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UNMANNED AERIAL VEHICLES FOR SUSTAINABLE AGRICULTURE

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----------ABSTRACT----------

Drones are also known as unmanned aerial vehicle. They are the class of aircrafts that can fly without the onboard presence of pilots. Unmanned aerial vehicles are employed in various real life applications such as payload delivery,traffic monitoring and surveillance. The use of UAVs in any of these applications necessitates the planning of feasible and optimal trajectories for the motion of the vehicles. UAVs were originally developed through the twentieth century for military missions and by the twenty first century they had became an inevitable assets to human. Due to the improved control technologies and cost fell,their use expanded to non-military purposes. These include aerial photography,precision agriculture,forest fire monitoring,river monitoring,environmental monitoring,policing and surveillance,infrastructure inspections,smuggling,product deliveries,entertainment and predominantly in agriculture and allied sectors. The term Unmanned Aircraft System(UAS) was adopted by the United States Department of Defense and the United States Federal Aviation Administration in 2005 .An agricultural drone is an unmanned aerial vehicle used in agriculture operations,mostly in yield optimization and in monitoring crop growth and crop production. Agricultural drones provide information on crop growth stages,crop health and soil variations. For efficient field planning,agricultural drones can be used for soil and field analysis. They can be used to mount sensors to evaluate moisture content in the soil,terrain conditions,soil conditions,soil erosion,nutrients content and fertility of the soil. Light weight unmanned aerial vehicles will revolutionize spatial ecology according to Anderson and Gaston in the year 2013.In fact,since last few years farmers are realizing the benefit of drones in agriculture. Drones carrying special sensors can be used to measure pasture growth. Monitoring the livestock population is an essential step in farm management and it can be done easily with the help of drones.

KEYWORDS:***Unmanned aerial vehicle,agricultural drones,necessity,livestock and sustainability.***----------

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INTRODUCTION

Drones are small remotely controlled aerial vehicles i.e., they are unmanned aerial vehicles. They look like helicopters or reconnaissance aircraft and without doubt,one of their strengths is the many different applications for which they can be used. In 1935,the british produced a number of radio-controlled aircraft to be used as targets for training purposes. It is believed that the term drone was used at this time,inspired by the name of these models,the DH.82B Queen Bee.Abraham Karem is a designer of fixed and rotary-wing unmanned aircraft. He is regarded as the founding father of UAV technology. High fluid pressure at the bottom and low pressure at the top of the propeller causes an upward force which is called as a lift. This force is responsible for lifting the weight of an aero-plane or drone. The amount of lift force depends on the angle of inclination of the aero-foil or propeller. The earliest UAVs were known as remotely piloted vehicles (RPVs) or drones. Drones were small radio-controlled aircraft first used during World War II as targets for fighters and antiaircraft guns. Dual Global Navigation Satellite Systems (GNSS) like GPS and GLONASS drones are able to operate in both satellite and non-satellite modes,providing enhanced connectivity during operation. Israel has become the first –ever country to allow drones in civilian airspace.

AGRICULTURAL DRONES

An agricultural drone is an unmanned aerial vehicle used in agricultural operations,mostly in yield optimization and in monitoring crop growth and crop production. As drones entered use in agriculture,the Federal Aviation Administration(FAA) encourages farmers to use this new technology to monitor their fields. The FAA publishes rules for commercial drone operations. These rules require that commercial drone operators pass a knowledge exam,register their aircraft and fly in accordance with published restrictions. Software programmes for analyzing and correcting crop production have the potential to grow in this market. Farmers will fly a drone over their crops,accurately identify an issue in a specific area and take necessary actions to correct the problem. This gives the farmer time to focus on the overall task of production instead of spending time surveying their crops. Additional uses include keeping track of livestock,surveying fences and monitoring for plant pathogens.

FUTURE OF DRONES IN AGRICULTURE

Drones will be necessary for farmers to cover their land in a way that uses less time and effort. Spraying takes 40-60 times longer than an aerial application of fertilizers,herbicides and other inputs. Drones may also be used to monitor plan development and spot pests,weeds and other dangers. They have long been predicted to revolutionize cargo delivery. They help farmers a lot in increasing their farming output. The trend comes amid the federal governments ambitious plan to make India a hub for drones by 2030.To recognize the benefit of drones,International Drones Day was celebrated on the first Saturday of every year. To facilitate further growth,the Government has approved Production Linked Incentive (PLI) Scheme for Drones and drone components in India. For implementation of this scheme during 2022-2023 to 2024-2025,a corpus of RS.120 crores has also been allocated.

TYPES OF DRONES

There are several bases for categorizing the drones but we have described the types of drones according to Watts *et.al* (2012).In this study,drones have been classified into seven categories. They are,

1. Micro Air Vehicles(MAV)
2. Vertical take-off and landing(VTOL)
3. Low Altitude-Short Endurance(LASE)
4. Low Altitude –Short Endurance Close
5. Low Altitude Low Endurance
6. Medium Altitude and High Altitude Long Endurance(HALE)

CHALLENGES AND OPPURTUNITIES OF DRONES IN AGRICULTURE

- Drone technology,training integration and deployment is perceived to have higher costs.
- Legislations are meagre,little or a low interpretation of laws in aviation that don't fit perfectly for UAVs. Therefore,legislation need to be drafted to control the emerging UAV prospects and application areas.
- UAV flight time depends on the power of the batteries. In most UAVs,especially the multi-rotor type,batteries can indeed only sustain a flight time of about 10-30 minutes and could be poorer while flying at high wind speeds. The battery technologies have to be improved.
- Bacause of the small size of the majority of drones,they cannot hold much inputs at once. Hence,their uses are limited to simple areial imagery and visualization.
- Drones are still very much in their infancy to use as data gathering devices. There is a need to establish successful acquisition of data and data multiplication techniques which are highly significant in transforming such data into relevant information.

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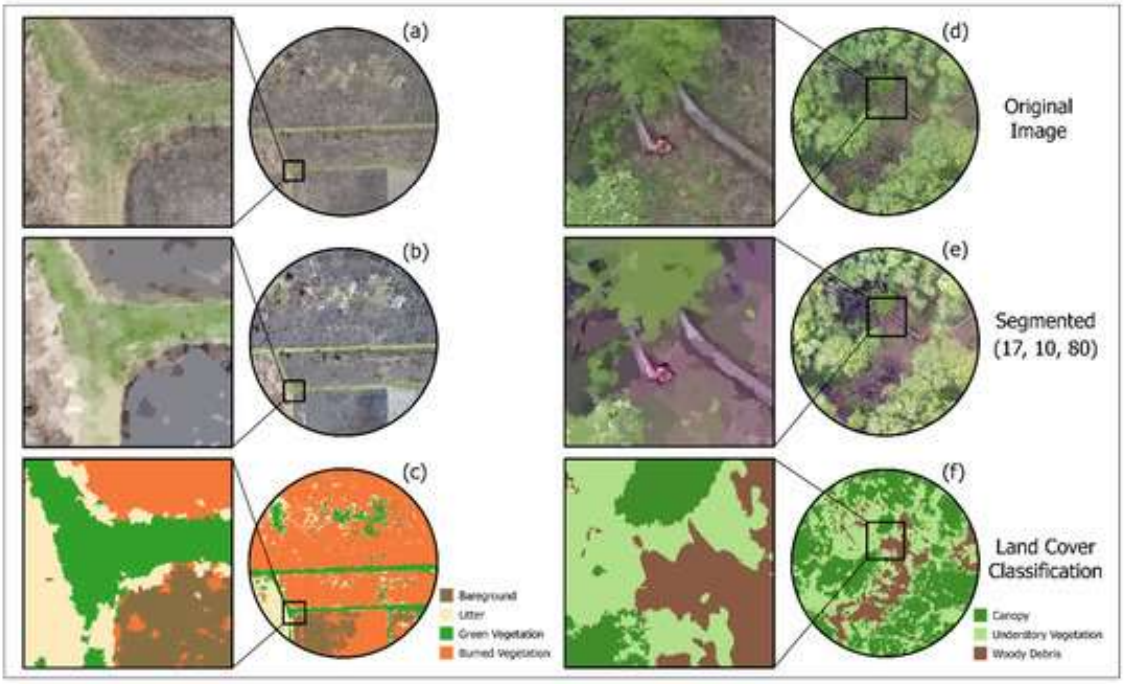
- There are also some manufacturing issues and meeting farmers demands for UAVs. This is largely anticipated as Agricultural cases are still being investigated and tested by industry. In India,manufacturing is carried out on a limited scale,as well as the capital costs stay high.

ROLE OF DRONES IN AGRICULTURE

- FIELD AND SOIL ASSESSMENT - Before the start of the season and after crop planting,data collected by drones regarding soil analysis is instrumental in planning the crop species to be sown,pattern of planting and determining the amount,time of irrigation and nutrient application. These management decisions taken at farm level can enhance overall productivity of the farm.

- **PLANT ESTABLISHMENT** - Due to labour scarcity,now-a-days sowing of crops has become an expensive and burdensome endeavour which traditionally requires a great deal of human labour. Drones have simplified planting of crops on a large scale with utmost exactness and accuracy in short time of span.This method of planting using drones has brought down the cost of planting upto 85% and reduces the work through on-ground-planting.



- **PRECISION CROP SPRAYING** - Site specific crop spraying can be done using drones equipped with sensors where it scans the cropped area on a real time basis and ensures precise quantity of liquid is sprayed on that target place. Indeed,experts estimated that drones can complete aerial spraying upto five times faster than those of conventional spraying. It enhances accuracy in spraying,saves time and input costs of farmers. It indirectly reduces the pesticide pollution in groundwater.

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- **CROP MONITORING** - Crop production challenges i.e, unpredictable weather extremes create biggest obstacle in monitoring crop at field level. The greatest benefits of using unmanned drones are its simplicity and efficiency of massive-scale surveillance of crops and agricultural land. Satellite imagery had been used to get a view of the farm on a large scale ,whilst helping to find potential problems in crop monitoring.At present,animations of time series can provide precise development of a crop and reveal production inefficiencies,enabling better crop management.

- **IRRIGATION MANAGEMENT** - Agricultural drones equipped with thermal sensing cameras have that capability to offer phenomenal perspective into particular troubled areas of the farm for irrigation application. Several insights were monitored through these thermal digital cameras from low moisture stressed condition to waterlogged condition,thus allowing farmers to take irrigation management decisions based on water status in the soil.

- **CROP HEALTH ASSESSMENT** - Crop health monitoring is very essential to detect crop ,bacterial and fungal diseases. It is done by drones using green visible light along with near- infrared light to scan the crop for assessing disease incidence in spatial and temporal variation based on crop reflectance. Early detection of disease is possible to make in before interventions to safeguard the crop.
- **LIVESTOCK MONITORING** - Drones have several potential applications in animal husbandry. Each individual animal is tagged with sensors or radio frequency identification(FRIDs) tags to monitor feeding activity and their movements using drones. By using this,tracking of livestock can be done in much higher frequency,within less time and investment in personnel. Remote sensing-fencing,virtual

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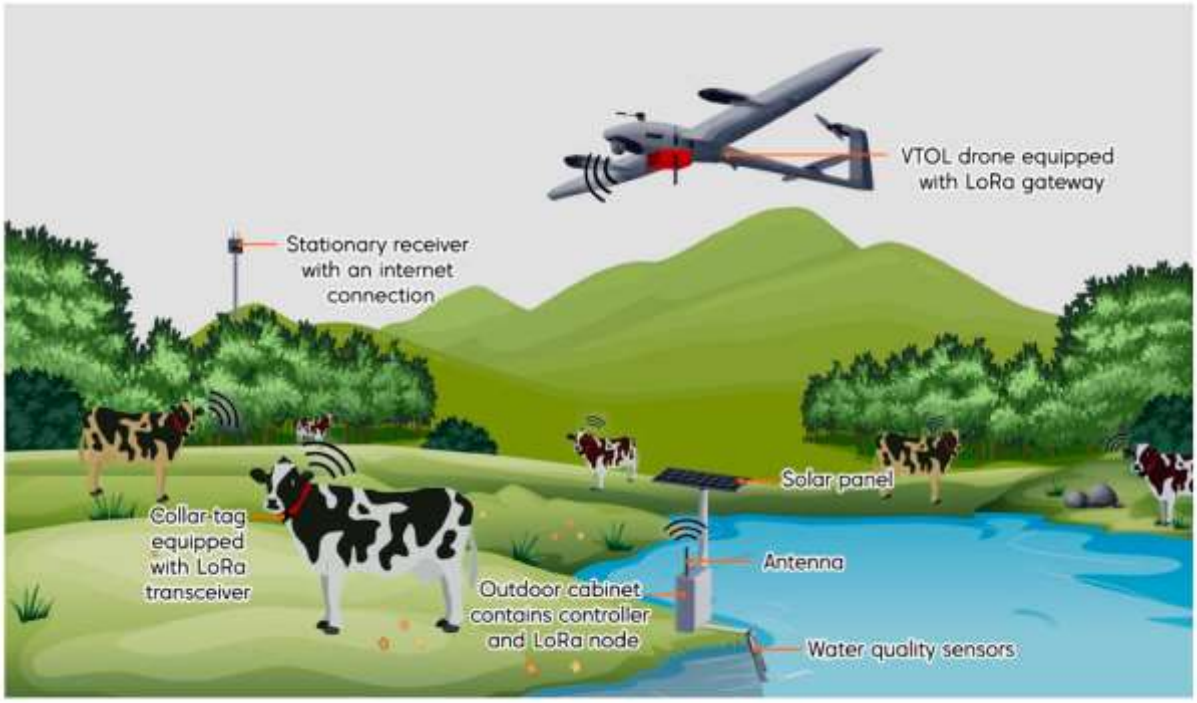
boundaries or remote sensing-zoning essentially means in creating a virtual obstacle or security fence across spatial area of interest especially in free range practice of livestock grazing.



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CONCLUSION

Drones are considered to be robots which essentially fly. Agricultural drones are blooming like any other farm equipment which seems to be an incredible innovative technology in Indian agriculture. This technology can be widely adopted with advantages such as site specific precision information on spatial variation of different management practices which can lead to increased productivity and enhances input use efficiency at the farm level.

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