 85 percent. These systems shoot pods with seeds and plant nutrients into the soil, providing the plant with all the nutrients necessary to sustain life.

**Crop spraying:** Drones can scan the ground and spray the correct amount of liquid, modulating distance from the ground and spraying in real time for even coverage. The result: increased efficiency with a reduction in the amount of chemicals penetrating groundwater. Experts estimate that aerial spraying can be completed up to five times faster with drones than with traditional machinery.

**Crop monitoring:** Vast fields and low efficiency in crop monitoring together create farming's largest obstacle. Monitoring challenges are exacerbated by increasingly unpredictable weather conditions, which drive risk and field maintenance costs.

**Irrigation:** Drones with hyper-spectral, multispectral, or thermal sensors can identify which parts of a field are dry or need improvements. Additionally, once the crop is growing, drones allow the calculation of the vegetation index, which describes the relative density and health of the crop, and shows the heat signature, the amount of energy or heat the crop emits.

**Health assessment:** Assessing crop health and spotting bacterial or fungal infections on trees is essential. By scanning a crop using both visible and near-infrared light, drone-carrying devices can identify which plants reflect different amounts of green light and NIR light. This information can produce multispectral images that track changes in plants and indicate their health.

**Crop health monitoring:**

Drones can be used for monitoring the conditions of crops throughout the crop season so that need-based and timely action can be taken. By using different kinds of sensors for visible, NIR, and thermal infrared rays, different multispectral indices can be computed based on the reflection pattern at different wavelengths. These indices can be used to assess the conditions of crops like water stress, nutrient stress, insect-pest attack, diseases, etc. The sensors present over the drones can see the incidence of diseases or deficiencies even before the appearance of visible symptoms. Thus, they serve as a tool for early detection of the diseases. In this way, drones can be used for early warning systems so that timely action can be taken by applying remedial measures based on the degree of the stress. UAVs (Drones) are capable of observing the crop with different indices. The UAVs can cover up hectares of fields in a single flight. For this observation, thermal and multispectral Cameras to record the reflectance of the vegetation canopy, which is mounted to the downside of the quadcopter. The camera takes one capture per second stores it into memory and sends it to the ground station through telemetry.

**Diseases monitoring:**

Crop diseases can be devastating and classified as fungal, bacterial, or viral. Drones equipped with Infrared cameras can see inside plants giving a clear image of the condition thereof. If a farmer can detect an infection before it spreads, preventative measures can be taken - like removing the plant - before the infection spreads to neighbour plants. Image-based tools can, thus, play an important role in detecting and recognizing plant diseases when human assessment is unsuitable, unreliable, or unavailable, especially with the extended coverage provided by UAVs. RGB and multispectral images have been preferred methods for acquiring information about the studied areas, but hyperspectral and thermal images have also been tested. The latter is employed mostly to detect water stress signs potentially caused by the targeted disease.

## CONCLUSION

Drones have great potential to transform Indian agriculture. With the advancement of technology in the future, the production of drones is expected to become economical. The modern youth are not attracted to farming due to the hard work and drudgery involved in it. The implication of drones may fascinate and encourage the youth towards agriculture. Drones provide real-time and high-quality aerial imagery compared to satellite imagery over agricultural areas. Also, applications for localizing weeds and diseases, determining soil properties, detecting vegetation differences, and the production of accurate elevation models are currently possible with the help of drones. Drones will enable farmers to know more about their fields. Therefore, farmers will be assisted with producing more food while using fewer chemicals. Nearly all farmers who have made use of drones have achieved some form of benefit. They can make more efficient use of their land, exterminate pests before they destroy entire crops, adjust the soil quality to improve growth in problem areas, improve irrigation for plants suffering from heat stress and track fires before they get out of control. Therefore, drones may become part and parcel of agriculture in the future by helping farmers manage their fields and resources in a better and sustainable way.

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