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Drone Agriculture Technology: A smart farming technique for Sustainable Agriculture

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Introduction

Drone agriculture technology is an advanced farming technique which can replace the conventional manual activities practiced in agriculture. These high technology drones facilitate crop and agricultural businesses to increase crop production by saving time and making better strategic decisions for increasing the efficiency and effectiveness of farms. Incorporation of drones in agricultural activities is also emerging as a component of precision agriculture. DRONE(Dynamic Remotely Operated Navigation Equipment) is also known as UAV/UAVs (Unmanned Aerial Vehicle/Systems), UAS (Unmanned Aircraft Systems) and is described as the remotely piloted aircraft systems (RPAS), made up of a propulsion system, a programmable controller with or without the satellite navigation system, having automated flight planning features. It is retrofitted with a different configuration of payloads of sensors with digital imaging capabilities such as multi spectral, high-resolution camera systems and actuators, for field survey, crop scouting, alongwith spraying systems for spraying and spreading applications and surveillance in livestock and fisheries. Sensors used in agricultural drones are sensitive to the following bands of electromagnetic waves and provide real time information on cultural operations and management:

1. Red, Green, and Blue (RGB) bands: These bands are used for counting the number of plants, for modeling elevation, and visual inspection of the crop field.

2. Near Infra-Red (NIR) band: This band is used for water management, erosion analysis, plant counting, soil moisture analysis, and assessment of crop health.

3. Red Edge band (RE): It is used for plant counting, water management, and crop health assessment.

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4. Thermal Infra-Red band: This band has applicability in irrigation scheduling, analyzing plant physiology, and yield forecasting.

The drone is designed to be either remotely controlled over wireless communication or can be programmed to travel the predefined path using complex navigation algorithms running on onboard controllers. Using image processing algorithms every individual plant can be located and analyzed for any biotic stress such as pests and diseases which can prevent any losses and protect the crops from unpredictable weather. Application of drones is specially advantangeous in hilly areas in replacing labour intensive and hazardous conventional methods. Thus drones can become the facilitators of farming activity in the exceptional times of COVID 19 amidst labour deficit due to social distancing norms and also its wide applications have opened many opportunities for its beneficial use in agriculture.

Working and Types of drones

A drone is controlled manually with a handheld radio control transmitter which manually controls the propellers. The 4 propellers of a drone or quadcopter are fixed and vertically orientated.. Sticks on the controller allow movements in different directions and trim buttons allow the trim to be adjusted to balance the drone. Screens can also be used to receive live video footage from the on-board camera and to display sensor data. On-board sensors can provide helpful settings such as auto altitude where the drone will move at a fixed altitude, and GPS hold, where the drone will remain at a fixed GPS position.Fig 1: A drone

There are two types of drones based on their structure:

Rotary drone which are used for surveillance, and detection of crop pests, diseases and weeds. Due to numerous rotors in this drone more energy is consumed which makes its battery life a problem and rotary drone have a flight time ranging from 10 to 20 minutes.

Fixed wing drone which are used for aerial surveys, capturing high – resolution aerial photos, mapping and land surveying. These drones have extended battery life as it only have

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one rotor and most fixed-wing drones remain in the sky for up to 20 minutes and travel faster than rotational drones.

Drones designed for agricultural operations are as follows:

Multi rotor drone : It is a unmanned aircraft powered with rechargeable batteries which was launched in China to apply crop protection products in fields. It is equipped with only a 5-10 liters tank can treat up to 1 hectare of rice in 10 to 15 minutes. These drones can fly during both day and night and recent models can detect and avoid obstacles during flight

Fig 2: Multi rotor drone

DJI Agras MG-1 (DJI, 2017): It is used for precision variable rate application ofliquid pesticides, fertilizers and herbicides. The MG-1's propulsion system allows the aircraftto carry up to 10 kg liquid payloads, including pesticides and fertilizers to cover an area of4,000-6,000 m² in just 10 minutes, which is around 40 to 60 times faster than manual sprayingoperations. Spraying system of the drone automatically adjusts its spray according to theflying speed so that an even spray is always applied to avoid pollution and economize operations.

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Fig 3: **DJI Agras MG-1drone**

Applications of Drones in Agriculture:

1. **Soil Analysis for field planning:** Drones can be used to produce accurate 3-D maps that can be used to conduct soil analysis on soil properties, moisture content, and soil erosion. Use of drones also help farmers for soil and field analysis for irrigation, planting planning, and nitrogen level in soil before sowing any crop.
2. **Seed Pod Planting:** Additional attachment below the drone systems is designedable to shoot pod containing seed and plant nutrients into the already prepared soil which will reduce plantingcosts.
3. **Crop Monitoring:** Drones can be used to set its monitoring routes by gathering multispectralgeospatial and temporal datasets at pre-defined scales that relate to crop development and health. Data analytics help in getting insights on crop health much before being visible by manual field scouting.
4. **Crop Spraying:** Drones can carry suitably sized reservoirs, which can be filled withfertilizers, herbicides, or pesticides for crop spraying on large areas in less time.Cropspraying is much safer and cost-effective by its autonomous and pre-programmed run onspecific schedules and routes. Use of drones for agriculture spraying, also reduces the contact of humans with fertilizers, pesticides and other harmful chemicals. Drones enhances spraying capacity up to five times faster than with traditional machinery.
5. **Irrigation:** Drones loaded with thermal, multispectral or hyper-spectral sensors can identifythe parts of the field with moisture deficits using multispectral indices. This helps in planningtimely irrigation to the identified areas with precision.
6. **Crop health assessment:** Plants reflect visible & near-infrared light and its intensity varieswith health status and stress levels experienced by plants. Drones fitted with sensors capableof scanning crops using visible and near infrared light can be used to track crop health overperiod of time and also to monitor response to remedied measures.
7. **Crop surveillance:**. Drones based agriculture mapping can help farmers remain area-wise updated on the plants status and point out which field areas require attention. Drones inspect the field with infrared cameras and determine light absorption rates to estimate the state of crops. Based on realtime and accurate information, farmers can take measures to improve the

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state of plants in any spot of the field. This feature of crop surveillance and crop health assessment also forms the basis of the use of drones for enhancing agricultural insurance tools for cross verifying farmers' insurance claims.

8. **Weed identification :** Apart from soil conditions, drones can also detect and inform farmers about field areas inflicted by weeds, disease and insect pests. Based on this information, farmers can optimize the use of chemicals needed to fight infestations, hence reducing the expenses and also contribute to better field health.
9. **Crop insurance:** Drones can be used for precisely estimating and monitoring of the crop failure. So, it can be helpful for the farmers as well as for insurance companies in providing insurance claims based on the degree of damage. This technology has great potential in accurate and effective implementation of crop insurance scheme, namely *PradhanMantri FasalBima Yojana* in India without any bias
10. **Geofencing or protecting the field from animals:** Birds are the major problem after sowing seeds of many crops. This needslabour to protect the field. A couple of drone flights can scare the birds away from field.

Advantages and Disadvantages of Drone Agriculture Technology

Advantages :

1. **Security:** The agriculture sprayer drones are controlled from a distance by trained pilots.This process eradicates the involvement of farmers or farm labourers in direct contact withpoisonous chemicals and adverse operational conditions.
2. **High field capacity and efficiency:** Drones have very less turnaround time and other field operational delays. The drone can spray 50-100 acres per day depending upon the capacity of drone which is 30 times more than the traditional knapsack sprayer.
3. **Wastage reduction:** Due to a high degree of atomization while spraying, 30% of pesticide is saved. Pesticides in the form of chemical fog can be sprayed at all levels of the crop.
4. **Water saving:** Drone utilizes ultra-low volume spraying technology, thus saving 90% of water in comparison to traditional spraying methods.
5. **Easy to use and maintain:** The agricultural drone are made rugged. It has low maintenance cost, a long productive lifespan, and its parts replacement is simple, as and when required for the company offering drone services.

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Disadvantages

Flight Time and Range: Along with benefits, drones for agricultural use have some limitations. Due to relatively higher payloads, the flight duration of drones used in agriculture is short, ranging from 20-60 minutes. This results in limited coverage of land with every charge. The cost of drones increases significantly with longer flight time.

1. **Initial Cost:** Mostly, agricultural drones used for surveying have fixed wings and may costup to $25000 (Precision Hawk's Lancaster) based on features and sensors necessary forexecuting its intended use. Some drones are costlier as it includes cost of imaging sensors,software, hardware and tools. The initial cost is also proportional to the payload and flightduration capacities, apart from sensors and features included.
2. **Connectivity:** Online coverage is mostly unavailable in the arable farms. Under such asituation, any farmer intending to use drones has to invest in connectivity or buy a drone withlocal data storing capability in a format that can be transferred and processed later.
3. **Weather Dependent:** Under windy or rainy conditions, flying drones is not easy, unliketraditional aircrafts. Drones are weather dependent.
4. **Prohibited flight areas:** In some regions, the use of drones had prohibited due to privacy and other security concerns.

Conclusion:

Drone technology is becoming popular due to its potential to carry out agricultural activities efficiently. Many startups have been encouraged to enhance the technical standards of the drones but its operational policy and cost are becoming the hurdle for its deployment by farmers. Thus there is a need of research for optimizing operational protocols and costs of drones and making them farmers friendly for effectives agricultural practices.

References:

1. Pathak ,H., Kumar, G.A.K., Mohapatra, S.D., Gaikwad, B.B and Rane, J.,(2020), Use of Drones in Agriculture: Potentials, Problems and Policy Needs, Publication no. 300, ICAR-NIASM, pp 13+iv.

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2. Ahirwar, S., Swarnkar, R., Bhukya S. and Namwade, G. 2019. Application of Drone in Agriculture. Int. J. Curr. Microbiol. App. Sci. 8(01): 2500-2505.