Application of Drones in Agriculture in India

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Abstract

The population is increasing tremendously and with this increase the demand of food. The traditional methods which were used by the farmers are 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. Drone's technologies saves the excess use of water, pesticides, and herbicides, maintains the fertility of the soil, also helps in the efficient use of man power and elevate the 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. In the methodology, we used a comprehensive review from other researches in this world. This paper summarizes the current state of drone technology for agricultural uses, including crop health monitoring and farm operations like weed management, evapo-transpiration estimation, spraying *etc*.

Introduction

As much as India depends upon the agriculture, still it is far short from adapting latest technologies in it to get good farm. Developed countries have already started use of UAVs in their precision agriculture photogrammetry and remote sensing. It is very fast and it could reduce the work load of a farmer. In general, UAVs are equipped with the cameras and sensors for crop monitoring and sprayers for pesticide spraying. In the past, variety of UAV models running on military and civilian applications (Aditya and Kulkarni, 2016). A technical analysis of UAVs in precision agriculture is to analyse their applicability in agriculture operations like crop monitoring crop height, estimations pesticide, spraying soil and field analysis. However, their hardware implementations are purely depended on critical aspects like weight, range of flight, payload, configuration and their costs (Nanami, 2007).

The Japanese were the first to successfully apply UAS technology to agricultural chemical spraying applications in 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 (Blyenburgh, 1999).

Drones and the Indian Agriculture Industry

Drones are uncrewed aerial vehicles (also known as UAVs), which are used for surveillance in various industries. Till now, they were primarily used by companies working in industrial sectors such as mining

and construction, army, and hobbyists. But now, drone technology is increasingly available for use in various sectors of agriculture as well. Though the technology is still nascent in India, many companies are trying so that it is easily available to Indian farmers and ready to be used to increase efficiency in agricultural production.

The Use of Agni-Drones is on the Rise

On 26th January 2022, the Government of India has also released a certification scheme for agricultural drones, which can now carry a payload that does not include chemicals or other liquids used in spraying drones. Such liquids may be sprayed by following applicable rules and regulations.

On 23rd January 2022, to promote the use of drones for agricultural purposes and reduce the labour burden on the farmers, the government of India has recently offered, a 100% subsidy or 10 lakhs, whichever is less, upto March 2023 to the Farm Machinery Training and Testing Institutes, ICAR Institutes, Krishi Vigyan Kendra's & State Agriculture Universities. Additionally, a contingency fund of Rs. 6,000.00 ha⁻¹ will also be set up for hiring Drones from Custom Hiring Centres (CHC). The subsidy and the contingency funds will help the farmers' access and adopt this extensive technology at an inexpensive price.

On 16th November 2020, the Indian government granted the International Crops Research Institute (ICRISAT), to use of drones for agricultural research activities. With this move, the government hopes to encourage budding researchers and entrepreneurs to look at budget-friendly drone solutions for more than 6.6 lakh Indian villages.

Though the usage will be conditional, yet it is a revolutionary step. Amber Dubey, Joint Secretary, Ministry of Civil Aviation, emphasized that drones are poised to play a big role in agriculture, especially in areas including precision agriculture, improvement in crop yield, and locust control (Figure 1).

Figure 1: Pesticides spray by using drones for locust control

Advantages of using Drones in Agriculture

According to recent researches, the global drone market within agriculture would grow at 35.9% CAGR and reach $5.7 billion by 2025. The use of drone technology in agriculture is here to stay. This emerging technology can help reduce time and increase the efficiencies of the farmers. The use of drones in the agricultural sector is only expected to rise as the industry matures, and so it is good to know how to use this technology judiciously. Drone use advantage indicated in Figure 2.
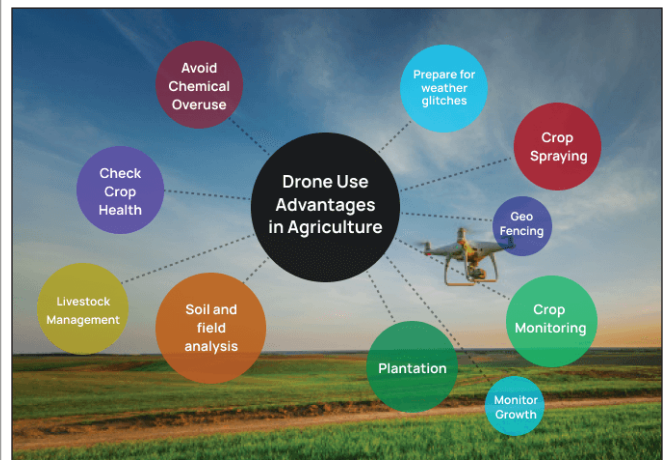

Figure 2: Advantage of drone in Agriculture sector

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.

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.

Plantation

Drones can help in planting trees and crops, which was done by farmers before. This technology will not only save labour costs, 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.

Livestock Management

Drones can be used to monitor and manage huge livestock as their sensors have high-resolution infrared cameras, which can detect a sick animal and swiftly take actions accordingly indicated in Figure 3. So, the impact of drones on precision dairy farming is soon to become a new normal.

Figure 3: Uses of drones in livestock management

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 indicated in Figure 4, as compared to traditional methods. Thus, drone technology can usher in a new era for precision agriculture.

Figure 4: Uses of drone for fertilizers spraying

Check Crop Health

Farming is a large-scale activity that takes place over acres of land. Constant surveys are necessary to monitor the health of the soil and the crop that has been planted.

Manually, this may take days, and even then, there is space for human error. Drones can do the same job in a matter of hours. With infrared mapping, drones can gather information about both the health of the soil and the crop.

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. Figure 5 indicated proper use of chemical by using drone detect the plant growth and population by using drone.

Figure 5: Indication of similar growth and population by using drones in field

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.

Geo-Fencing

The thermal cameras installed over drones can easily detect animals or human beings. So, drones can guard the fields from external damage caused by animals, especially at night.

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 towards farming due to 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 an accurate elevation models are currently possible with the help drones. Drones will enable farmer know more about their field. Therefore, drones may become part and parcel of agriculture in the future by helping farmers in managing their fields and resources in a better and sustainable way.

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