Agricultural Aerial Drone Technology

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HINKLER AGTECH INITIATIVE

A CASE STUDY BY CENTRAL QUEENSLAND UNIVERSITY

INTRODUCTION

This trial was undertaken as part of CQUniversity's Hinkler AgTech Initiative.

The Initiative aimed to increase the productivity and profitability of the Bundaberg region's agricultural sector through greater availability and utilisation of agricultural technology (AgTech).

An extensive consultative process undertaken with agribusinesses identified on-farm needs that may be addressed using AgTech. Trials of selected AgTech products and services were then undertaken in partnership with agribusinesses and technology providers to determine the technologies' efficacy in on-farm conditions.

This case study provides an overview of findings from one of the technology trials, including grower feedback and considerations for other growers when deciding whether to utilise the technology in their own enterprise.

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Introduction

Australian agriculture is seeing a rapid emergence of new technologies that are changing traditional farming practices.

Agricultural technology (AgTech) promises improved productivity and yield and the ability for growers to make better decisions, but the rate of uptake of AgTech remains impeded by several factors. These factors include a lack of awareness by growers of potential technology solutions, difficulty in evaluating the on-farm efficacy of technology and a gap between grower needs and technology developments.

The aim of this case study is to assist growers by providing background information on a commercially available technology, including details of its performance and value proven through on-farm trials.

Unmanned Aerial Vehicle (UAV), or drone, technology is revolutionising Australian agriculture by offering farmers unprecedented capabilities and insights. Equipped with advanced sensors, cameras, and GPS systems, drones provide farmers with an array of real-time data, enable crop mapping and surveillance and facilitate precise spraying and seeding.

Oztech Drones is based in Bundaberg and is one of Australia's leading providers and operators of UAVs within the agricultural sector.

FIGURE 1: Drone Applying Pesticide to Peanut Crop

FIGURE 2: Swarm Drones Seeding

What Does the Technology Deliver?

Drones can deliver a vast array of benefits to farmers. By capturing high-resolution aerial imagery, drones enable farmers to closely monitor the health and condition of their crops. They can detect early signs of nutrient deficiencies, pest infestations, or other crop issues, enabling farmers to take timely action and minimise crop damage.

Drones are also an excellent tool for mapping and surveying, providing accurate and detailed maps that help farmers make informed decisions regarding land management. The integration of GPS and mapping technology allows farmers to conduct land surveys, plan drainage systems, and establish precise crop boundaries. This precise mapping data can be integrated with other technologies such as precision farming techniques.

Agricultural spray drones can efficiently apply pesticides, herbicides or fertilisers to crops, covering large areas quickly and efficiently and in conditions such as wet weather, that may inhibit traditional land-based methods.

By deploying various imaging sensors, drones can be used to monitor and assess a range of farm attributes, including for example, soil moisture levels, temperature, and vegetation cover. This data may assist farmers with optimising irrigation schedules and ensuring efficient water usage. Thermal imaging cameras mounted on drones may be used to remotely observe livestock health and behaviour. Real-time monitoring enables timely interventions, ensuring the well-being of animals and optimising livestock management practices.

The deployment of swarm drones, which are multiple drones operated together in a coordinated manner by one or more operators, potentially deliver increased efficiency and effectiveness over single drone usage. Swarm drones can cover larger areas in a shorter amount of time, saving time and resources and addressing issues such as pest infestations in a timely manner.

Drones also deliver a range of workplace health and safety benefits to farmers by reducing exposure to chemical spray and access to potentially hazardous areas such as steep slopes or greenhouse roofs.

FIGURE 3: A Single Drone Can Cover a Large Expanse of Crop Very Quickly

FIGURE 4: Aerial Drones are Capable of Spraying & Seeding

FIGURE 5: A Single Drone Can Cover a Large Expanse of Crop Very Quickly

What is Required from the Farmer?

A farmer may either purchase a drone, and associated accessories, outright for their own personal use or engage a licensed drone operator with expertise in agricultural applications. If a farmer plans to operate the drone themselves, they may need to undergo training and obtain the necessary certifications or licences. Depending on the size of drone and the location of its deployment, some jurisdictions require remote pilot certification, which involves passing an exam to demonstrate knowledge of aviation regulations, flight operations, and safety protocols. Training courses may be available through local aviation authorities, drone manufacturers, or certified training providers.

Farmers also need to choose the appropriate drone and equipment for their needs. Factors to consider include the drone's flight time, payload capacity, camera or sensor capabilities, and compatibility with specific software or applications. It is important to select a drone that suits the intended applications and can effectively capture the required data for analysis.

Licensed operators already have the necessary certifications, knowledge, and experience to operate drones safely and effectively. When engaging a drone operator, farmers should consider their qualifications, experience in agricultural drone operations, and their ability to provide the desired services. Proper planning, understanding of regulations, and collaboration with experts can maximise the benefits and effectiveness of agricultural drone use.

FIGURE 6: Drones Can Be Flown Remotely by a Single Operator

How Does the Technology Work?

Agricultural drones work through a combination of hardware, software, and advanced sensors. The hardware components typically include a lightweight and maneuverable aircraft, propellers for lift and propulsion, and a navigation system that includes GPS technology for precise positioning and flight control. Drones are often equipped with high-resolution cameras, multispectral or hyperspectral sensors, LIDAR (Light Detection and Ranging) scanners, or thermal imaging cameras. These sensors capture data and imagery from above, providing valuable information about crops, soil conditions, and other relevant parameters.

The software aspect of agricultural drones involves flight planning and control. Farmers or operators can predefine the flight path using specialised software, specifying the areas to be surveyed or the tasks to be performed. Once the drone is airborne, it follows the predefined flight path autonomously or under remote control. The software also allows for real-time monitoring and adjustments during flight.

During flight, the sensors on the drone collect data, capturing images or generating other types of information related to the agricultural environment. For example, cameras can capture high-resolution imagery of crops, allowing farmers to monitor their health and detect any issues. Multispectral or hyperspectral sensors can capture data beyond visible light, enabling the analysis of vegetation indices and identifying specific crop characteristics such as chlorophyll content or stress levels. Thermal imaging cameras can detect variations in temperature, aiding in livestock monitoring or irrigation management.

Once the data is collected, it is processed using specialised software that can stitch together images, analyse data, and generate actionable insights. This data analysis allows farmers to assess crop health, detect pest infestations, identify nutrient deficiencies, map field boundaries, and make informed decisions regarding resource management and other farming practices.

Technology Provider

The agricultural drone industry in Australia has witnessed the emergence of many supply companies and pilot services dedicated to serving the specific needs of the agriculture sector. These companies offer a range of products and services tailored to support farmers and agricultural businesses in optimising their operations.

For example, OzTech Drones, based in Bundaberg, Queensland, is a reputable and innovative drone service provider catering to the agricultural and mining sectors. With their expertise in the region, they offer comprehensive drone solutions tailored to the specific needs of local farmers.

Oztech Drones are an approved agent for XAG aerial and terrestrial drones and offer a suite of support, training and licensing services.

Applications of Technology (Current and Potential)

Compared to traditional farming equipment, drones are lightweight and portable and therefore able to be deployed in most cropping systems and farm layouts.

Farmers are increasingly deploying drones equipped with multispectral and hyperspectral cameras to capture high-resolution aerial imagery of their crops. This imagery provides valuable insights into crop health, allowing farmers to identify areas of stress, disease, or nutrient deficiencies. By analysing this data, farmers can make targeted interventions, such as adjusting irrigation, applying fertilisers, or applying pesticides only where necessary.

Drones are also being utilised for crop spraying and seeding operations, particularly in large-scale farms. Instead of traditional tractor-based spraying methods, drones can precisely apply sprays and seed to specific areas, even after wet weather can make the land impassable to land-based machinery. With the help of advanced GPS and mapping technologies, drones can navigate through the fields autonomously, avoiding obstacles and accurately targeting required areas.

Another rapidly advancing application of drones is monitoring of livestock. Drones equipped with thermal imaging cameras can quickly and efficiently survey large areas of pasture to locate and count animals. This enables farmers to track the health and well-being of their livestock, identify potential issues such as injuries or distress, and monitor grazing patterns. Additionally, drones can help identify areas with poor pasture quality, allowing farmers to optimise rotational grazing strategies and improve overall livestock management practices.

As drones become less expensive, the deployment of swarm drones (two or more drones flown in unison to perform a given task) will become more common. A trial of swarm drones to spray pesticide on a 40ha sweetpotato crop and 30ha lucerne crop was undertaken in Bundaberg, as part of the CQUniversity's Hinkler AgTech Initiative. The greatest value of the swarm drone technology demonstrated through this trial was the productivity gained by avoiding significant pest infestations, due to prevailing weather conditions.

FIGURE 7: Drones Are Able to be Deployed Easily on Sloping Land

FIGURE 8: Drone Applying Whitewash to Greenhouse Covers

Applications of Technology (Current and Potential)

Both crops needed to be sprayed immediately for optimum spray efficacy. A single drone would need to be deployed over several mornings, running the risk of continued inclement weather and greater pest infestation. The grower estimated that the ability to deploy swarm drone technology immediately in a single application averted a crop loss of approximately 30%.

Another benefit of swarm drone technology demonstrated in this trial was the savings in costs compared to single drones performing the same work. The charge out rate for a single drone / single operator deployment is usually based on a 'per hour' basis. The charge out rate for swarm drone deployment is derived on a per hectare basis to allow for the cost of multiple drones and operators. Based on these costs, the grower saved $1400 and $1500 respectively for the sweetpotato and lucerne flights by deploying swarm drone technology vs single drone technology.

Another trial undertaken through the Initiative assessed the feasibility of deploying a drone to spray whitewash on a commercial greenhouse roof. Whitewashing is a widespread practice by growers aimed at reducing the amount of heat that enters the greenhouse during hotter months. A qualified, licensed drone pilot deployed a XAG P30 drone to spray whitewash medium over 7ha of commercial greenhouse covers in the Bundaberg region. The grower had previously employed both manual and helicopter-based spray methods. The drone completed the whitewash application in only 35hrs of flying time, covering the entire 7ha of covers at a constant rate of 2000m²/hr, with no need for resprays.

The greatest value of drone technology, compared to traditional whitewash application methods, was the significant cost and time savings. Savings of $4000 and $23000 were achieved over manual and helicopter-based spraying respectively. Another significant value of deploying drone technology for this application was the health and safety benefits. The drone creates negligible spray drift compared to a helicopter, reducing risk of inhalation and enabling on-ground staff to continue working during the spray operation. There was also no need for the setup of ladders and scaffolding or workers to access high, fragile structures.

One of the most rapid areas of change in drone technology will be in the software that facilitates and enhances drone operations. Artificial Intelligence (AI) is an example of customised software that is increasing the capability of drones. Autonomous drone technology is also rapidly advancing, allowing drones to operate with minimal human intervention. Improved autonomy will enhance the efficiency, safety, and scalability of drone operations across the agricultural sector.

FIGURE 9: Swarm Drones Offer Greater Efficiency for Large Applicaitons

Value of Technology

The cost of agricultural drones and accessories can vary depending on type of drone, its features, payload capacity, and additional accessories. Entry level drones with basic features and capabilities suitable for simple aerial imaging or crop monitoring can cost between $500 - $2000. Mid-range agricultural drones with higher-resolution cameras, longer flight times and improved stability, and suitable for precision agriculture, cost between $2000 - $10,000. Professional-grade agricultural drones, typically used by professional drone service providers usually come with specialised sensors like multispectral or thermal cameras. These top-end drones offer greater accuracy, higher payload capacities, advanced flight-planning capabilities and range from $10,000 to $50,000 or more.

In addition to the drone itself, there are additional accessories and software that may be required for specific agricultural applications. These can include spare batteries, charging stations, remote controllers, data analysis software, and customised sensors. These accessories can add to the overall cost, depending on the specific needs and requirements of the user.

The cost of engaging a professional drone pilot can range from $150 - $400 / hr, depending again on the size and capability of the drone, and associated sensors, being deployed. For larger broadacre applications, such a spraying or seeding, most drone operators charge a rate per hectare.

The value of agricultural drone technology to a farmer varies according to its application and mode of use, but includes for example:

- ***Enhanced crop yield and quality:*** By detecting diseases, pests, or nutrient deficiencies early on, farmers can apply targeted treatments, resulting in healthier crops with higher yields and improved quality.
- ***Cost savings:*** Drones streamline the process of on-farm data collection, allowing farmers to make informed decisions and optimise resource allocation. By accurately identifying areas that require intervention, farmers can minimise the use of fertilisers, pesticides, and other input costs.
- ***Time efficiency:*** Drones can cover large areas of farmland quickly and efficiently, reducing the time required for manual inspections and data collection. This allows farmers to make timely decisions and promptly take appropriate actions.
- ***Better risk management:*** By monitoring fields and livestock from the air, farmers can quickly spot problems like water stress, pest outbreaks, or infrastructure damage. Early detection enables proactive risk management, reducing the likelihood of crop losses or livestock health issues.
- ***Increased safety:*** Drones eliminate or reduce the need for farmers to physically access hazardous or hard-to-reach areas. This improves safety by minimising risks associated with climbing ladders, navigating rough terrain, or handling dangerous machinery.
- ***Data-driven decision making:*** Drones generate precise and detailed data about farmland conditions.

FIGURE 10: Agricultural Spray Drones Cause Minimal Drift

Additional Considerations

Before deciding to buy or deploy an agricultural drone, a farmer should consider the following factors:

- ***Overall cost:*** Evaluate the cost of purchasing the drone itself plus any additional equipment or software and ongoing costs such as maintenance, repairs, training, and insurance. Compare these costs with potential benefits to determine if the investment is financially viable.
- ***Deployment activities:*** Drones are particularly useful for tasks like crop monitoring, precision spraying, mapping, and livestock surveillance. Assess whether these activities are essential for your farming operations and if a drone can provide significant benefits.
- ***Skill and Training:*** If buying your own drone, evaluate the level of skill and training required to operate the drone effectively. Consider the time and effort needed to learn how to use the drone, interpret collected data, and integrate it into farm management practices.
- ***Experience and reputation of drone operator:*** As for any service provider, not all agricultural drone operators are equal. An operator's experience and skill are critical to them being able to provide a safe and cost-effective service. Many larger drone manufacturers, such as XAG, list recommended local operators on their web pages.
- ***Support and Service:*** Research the availability of technical support and service for the drone and its components. Consider the reputation of the manufacturer or supplier and their ability to provide assistance, spare parts, or repairs promptly.
- ***Data Management:*** Assess your ability to manage and analyse the data collected by the drone. Consider whether you have the necessary infrastructure, software, or personnel to process and interpret the data. Drone-generated data can provide valuable insights, but it needs to be effectively utilised to derive meaningful decisions.
- ***Regulations:*** A farmer should familiarise themselves with local regulations governing the use of agricultural drones. Different regions may have specific rules regarding drone flight, altitude limits, permits, and privacy concerns.
- ***Environmental Factors:*** Consider environmental factors such as weather conditions and terrain. Drones can be affected by wind, rain, or extreme temperatures, limiting their effectiveness in adverse conditions.
- ***Integration with Existing Systems and Technology:*** Assess how the drone will integrate with your existing farm management systems, such as precision agriculture tools or software. Compatibility and data sharing capabilities between the drone and other systems are essential for seamless integration and efficient decision-making.

By considering these additional factors, farmers can make a more informed decision about whether to purchase or deploy an agricultural drone, ensuring it aligns with their specific needs and provides tangible benefits for their operations.

REFERENCES AND INFORMATION SOURCES

For further information on this trial and results, email CQUniversity's agricultural research team:
agriculture@cqu.edu.au

For further information regarding drone rules and considerations when buying a drone, visit the Australian Government's Civil Aviation Authority (CASA) web page:
casa.gov.au/knowyourdrone/drone-rules

For further details on agricultural applications of drones, including the XAG P30 spraying system, contact OzTech Drones, Bundaberg:
www.oztechdrones.com

Summaries of other technology trials undertaken through the Hinkler AgTech Initiative are available at:
bundabergagtechhub.com.au

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