PROSPECTS OF DRONES TECHNOLOGY IN INDIAN AGRICULTURE: A REVIEW.

Nawabpet Prudhvi, **K.Sudha Sundari**, Assistant professor in Agriculture, School of Agriculture, Loyola Academy Degree and P.G. College, Old Alwal, Secunderabad, 500010.
Guntimadugu Sanhthosh Kumar Raju, research scholar, Department of Agronomy, Lovely Professional University, Phagwara, Punjab, India : prudhvi.agronomy@gmail.com

ABSTRACT:
India contributes a major share in Agriculture world-wide. Majority of the population in India depend directly or indirectly on Agriculture. Traditional methods need to be replaced by new technologies in farming to get the maximum returns and to cater the needs of the growing population. One such technology is the implementation of drone usage in various fields of agriculture. Professionally called as Unmanned Aerial Vehicle (UAV), they are controlled by an infrared remote system. This review helps in understanding the technology and their usage in Field survey, analysis, pest and disease monitoring, weather forecasting, spraying and ranching.

Key words: Drones, UAV, Remote system, Field survey.

INTRODUCTION:

Drones are professionally known as Unmanned Aerial Vehicle (UAV). It is simply an aircraft without human pilot. Drones are generally controlled using an infrared remote system. By establishing a communication between the drone and the remote, the entire vehicle is controlled. Drones are also known as Remotely Piloted Aircraft (RPA). Drones are initially developed in 20th century for use in military missions. Slowly with advancement in technology, the usage of drones have entered in various other sectors like Aerial Photography, Agriculture, Deliveries and even in monitoring forest fires. Based on different parameters, drones have been classified into various categories like Nano, Micro, Miniature/Small/Medium /Large.

India is one of the major players in the agriculture sector worldwide. Agriculture is the primary source of livelihood for about 58% of India's population. India has the world's largest cattle herd (buffaloes), largest area planted in wheat, rice, and cotton, and is the largest producer of milk, pulses, and spices in the world. It is the second-largest producer of fruits, vegetables, tea, farmed fish, cotton, sugarcane, wheat, rice, cotton, and sugar. Agriculture sector in India holds the record for second-largest agricultural land in the world generating employment for about half of the country's population. Thus, farmers become an integral part of the sector to provide us with means of sustainance. The world's population is on the track of reaching 9.7 billion by 2050, requiring a corresponding 70 percent increase in calories available for consumption, even as the cost of the inputs needed to generate those calories is rising. . Demand for food is growing and at the same time, the supply side faces constraints in land and farming inputs. By 2030, the water supply will fall short of 40 percent in meeting global water needs. Rising energy, labor, and nutrient costs are already pressuring profit margins. About one-quarter of arable land is degraded and needs significant restoration before it can again sustain crops at scale.

Farmers are now facing diverse problems in Agriculture. Climate change, soil quality, prevalence of weeds, insects, population growth, urbanization and deteriorated environment have all been identified as global concerns. Climate change is now having a major impact on food security and more than 815 million people are chronically hungry and among them 64 % are situated in Asia (Pathak et al., 2020). Adoption of modern technologies in agriculture, such as the use of drones or unmanned aerial vehicles (UAVs) can significantly enhance risk and damage assessments and revolutionize the way we prepare for and respond to disasters that affects the livelihood of vulnerable farmers and the country's food security (FAO, 2018). In most of the developed and developing nations, Agriculture is

widely mechanized by using latest tools and machines. Tractors, threshers, monoculture, harvester, baler, hay rake, land Imprinter and drip irrigation are the supporting equipment used on fields. Drone is the latest addition in this category and the most rapidly spreading tool in Agriculture. (Deepali Kamthania, 2022) Drone is frequently utilized in farms to help the farmers as a part of 'Precision Agriculture' to modernize farming in developed countries. Within a few years, drones will become more common in both large and small farms in developing countries too. Modern farmers have already started using high-tech solutions such as UAVs for monitoring and forecasting in agriculture.

Drones can collect data on crop yield, livestock health, soil quality, nutrient assessments, weather and rainfall patterns, and other aspects. This information is then utilized to produce a more accurate map of any existing problems, as well as remedies based on highly dependable data. Goldman Sachs predicts that the agriculture sector will be the second largest user of drones in the world with in next five years. (FAO, 2017) With the advent of artificial intelligence and machine learning (AIML), computer vision (CV) is the most promising branch of it that is increasingly used to automate the human actions with precise accuracy and efficiency. Drones are using CV technology to control all the actions during its projected flight and interactive actions and feedback with ground station. Drones can play a vital role in scaling and managing large farmlands.

Characteristics of agricultural drones include: (Deepali Kamthania,2022)
1. Drone must fly according to waypoints definition.
2. It must control its flight altitude.
3. Drone must sense and avoid obstacles during the flight.
4. It must land according to the state of the battery automatically.
5. Acquired images must be stabilized with a gimbal.

Applications of drones in farming:
Drones are transforming how agriculture and farming are done. By implementing drone technology, farms and agriculture businesses can improve crop yields, save time, and make land management decisions that will improve long-term success.

Agricultural drones allow farmers to obtain access to a wealth of data they can use to make better management decisions, improve crop yields, and increase overall profitability. Drones can be used to collect data related to crop yields, livestock health, soil quality, nutrient measurements, weather and rainfall results, and more. This data can then be used to get a more accurate map of any existing issues, as well as create solutions based upon extremely reliable data. The agriculture industry is no stranger to embracing changing technological trends to streamline business. The use of drones in agriculture is the next technological wave that'll help agricultural businesses meet the changing and growing demands of the future. The United Nations has experimented with drones in various areas.

Below are the different areas in agriculture where drone technology can be applied for enhancing productivity:

1. **Weather forecasting:**
    Drones can be used to predict the weather. They can be used to get very high heights in a harsh environment. Farmers can plant their crops according to the favorable climate of the crop in certain weather conditions. If more sensors are added to the drone, the drone can provide accurate weather forecasts.
2. **Soil and field analysis**
    At every stage of crop cycle drones can be used to help obtain useful data. By obtaining 3D maps of existing soil, we will be able to monitor potential soil quality, nutrient management, or soil dead zones. This information can help farmers determine the most effective patterns for planting, managing crops, soil, and more. Ongoing monitoring can help to better utilize water resources, and more effectively manage crop nutrient levels.

3. **Seed planting**

Drone planting is a newer technology and not very widely used, but some firms are experimenting with drone planting. Essentially, manufacturers are experimenting with custom systems that can shoot seed pods into prepared soil. Drone startup companies have been instrumental in developing unique drone technologies to assist with a wide range of ecological and agricultural issues. E.g.- Drone seed. This same drone technology can be adapted and applied to a wide range of farm types, reducing overall planting times and labor costs across the board.

4. **Crop spraying and spot spraying:**

Drones are used to spray pesticides that prevent the spread of crop diseases. (Yallappa, et. al. 2017) With the increasing cost of human labour in the field of agriculture, a lot of new technologies have been emerging every day. In order to reduce the labour cost, one such innovative and technically sound technology is drones in spraying of foliar Fertilizers , Pesticide, Insecticide, Herbicides. By using drones we can reduce the usage of pesticide drastically and also the cost incurred for spraying is very low. When compared to manual labour, the rate of spraying is uniform.

5. **Irrigation monitoring and management:**

Farmers use drones to monitor water levels by inserting a sensor into it to measure the soil humidity levels (Kitpo et al 2018) This allows for effective irrigation because farmers can see areas that need water.

6. **Crop mapping and surveying**

Crop monitoring, agricultural map, land photogrammetry, research and data collection can be made easy with the help of a drone camera. Since the land is very large, drones make it easy to gather all the information correctly. (Reinecke et al 2017) Using geo-fencing techniques to markup the area of the vegetation, the drones in their flight first create a digital map of the field. Using this digital map and photos obtained through the multispectral camera fitted in the drone, the data can be analyzed using the Normalized Difference Vegetation Index (NDVI) techniques. The health of the crops such as pests, weeds and disease detection can be done efficiently.

7. **Crop count and plant emergence analysis**

Precision Agriculture has helped in reducing human errors in Agriculture by cutting down the costs in Crop management. Yield estimation can automatically be done by estimating the number of plants or by tracking the growth of plants.UAVs are already used in Precision Agriculture to improve productivity and profitability by providing synoptic data and task maps to farmers (Tokekar et al 2016)

8. **Planting of seed from air**

Due to their cost effectiveness and versatility, drones are becoming a favourable tool for solving environmental issues like deforestation. For restoration of forests, a novel technology called Quadcopter is being used. A Quadcopter is equipped with GPS navigation system equipped with an Operator. The GPS receives coordinates for the selected area. The seed dispenser mechanism releases the seed in the target area.

9. **Land surveying**

The application of drones in field surveying helps the agriculture community in solving a long standing issue of boundary between two farmers' lands.

10. **Drones for Ranching (Animal Husbandry)**

This area of application in agriculture involves rearing animals for meat. A farmer can well have a vast expanse of land where he keeps his farm animals and deploys an autonomous quadcopter UAV to inspect the animals from time to time. With the utilization of drones at the ranch, whenever there is an emergency with any cattle, proper visualization is carried out with a drone instead of a physical presence. (Azeta et al 2019) Some drones are equipped with thermal imaging cameras that enable a single pilot to manage and monitor livestock. This allows farmers to keep track of livestock at much greater frequency, and with less time and staff investment. The drone operator can quickly check in

on herd to see if there are any injured or missing livestock, as well as see livestock which are giving birth(Kalamkar et al 2020).

Limitations of drones:

Agriculture Drones have the following limitations

1. High initial cost of purchase
2. A traditional farmer is unable to perform the necessary analysis on drone images. To operate agriculture drones, you need some basic knowledge and skills. In these circumstances, the farmer will need to learn image software skills and knowledge.
3. Among the many serious negative environmental consequences, the threat to wildlife particularly birds, is a major concern
4. Extreme weather makes flying them difficult. Extreme rain, fog, or wind can all prevent the devices from flying or recording the required space. The electronic components of a drone can be damaged by rain. A high amount of sunlight is required for image capture.
5. Need some government clearance to use it.
6. With the ever-changing laws and regulations surrounding drone flight, the growing list of restrictions surrounding air space could result in financial or legal penalties.
7. The battery life of a drone survey is a limitation. It reduces the drone's flight time.

Conclusion:

The application of drone technology in agriculture is an advantage for farmers. It will have a direct impact on the crop yield and productivity The need is to deliver the technology appropriately to the local farmers, so that they can benefit from the technology. This requires government and corporate support to reach out to farmers and create correct education and awareness about the technology. In the future too, there are multiple possible ways the collected data can be used, to support the local farmers. Agriculture drones ensure the development of sustainable agriculture if applied and performed effectively.

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