

DRONE TECHNOLOGY: APPLICATION IN AGRICULTURE

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ABSTRACT

The mechanization of agriculture has increased farm efficiency and productivity enormously. Drone technology can help meet the feeding needs of the rapidly increasing population by producing quality food with efficient manpower and resources. Drone technology can help reduce farmers' work to a large extent. Drones can help farmers optimize inputs, react more quickly to pests and diseases, save time from crop scouting, and also helps in yield prediction. Drones can monitor any crop in any geographical area. The use of drone technology is expected to be increased in future, which will help improve crop yields and productivity.

INTRODUCTION

Agriculture is the main occupation for the majority of people in India. The mechanization of agriculture has increased farm efficiency and productivity enormously. To meet the feeding needs of the rapidly increasing population, we need to use special instruments designed by engineers to serve the agriculture sector. One such example of the modern-day technologies used nowadays is drones in almost every sector, as the economy is growing very fast due to limited environmental resources. According to the reports use of drones will increase quickly in the upcoming few years. From scouting to security, drone use will become ubiquitous on small- and large-scale farms. For large-scale farming, drones in precision farming have already become an essential part of the farming operation.

DRONE

An agricultural drone is an unmanned aerial vehicle to help optimize agricultural operations, increase crop production, and monitor crop growth. Sensors and digital imaging capabilities can give farmers a richer picture of their fields. Adopting drones in agriculture would help farmers in early preparation and quick response in disaster, enhancing food security. External factors such as weather, soil conditions and temperature play an essential role in agriculture. Agricultural drones enable farmers to adapt to specific environments to make conscious decisions. The data will help regulate plant health, crop processing, crop discovery, irrigation, field soil analysis and crop damage assessments. Drone surveys help

increase crop yields and minimize time and cost. The government of India has determined the significance of unmanned aerial vehicles, machine learning and artificial intelligence with its Digital Sky Online platform. The demand for drone technology, equipped with artificial intelligence (AI), machine learning (ML) and remote sensing, has increased daily due to its advantages.

ADVANTAGES OF USING DRONES IN AGRICULTURE

USEFUL IN SPRAYING: Drones apply fertilizers, pesticides, fungicides, and seeds more efficiently than traditional methods. Spraying all these can be done easily and faster, saving time. Drones can also be used in uneven areas, steep or when there is no access for spraying; drones can be the best option. Farmers can also easily tackle the issues of pest and disease attacks.

GEO-FENCING: The geo-fencing feature helps where the drone is flying, and the GPS in drones automatically receives restrictions and warnings. For mapping in the agricultural field, geofencing can be used. Geofencing can be used to fence off a restricted area, and it is the best modern technology that helps the farmer protect his crop.

MONITORING OF CROPS: The multispectral camera sensors help identify the stress in the initial stages of the crop and encourage farmers to plan proper crop treatments. For monitoring the health of the crop where the light is poor, clouds cover, and closed fields, drones help in monitoring using satellite imaging.

SEED SOWING AND PLANTATION: For plantation purposes, drones are widely used in agriculture. In the forestry industry, automated drone seeders are mostly used. Planting can be done easily using drones rather than traditional methods. Drones help in sowing in large areas with greater accuracy in less time. In the targeted areas, drones help drop seed balls for more trees.

ANALYSIS OF SOIL AND FIELD: Drones produce precise 3D maps for soil analysis, which can be useful in planning seed planting patterns. With the help of drones, a soil analysis can be done as they provide nutrient management and irrigation data. For landform identification, the advanced use of GIS mapping techniques helps to understand ground conditions in the field within a shorter duration.

MANAGEMENT OF LIVESTOCK: Monitoring of hundreds of animals is challenging, but drones equipped with cameras and thermal imaging scanners can help quickly inform farmers' health conditions. Managing livestock's fundamental activity is to feed animals and take proper care. Thus, UAVs help to monitor animals' health, welfare, and production.

CHECK CROP HEALTH: Recently, drone technology has utilized the automated crop monitoring service for checking crop health. Crop health is important for good crop production and improved quality in yield. For crop health inspection, drones play a major role and are the best solution for farmers.

AVOID OVERUSE OF CHEMICALS: Chemicals will result in health risks to humans and negatively impact the environment; thus, using drones can reduce the overuse of chemical fertilizers. When the crop needs fertilizers, farmers can easily spray them without difficulty in less time.

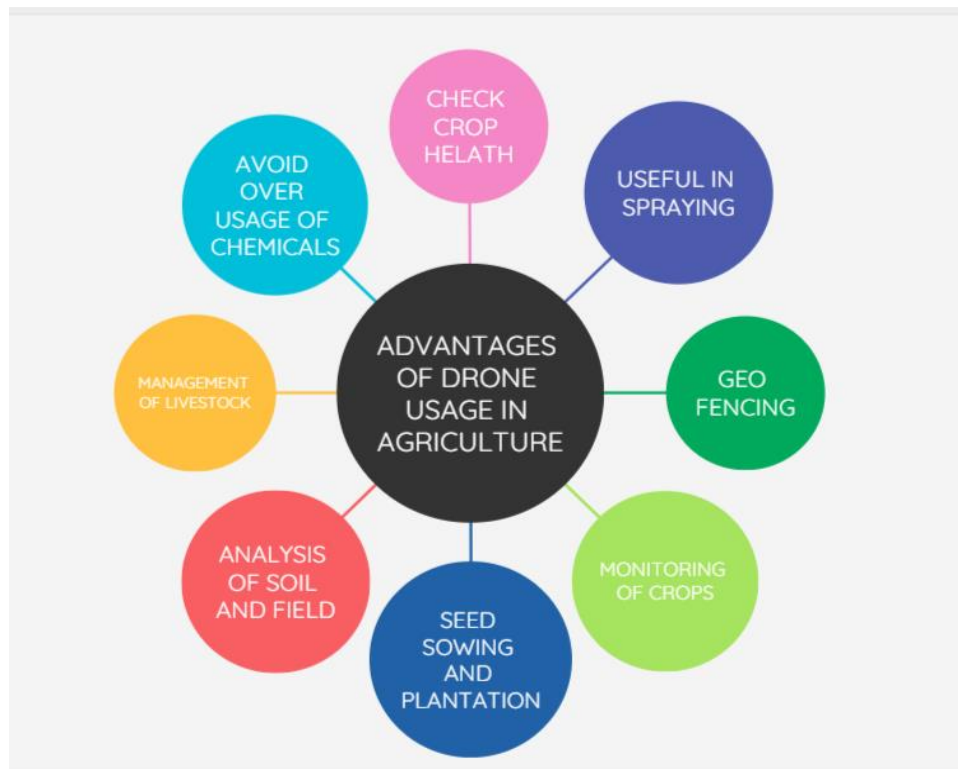


Figure:1 Advantages of using the drone in Agriculture

THE DATA CAPTURED USING AGRICULTURE DRONES TAKES PLACE IN THE FOLLOWING STAGES

ANALYZING THE AREA: Establishing the boundary is the first step in analyzing the area. This identifies the area that needs to be tested. After analyzing the area, the GPS information should be uploaded into the drone's navigation system.

USING AUTONOMOUS DRONES: For collecting the required information or data, drones can fly directly to gather the information required for the farmer.

UPLOADING THE DATA: The uploaded data in the drone will help farmers know the farm management system throughout the season and the required information needed for profitable crop production.

OUTPUT: The data which is collected is formatted in such a way that farmers will understand that data without any hassle. The extensive collected data can be displayed by popular methods like 3D mapping or photogrammetry.

APPLICATION OF DRONES IN AGRICULTURE

MONITORING OF CROP HEALTH: Drones help monitor crop health and timely action required throughout the season. Before the appearance of visual symptoms, the sensors present in the drones will help detect deficiencies or diseases of the crop. Based on the detected stress of the crop, the early decision can be taken as a warning for taking required measures. In a single flight, UAVs can cover hectares of land. Drones help monitor crop health in tall trees and crops, which is challenging for farmers. Thus, it can help reduce yield loss to a maximum extent by easily identifying the field conditions and spraying pesticides.

MONITORING OF WATER STRESS: In agriculture, irrigation plays a vital role. Unmanned aerial vehicles help monitor crop fields to improve water stress management in agriculture. When irrigation is not given at the optimum level, the crop suffers from water stress at different stages of crop growth. Using a remote-sensing drone helps to address the water stress efficiently and helps the farmer decrease his burden to a large extent.

CONTROL OF DISEASES: The occurrence of diseases causes a significant reduction in crop yield. Using drones equipped with infrared cameras can also see the inside plants, providing a clear image of crop conditions. Various preventive measures can be taken only if the farmer can detect the infection before it spreads. Thus when human assessment is unavailable, image-based tools will play an essential role in detecting the diseases.

NUTRIENT STATUS AND DEFICIENCIES MONITORING: Plants must be given the required nutrients to produce a good yield. Nutrients like nitrogen, phosphorous, potassium etc., are required for crop quality production and disease resistance. The crop becomes stressed if the soil does not contain appropriate nutrients. Thus drones help in monitoring the deficiency of nutrients in the soil.

CONTROL OF WEEDS: Weeds cause severe problems by competing with crops for light, moisture, nutrients, etc., resulting in losses to crop yield and growth. The use of herbicide more will also result in herbicide-resistant weeds evolution. Spraying herbicides all over the field is also difficult for farmers. Thus, using drones for weedicide application helps minimize weeds effectively. Spraying can be possible in any field even during sunny and drizzling conditions. It is also the safest method to reduce health hazards while spraying weedicides.

ESTIMATION OF EVAPOTRANSPIRATION: Evapotranspiration is the process of water evaporation from land to the atmosphere and through transpiration by living plants. The drones can help in the estimation of evapotranspiration losses.

SPRAYING: For higher productivity, drone technology can spray chemicals and fertilizers that can make work easier and faster for the farmers. For spraying large areas, UAVs are required. The quadcopter is a small device that can spray indoor and outdoor crops.

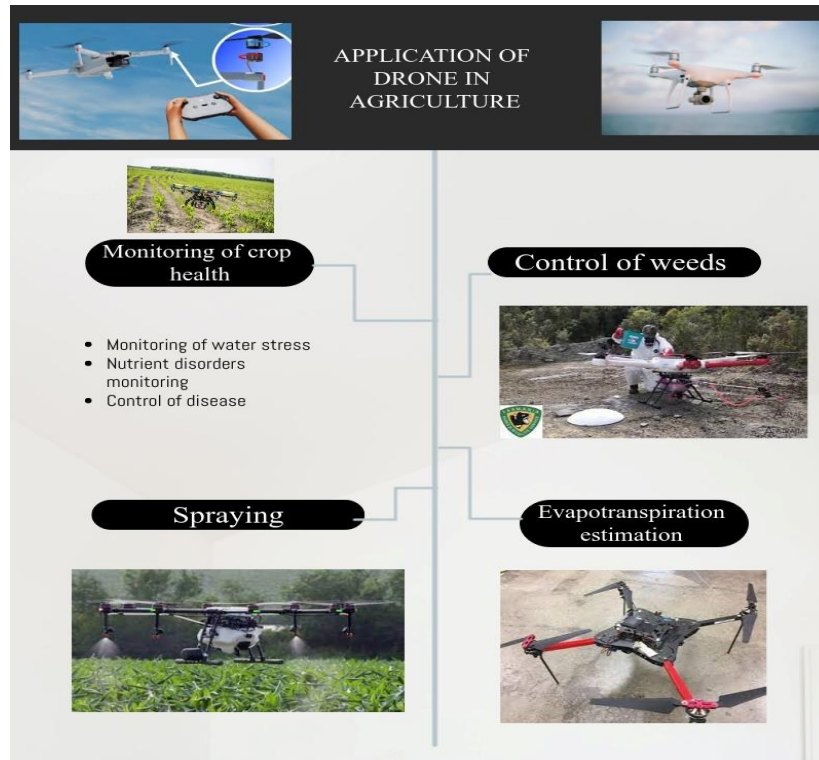


Figure 2: Application of drones in agriculture

BENEFITS OF DRONE TECHNOLOGY

ENHANCED PRODUCTION: Crop production can be increased through drones as it helps the farmers with irrigation planning, and updates to farmers are regular about their crops. Detection of diseases and pests attack with the help of drones can minimize the yield losses.

GREATER SAFETY FOR FARMERS: For spraying pesticides in terrain areas, taller crops, hilly areas, and infected areas, using drones is convenient and safer for farmers. Using drones can also help prevent pollution by using fewer chemicals and greater safety for farmers.

USEFUL FOR INSURANCE CLAIMS: In case of crop damages, farmers use the data captured through drones to claim crop insurance. The captured data can be used and insured to calculate risks and losses.

10X FASTER DATA FOR QUICK DECISION MAKING: Drones help make quick decisions and allow the farmer to save time. Sensors present in drones help in capturing and analyzing data. Diverse crop management can be made as sensors can be fixed for obtaining accurate information.

USE OF DRONES

SCOUTING/ MONITORING PLANT HEALTH: In monitoring plant health, drone plays an important role. Drones equipped with imaginary equipment known as Normalized difference vegetation index (NDVI) give detailed colour information on the plants' health. Thus, it helps the farmers to deal with the problems quickly.

MONITORING FIELD CONDITIONS: For monitoring the soil health and the field condition, drone field monitoring is used. Accurate mapping can be done with the help of drones which help the growers to find any irregularities in the field. Drones help monitor the current status of crops, vegetation, and soil fertility status throughout the crop season and help reduce yield losses.

PLANTING AND SEEDING: Drones help planting seeds within less time. At present automated drone seeders are used mostly in forestry industries for sowing. Around ten drones can plant 4,00,000 trees a day. Planting seeds through drones is easy and time-saving. The UAV help in spraying seeds to reforest lands.

SPRAY APPLICATION: Drone technology helps farmers to spray fertilizers easily. Drone sprayers save workers from chemical hazards occurs while spraying chemical through backpack sprayers. Drones help deliver the fine spray application only to the targeted site areas to maximize efficiency and save chemical costs.

SECURITY: For farm management, drone security is fast growing in agriculture. It helps monitor the far areas and saves valuable time for frequent monitoring. Monitoring remote areas, which is used to take hours of walking, can be completed in a few minutes.



Figure 3: Use of drones in agriculture

CONCLUSION

The mechanization of agriculture has increased farm efficiency and productivity enormously. Drone technology can help meet the feeding needs of the rapidly increasing population by producing quality food with efficient manpower and resources. Drone technology can help reduce farmers' work to a large extent. Drones can help farmers optimize the use of inputs, react more quickly to pests and diseases, save time

from crop scouting, and also helps in yield prediction. Drones can monitor any crop in any geographical area. Being a modern agriculture technology, its uses are expected to grow significantly in the coming years.

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