Getting Smart about farming

THE HOMESTEAD/DEMONSTRATION ROOM AT KIRBY SMART FARM. (PHOTO COURTESY: UNIVERSITY OF NEW ENGLAND)

"Our fathers used to say that the master's eye was the best fertilizer."

– Pliny the Elder, *Historia Naturali*

By FRANK SMITH

While Pliny might have been right 2,000 years ago, the development of precision agriculture, microsensors and remote sensing has provided farmers with access to more accurate and detailed information to help make management decisions.

PROFESSOR DAVID LAMB (RIGHT) EXPLAINS THE SMART FARM DATA COLLECTION OPTIONS TO THE HON. BARNABY JOYCE MP (LEFT), FEDERAL MINISTER FOR AGRICULTURE. (PHOTO COURTESY: UNIVERSITY OF NEW ENGLAND)

Developments that pave the way for smart farming include:

- The National Broadband Network which will make it possible for all Australian farms to access a broad range of digital services;
- Low cost and ubiquitous sensor technology that will collect data continuously on crops, livestock, water, weather and farm machinery;
- The availability of mobile sensing technologies with accurate positioning systems to measuring changes in crop and pasture biomass and canopy characteristics;
- Local wireless systems that make it easier to connect up sensors and computers.
- Smart personal devices and apps that make it easier to access information on the move;
- Cloud computing technology that simplifies access to and sharing of information with other users including advisers and consultants and provides the capacity to analyse diverse information sources;
- Increasing ease of use of video-conferencing systems make it easier to bring remote veterinary and other agricultural advisory services onto the farm, many of which can be supported by in-situ sensor technology.

"Agriculture has been slow to adapt to the digital world; but it may be about to come in a massive way to a paddock near you."

The University of New England is transforming 'Kirby', its 2,800 hectare commercial farm, into a smart farm. This will be a test bed for new technologies and a demonstrator site showcasing the latest on-site technologies aimed at improving productivity, environmental sustainability, safety, workflow and social/ business support networks on Australian farms.

Professor David Lamb, Head of the smart farm project, told *Landline* that the new facility will also provide significant research extension opportunities for demonstration of the latest technologies to farmers and professionals already working in the industry.

"For example we have an ear-tag livestock tracking system, a satellite-based pasture monitoring tool, and even a prototype virtual fence working. Taken together this suggests a future where farmers can observe both their pasture and livestock, and then move livestock around without setting foot in the paddock," he said.

"By combining the demonstration farm-house with a visitor and teaching centre we open the facility up to the wider community, giving schools and interest groups the opportunity to learn more about new agricultural technologies.

"One of our biggest challenges will be to anticipate which emerging agricultural technology will take off and which ones will end up being parked in the shed. But that's part of the smart farm's work, using real world agricultural practices to put technology to use in a research environment.

"While we are happy to have a super hi-speed connection for research and education, it's important to remember the very real communications limitations that many farming families face every day, so the smart farm will also have the capacity to replicate every one of those systems."

MONITORING SOIL CONDITIONS

As a first step a wireless sensor network for monitoring of soil conditions has been deployed. Over 100 monitoring stations each sample soil moisture, soil temperature, soil electrical conductivity, and air temperature every five minutes. Other sensors, such as weather stations and light sensors, are also deployed across the farm.

"Soil moisture cuts across a whole range of operations on farm. Simple things like: can I work the soil? Should I sow? Should I apply fertiliser? Should I put animals on this paddock? How much moisture have I got? How much pasture growth have I got ahead of me? So, if you understand soil moisture, you can cut across a whole range of decisions.

Together these sensors create an information stream to support decision making for pasture and livestock management. Local wireless networks allow the fixed and mobile sensors to send a continuous stream of data to a remote cloud based computing and analytic service. The information platform is supported by a baseline farm database comprising of numerous spatially-enabled 'information layers' (eg fencelines, topography, soil characteristics, etc) using commercially-available technology.

CSIRO which is collaborating with University of New England at Kirby, is also developing a 'Digital Homestead' at CSIROs Lansdown Research Station near Townsville, Queensland designed for northern beef enterprises.

Sensors collect data from on-farm sensing of soils, vegetation, livestock and the environment as well as from external sources such as climate forecasts and market information, integrating them into a simple and usable cloud-based decision support systems for farmers and agriculture advisers.

MINISTER FOR AGRICUTURE BARNABY JOYCE WITH LEFT TO RIGHT DEREK SCHNEIDER, UNE-PARG (PRECISION AGRICULTURE RESEARCH GROUP) SENIOR TECHNICAL OFFICER; PROFESSOR DAVID LAMB, LEADER OF THE UNE SMART FARM PROJECT; BARNABY JOYCE; PROFESSOR ANNABELLE DUNCAN, VICE-CHANCELLOR OF UNE. (PHOTO COURTESY: UNIVERSITY OF NEW ENGLAND)

FARMER DUGALL MCDOUGALL (L) AND GORDON FOYSTER (R) CEO OF TAGGLE P/L. THE COW IS FITTED WITH A RADIO EAR TAG CALLED A TAGGLE. (PHOTO CREDITS: RICK BURD OF AGROBOTIX)

TRACKING CATTLE

The project uses a commercial cattle tracking sensor developed by Taggle, an Australian technology company. The Taggle sensor is a low-powered ear tag that can track an animal's position with a range of approximately 7kms with an accuracy of about 15 metres.

The system can be used to provide the real-time location of livestock as a map-based interface for a mobile smart device or desktop website. It can also be used to send SMS alerts when livestock move outside of a pre-determined area.

GRAZING MANAGEMENT

Data from the wireless cattle tracking systems will increasingly be able to provide analysis of the pasture productivity, locating which parts of a paddock are highly productive versus areas that could be targeted for improvement. This data could then be used to optimise the location of feeding and watering points.

There is also the opportunity to link cattle tracking and activity data to the NLIS (National Livestock Identification System) animal identification system to assist with herd management and breeding.

Cattle tracking provides location only at this stage. But from that you can deduce a whole range of information about their behaviour, said Professor Lamb.

"There's a whole range of opportunities around developing fingerprints of behaviour. For example, developing an alarm for when they're attacked, if they happen to be stolen, if they're calving or if they're dead. But also even down to how much pasture have I got? By actually watching those dots moving around on the map, the animals tell you themselves," he said.

SHEEP ON THE PROPERTY. (PHOTO COURTESY: UNIVERSITY OF NEW ENGLAND)

CROP INSPECTION BY DRONE

New Zealand sheep and cattle farmer Neil Gardyne started to use a drone to collect real time data without having to physically go to the particular enterprise with a quad bike or vehicle. This reduced his dead running time by 40 per cent and reduced the risk of injury, which allowed him to strategically plan the business based on real time data.

A drone can be autonomously flown to look for cast sheep and monitoring water troughs.

Mark Gardyne (13) is the drone pilot and drones are capturing the interest of young people, which will enhance agricultural resilience and sustainability of farming into the next generation, says Mr Gardyne.

In a cropping situation a drone fitted with multichannel remote sensors that measure visible and infra-red reflectance can be set to overfly a paddock. During the flight, important canopy data are measured, transferred onto the internet and evaluated. The farmer receives these data shortly afterwards on a mobile phone providing information, for example, about plants that appear to be nutrient or water deficient.

DRONES USED TO MONITOR CROPS AND PASTURES. (PHOTO CREDITS: RICK BURD OF AGROBOTIX)

Precision agriculture allows areas of deficiency to be treated separately from the rest of the paddock, this saving overuse of fertilizer or other resources.

CSIRO says soil monitoring technology such as this can provide significant benefits to the farmer's bottom line. For example, cotton growers using these sensors are almost doubling their yields per megalitre of water used when they vary irrigation rates according to the localised needs of the soil and plants, rather than taking the one-size-fits-all approach for a whole field.

The same technology may detect plant diseases and allow treatment of infected areas, rather than the whole crop.

ON THE QUAD BIKE IS UNE LEADING FARM HAND, SIMON CROSS. (PHOTO COURTESY: UNIVERSITY OF NEW ENGLAND)

AVOIDING DEATH BY DATA

Professor Lamb said like all technology, we can face death by data. We need to be able to render all that data down into critical, actionable information, such as a simple SMS alert.

"A lot of the technology that's being deployed on this farm can either be accessed directly on the internet, or if you're not interested in using the computer or the internet, we can use one of these standard video conferencing units that can double as your desktop screen and have a conversation with a consultant in town."

"Let's say you have an animal calving. The farmer gets an SMS alert to say animal number 58 is likely to be calving based on its behaviour.

"Same with the pasture. If you have a satellite monitoring your pastures, maybe you get an SMS alert when your pasture biomass drops below 1,000 kilograms per hectare, which is a level at which you want to move your animals off to maintain a good bounce back when the rains come again."

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