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The case for drones in UK agriculture



Drones in UK agriculture can enable a step change in improving efficiencies within the sector. Drones are becoming a key driver to help farmers monitor crop growth, capture soil characteristics, build richer pictures of their fields, increase crop production, improve farming efficiency, and maximise profits. Among the many benefits, drones can also be used for precision crop spraying and plant seeds at precise locations.

The following two case studies outline the social, economic, and environmental benefits of using drones compared to traditional inspection methods. They also illustrate how farmers, agronomists and other stakeholders in the agriculture sector can benefit from using drones.

Key takeaways

- Connected Places Catapult, together with Agri-EPI centre showcased innovative examples of using Artificial Intelligence and Drone Technology in the agriculture sector to improve efficiency, sustainability, and profitability for farmers.
- In the first case study, Connected Places Catapult partnered with Outfield Technologies (Cambridge based start-up) and Bardsley England (Top fruit producer at the forefront of using innovative technologies) to highlight how Artificial Intelligence, 3D mapping, and drone technology can be used for getting high accuracy yield estimates and reduced fruit variability between trees for high value crops such as orchard fruit.
- Traditional methods of gathering fruit farm information are inaccurate and less efficient. Manual inspection of farms limits fruit growers assessing a small sample size of less than 5% of trees in an entire fruit farm. According to UK apple producer Bardsley England, the estimation of yield by traditional way of hand count of trees are often inaccurate - sometimes up to 20% out.
- Drones offer a step change in the way that fruit farmers can gather their data and the speed at which it can be processed. According to Outfield Technologies, drone enabled inspection allows significantly large sample size about 20% of trees in a fruit farm to be covered in a matter of few minutes.
- Using advanced computer vision and machine learning technology, the drone captured data can be transformed into actionable insights allowing growers to make data driven decisions throughout the entire growing season. Outfield technologies analysis shows that a 10% increase in productive yield from an orchard for growers using the Outfield system
- Food wastage can be reduced by up to 50%, as the number of fruits that are too small or too large is reduced. By using blossom mapping from the drone captured data, growers can adhere to the strict fruit sizing requirements of the supermarkets.
- In the second case study, Connected Places Catapult brought together HSE, drone spraying operators and pesticide manufacturers for an online seminar event to highlight the benefits of crop spraying using drones and current state of play in UK in terms of trials being conducted for getting approvals.
- Precision agriculture technologies such as variable-rate application of inputs such as seeds and chemical fertilisers are needed to increase crop yields without increasing land use and having low impact on the environment. It is estimated that projected intensification of agricultural production may reduce biodiversity by 11% in 2040.
- Traditional crop spraying methods are limited in terms of safety and accuracy. However, Drones can improve the safety and accuracy of crop spraying. Precise or spot application of chemical fertilisers using drones can lead to reduction in fertiliser use for farmers, thereby maximising profits.
- Drones for crop spraying is not allowed in the UK currently primarily due to the lack of empirical data. The regulator (HSE) needs to be satisfied that spraying can happen without causing harm to human health or having detrimental effects on the environment. HSE have created a working group to facilitate the adoption of drone spraying by key players in the sector pooling knowledge, expertise and resources



How the UK agriculture sector will benefit from drone technology and artificial intelligence

Challenges

How drones can help

Supply Chain management

UK agriculture has witnessed increased volatility in food prices due to supply chain issues. This coupled with Britain's exit from EU with no trade deal has had a hard impact on the sector. The most common issues being reduced workforce, uncertainty about payments and approval delays leading to food wastage

Drone technology can help farmers better estimate their yield, enabling them to plan for harvest. This means that resources can be deployed effectively, and accurate information can be given to supply chain partners.

Drones can help reduce food wastage by enabling fruit farmers to produce fruit with less size variability, enabling easier marketing to their retail customers.

Climate change

Agriculture and food production has had to adapt to changing weather conditions to ensure increased resilience in food systems. There needs to be stronger solutions for the agriculture sector to help reduce greenhouse gas emissions and meet climate change commitments.

Precision farming has the potential to address the environmental issues faced by the agricultural sector. Drone technology can be used to capture data about crops and soil so that farmers can identify deterioration of soil and apply chemical fertilisers in a targeted manner.

Size variability of orchard fruit

The fruit sector has strict size requirements which growers must adhere to get the best price for their produce.

The agriculture sector can use drones to monitor and sample during the growing season to reduce variability and food wastage.

Using machine learning, data from drones can be transformed into actionable insights allowing growers to make data driven decisions throughout the entire growing season.

Case Study 1: The benefits of using drone technology and artificial intelligence for high value crops and orchard fruit farmers

Drones offer a new level of precision farming for high value crops and orchard fruit enabling them to maximise harvests. Through the combination of artificial intelligence and drone technology, growers will reap the benefits of boosted yields, reduced costs, and improved harvest management, while decreasing CO2 emissions.

The benefits for introducing drone technology to fruit farming include:

- Accurate yield data compared to manual estimates, saving time and money
- Insights into farm performance, allowing for better resource planning and targeted farm operations
- Reducing the use of chemicals
- Reducing food wastage

Drones also allow for faster, more accurate orchard surveys, delivering a range of benefits compared to the business as usual approach.

Business as usual

- Orchard inspections are usually conducted by farm staff and can be time consuming depending on sample size.
- Yield estimates are produced by hand counting and growers are limited to assessment of a small sample size, less than 5% of an entire orchard.
- Currently, fruit farmers treat the orchard as a standardised block. This approach is costly, inaccurate, and not good for the environment.



Drone Survey

- Drones enable coverage of large areas of land, quickly and efficiently. This means that larger sample areas (20% or more of the orchard) can be assessed in a matter of minutes.
- Drones are cost-effective and can be scaled to any business size, including small farms, providing an objective data source while monitoring crop performance.
- In addition, food waste can be reduced by up to 50% as the drone captured data enables farmers to prevent fruit overloading on trees ensuring fruits are not outside the high value size band. This gives farmers improved confidence to fulfil contracts with supermarkets. Drones can also create blossom maps, which are used to target specific areas for thinning agents, fertilisers, and nutrient applications, leading to reduced inputs.

Demonstration of how fruit growers can benefit from the use of drone technology and artificial intelligence

Connected Places Catapult, together with Agri-EPI Centre, showcased an innovative example of using artificial intelligence and drone technology in the agriculture sector to improve efficiency, sustainability, and profitability for farmers.

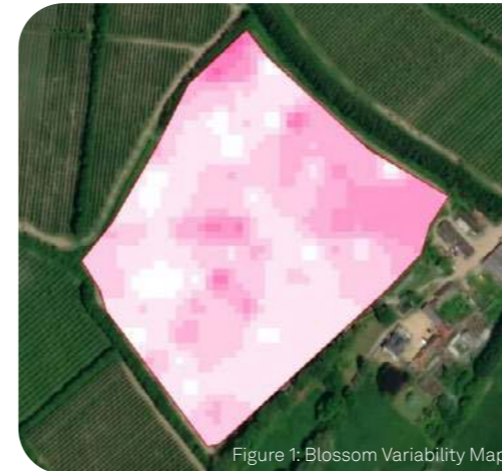
Partnering with Outfield Technologies (Cambridge based start-up) and Bardsley England (top fruit producer at the forefront of using innovative technologies), the demonstration highlighted how artificial intelligence, 3D mapping and drone technology can be used for high accuracy yield estimates and reduced fruit variability between trees for high value crops such as orchard fruit.



Benefits of Outfield Technology's system for growers

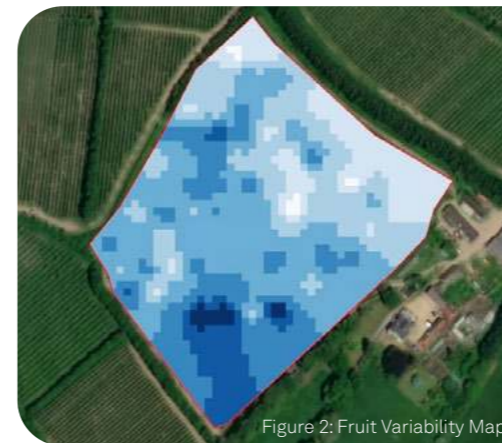
The Outfield Technology system uses cutting-edge drone and machine learning technologies to provide growers with detailed crop insights. The system has been specifically designed for orchard tree crops and uses consumer photography drones to gather data; rather than bespoke drone packages with multi-spectral, hyper-spectral or lidar sensors. Outfield Technology's analysis shows that farmers can increase productive yield from an orchard by 10%.

The following outputs are provided to growers:



Blossom mapping

Growers can identify areas in the orchard where there are too many flowers; meaning the trees will be overloaded with fruit. If the trees are overloaded, the average fruit size for the whole tree will be smaller and the fruit produced will be outside the high value size band. Using Outfield Technology's maps, growers can address the blossom loading early in the season, ensuring the trees have the correct number of fruits.



Fruit mapping

Growers can monitor fruit numbers during the season, highlighting areas of overloading. Through the season, this data can be used to guide interventions in the orchard to manage fruit counts and size such as: hand thinning fruit from the trees, applying growth regulator agents to the trees, and pruning the roots of the trees.



Tree size mapping

Through tree size mapping, growers can identify underperforming areas of an orchard, highlighting soil or irrigation problems. Targeted application of fertiliser to weaker trees over two or three seasons will raise the productivity of those underperforming areas.

Outfield Technology, Co-Founder Oli Hilbourne, said:

"Drone technology is a perfect fit for horticulture and fruit growing. Fruit farms are some of the most productive farming land in the world, but they are also very capital and labour intensive. By using drone systems for data gathering, Outfield is giving fruit growers the data they need to make spraying, pruning, and picking decisions, reducing their costs and improving their sustainability."

Outfield Technology user, farmer Paul Seeley, said:

"Understanding where the fruit is across my orchard and the expected tonnage allows me to efficiently plan my labour and storage, allowing me to utilise resources effectively and keep costs to a minimum."

Case Study 2: The benefits of using drone technology for crop intervention

Agriculture drone spraying offers a new level of precision farming and improvement in safety for farmers. Farmers can harness the drone technology for this application as it offers a targeted and precise solution; replacing labour-intensive, time-consuming, and potentially harmful use of backpack sprayers and other equipment.

The crop spraying sector will benefit from drone technology by:

- Increasing the accuracy of drone spraying, reducing chemical wastage
- Improving operational efficiencies leading to cost benefits



Collaboration with regulators and industry partners

Connected Places Catapult and Agri-EPI Centre convened the Health and Safety Executive, drone spraying operators and pesticide manufacturers for an online seminar, highlighting the potential benefits of crop spraying using drones, and the current legislative conditions in the UK. The discussion provided valuable engagement between operators and regulators, supporting ongoing efforts to develop a shared understanding of the risks and ensuring that drone spraying can be done safely.

Crop spraying using drones is currently not allowed in the UK. A farmer will need to seek approvals from the Health and Safety Executive and the Civil Aviation Authority for drones to spray crops. The Health and Safety Executive must be satisfied that spraying will take place without causing harm to human health or having a detrimental effect on the environment.

A key challenge facing regulators and the drone aerial spraying sector is improving the available data on drone aerial applications to ensure they can be evaluated from a risk assessment and management perspective. When approaching risk assessments, regulators consider factors such as:

- Human toxicology
- Operator and bystander exposure
- Dietary exposures
- Environmental fate and behaviour
- Ecotoxicology
- Physical and chemical properties
- Efficacy

Among these factors, key data related to human and environmental exposure, such as spray drift, is lacking for regulators to assess applications for apply pesticides by drone. A combination of aspects, such as drone spray design, operational characteristics and application practices have the potential to create different risks from those associated with traditional methods.

To meet the regulatory requirements, regulators and drone spraying operators will have to cooperate and build a shared understanding of the risks associated with aerial drone spraying. HSE have created working group (Drone Stakeholder Working Group - Pesticides) recently to facilitate the adoption of drone spraying by key players in the sector pooling knowledge, expertise and resources.

Benefits of crop spraying using Drones as compared to traditional methods

Drones may allow safer, faster, and precise application of plant protection products that can deliver a range of benefits compared to existing methods.

Business as usual

- Ground based means of crop spraying are usually carried out by hand or using tractors.
- Tractor based crop spraying involves tractors with boom sprayers attached covering the entire field by driving along the Controlled Traffic Farm (CTF) lines
- Knapsack sprayers are time consuming and labour intensive and they expose human operators to chemicals.
- The spraying of crops manually with knapsack sprayers over large areas is expensive.
- Using helicopters for aerial crop spraying is more expensive compared to ground-based spraying methods.
- Aerial based spraying using helicopters leads to more spray drift which can affect roads, Waterways, or other areas in the vicinity.
- Traditional spraying means using tractors and helicopters are fossil fuel based.



Drone Survey

- Drone based crop spraying is more precise and cheaper when compared to traditional aerial spraying using helicopters. (In the UK helicopter spraying has been mainly used only for bracken control.)
- Drones can access remote areas which are inaccessible or hard to access on foot or using tractors.
- Drones are fully electric thereby have no requirement on fossil fuels to work. The carbon footprint for spraying can be significantly reduced by using drones, especially if charged using renewable energy.
- Drones can cover much larger areas in far less time compared to knapsack spraying.
- Drones can ignore Controlled Traffic Farm (CTF) lines and prevent crops being crushed while spraying.





The business case: economic, social, and environmental

Economic Case

Increase efficiency

- Drones cover large areas of land quickly and efficiently, and enable better yield estimations. Meaning growers can efficiently plan storage, labour, farm resources and transportation requirements and have more certainty about the quality and quantity of the fruit being produced.

Increased accuracy

- As drones provide a higher level of accuracy, less chemicals could be used. They provide quick and low-cost farm related data to assist in effective decision makings.

Social Case

Labour shortage

- Through automation, drones allow labour to be redeployed to other areas of farm operations.

Reduce exposure to chemicals

- Using drones to spray crops means that fewer labourers will be exposed to chemicals compared to manual spraying.

Environmental Case

Reduce food waste

- Blossom mapping can assist farms in tackling food waste by allowing growers to adhere to the strict fruit sizing requirements of buyers. This means that food wastage could be reduced by up to 50%.

Climate change

- Drones capture data for each tree in an orchard, enabling growers identify underperforming area. In turn, helps guide the precision application of fertiliser which leads to reduced usage of chemicals, reducing costs for the growers, and lower CO2 emissions.

These demonstrations and online webinars have been carried out in partnership with:



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For more information on how drones can benefit your organisation, or to learn more about the Drone Pathfinder Catalyst Programme please visit our webpage:
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