



Drone Technology used in Agriculture Field

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The use of drones in almost every sector of the economy is growing fast, but drone usage in the agricultural industry is booming. According to some reports, the agricultural drone market is expected to grow from a \$1.2 billion (USD) industry in 2019 to \$4.8 billion in 2024. From scouting to security, drone use will become more ubiquitous on large and small scale farms in a few short years. The information gathered by drones on farms is often used to better inform agronomic decisions and is part of a system generally referred to as 'precision agriculture'. In many areas, drone use has become an essential part of large scale precision farming operations already. The data collected from drones recording fields help farmers plan their planting and treatments to achieve the best possible yields. Some reports indicate that using precision farming systems can increase yields by as much as 5%, which is a sizeable increase in an industry with typically slim profit margins. In this article we will take a look at some of the areas where drone technologies are already being used on farms, some new agricultural drone technologies being explored, and we will touch on some of the steps and challenges to adopting widespread drone use in agriculture.

Scouting/Monitoring Plant Health: One of the uses for drone imagery that has already been rolled out with great success is for monitoring plant health. Drones equipped with special imaging equipment called Normalized Difference Vegetation Index (NDVI) use detailed colour information to indicate plant health. This allows farmers to monitor crops as they grow so any problems can be dealt with fast enough to save the plants. This image illustrates simply how NDVI works. Drones using 'regular' cameras are also used to monitor crop health. Many farmers already use satellite imagery to monitor crop growth, density, and colouration, but accessing satellite data is costly and not as effective in many cases as closer drone imaging. Because drones fly close to fields, cloud cover and poor light conditions matter less than when using satellite imaging. Satellite imaging may offer to the meter accuracy, but drone imaging is capable of producing accurate image location to the millimetre. This means that after planting, areas with stand gaps can be spotted and replanted as needed, and disease or pest problems can be detected and treated for right away.

Monitoring Field Conditions:- Drone field monitoring is also being used to monitor the health of soil and field conditions. Drones can provide accurate field mapping including elevation information that allow growers to find any irregularities in the field. Having information on field elevation is useful in determining drainage patterns and wet/dry spots which allow for more efficient watering techniques. Some agricultural drone retailers and service providers also offer nitrogen level monitoring in soil using enhanced sensors. This allows for precise application of fertilizers, eliminating poor growing spots and improving soil health for years to come.

Soil and field analysis:- For efficient field planning, agricultural drones can be used for soil and field analysis. They can be used to mount sensors to evaluate moisture content in the soil, terrain conditions, soil conditions, soil erosion, nutrients content, and fertility of the soil.

Planting & Seeding:- One of the newer and less wide spread uses of drones in agriculture is for planting seeds. Automated drone seeders are mostly being used in forestry industries right now, but the potential for more widespread use is on the horizon. Planting with drones means very hard to reach areas can be replanted without endangering workers. They are also able to plant much more efficiently with a team of two operators and ten drones capable of planting 400,000 trees a day.

Spray Application- Drone use to apply spray treatments is already widespread in south-east Asia, with South Korea using drones for approximately 30% of their agriculture spraying. Drone sprayers are able to navigate very hard to reach areas, such as steep tea fields at high elevations. Drone sprayers save workers from having to navigate fields with backpack sprayers, which can be hazardous to their health. Drones sprayers delivery very fine spray applications that can be targeted to specific areas to maximize efficiency and save on chemical costs. Currently drone sprayer regulations vary widely between countries. In Canada, they are not currently legal as more testing needs to be done to understand the impact of spray drift. Some regulation proposals recommend that only trained professionals be tasked with flying spray drones as is the case with Yamaha, who does not sell the spray drones they manufacture, but leases spray drone services complete with licenced operators.



Crop monitoring:- Crop surveillance is the supervision of crop progress from the time seeds are sown to the time for harvest. This includes providing fertilizers at the right time, checking for pest attack, and monitoring the effect of weather conditions. Crop surveillance is the only way that a farmer can ensure a timely harvest, especially when dealing with seasonal crops. Any errors at this stage can result in crop failure. Crop surveillance helps in understanding and planning for the next farming season. Drones can help in effective crop surveillance by inspecting the field with infrared cameras and based on their real-time information, farmers can take active measures to improve the condition of plants in the field.

Security:- Drone security is a fast growing industry apart from agriculture but is also extremely useful to farm management. Using drones to monitor the far reaches of a farm without having to get there saves valuable time and allows for more frequent monitoring of hard to reach areas. Drone cameras can provide an overview of farm operations throughout the day to ensure operations are running smoothly and to locate equipment being used. Security drones can be deployed to monitor fencing and perimeters of more valuable crops like cannabis instead of employing more security personnel. Drone cameras are also being

used in exciting ways to protect farm animals by locating missing or injured herd animals in far off grazing areas. Monitoring remote areas, which used to take hours of walking can now be completed in a few minutes.

Drone Pollination:- Some of the newer uses for drone use in agriculture are still in testing and development. One of the most publicized (and often fictionalized) uses is pollinating drone technology. Researchers in the Netherlands and Japan are developing small drones that are capable of pollinating plants without damaging them. The next step is to create autonomous pollinating drones that will work and monitor crop health without constant instruction from operators.

Plantation:- Drones can help in planting trees and crops, which was done by farmers before. This technology will not only save labor but also help in saving fuels. Soon, it is expected that budget-friendly drones will be used instead of huge tractors, as they emit harmful gases and pollute the environment in the process.

Crop spraying:- Agri-drones can be used to spray chemicals as they have reservoirs, which can be filled with fertilizers and pesticides for spraying on crops in very little time, as compared to traditional methods. Thus, drone technology can usher in a new era for precision agriculture.



Avoid overuse of chemicals:- Drones can prove to be especially effective in reducing the overuse of pesticides, insecticides, and other chemicals. These chemicals indeed help to protect the crop. But, their overuse can prove to be detrimental. Drones can detect minute signs of pest attacks, and provide accurate data regarding the degree and range of the attack. This can help farmers calculate the required amount of chemicals to be used that would only protect the crops rather than harming them.

Monitor growth:- Even when everything is going according to plan, crops need to be surveyed and monitored to ensure that the right amount of yield will be available at the time of harvest. It is also important for future planning, whether it is about determining the right price for the open market, or harvesting cyclical crops. Drones can provide accurate data about every stage of crop growth, and report any variations before they become a crisis. Multispectral images can also provide accurate information about subtle differences between healthy and unhealthy crops that may be missed by the naked eye. For example, stressed crops will reflect less near-infrared light as compared to healthy crops. This difference cannot be detected by the human eye always. But drones can provide this information in the early stages



Drone AI:- Another drone technology in development also involves machine learning. Improving Artificial Intelligence (AI) in drones is important to be able to make them more useful to smaller farmers in developing nations. Current drone technologies are more effective in monitoring well known crops like corn which are planted in large monocultural field patterns. Drone monitoring programs, as they stand, have a hard time recognizing areas with increased crop diversity, less well known produce, and grains which look similar throughout their growth stages and so are less effective in monitoring crop growth and health. More work is needed to be able to train AI systems to recognize less common crops and more diverse planting patterns.

Benefits of agri-drones

- **Security:** The drones are operated by trained drone pilots. So, there are no chances of their misuse.
- **High efficiency:** Drones do not have any operational delays and can work double the speed of human labor.
- **Water-saving:** In comparison to traditional spraying methods, agricultural drones use ultra-low volume (ULV) spraying technology, thus saving more water.
- **Low cost and easy to maintain:** Agri drones are sturdy, low in cost, and require minimum maintenance. Some of the key features include a detachable container, low-cost frame, precise spraying of pesticides

Limitations of agri drones

- **Connectivity issue:** Often, online coverage is unavailable in rural areas. Under such circumstances, a farmer needs to invest in internet connectivity, which can turn into a recurring expense.
- **Weather dependent:** Drones do not have any operational delays and can work double the speed of human labor.
- **Weather dependent:** Drones are heavily dependent on good weather conditions. Under rainy or windy weather conditions, it is not advisable to fly drones.
- **Knowledge and Skill:** Using new technology is a welcoming change but using it daily requires the right skillset and adequate knowledge. An average farmer may struggle to understand drone functions. Either he must acquire the knowledge or remain dependent on an experienced person.