

Application and Advantages of Unmanned Aerial Vehicles (Drone) in Agriculture

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SUMMARY

Agriculture becomes extremely important as a main source of food production to feed the population in this planet. On the other hand, agriculture provides a lot of benefits to the country such as food and non-food product, transportation and balancing the environment. The demand for food security creates pressure to the decision maker to ensure our world has sufficient food for the entire world. Thus, the usage of the unmanned aerial vehicle (UAV) is an alternative to manage a farm properly to increase its yield. In order to promote the use of UAV in the agriculture farming to support its sustainability, this article provides an understanding towards the usage of UAV in its agriculture applications.

INTRODUCTION

According to the “Agriculture in 2050 Project”, the world population will reach about 10 billion by 2050. Consequently, food production will require a 70% boost. However, with changing climate and farmland ecological conditions, pest outbreaks in agricultural landscapes are becoming more frequent, increasing the threats to crop production. The use of pesticides is an integral part of modern agriculture and contributes to the productivity and quality of most agricultural products. It is estimated that the use of agrochemicals prevents a loss of up to 45% of the world’s food supply. The main spraying equipment used in conventional farming is the manual air-pressure and battery-powered knapsack sprayers (Chenet *et al.*, 2021). The World Health Organization (WHO) estimated one million cases of ill effects when spraying the pesticides in the crop field manually. In addition, these conventional sprayers can cause major pesticide losses and environmental harm. In order to reduce humans’ and environmental harm, as well as to deal with labor shortage, spraying mechanization is imperative. Agriculture is the backbone of India’s economy. In India people still believe that earth is our mother that will feed us. Contribution of Agriculture to GDP has fallen between 17% to 18% from 50% in the 1950s which employs more than 50% manpower. Many of the agricultural products yield is low due to farming dependent upon environmental conditions and diseases caused by pests. With changing climate and farmland ecological conditions, pest outbreaks in agricultural landscapes are becoming more frequent, increasing the need for improved crop production tools and methods. UAV-based agricultural spraying is anticipated to be an important new technology for providing efficient and effective applications of crop protection products. Agricultural aerial spraying, both manned and unmanned, is often the most economical and rapid method for providing efficient and effective applications for crop pest control, allowing for rapid responses to sudden pest outbreaks. Moreover, it can cover a large field without destruction to the crop or soil physical structure, compared with ground plant-protection machinery, which is very important. With the increased demand for precision agriculture (PA) and smart farming, UAVs are going to play a crucial role in the development of the agricultural sector. In this article, applications of UAVs in agriculture are of particular interest with advantages of UAVs and crop farming. This article discusses the different types of UAVs, their application in pest control, crop irrigation and other agriculture-related activities.

Types of UAVs

UAVs can be classified based on usage, with some being used for photography, aerial mapping, surveillance, cinematography etc. There are three major types of UAVs, which are:

- Multi-rotor UAVs
- Fixed-wing UAVs
- Single-rotor Helicopter

Multi-rotor UAVs: These are the most common type of UAV, evident by their wide popularity among professionals and hobbyists alike. They find applications in photography, aerial video surveillance, recreational sports and games etc. They are the easiest to manufacture and also the cheapest type of UAV. Multi-rotor UAVs are further classified based on the number of rotors on the platform.



Fig.1 Multi-rotor UAVs

There are those with three rotors called tricopter, with four rotors called quadcopter, with six rotors called hexcopters and those with eight rotors called octocopter. Flying a multi-rotor UAV does not require exceptional skill unlike the other types of UAVs.

Fixed-wing UAVs: These types of UAVs have wings similar to normal aircrafts. Unlike the Multi-Rotor UAVs, they do not exert a lot of energy to stay afloat in the air, hence able to fly longer; having average flight times of over an hour. Longer flight time makes them most ideal for long distance operations. However, they cannot hover on a spot and are thus not suitable for aerial photography. Furthermore, they are more expensive and require exceptional flying skill to operate.



Fig.2 Fixed-wing UAVs

Single-rotor UAVs: Single rotor UAVs are also called monocoverters and look very much like helicopters in design and structure. Though they are called single rotor UAVs, they actually have two rotors - a large one on top and a smaller one at the tail. The bigger rotor is for lift while the smaller is used for control. They have significantly longer flying time than their multi-rotor counterpart, as they are often powered by gas engines. These UAVs are also highly maneuverable and much more efficient than the multi-rotor types.



Fig.3 Single-rotor UAVs

Application of Unmanned aerial vehicle in crop farming

Soil and field analysis: The use of UAVs for soil information sourcing is helpful at the early start of a crop cycle. The data collected helps in early soil analysis, and is also useful in planning seed planting patterns. These data can also assist the farmer in making irrigation plans as well as determining the quantity of fertilizer needed on the soil or field after planting. Using a data-driven approach, the farmers can improve the overall yield

quantity of agricultural produce, while significantly saving on fertilizers and pesticides. All these are made possible through the analysis of remote images captured with UAV.

Planting: Planting crops is a costly and cumbersome endeavor that has traditionally requires a lot of manpower. UAVs have simplified crop planting for farmers, with their abilities to cover large acres of land within a short period with utmost precision and accuracy. Today's high-end UAV farming technology offers UAV-powered planting techniques that reduce planting costs by up to 85%. The reduction in planting costs is a result of the UAV's capability of performing multiple tasks at the same time.

Crop and spot spraying : Crop spraying is usually a tough and onerous task for farmers and agricultural production companies. It involves covering extremely large expanses of land comprehensively to ensure proper growth of crops. Agricultural UAVs have simplified crop spraying for farmers; as they can cover large expanse of land within a very short time interval. Using sensors, UAVs can automatically adjust their height when spraying across uneven fields. This improves the spraying accuracy and conserves resources.

Crop monitoring: A combination of large farm fields and low efficiency in crop monitoring system are some of the greatest farming challenges. The challenge of monitoring is further aggravated by unpredictable weather conditions, which drive up risk and field maintenance costs. An agricultural UAV helps the farmer overcome some of these challenges. UAVs with thermal imaging cameras enable the farmer to monitor his farm. The farmer can check the state of crops in the farm, as well as areas that need urgent attention. The result is improved yield and greater profit.

Irrigation: Agricultural UAVs fitted with thermal imaging cameras have the capability to providing tremendous insights into specific troubled areas in the farm. Using the thermal cameras, the farmers are able to determine areas with low soil moisture, pinpoint crops that are dehydrated, locate areas that are water-logged and in general have a sense of the overall health status of crops in the field. Such precise and specific monitoring were either not possible with traditional farming, inefficiently done or extremely expensive as experts have to be contracted to carry out the task and proffer adequate solutions.

Advantages of unmanned aerial vehicles

- **Limited Constraints:** Being air borne they are not hindered by physical constraints such as road/soil terrain, uneven paths and obstacles. They can simply fly over them all.
- **Shorter travel path:** It is well known that the shortest distance between two points is a straight path. UAVs are best suited for this, as they can fly directly in straight paths. This is not always the case with land based vehicles.
- **Flying dark:** In the case of autonomous UAVs, the UAVs can be programmed to fly in pitch darkness or at times with near zero visibility when it would be difficult for humans to manually control them.
- **Time and labor savings:** Activities such as head count, monitoring and mustering often require the employment of more hands to help out. These can be both labor intensive and time consuming. With the use of UAVs, the number of extra laborers required is significantly cut down, while simultaneously saving time. Similarly, in crop farming, UAVs can spray crops about 40–60 times faster than human laborers can.
- **Cost:** Beyond savings in time, cutting down on laborers directly translates to cost savings. Though, capable UAVs are not cheap and there is also the added cost incurred in form of electricity to recharge the batteries; the cost savings and advantages of UAVs still significantly outweighs the manual and labor intensive processes of traditional/crude agriculture.
- **Aerial photography and imaging:** With the use of UAVs, farmers can quickly obtain aerial images of their entire farm or select areas of interest. This can be useful in determining when fruits start to sprout or when pests and weeds are choking out crops.

CONCLUSION

In the past decade latest technologies are included into the precision agriculture to improve the productivity of the crop. These technologies are useful where human interventions are not possible for spraying of chemicals on crops and scarcity of the labor. It also helps the spraying job easy and faster. Unmanned Aerial Vehicles or UAVs are essentially flying robots. Though initially designed for military use, they are now widely

used in various areas, from recreational sports, fire-fighting. In this article discusses an application of UAVs to commercial Agriculture. We presented three major types of UAVs, and though the multi-rotor UAV with its ability to hover on spot and take-off and landing vertical may seem well suited for agriculture, its limited flight time is a major limitation. A detailed insight into the applications of UAVs in crop production was also presented.

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