A STUDY ON THE USAGE OF DRONES AND ITS TYPES IN INDIAN AGRICULTURE

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Abstract

Presently in India and around the world agriculture still remains a primary objective, based on which human existence is possible. Technological advancement in the area of Drones has given ample amount of support to various sources. Usage of Drones in agriculture is at slow space in India when compared to other developed countries. The farmers of India need awareness about UAS (Unmanned Aircraft System) which can help them in different types of activities related to agriculture and also help them to look after the live stocks remotely. Using Drones a farmer can spray pesticides from a distant location, analyze the health of the crop, detection of weeds, and also use less manpower for agricultural activities. A Drone can help a farmer increase the yield of the field and earn good profit. This article aims is to present different types of Drones and their usage. First, we present the objectives of the Drone, followed by its types and usage, and conclude the article with its outcome.

Keywords: Drone, UAV; unmanned aerial vehicle; agricultural UAV; spraying system; livestock; https://www.mdpi.com/search?q=agricultural+monitoring

Introduction:

The recent developments in the technological sector has given opportunity to farmers in introducing drone technology in cultivation of crops and has been initiated by the Central Government of India, in improving the yield of the crop. India being an agricultural country, producing varied number of crops in different parts of the country, needs a better and more advanced system which will be used to monitor the crops, their condition, check on livestock, etc. As per the Indian federal budget of 2022-23, the government is keen to use 'Kisan' (Hindi for farmers) Drones to boost the agricultural sector in the country.

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Kisan Drones are been promoted for crop assessment, digitization of land records, and spraying of insecticides and nutrients. Kisan Drones of high-capacity can be used to carry vegetables, fruits, fishes to the market directly from the farms. "These items will be supplied directly to the market with minimal damage, consuming lesser time, resulting in more profits to farmers and fishermen," ('What is Kisan drone? Five Kisans you should know', Livemint, Fknow, 2022).

The scope of Drones in Agriculture is expanding at a higher rate day by day. Among them, there are drones having specific applications that can help farmers in making the assessment of soil according to which relevant type of fertilizers can be used on the field to increase the nutrition level which will show better growth in crop cultivation. Apart from this drones can also be used for surveillance and field management.

Literature Study:

Incorporating novel technologies has been identified as a promising solution to address these challenges. Smart farming (Brewster et al., 2017; Tang et al., 2021) and precision agriculture (Feng et al., 2019; Khanna & Kaur, 2019) have emerged as a result of such debates. The former is a general notion for adopting information communication technologies (ICT) and other cutting-edge innovations in farming activities to increase efficiency and efficacy (Haque et al., 2021). The latter focuses on site-specific management in which the land is divided into homogeneous parts, and each part gets the exact amount of agricultural input for crop yield optimization by means of novel technologies.

In addition to the abovementioned technologies, remote sensing has been considered a technological tool with a high potential to improve smart and precision agriculture. Satellites, human-crewed aircraft, and drones are popular remote-sensing technologies (Tsouros et al., 2019).

Rahman M.F.F et al (2021) have done a comparative study on application of UAV Systems in Agriculture. They state that due to their low cost and small size, UAVs have the ability to help agriculture in developing countries with economic prosperity particularly by reducing health related risks associated with manual pesticide spraying and the number of workers.

Rana V. and Mahima (2020) in their review of the Impact of Drone Technology in Agriculture discuss various applications of different technologies in Agriculture like Unmanned Aerial Vehicles (drones), Artificial Intelligence, etc. They list different applications of drones:

- Soil and pasture examination
- Planting (Drones can fire nutrient pods containing a seed into the soil, at just the right depth and help with reduced cost and effort in planting trees on a scale)
- Monitoring Crops
- Health Evaluation of Plants

Mogili U.M.R. and Deepak B.B.V.L. (2018) have reviewed the Application of Drone Systems in Precision Agriculture. They state that drones are used to spray pesticides to avoid the health problems of humans when they (humans) spray manually. Also, drones can operate in areas where it may be difficult for human beings to operate.

Objectives:

The basic objective of this study is, how a farmer can utilize the drone (UAV) in agriculture activities, such as spray pesticides from a distant location, analyze the health of the crop, detection of weeds, and also use less manpower for agricultural activities.

Government Scheme on the Application of Drone Technology.

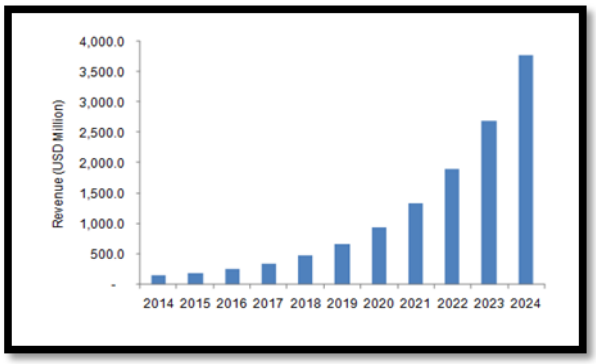
Looking into the advantages of drone technologies in agriculture, the Department of Agriculture & Farmers Welfare (DA&FW) has released the Standard Operating Procedures (SOPs) which provide concise instructions for effective and safe operations of drones for pesticide and nutrient application. The Central Insecticides Board & Registration Committee (CIB&RC) has prescribed the guidelines/protocols for registration requirements of pesticides for drone application. It has also finalized the test protocols for phytotoxicity evaluation and for bio-efficacy evaluation of pesticide formulation. In order to promote the use of drone technology in agriculture, the following provisions have been made under the guidelines of the Sub-Mission on Agricultural Mechanization (SMAM) being implemented by DA&FW:

(i) Financial assistance @ 100% of the cost of agriculture drones up to a maximum of Rs. 10 lakhs per drone is provided for the purchase of drones by institutes under Indian Council of Agricultural Research, KrishiVigyanKendras (KVKs), State Agriculture Universities (SAUs), State and other Central Government Agricultural Institutions/Departments and Public Sector Undertakings (PSUs) of Government of India engaged in agricultural activities. The Farmers Producers Organizations (FPOs) are provided grants up to 75% of the cost of agriculture drone for its demonstrations on the farmers' fields. A contingency expenditure of Rs.6000 per hectare is provided to implementing agencies that do not want to purchase drones but will hire drones for demonstrations from Custom Hiring Centres, Hi-tech Hubs, Drone Manufacturers, and Start-Ups. The contingent expenditure to implementing agencies that purchase drones for drone demonstrations is limited to Rs.3000 per hectare.

(ii) In order to make available drone services to farmers on a rental basis, financial assistance @ 40% up to a maximum of Rs. 4.00 lakhs are provided for the purchase of drones by Custom Hiring Centers under Cooperative Society of Farmers, FPOs and Rural entrepreneurs. Agriculture graduates establishing Custom Hiring Centers are eligible to receive financial assistance @ 50% of the cost of the drone up to a maximum of Rs.5.00 lakhs per drone.

(iii) For individual purchase of drones, the Small and Marginal, Scheduled Caste/Scheduled Tribe, Women, and North Eastern State farmers are provided financial assistance @ 50% of the cost up to a maximum of Rs. 5.00 lakhs, and other farmers @ 40% up to a maximum of Rs. 4.00 lakhs.

The following graphs show potential and a gradual increase in the usage of drones in the agriculture sector and by the end of 2024 the country will touch a mark of 4000 USD Million. Based on this graph we can estimate the usage of drones in agriculture helping farmers around the world



Agriculture Drones Market Size, Share | Industry Report, 2024

How do you farmers use drones in agriculture?

The main benefit of drones in agriculture is, Enhance temporal and spatial sensing resolutions, Facilitate precision agriculture, classification and scouting of crops, usage of fertilizer Monitoring of drought, Biomass Estimation Yield estimation, Disaster Reduction conservation of Wildlife and Forestry, Assessment of Water Stress and Pest, Weeds, and Disease detections.

Crop health monitoring

The basic purpose of Drones in agriculture is to check the condition of the crop in its season so that timely treatment can be given to protect the crop. Usage of different types of sensors can also be used in this regard. A farmer can make an estimation on various components such as level of water, soil strength, pest attack, and identification of diseases. UAV or Drone can be used to observe the crop with different indices[Simelli, Ioanna]. The UAVs are having the capability to cover hectares of fields in a single flight. For this observation thermal and multispectral Cameras to record the reflectance of the vegetation canopy, which is mounted to the downside of the quad copter. The camera takes one capture per second and stores it in memory and sends it to the ground station through its wireless connection.

Disease Control:

It is a common aspect which is found in Agriculture. There are various forms of disease which affect the volume of a crop leading to an economical loss. A farmer has to be more vigilant and has to check the crop from time to time to detect the diseases and carry out its related method of treatment. A farmer can analyze the images captured by the drone, recognize plant disease and activate count measure on

the crop with minimum intervention of humans. A drone can produce RGB multispectral images which are the most accepted images in developed countries to estimate the intensity of the disease.

Checking the level of Nutrient

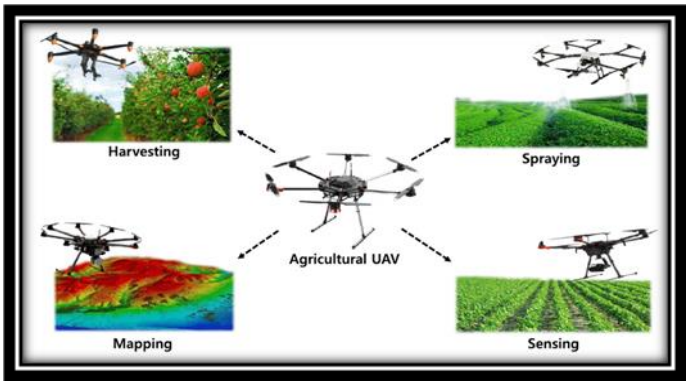
A plant of any kind requiresa sufficient amount of nutrients to grow. When a crop is cultivated a farmer has to spend more amount of money on fertilizer and manpower. This problem can be reduced by using drones, which can spray the entire field in less amount of time, and does not need manpower. A drone can spay the nutrient efficiently on the entire crop.

Weed Control.

A traditional weed control management, a farmer has to pluck the weed by hand or used specialized tools to remove weed from the field. It is a plant that is not desired to be present during crop cultivation. A weed tries to consume more water and space than the actual crop, causing less crop growth and less yield.

Live Stock:

Drones can also be used in surveillance system monitoring live stock in and around the field. It is difficult for farmer to track the animals such Cattle, sheep, chickens, pigs, and other free-range animals can be difficult to keep track of. Especially, on large ranges. A, farmers can fly drones over hundreds, if not thousands, of acres to regularly capture a snapshot of their herds. And Precision Analytics Agriculture can evaluate drone imagery to deliver an accurate count. Deploying a thermal camera on a drone, farmers can identify sick livestock by their signature elevated body temperature.



Types of Drones in Agriculture

1. **Multi-Rotor Drones**

Multi-rotor drones are the easiest and cheapest option for getting an ‘eye in the sky.’ They also offer greater control over position and framing, and hence they are perfect for aerial photography and

surveillance. They are called multi-rotor because they have more than one motor, more commonly Tricopters (3 Rotors), Quadcopters (4 Rotors), Hexacopters (6 Rotors) and Octocopters (8 Rotors), among others. At large, quadcopters are the most popular multi-rotor drones.

Advantages:

1. It provides better control of the aircraft during the flight.
2. Due to its increased maneuverability, it can move up and down on the same vertical line, back to front, side to side, and rotate on its own axis.
3. It has the ability to fly much more closely to structures and buildings.
4. The ability to take multiple payloads per flight increases its operational efficiency and reduces the time taken for inspections.

2. Fixed-Wing Drones

A fixed-wing drone has one rigid wing that is designed to look and work like an aeroplane, providing the lift rather than vertical lift rotors. Hence, this drone type only needs the energy to move forward and not to hold itself in the air. This makes them energy-efficient.

Advantages:

- Fixed-wing drones cover longer distances, map much larger areas, and loiter for long times monitoring their point of interest. The average flight time is a couple of hours. But with a greater energy density of fuel (gas engine powered), many fixed-wing UAVs can stay aloft for 16 hours or more.
- This drone type can fly at a high altitude, carry more weight and are more forgiving in the air than other drone types.

3. Single-Rotor Drones

Single-rotor drone types are strong and durable. They look similar to actual helicopters in structure and design. A single-rotor has just one rotor, which is like one big spinning wing, plus a tail rotor to control direction and stability.

Advantages:

1. A single-rotor helicopter has the benefit of much greater efficiency over a multi-rotor, which increases if the drone is gas-powered for even longer endurance.
2. A single-rotor helicopter allows for very long blades, which are more like a spinning wing than a propeller, giving great efficiency.
3. If you need to hover with a heavy payload (e.g. an aerial LIDAR laser scanner) or have a mixture of hovering with long endurance or fast-forward flight, then a single-rotor helicopter is really your best bet.
4. They are built to be strong and durable.

4. Fixed-Wing Hybrid VTOL

Hybrid VTOL drone types merge the benefits of fixed-wing and rotor-based designs. This drone type has rotors attached to the fixed wings, allowing it to hover and take off and land vertically. This new category of hybrids are only a few on the market, but as technology advances, this option can be much more popular in the coming years. One example of fixed-wing hybrid VTOL is Amazon's Prime Air delivery drone.

Advantages:

1. The autopilot can do all the hard work of keeping the drone stable, leaving the human pilot with the easier task of guiding it around the sky.
2. Hybrid VTOL drones offer you the best of both worlds – fixed-wing & rotor-based designs.
3. They are perfect at either hovering or forward flight.

Some of the popular drone types other than the ones mentioned above include:

1. **Small Drones**

   These drone are used for recreational purposes, they cannot perform commercial functions that other drone models carry out. Small drones are too light and lack the stability required or accurately capturing images.

2. **MicroDrones**

   These are small drones, but they can still provide valuable intelligence because of their micro cameras. The British Military commonly uses this drone, and it's called the Black Hornet. It can fly up to 25 minutes (single Charge) and have a range of one mile.

3. **TacticalDrones**

   These drones are large without being bulky. Equipped with GPS technology and infrared cameras, they measure 4.5 feet and weigh 4.2lbs. it is often used in surveillance.

4. **Reconnaissance Drones**

   These drones measure approximately 16 feet in length, over 2200 pounds, and hover for 52 hours at 35,000 feet. They can be launched from the ground and are known as High Altitude Long Endurance drones (HALE) and Medium Altitude Long Endurance drones (MALE).

5. **Large Combat Drones**

   These drone types are approximately 36 feet long and are usually used to fire laser-guided bombs or air-to-surface missiles on targets. They have a range of over 1000 miles and can be used for up to 14 hours at a stretch.

6. **Non-Combat Large Drones**

   Although large, these drones are not for combat. They are more complex than Black Hornet and are used for larger-scaler recon missions.

7. **Target and Decoy Drones**

   These types of drones are used for monitoring and striking targets. The look of the decoy drone usually depends on the mission.

8. **GPS Drones**

   This drone type links to satellites via a GPS link to map out the rest of their flight, collecting data that can be extracted to make informed decisions.

9. **Photography Drones**

   Photography drones are outfitted with professional-grade cameras. 4K camera drones can take high-resolution pictures. These drone types make use of automated flight mode and precision stability to take pictures covering vast spaces.

Conclusion

The impact of Drone system in the Agriculture sector will transform the future of a farmer. With the new technology implemented in agriculture will definitely attract large number of young generation towards this sector. Adaptation of drones which will help a farmer in spraying fertilizers, real time diseases and weed detection, analysing soil condition, reaching areas where a human can’t reach, etc, will not only improve the quality of soil, but will also improve cultivation activities, increase production, improve quality, and improve the financial conditions of a farmer. Drones will become a part of agriculture in near future helping farmers in maintaining the field and utilize all available resources in a proper and efficient manner. At present we need to provide proper awareness and training to the farmer in the usage of Drones.

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