The drone revolution

By Geoff Trowbridge, FDI Associate

AT A GLANCE...

- Drones can gather more detailed and complete information far more quickly and more cost effectively than satellites, manned aircraft or conventional ground survey methods.
- Overseas demand for clean, agricultural products has never been higher and drones can maintain our competitiveness despite our high costs.
- Agricultural drones can provide farmers with immediate information about soils, plant health, growth rates, fertiliser requirements, weeds, pests and weather damage.

The practical benefits drones bring to agriculture

Immediacy and efficiency of drones

Since 1972 remote satellite sensing of the environment by Landsat has provided spatial and spectral resolutions of broad utility. But LandSat has a major issue of resolution (the level of detail that can be shown in an area). LandSat has a '30-metre' resolution, which means that two objects, thirty metres long or wide, sitting side by side, can be separated (resolved) on a LandSat image. For a fee, a farmer may get a 10 metre resolution but then it may take two to three weeks to receive it. Manned aircraft can provide one metre resolution but the cheapest aircraft, a Robinson R22 helicopter, costs $580,000 to buy and around $400 per hour to operate. By comparison, drones cost a fraction of this and only cents per hour to operate. Drones can be flown today and the data processed overnight.

A new tool in both precision and broad acre agriculture

Demand for clean, agricultural products has never been higher and we have the technology to maintain our competitiveness despite Australia's high costs. The emergence of low-cost, unmanned aerial systems (UAS) provide farmers with a new way to measure what is in their pastures and to improve their agricultural productivity. Drones equipped with very high resolution cameras can capture thousands of images in a single flight which produce 2D or 3D maps providing the farmer with detailed insights into every part of his paddock, crop or orchard. The information from optical, multispectral and infrared lenses, high definition video and moisture sensors is then available to the farmer in the comfort of his home office instead of out in the weather.

Agricultural sensors

The process of photosynthesis involves changes to the absorption and reflectance of different wavelengths of light which specific sensors can 'read' and interpret according to the type of plants. There are optical, thermal, multispectral and hyperspectral cameras but the most common are those that calculate the difference between the near infrared reflectance and optical reflectance in an algorithm known as Normalised Difference Vegetation Index or NDVI. NDVI images can differentiate between healthy plants (growing well or ready for harvest) and unhealthy plants which may indicate stress, nutrient deficiency, pests, weeds or other problems for a farmer to deal with.

Data processing

In a typical, 20-minute quadcopter flight, a drone will take around 10,000 photographs from a systematic grid pattern using predetermined track width, overlap and vertical or oblique look angles. The photographs are geotagged and recorded in a memory card in the camera. The memory card is transferred to a computer or laptop with specialised software. The software 'stitches' all the photographs together to generate point clouds, digital surfaces and terrain models and ortho-mosaics from which volumes, angles and distances can be readily measured. Processing the data may take hours depending on the number

Examples of commercial rotary wing drone on the left and a fixed wing drone on the right. (SOURCE: Geoff Trowbridge)

A drone's eye view of sugarcane on the Deguara farm at Mackay – drones can provide up to the minute aerial photography at a resolution and cost not possible by other means. (SOURCE: Project Catalyst)

of images and the processing power of the computer. Once processed, the farmer knows exactly where the problem areas are and can take whatever remedial action is warranted.

Zone maps

Most farmers are happy to know that their crop is in good, neutral or poor condition. NDVI images will divide the paddock into corresponding zones of green, yellow and red that simply enables the farmer to combine this with truth of soil data to quickly create prescriptions for a variable rate application using the appropriate delivery method.

Quadcopter or Fixed Wing?

Quadcopters are more appropriate for small, intensive plots. On larger paddocks, the farmer may only be able to spot check suspect areas or view from the boundary. The time and cost to do this increases with the size of the holding and often must be delegated or outsourced. Old fashioned boundary riders were replaced by helicopters, 4WDs, quad bikes and motor bikes long ago. Fixed wing drones offer a much more cost effective way to gather actionable, real time information about what is happening out there, right now, on much larger properties.

Measuring biomass

Aerial surveillance enables dairy farmers to work out whether they have enough feed or biomass for their cattle and whether it is time to move them to another paddock or feedlot.

Measuring plant health and composition

By analysing narrow wavelength bands reflected from plant tissue, farmers can tell a lot about plant health and composition, crop growth rates, make timely changes to farm management practices and forecast crop yield. The parameters are all readily discernible from aerial surveying using drones.

Assessing mid-season crop growth rates

The ability to inspect in-progress crops from above with NDVI or near-infrared (NIR) sensors is, so far, the primary use for drones in farming.

Mid-field weed identification

Using NDVI sensor data and post-flight image processing to create a weed map, growers and their agronomists can easily differentiate areas of high-intensity weed proliferation from the healthy crops growing right alongside them. Drones can detect and map the presence and extent of weeds, invasive plants, crop diseases and damage by feral animals.

Variable-rate fertiliser application

Drones provide the data that create NDVI maps to direct in-season fertiliser applications on various crops. By using drone-generated, variable-rate application (VRA) maps the farmer can apply differing amounts of fertiliser to struggling, medium and healthy areas, thereby decreasing fertiliser costs and boosting yields.

Irrigation equipment inspection

Managing multiple irrigation pivots is difficult, especially for large growers that have many crops spread out across a region. Once crops reach certain heights, mid-season inspections of the nozzles and sprinklers on irrigation equipment that deliver much-needed water, becomes an onerous task. Aerial inspection of sprinkler testing can save a lot of time and effort.

Monitoring cattle movements

Drones are a sound option for monitoring herds from overhead, tracking the quantity and activity level of animals on a property.

Evaluation of rehabilitation program

Degraded areas are often difficult if not impossible to access on foot due to claypan, sand dunes, erosion, holes, pits or saturation – conducting an aerial survey is a great way to start the process.

Bushfire detection and monitoring

Manned aircraft are expensive to fly – using UAVs equipped with an infrared camera or live video to monitor wildfires is much simpler and more efficient.

Managing prescribed burns

Drones can also be used to monitor prescribed burns and coordinate the location of fire lines with ground crews to ensure the burn is occurring as planned and no equipment or personnel are threatened.

They can assist with post-burn monitoring and for flora regeneration because newer mapping technology allows data layering to look at changes of interest to landowners, agronomists, ecologists and other scientists.

To buy or not to buy

The business case for embracing this technology is relatively simple. Farmers growing high value, short lifecycle, intensive crops who use drones to capture data on a frequent basis:

- Can map the health and vigour of their crops;
- Can observe changes over time;
- Can check to see if growth and health benchmarks are being met; and,
- Can be more confident of yields.

Increased yields of 10 per cent are commonly reported in table green vegetables, by orchardists, banana farmers, olive growers and others.

A cane farmer with 200 hectares and a yield of 90 tonnes per hectare at $50 per tonne of cane going forward would expect a cheque of $900,000. A five per cent improvement in yield would return an additional $45,000 so – all going well – his payback period on a $50,000 drone, with all the necessary technological capability, would be just over a year. And as the technology matures and demand grows, contractors will offer drones for hire.

The full extent of the influence commercial drones will have on agricultural production is difficult to predict as the capability is still in its technological infancy. But if farmers can make sound business decisions based upon drone acquired real-time, high quality data at a reasonable cost then the technology will have an important role to play in ensuring the success of modern agricultural enterprises.

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