Drones In Agriculture

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ABSTRACT

The agriculture industry has embraced drones as indispensable tools for farmers around the world. Farmers can use drones for everything from pest control to plant health monitoring. Drones allow farmers to constantly monitor crop and livestock conditions by air. They are also helping farmers to optimize agriculture operations, increase productivity, increase crop production, monitor crop growth, reduce pollution, reduce wastage, and reduce time spent in the field. This paper provides a brief introduction on the use of drones in agriculture.

Key Words: drones, drones in agriculture, agriculture drones, unmanned aerial vehicles

INTRODUCTION

Technology advances at a rapid pace. The global demand for agricultural machinery for production is growing. Agriculture significantly benefits from the commercialization of

drone use. Aeronautical engineering and aerial imagery have evolved and were combined to give birth to drone technology.

Today, farmers are dealing with increasingly complex issues such as climate change, water quality, soil quality, uncertain commodity prices, economic challenges in terms of productivity and cost-effectiveness, intense regulation, international competition, increasing labor cost, population increase, urbanization, an increasingly degraded environment, change in food preferences to name a few [1]. They are turning to high-tech to address the issues. They are compelled to seriously consider any tool that will boost productivity. One of such tools is drone, which is affordable and can easily be deployed.

DRONE (Dynamic Remotely Operated Navigation Equipment) is commonly referred as unmanned aerial vehicle (UAV). Although drones were initially designed for military purposes, they are now widely applied in civilian settings such as agriculture, emergency, border patrol, disaster relief, and law enforcement. Drones are becoming popular for capturing aerial images, supplementing pre-existing imaging technology such as satellites and manned aircraft. They are used extensively in various commercial and industrial applications, ranging from the military cinematography, wedding videos, railway track monitoring, wildlife monitoring, delivery of small packages, security purposes, law enforcement operations, disaster management, and agriculture.   The drones that are manufactured these days are getting smarter by integrating open source technology, smart sensors, better integration, more flight time, tracking down criminals, detecting forest, and other disaster areas [2].

Drones are equipped with all the software, sensors and hardware that a farmer will need to check the health of crop and survey farmland. A drone typically consists of propulsion and navigation systems, GPS, sensors, infrared cameras, software, and programmable controllers. The camera on a drone is a surveillance camera. Due to their size, drones cannot be boarded by a human body. They can be operated in two ways**:** directly by an operator and autonomously. Flying over the field, the drone takes high-resolution pictures with a camera. The drone is cost-effective approach to capture data about various crop conditions.   A typical drone is shown in Figure 1 [3].

A drone is a pilotless aircraft, designed to collect more accurate information than airplanes or satellites. Once the drone captures and processes the data, the data is sent to farmers in a readable format for management decisions. The data your drone collects will have to be processed with agriculture drone software [4]. The farmer can take the necessary actions to correct any problem.

WHY USE AGRICULTURE DRONES?

The drone used for agricultural activities is known as agriculture drone. There are two types of professionals who might want to own an agriculture drone: farmers and agriculture service providers.

With the world changing at fast pace, farmers will need to utilize new-generation technologies to address emerging challenges. Drones can they help farmers deal with a wide range of challenges. The use of drone technology in agriculture can become a game changer. By gaining access to a vast pool of data, farmers can increase crop yields, save time, reduce expenses, and act with accuracy and precision.

Drones can provide sustainable farming, improve yield, and increase farm productivity and profitability. They help farmers optimize the use of inputs such as seeds, fertilizers, water, and pesticides. Drone technology is used in crop scouting/monitoring, crop volume, generation of prescription maps, precision spraying, inspection of farm infrastructure (including irrigation), mapping and surveying of fields, crop damage assessment, and insurance claim forensics [5]. Agriculture drones are useful for aerial photography in livestock operations, spraying, drought assessment, monitoring, etc. Drone data is a powerful tool to help farmers visualize your fields. The high-resolution nature of drone data can be used by farmers to assess the fertility of crops, allowing agricultural professionals to more accurately apply fertilizer and reduce wastage.

APPLICATIONS

Agriculture has diverse and attractive uses for drones. Drone technology is currently being used for a variety of applications such as monitoring, mapping, irrigation, crop inspection, spraying, and surveying entire fields. Some common applications are illustrated in Figure 2 [6] and presented as follows [7].

- *Monitoring:* Agricultural fields often occupy large areas, making surveillance task very difficult. A major challenge in farming is inefficient crop monitoring of vast fields. Drones are useful for real time monitoring large areas of farmland, in a more accurate and cost effective manner than satellite imagery, helping farmers make data-driven decisions. Farmers can cost-effectively monitor the health of crops and livestock using drones. Remotely accessing fields can help detect bacterial early. Drones equipped with the appropriate sensors can identify which parts of a field need more water. They can monitor any type of crop during its

growing season. Parameters for monitoring include crop health**,** vegetation

indices**,** plant height**,** plant scouting**,** water needs, and soil analysis**.**

- *Mapping:* The process of using a drone to map or survey crops is straightforward.

  The drone can survey the crops periodically: daily, hourly or weekly. Mapping

  with software gives agriculture customers detailed insights about their crops that

  would not be noticeable otherwise. By using drones for agriculture mapping,

  farmers can stay updated on the health of plants. Based on accurate, real-time

  information, farmers can take measures to improve the state of plants in any

  location.

- *Seed Planting:* Drone planting allows shooting seed pods into prepared soil.

  Farmers can use drones to deliver seeds, herbicides, fertilizer, and water. This

  minimizes the need for on-the-ground planting, which can be costly, labor

  intensive, and time consuming.

- *Spraying:* Drones can spray fields with water, fertilizers or herbicides, reducing

  costs, manual labor and time spent on these processes. This limits human contact

  with fertilizers, pesticides and other harmful chemicals. Drones can detect

  infected areas with sensors and cameras. Figure 3 shows a drone used for

  spraying fertilizers [8].

- *Precision Agriculture:* Precision agriculture, crop management that uses GPS and

  big data, refers to the approach farmers manage crops to ensure efficiency of

  inputs and to maximize productivity, quality, and yield. The use of drones for

  precision agriculture is gaining momentum because of their capability to deliver

the most up-to-date info fast and efficiently. The use of GPS technology and GIS tools allow precision agriculture practices that enable monitoring and mapping of yield and crop parameter data within fields. Products can be traced from farm to fork using GPS locations for every point in the journey.

- *Sustainable Agriculture*: Sustainable land management can reverse the impact of climate change on land degradation. Agriculture can serve as an effective approach to sustainable agricultural management that allows agronomists, agricultural engineers, and farmers to help streamline their operations. The potential for drones in the improvement of sustainable agriculture is huge. Drones are helping to improve agriculture and achieve the Sustainable Development Goals.

Other uses of drones in agriculture include irrigation, seed planting, scheduling seeding and harvesting processes, and reducing usage of scarce resources.

BENEFITS

Just like any technology, drones have their pros and cons that farmers ought to know before investing in one. The evolution of drone technology and its overall affordability account for the increased application of drones. Having a drone in the sky allows you to find potential yield limiting problems in a timely fashion. Agricultural drones are known for their resource conservation and environmental friendliness. Other benefits of using drones for agriculture include the following [9]:

- *Increased Productivity:* Agricultural drones support the effort to meet the demand of feeding increasing world population. Images from drones can indicate the development of a crop with precision. Improving agricultural productivity is the key to building prosperity in smallholder communities and supporting their local economies.

- *Reduced Pollution:* With the help of drones, farmers can cut down on agricultural runoff.

- *Adapting to Climate Change*: Extreme weather conditions are on the rise. Climate change continues to create new layers of complexity for the agriculture industry. It is having a major negative impact on food security. It is limiting productivity, such as drought, flood, and damage caused by storms. With the use of drone technology, farmers are successfully working towards sustainability.

- *Multiplier effect:* The drone technology generates secondary employment opportunities in rural areas, from drone operator to computer engineering positions.

Additional benefits for agriculture drones include increase yields, easy to learn, save time, increased ROI, ease of use, integrated GIS mapping, color contrast crop health imaging, disease prevention, more visibility.

CHALLENGES

Barriers to widespread drone adoption include safety of drone operations, privacy issues, insurance-coverage questions, its complexity, and cost of using it. It is difficult to fly drones in extreme conditions. Drones are prone to interference with aircrafts since they

share the same airspace.   At the moment, drones cannot communicate directly with agricultural equipment. Other challenges include [10,11]:

- *High Costs:* Agriculture drones are generally expensive in the short run but worthwhile in the long run. The software and hardware that accompany drones could be expensive. High costs prohibit many farmers from using drone flight services. These include capital costs for drone equipment, labor costs for drone navigation.

- *Connectivity:* Operating drone will require some connectivity. For example, agriculture drone software often use Google Maps as their base layer. So it requires the Internet to work properly and lack of connectivity, particularly in remote areas, can be a challenge.

- *Limitations:* Strict regulations limit drones to only small areas in a single flight. Battery power limitations.

- *Flight Time and Flight Range:* Most drones have less flight time and covers less area. They have a short flight time of between 20 minutes to an hour. This makes limits the flight range. Drones that can offer longer flight time and longer range are relatively expensive.

- *Regulation:* Drones should be used responsibly. Farming with drones is considered commercial. It requires obtaining a remote pilot certificate from FAA. FAA requires drones fly at an altitude of not more than 400 feet. It is crucial for operators to keep up to date with regulations, such as individuals' privacy. Many

countries like Canada, Malaysia, Singapore, and Australia have made laws regarding use of drones.

Other challenges include interference with birds, weather dependent, required knowledge and skill

CONCLUSION

Agricultural drones are unmanned aerial vehicles used to monitor the health of crops and livestock. They can transform modern farming in a number of ways. The number of farmers adopting drones in their farms is growing. Drone technology keeps improving daily. With many manufacturers producing drones, it is hoped that the cost of the drones and the accompanying equipment will reduce. The future of drones in agriculture appears promising. Agricultural drones are here to stay. More information about agricultural drones can be found in the books in [12-16].

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Figure 1   A typical drone [3].
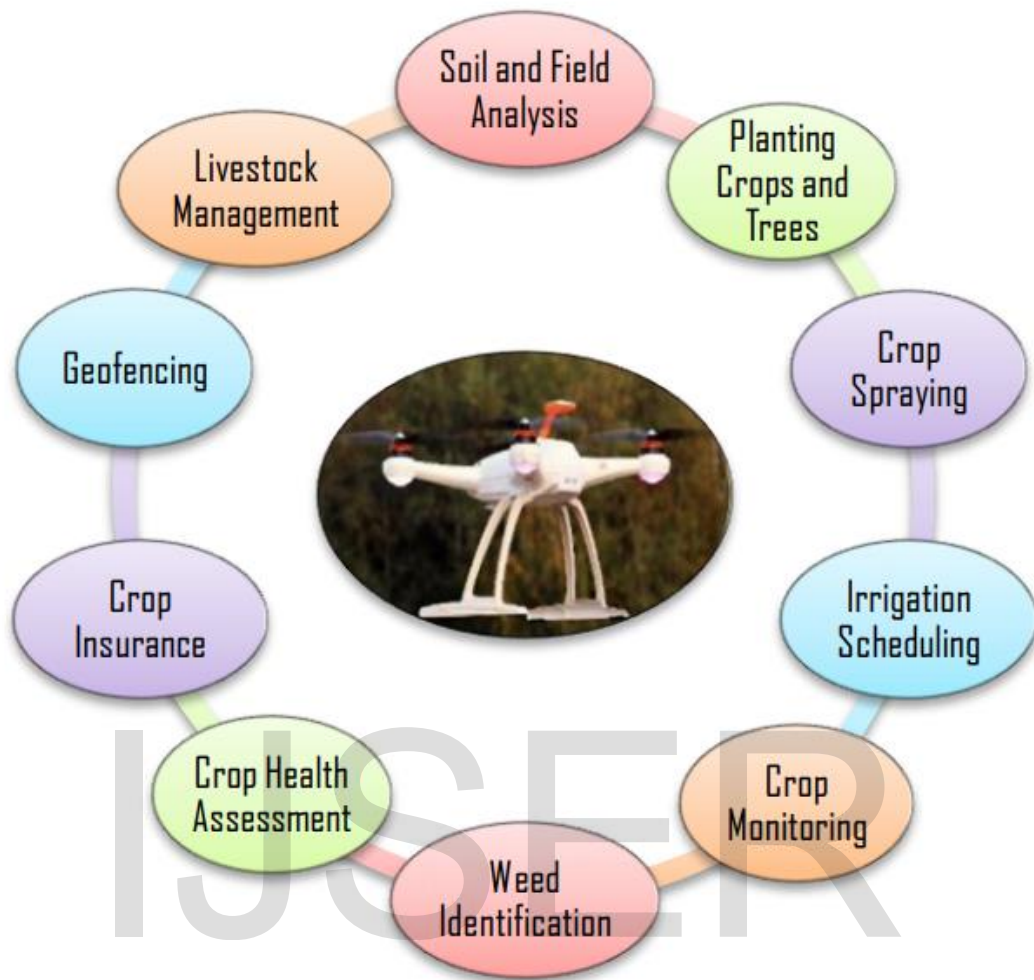
Figure 2   Applications of drones in agriculture [6].

Figure 3 Drone spraying fertilizers [8].