ASET JOURNAL OF MANAGEMENT SCIENCE
A Bi-Monthly Peer Reviewed Journal

Aset Journal Of Management Science
Volume 1/ Issue 1/ pg: 18-25

ADVANCE AGRICULTURAL METHODS - USE OF DRONES IN SATELLITE AGRICULTURE

Dr M.Kalaivani[1] & Dr.N.V.Suresh[2]

[1]Assistant Professor, Faculty of Management, SRM Institute of Science and Technology, Vadapalani, Chennai
[2]Associate Professor & Vice Principal, ASET College of Science and Technology, Chennai

Abstract

In the present scenario there have been too many advancements in satellite agriculture to increase crop output. Over 70% of the rural population relies on agriculture, particularly in developing nations like India hence in agriculture, drones have become game-changing technologies that are revolutionizing a variety of farming practised. Diseases cause severe losses in the agricultural lands, and these diseases were spread by weeds and insects, which lowers yields from agriculture. To improve the quality of the crop, pesticides and fertilizers are used to kill insects and other pests. The world health organization(WHO) reported that nearly one million diseases got solved by manual spray out pesticides and fertilizers across the crops but the Unmanned Ariel Vehicle (UAV) will be the new problem solver to spread the pesticides or seeds equally across the crops to solve this issue hundred percent.

Drones acquire data in real-time, giving farmers precise insights into the health of their crops, soil, water resources, and animals as well. Informed decisions, resource management, and targeted action by farmers lead to increased yields, reduced waste, and improved farm management. To be widely used and effectively utilized in agriculture, drones must overcome obstacles like rules and regulations, costs, data management, training, and public acceptance. Drones have the potential to improve agriculture's efficiency and sustainability by overcoming these obstacles.

This article gives an overview of drone applications in agriculture is provided in this article, with particular attention to crop monitoring, mapping, water management, and livestock care. Drones gather data in real-time, giving farmers precise insights into the health of their crops, soil, water resources, and animals. Informed decisions, resource management, and targeted action by farmers lead to increased yields, reduced waste, and improved farm management. To be widely used and effectively utilized in agriculture, drones must overcome obstacles like rules and regulations, costs, data management, training, and public acceptance. Drones have the potential to improve agriculture's efficiency and sustainability by overcoming these obstacles.

Key words: Drone; satellite Agriculture; Crop monitoring; Livestock management; Unmanned Aerial Vehicle; Spraying System

Introduction:

Agriculture is one of the primary economic activities in India. The foundation of the world's food production system, agriculture is essential to the survival of both human and animal populations. The agricultural sector in India accounts for between 60 and 70 percent of all employment. It has the second-largest amount of arable land after the United States of America. The extensive network of water sources for irrigation and the high fertility of the soil are the causes of this. Although resources are present, their effectiveness is not commensurate with their availability. The reasons for this include the limited availability of technology, the inexperienced and ignorant use of it by farmers, and the continued use of outdated techniques (Bhargava et al., 2014). Furthermore, pests, insects, and diseases affect the majority of crops, lowering yields. Insect or pest attacks have an impact on a variety of crops. Because insecticides and pesticides can be toxic to certain animals and birds, their effectiveness isn't always established. Additionally, it disrupts natural food chains and the animal food web (Shinde and Kulkarni, 2017). Crop disease causes a notably low throughput. Pests and diseases cause substantial decreases in crop productivity, especially in India where the weather is semi-arid (Shinde and Kulkarni, 2017). The impact of weather on agricultural productivity is enormous. In general, weather-based frangible agriculture systems have a higher crop density. According to surveys, there is a real chance that by 2050, as the world's population grows to 10 billion, there will be a food crisis. It implies that unless we develop and advance smart technologies in agriculture, our ability to produce food will go bankrupt.

Therefore, the development of an affordable technology for Indian farmers is imperative for the proper management of scarce resources. The system ought to assist farmers in promptly preventing crop diseases and enhancing the amount and quality of food produced. Because of their adaptability and versatility, drones have revolutionized many industries, including agriculture. These aerial vehicles, fitted with sophisticated armour, tackle crop management, mapping, livestock surveillance, and water management. Drones give farmers the ability to make well-informed decisions, maximise resource utilisation, and boost overall productivity by supplying accurate and timely data.

This article has discussed the various use of drones in agriculture and how they are changing conventional farming agriculture methods. We will explore the domains of mapping and surveying, livestock management, irrigation and water management, and crop monitoring and management. It also talks about the difficulties and potential applications of integrating drones into agricultural operations.

Literature review:

(Elijah et al., 2018; Friha et al., 2021; Inoue, 2020;) Future environmental issues may arise from the intensification of farming practised combined with rising fertilizer and pesticide usage. In a similar vein, there is a global decline in the number of farmers and arable land. These difficulties highlight the demand for creative and sustainable farming methods.

(Haque et al., 2021) The former is a broad idea that emphasizes using information and communication technologies (ICT) and other state-of-the-art innovations in farming to boost productivity and effectiveness.

(Tang et al., 2021) This article found that introducing novel technologies has been identified as a promising solution to address these challenges. Smart farming

(Feng et al., 2019; Khanna & Kaur, 2019) The precision agriculture have emerged as a result of such debates like modern technologies will provide smart solution to the smart farming.

(Ewing et al., 2020; Shuai et al., 2019), Improvements in sensors, UAVs, and other related technologies, as well as their communication and data transfer methods, are necessary to advance research in agricultural surveillance. Another high-potential research area is the integration of drones with various technologies for optimizing various tasks related to smart agriculture, such as monitoring, agricultural surveillance, and decision-making.

Mohammad Fatin Fatihur Rahman,Shurui Fan,Yan Zhang andLei Chen (2021) Producers will therefore be able to pinpoint the precise amounts of water, fertilizer, and pesticide that are lacking. Undoubtedly, UAVs have become increasingly popular among agricultural technology developers due to the need to maintain the balance between cost and quality. Their prominent roles are growing without compromising this characteristic. Utilising remote sensing equipment to spray pesticides and crops, UAVs equipped with 3-D mapping capabilities can analyse field data and keep a close eye on livestock and crops. Although there's still a long way to go, agricultural unmanned aerial vehicles still have relatively high operating costs. Notably, there are several areas that can be gradually improved, including the processing system, nozzle types, battery capacitance, and image capture.

Rajendra P. Sishodia 1,Ram L. Ray and Sudhir K. Singh (2020) found that Many data on crop biophysical parameters can be obtained from hyper spectral images obtained with state-of-the-art sensors installed on some of the recently launched satellites and unmanned aerial vehicles. Unfortunately, the processing of images is complex and these sensors (UAVs) are costly [246]. To synthesize and generate the useful information required for PA applications, it is necessary to investigate and develop innovative communication and information technologies as well as spectral and chemo metric decomposition techniques. At the scale required for many PA applications, artificial intelligence techniques, such as machine learning, have the potential to generate continuously occurring information in space and time from instantaneous satellite data. Hybrid approaches can support such AI techniques by combining the understanding gained from physically based models to help develop techniques useful in PA in decision making.

Jeongeun, Seungwon, Chanyoung, Hyoung(2019) unlimited potential is shown by agricultural UAVs. In these early phases of research and development, there are still a lot of restrictions and difficulties. We review the platforms, control, and uses of agricultural unmanned aerial vehicles (UAVs) that have been developed or studied in this paper. In addition, a number of restrictions, potential uses, and current developments pertaining to agricultural unmanned aerial vehicles (UAVs) are presented in order to outline the future course of multi-robot system research as a means of resolving issues and constraints with regard to robot-based smart farming systems.

Alessandro Matese,Piero Toscano,Salvatore Filippo Di Gennaro(2015) This study, which compared various remote sensing platforms, showed that similar results can be obtained with varying resolutions in UAV vineyards. This paper also highlights the possibility of differentiating between the canopy and inter-rows in low-resolution images, which restricts the applicability of these platforms in the case of variable rate spraying, given the distinctiveness of vineyards' cropping structure.

T. Qayyum, Z. Trabelsi, A. Malik, and K. Hayawi (2022) WSNs used in variety of applications and its employed in smart farming to monitor environmental factors such as temperature, light, and moisture content of the soil that impact crop growth. Making educated decisions about fertilization, irrigation, and other agricultural practised with the use of the data gathered by the sensor nodes can boost productivity and increase crop yields.

A. Hafeez, M. A. Husain, S. P. Singh, A. Chauhan, M. T. Khan, N. Kumar, A. Chauhan, and S. K. Soni, (2022) this study found that, after 2017, the use of drones for precision agriculture increased. This is because UAV weight, cost, and payload capacity have all decreased. Multi-copter and fixed-wing drones are the most common types used for monitoring crop health and detecting livestock. These drones are getting smaller and less expensive every day. Because of their large payload capacity, unmanned helicopters are primarily used for spraying fertilizer and pesticides. Nonetheless, the use of multiple helicopters for pesticide application is steadily rising. For spot spraying, multi copters are a better choice due to their increased flying stability. Drone cameras' weights, sizes, and resolutions have changed significantly over time. Because multispectral cameras require more for feature extraction, RGB cameras are being replaced by multispectral ones.

A. D. Boursianis, M. S. Papadopoulou, P. Diamantoulakis.. (2022) In satellite agriculture, the use of Unmanned Aerial Vehicle (UAV) systems for crop management and monitoring is growing. UAV systems can be used to monitor a variety of crops, including various cereals. These crops are frequently observed for disease detection, growth stages, and yield prediction. Fruits and vegetables: This includes potatoes, tomatoes, citrus, apples, and grapes. UAVs can detect pests and diseases, monitor crop health and growth, and estimate yield. Oil seeds: Canola, sunflower, and soybean seeds, among others. UAVs can be used to track crop growth, evaluate plant health, and forecast yields. Specialty crops: include tobacco, coffee, tea and cocoa.

Matthew Ayamga , Bedir Tekinerdogan and Ayalew Kassahun(2021) it is found that there is lack of skills to drone and related technologies and there is lack of resources to purchase drone also the biggest hinder for the drone technology implementation and enforcement.

Berie, H.T.; Burud, I.(2018) there is a source of evidence on the potential applications of unmanned aerial systems (UAS) in forestry worldwide. These lessons need to be applied in addition to the current approaches, and they can be modified to fit Ethiopian circumstances. Nevertheless, because UAS have a very narrow flying altitude range, caution should be used when operating them in rugged topographic environments. In addition, UAS laws ought to be made clear to ensure that national security is not jeopardized.

Types of UAV Applications in satellite Agriculture:

Crop Monitoring and Management: Crop Health Assessment: Drones equipped with multispectral or hyper spectral sensors can capture images of crops and assess their health by analyzing factors like chlorophyll levels and stress indicators.

Weed Detection: UAVs can identify and locate weeds within fields, enabling precise herbicide application or targeted manual removal.

Precision Irrigation: Soil Moisture Monitoring: Drones can carry sensors that measure soil moisture levels at various depths, helping farmers optimize irrigation strategies.

Water Stress Assessment: UAVs monitor crops for signs of water stress and provide insights for efficient irrigation management.

Crop Spraying: Precision Application of Pesticides and Fertilizers: UAVs equipped with spray systems can precisely apply pesticides, herbicides, and fertilizers, reducing waste and environmental impact.

Yield Prediction: Plant Counting: Drones can be used for counting plants and estimating crop yield, enabling better harvest planning.

Field Mapping and 3D Modeling: Aerial Imaging: UAVs capture high-resolution imagery of fields, creating detailed maps and 3D models. This information helps farmers analyze topography, drainage patterns, and plan field layouts more effectively.

Disease and Pest Detection: Early Detection: Drones can identify signs of pest infestations or diseases in crops, allowing for early intervention and reduced crop losses.

Livestock Management: Livestock Tracking: UAVs can be used to monitor and manage livestock by providing aerial views of their location and health.

Weather and Climate Data Collection: Weather Monitoring: Drones equipped with weather sensors can collect real-time data on temperature, humidity, wind speed, and more, helping farmers make informed decisions.

Infrastructure Inspection: Infrastructure Maintenance: UAVs are employed to inspect agricultural infrastructure like irrigation systems, barns, and fences, ensuring they are in good condition.

Pollination Assistance: Some UAVs have been designed for pollination purposes, which can be beneficial in orchards and greenhouses.

Crop Scouting and Pest Management: UAVs provide a cost-effective way to scout fields for potential issues and pests, helping farmers make decisions about where to focus their attention.

Agricultural Research: Drones are valuable tools for researchers to conduct experiments, gather data, and conduct trials in agricultural studies.

Remote Sensing and Data Analysis: UAVs gather large volumes of data, and data Analytics tools can help farmers make data-driven decisions and optimize their agricultural practices.

Post-Harvest Analysis: Drones can assess the post-harvest condition of crops, aiding in quality control and supply chain management.

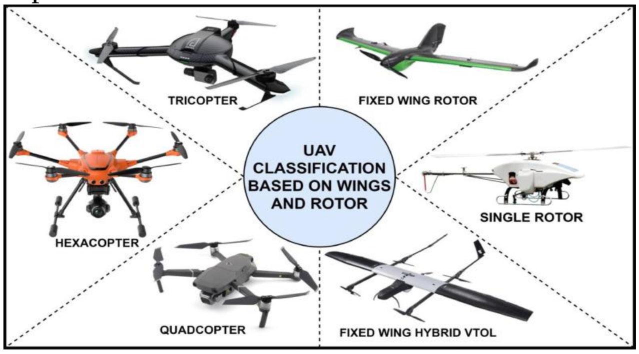
Disaster Response: In the event of natural disasters such as floods, wildfires, or hurricanes, UAVs can be used for damage assessment and disaster relief efforts.

UAV based on wings:

Fixed-Wing UAVs: High Aspect Ratio Wings: These UAVs have long and slender wings, often resembling traditional aircraft. They are known for their efficiency and long-endurance capabilities, making them suitable for applications like surveillance, reconnaissance, and mapping.

Low Aspect Ratio Wings: UAVs with short and broad wings provide better stability and maneuverability at lower speeds. They are often used for close-range surveillance and short-range missions.

Rotary-Wing UAVs: Multi rotor: Multi rotor UAVs have multiple rotors, typically four, six, or eight, and are known for their vertical takeoff and landing (VTOL) capabilities. They excel in tasks that require hovering, precision, and maneuverability, such as aerial photography and surveillance.
Single Rotor and Tandem Rotor: These UAVs feature one or two large rotors, similar to traditional helicopters. They are capable of vertical takeoff and can achieve higher speeds and altitudes compared to multi rotor UAVs. They are used for applications like cargo transport and search and rescue missions.
Hybrid-Wing UAVs:
These UAVs combine features of both fixed-wing and rotary-wing aircraft. They can take off and land vertically like rotary-wing aircraft and then transition to fixed-wing flight for longer-range and more efficient cruising. Hybrid-wing UAVs are often used in military and surveillance applications.
Ornithopter UAVs: Ornithopter UAVs mimic bird flight by using flapping wings. While these UAVs are still in the experimental stages and have limited practical applications, they are being researched for tasks that require extreme maneuverability and bio-inspired designs.
Blended-Wing UAVs: Blended-wing UAVs have a unique design that blends the body of the aircraft with its wings, creating a more streamlined and efficient structure. They are known for their potential in long-endurance missions and are still in the research and development stage.
Flying Wing UAVs: Flying wing UAVs have a wing configuration that lacks a distinct fuselage, and the entire aircraft consists of a single, continuous wing. They are often used in military applications and have a distinct appearance.
The choice of wing configuration depends on the specific mission requirements, including range, endurance, payload capacity, and maneuverability. It's essential to select the appropriate UAV type based on the intended application. Additionally, advancements in UAV technology continue to expand the possibilities for different wing configurations and their capabilities.



Drone usage regulations in India for the agriculture purpose:

Registration and Licensing: Drones used for commercial purposes, including agriculture, typically need to be registered with the Directorate General of Civil Aviation (DGCA). There are different categories of drones, and the requirements can vary depending on the size and purpose of the UAV.
No-Permission, No-Takeoff (NPNT): The NPNT system is implemented to ensure that drone operations are authorized in specific airspace. Before taking off, drone operators must obtain permission through a digital platform.
Height Restrictions: There may be altitude restrictions, typically not allowing drones to fly above a certain height (e.g., 400 feet) to prevent interference with manned aircraft.
Remote Pilot License (RPL): Operators may need to obtain an RPL to operate drones for agricultural purposes commercially. This involves passing an examination and meeting certain criteria.
Privacy and Data Security: Ensure compliance with privacy and data protection laws when using drones, as they capture images and data that may have privacy implications. Get the necessary consent from landowners if you're flying over private property.
Safety Guidelines: Follow safety guidelines provided by the DGCA, such as maintaining a safe distance from people and property, especially during crop spraying or monitoring.
Permissions for Specific Activities: Depending on the specific agricultural activity, you may

need to obtain additional permissions. For instance, if you plan to use drones for crop spraying, you may need approval from the Ministry of Civil Aviation.

Restricted Zones: Certain areas, such as military installations and sensitive locations, may be designated as no-fly zones. It's essential to be aware of and respect these restrictions.

Equipment Standards: Ensure your drone complies with equipment standards and specifications defined by the DGCA.

Reporting Incidents: Any accidents or safety incidents involving drones should be reported to the relevant authorities.

It's crucial to stay updated with the latest regulations and guidelines because they are subject to change. Always check with the DGCA and other relevant government bodies for the most current rules and requirements for using drones in agriculture in India.

Applications of drones in satellite agriculture:

Unmanned Aerial Vehicles (UAVs), commonly known as drones, have found numerous applications in precision agriculture. These applications have revolutionized the way farmers manage their crops and livestock by providing valuable data and insights. Here are various applications of UAVs in precision agriculture:

Crop Monitoring and Health Assessment:

Aerial imagery and multispectral or hyper spectral sensors on UAVs can capture high-resolution images of crops. Analyzing these images helps farmers monitor the health and vitality of crops, detect stress, diseases, and nutrient deficiencies.

Early detection allows for targeted interventions, reducing the need for widespread chemical applications.

Field Mapping and Soil Analysis: UAVs can create detailed 3D maps of fields, helping farmers understand the topography and drainage patterns.

Soil sampling and analysis can be conducted more efficiently by collecting soil samples from various locations within a field, optimizing fertilizer and irrigation plans.

Irrigation Management: Thermal and multispectral sensors on UAVs can identify areas of over-irrigation or under-irrigation. This data enables precise irrigation management, reducing water wastage and improving crop yield.

Planting and Seeding: Some UAVs are equipped with seed dispensing mechanisms, allowing for precision planting. This ensures optimal seed spacing and depth, improving crop uniformity.

Pest and Disease Management: UAVs can be used for the early detection of pest infestations and diseases. They can help in monitoring the spread of pests and diseases and enable the targeted application of pesticides or biological control agents.

Crop Scouting: UAVs are used for regular field scouting, allowing farmers to assess crop conditions without physically walking through the entire field. This saves time and provides a broader view of the field's status.

Yield Estimation: Using aerial imagery and data collected throughout the growing season, farmers can make more accurate predictions of crop yields. This information aids in crop marketing and resource allocation.

Livestock Management: UAVs can be used to monitor the health and location of livestock. They help in tracking the movement of animals, assessing pasture conditions, and identifying potential issues such as injured or missing animals.

Environmental Monitoring: UAVs are valuable for assessing the environmental impact of farming activities. They can be used to monitor erosion, track the health of adjacent ecosystems, and ensure compliance with environmental regulations.

Precision Application of Inputs: UAVs can be equipped with precision applicators for fertilizers, pesticides, and herbicides. This reduces input costs and minimizes the environmental impact.

Weather and Climate Data Collection: UAVs can gather meteorological data, helping farmers make informed decisions based on real-time weather conditions.

Crop Research and Development: UAVs are used in research to develop new crop varieties, study plant physiology, and improve farming techniques.

UAVs have proven to be a valuable tool in precision agriculture, increasing productivity, reducing costs, and promoting sustainable farming practices. The data collected by these drones allows farmers to make data-driven decisions and optimize their operations for better crop yield and resource management.

Conclusion:

From this study it is concluded that the usage of drones in agriculture would be the biggest form of technology in smart farming. This technology will make the farmers ease to their regular activity in farming and also the productivity of the crops will get increase. Undoubtedly the drone is creating a revolution in satellite farming, farmers are facing many challenges today the main challenges are pest control and feeding of seed in the soil. The drone technology provides ability to localise the pest control and improve the efficiency of the crops. Study reveals that drone is the promising technology for the satellite farming.

References

A. D. Boursianis, M. S. Papadopoulou, P. Diamantoulakis, A. LiopaTsakalidi, P. Barouchas, G. Salahas, G. Karagiannidis, S. Wan, and S. K. Goudos, "Internet of Things (IoT) and Agricultural Unmanned Aerial Vehicles (UAVs) in smart farming: A comprehensive review,"

A. Hafeez, M. A. Husain, S. P. Singh, A. Chauhan, M. T. Khan, N. Kumar, A. Chauhan, and S. K. Soni, "Implementation of drone technology for farm monitoring & pesticide spraying: A review," Information Processing in Agriculture, vol. 10, no. 2, pp. 192–203, 2022. [Online]. Available: https://doi.org/10.1016/j.inpa.2022.02.002

Alessandro Matese,Piero Toscano,Salvatore Filippo Di Gennaro,Lorenzo Genesio 1,Francesco Primo Vaccari, Jacopo Primicerio, Claudio Belli, Alessandro Zaldei, Roberto Bianconi and Beniamino Gioli (2015), Intercomparison of UAV, Aircraft and Satellite Remote Sensing Platforms for Precision Viticulture, Remote Sens. 2015, 7(3), 2971-2990; https://doi.org/10.3390/rs70302971

Berie, H.T.; Burud, I. Application of unmanned aerial vehicles in earth resources monitoring: Focus on evaluating potentials for forest monitoring in Ethiopia. Eur. J. Remote Sens. 2018, 51, 326–335.

Elijah, O., Rahman, T.A., Orikumhi, I., Leow, C.Y., Hindia, M.N., 2018. An overview of Internet of Things (IoT) and data Analytics in agriculture: benefits and challenges. IEEE Internet Things J. 5 (5), 3758–3773.

Ewing, J., Oommen, T., Jayakumar, P., Alger, R., 2020. Utilizing hyper spectral remote sensing for soil gradation. Remote Sensing 12 (20), 3312. https://doi.org/10.3390/rs12203312.

Feng, X., Yan, F., Liu, X., 2019. Study of wireless communication technologies on Internet of Things for precision agriculture. Wireless Pers. Communication 108 (3), 1785–1802.

Haque, A., Islam, N., Samrat, N.H., Dey, S., Ray, B., 2021. Smart farming through responsible leadership in bangladesh: possibilities, opportunities, and beyond. Sustainability 13 (8), 4511.

Inoue, Y., 2020. Satellite- and drone-based remote sensing of crops and soils for smart farming–a review. Soil Sci. Plant Nutr. 66 (6), 798–810. https://doi.org/10.1080/00380768.2020.1738899.

Internet of Things (Netherlands), vol. 18, no. xxxx, p. 100187, 2022. [Online]. Available: https://doi.org/10.1016/j.iot.2020.100187

Jeongeun, Seungwon, Chanyoung, Hyoung, Unmanned Aerial Vehicles in Agriculture: A Review of Perspective of Platform, Control, and Applications, July 2019, IEEE Access PP(99):1-
DOI: 10.1109/ACCESS.2019.2932119

Matthew Ayamga , Bedir Tekinerdogan and Ayalew Kassahun Exploring the Challenges Posed by Regulations for the Use of Drones in Agriculture in the African Context, Land 2021, 10, 164. https://doi.org/10.3390/land10020164

M ohammad Fatin Fatihur Rahman,Shurui Fan,Yan Zhang andLei Chen, A Comparative Study on Application of Unmanned Aerial Vehicle Systems in Agriculture, Agriculture 2021, 11(1), 22; https://doi.org/10.3390/agriculture11010022

Rajendra P. Sishodia 1,Ram L. Ray and Sudhir K. Singh, Applications of Remote Sensing in Precision Agriculture: A Review, Remote Sens. 2020, 12(19), 3136; https://doi.org/10.3390/rs12193136

Shuai, G., Martinez-Feria, R.A., Zhang, J., Li, S., Price, R., Basso, B., 2019. Capturing maize stand heterogeneity across yield-stability zones using Unmanned Aerial Vehicles (UAV). Sensors 19 (20), 4446. https://doi.org/10.3390/s19204446.

T. Qayyum, Z. Trabelsi, A. Malik, and K. Hayawi, "Trajectory design for uav-based data collection using clustering model in smart farming," Sensors, vol. 22, no. 1, 2022. [Online]. Available: https://doi.org/10.3390/s22010037

Tang, Y., Dananjayan, S., Hou, C., Guo, Q., Luo, S., He, Y., 2021. A survey on the 5G network and its impact on agriculture: challenges and opportunities. Computer Electronic Agriculture 180, 105895 https://doi.org/10.1016/j.compag.2020.105895.