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Role of Drone Technology in Indian Agriculture: A Game Changer

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India's economy is primarily based on agriculture. The majority of rural households still rely on agriculture as their primary source of income. India's economy is also strongly reliant on agricultural products, which account for a large amount of the country's exports. Despite its growing importance, our agriculture sector is still lagging behind in technological improvements. Crop failure owing to climate change, uncontrolled use of agrochemicals, bad weather conditions, pest infestations lack of pre-and post-harvest management technologies have been major contributions to this situation. Furthermore, Indian farmers are still reliant on monsoon rains for irrigation and employ age-old farming practices. As a result, despite farmers' best efforts, the quality and quantity of agricultural produce is highly affected by such external forces.

In order to overcome these adversities, the agricultural sector must immediately implement cutting-edge digital and precision agriculture technologies to boost farm output and give all farmers equal access to market information.Drones are one such technology that has the potential to transform the agriculture sector.The use of drones is steadily growing as part of an effective approach to sustainable agricultural management that allows farmers to help streamline their operations, such as seed sowing, crop growth monitoring, fertilizer applications, pest attack monitoring, disease symptoms, water needs etc. Products can be accurately traced from farm to fork using GPS locations for every point in the journey, rather than more traditional time and labor-intensive data collection.

What are drones?

Drones are Unmanned/Uncrewed aerial vehicles (UAV), weighing up to 20 kg. Drones can be operated either directly, in which a human has complete control of the vehicle by wireless remote; and autonomously,in which the vehiclefollows a route and command based on the data from GPS or other sensors.Typically, drones include a navigation system, GPS, multiple sensors, high-quality cameras, programmable controllers, and tools for autonomous drones.

How drones work in agriculture sector?

The drone uses a camera or sensor to take high-resolution photographs while flying over the field. These photos are recorded in different bands based on a determined parameter, ranging from visible, near-infrared, and infrared spectrum. The images gathered are unprocessed data that will need to be interpreted further. The photos are immediately transferred to the cloud/software, where multiple prescription maps are developed based on the activity that the farmer wants to undertake on the field. The maps can then be transferred to specialised farm equipment, which will modify the number of inputs (seeds, fertilisers, and pesticides) that need to be applied to the area.

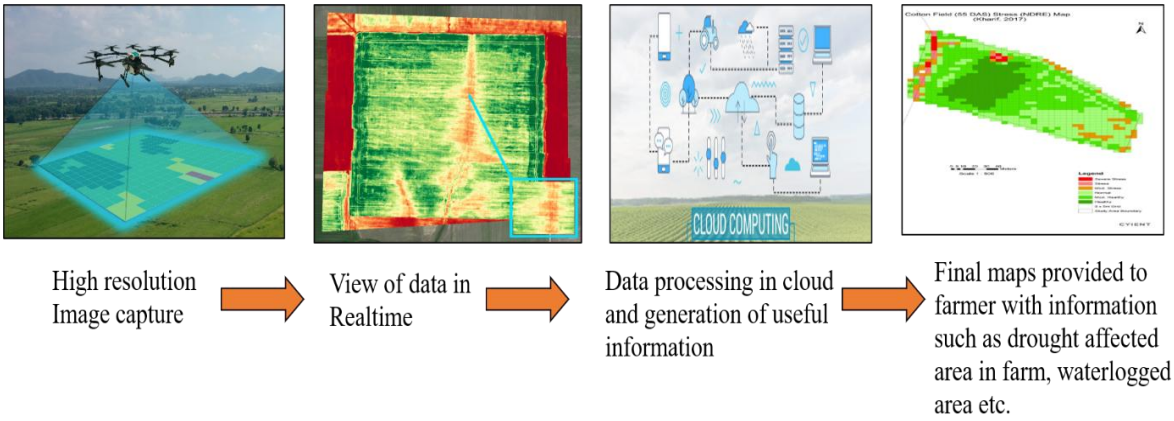

Figure 1. Working of drone in agriculture sector

Applications of Drone technology in agriculture sector

Field and soil monitoring: Drone based field monitoring is utilised to keep a track of soil health, topography, and agricultural conditions. Drones can give precise field mapping, including elevation data, allowing farmers to spot any anomalies in the area. Knowing the elevation of a field helps determine drainage patterns and wet/dry zones, allowing for more efficient ploughing, tilling, watering tactics etc. Soil conditions such as moisture content, organic matter, nitrogen and phosphorous levels, soil erosion, nutrients content, and microflora can be monitored using this technology.

Planting and Seeding: At the moment, automated drone seeders are largely utilised in the forestry industry, but they have the potential to become more widely used in agriculture sector in near future. Drone planting allows for the replanting of difficult-to-reach locations without endangering workers specially in arid, semi-arid and high-altitude regions.This technology not only saves the labor but also helps in saving fuels. Budget-friendly drones are projected to replace large tractors in the near future, as they generate toxic gases and degrade the environment. Moreover, drone-based seed sowing and sapling plantation ensures consistent and efficient operations.

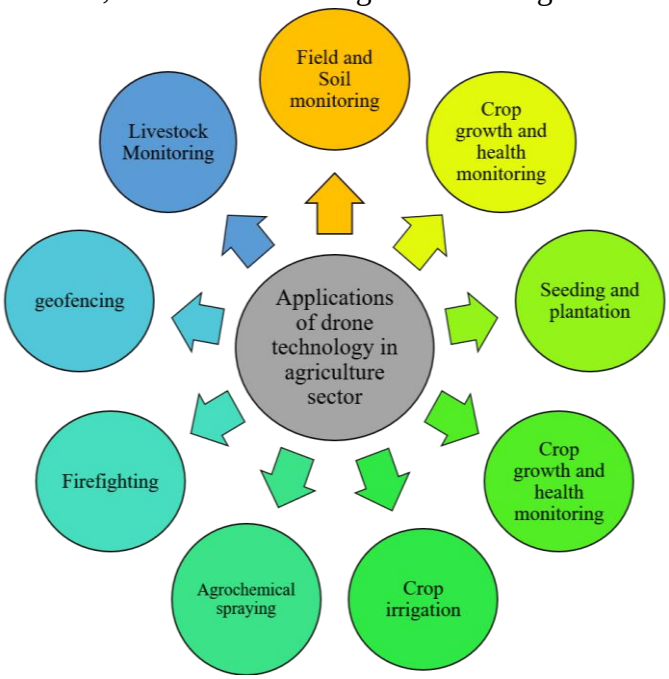

Figure 2 Applications of drone technology in agriculture sector

Crop growth monitoring: Monitoring of a crops' progress from seeding to harvesting is a critical step. This includes germination frequency of seeds, number of shoots/tillers/branches/flower/ canopies/plant height, crop maturation time, apt time for crop harvest, fertiliser application, tracking the impact of meteorological conditions and many more. Crop surveillance is the only way that a farmer can ensure a timely harvest, especially when dealing with seasonal crops.

Crop health monitoring: Tracking the health of the crop and spotting diseases at early stage plays critical role in crop productivity. Plants that reflect green light and Near-infrared

spectroscopy (NIRS) light can be detected by agriculture drones. This data is used to create multispectral images that can be used to track crop health. Quick monitoring can save crops from various diseases and result in good productivity. Moreover, in the event of crop failure, the farmer can document the losses in order to file proper insurance claims.

Agrochemical Spraying: Agri-drones have reservoirs, that can be filled with fertilizers and pesticides to spray on crops. This technology minimizes the agrochemical-human contact that saves the farmers from various health risks. Moreover, drone spraying is a fast, precise and safe method, as compared to traditional methods. 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 and is effective in reducing the overuse of pesticides, insecticides, and other chemicals. Thus, drone technology can usher in a new era for precision agriculture.

Crop irrigation: In irrigation management drones can play two roles, first they can detect possible pooling or leaks in farm irrigation system. Drones paired with thermal cameras are ideal as they are able to detect and see from above what humans cannot from the ground. As the need for more efficient water usage increases having a drone that is able to track and monitor irrigation is essential. With thermal and conventional cameras, drones are able to spot water pooling. With larger farms, having the ability to have a bird's eye view of what is being watered, and at what time, allows farmers to more effectively use water resources. Secondly, they can be used to irrigate the crops by water spraying method just like agrochemicals. Many countries are developing large sized drones with big reservoirs to store water for irrigation purpose. With sensors ability precision irrigation of crops can minimize the water wastage and manage the water efficiency that can be of great value in arid and semi-arid regions of the world.

Livestock Monitoring: Farmers can use the drone survey to keep track of not only their crops but also their cattle's movements. Thermal sensor technology aids in the recovery of missing animals and the detection of injury or illness.

Geofencing: Drones equipped with infrared cameras can readily detect animals or humans entering/encroaching the farm area. As a result, drones can protect the crops from animal damage, especially at night.

Farm firefighter: Forest fires and farm fires can contribute to damage of flora, fauna and crop produce critically. In firefighting, drones can play a variety of functions,it can assist the firefighters when coupled with a thermal camera, can show operators where the fire hotspots are, as well as see through smoke and in low light circumstances deep in the forest. Operators can then use the thermal camera to keep an eye on crew members and conditions, enhancing efficiency and safety. In dark or low-light situations, the drone can also be equipped with a spotlight to help firefighters. Drones can also assist in assessing crop damage after the smoke has cleared. Drones enable firefighters to scout out dangerous flames quickly and effectively, view and monitor a huge blaze and the surrounding region, and more. They can also spray extinguishers and water on fires at difficult terrains and locations where machinery and firefighters cannot reach.

Promotion of drone technology in agriculture sector in India

In India, a number of drone-based agricultural projects are undergoing. The current Indian government is also supporting the use of drones along with smart machines.Survey conducted by marketing and consultancy firm, blue weave Consulting, forecasted that the Indian Agriculture Drones market is expected to grow fourfold by 2028, with a predicted Compound Annual Growth Rate (CAGR) of more than 25% between 2022 and 2028 (Figure 3).

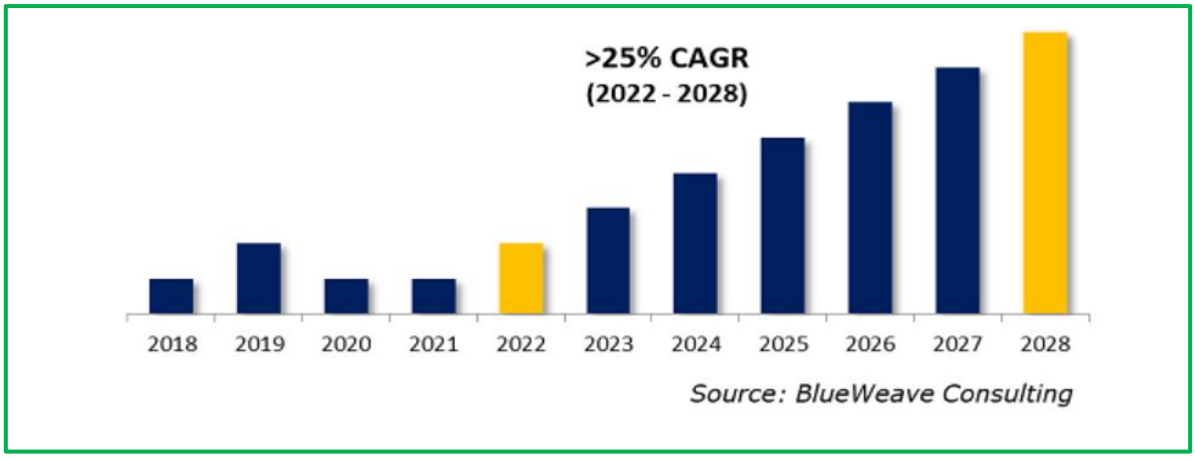

Figure 3. Indian agriculture drone growth market

(Source: https://www.blueweaveconsulting.com/report/india-agriculture-drones-market/agriculture-sample/report)

The Indian government gave the International Crops Research Institute (ICRISAT) permission to utilise drones for agricultural research on November 16, 2020. The government hopes that by taking this step, budding researchers and entrepreneurs would be inspired to look at low-cost drone solutions for India's 6.6 lakh villages. On 23rd January 2022, to promote the use of drones for agricultural purposes and reduce the labor burden on the farmers, the government of India has recently offered, a 100% subsidy or 10 lakhs, whichever is less, up to March 2023 to the Farm Machinery Training and Testing Institutes, ICAR Institutes, KrishiVigyanKendras& State Agriculture Universities. Further, 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.

Limitations of drone technology in agriculture sector

Using drone technology on a regular basis necessitates the correct skill and understanding for farmers. Drone functions may be difficult to comprehend for the common farmer. Either they must gain the necessary expertise or must rely on an expertise. In rural places, internet access is frequently unavailable. In such cases, a farmer will need to invest in internet connectivity, which will become a regular cost. Drones, are extremely reliant on favorable weather, they may work in rainy season but picture quality may get affected due to rain, affecting the output information. Besides, flying drones needs some permits from the government and cannot be flown over farms present near or around sensitive zones such as defence premises, research laboratories, airports etc.

Conclusion

In the view of experts, drone technology will transform Indian agriculture sector in the future. Many Indian startups are also expressing interest in the market, with plans to invest in low-cost drones that may assist farmers while also providing employment possibilities for rural youngsters and improving farmers' expertise. The industry, on the other hand, requires mature decisions that take into account the expanding population, farmer demands, operational policies, and dwindling farmland. In addition, competent operators are required to expand the still-unexplored drone industry. Our farmers and drone pilots are the forerunners of a new era. Overall, it will be interesting to see how things progress and how beneficial drone applications prove to be over time.