Case study 5

Using Digital Agricultural Tools for Soil Management at Charles Sturt University Global Digital Farm

Charles Sturt University Global Digital Farm (GDF) is one of Australia's first hands-free commercial farm. The GDF is a 1,600-hectare commercial mixed-farm operation located at Wagga Wagga, New South Wales. Research conducted at the GDF is changing modern farming practices by incorporating digital technology to help farmers make the right decisions at the right time. The farm uses static and mobile sensing technologies and telecommunications innovations to provide data-driven insights.

Remote and proximal sensing and surveying technologies create data layers that provide a greater understanding of spatial variability of plant-soil-water interactions and pave the way for site-specific management of soils, to maximise crop and pasture production while maintaining soil and plant health.

Image courtesy: Charles Sturt University - Global Digital Farm

1. Collating available spatial layers

In the past five years, the broadacre cropping block at CSU has collected various spatial layers that are essential for creating a precise field zone map. This map will help in determining future sampling and fertiliser management plans. The layers available include remotely sensed crop vigour, proximally sensed soil EM, and crop yield.

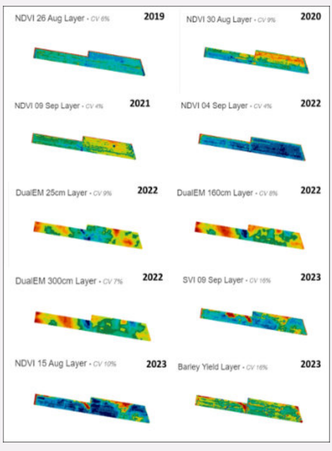

Figure 1 Screenshots taken from PCT Ag, a Precision Ag software program used by CSU Global Digital Farm. Screenshots include spatial layers captured in the one paddock across the last five seasons. Source: Charles Sturt University - Global Digital Farm.

Source: Charles Sturt University - Global Digital Farm

2. Creating management zones and informed soil sampling

The paddock has been divided into zones with similar characteristics using a statistical clustering technique based on the ten data layers provided. Now that statistically similar zones have been produced, Latin hypercube (LHC) analysis can be utilised to capture the soil's spatial variability with fewer samples taken for soil analysis. This approach ensures a representative spread across available spatial datasets based on the distribution in the layers.

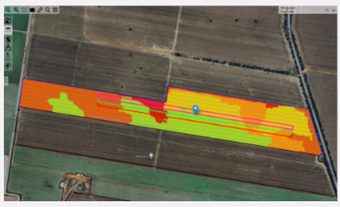

Figure 3: Screenshots taken from PCT Ag, a Precision Ag software program used by the CSU Global Digital Farm. Screenshots illustrate the strip trial design produced based on the statistical spatial zones created. Source: Charles Sturt University - Global Digital Farm.

Source: Charles Sturt University - Global Digital Farm

3. Strip trial design

Following the analysis of soil samples, now, the spatial variability of soil properties has been captured across the paddock. A strip trial design to conduct experiments in the field across various management zones can be developed, considering the influence of inherent soil variability, for assessing the effect of various fertiliser strategies on crop performance.

This involves dividing the field into sections and applying different fertiliser rates, types or methods to observe the impact on crop growth and productivity. This helps farmers identify the optimal product and rate for each zone. These rates can then be integrated into a Variable Rate Application (VRA) map, which can be loaded into the farm machinery via a controller file. The machine's GPS technology guides it across the field, and the onboard computer reads the controller file in real-time, automatically adjusting the application rates of the inputs according to the georeferenced prescriptions on the map.

Figure 2: Screenshots taken from PCT Ag, a Precision Ag software program used by CSU Global Digital Farm. Screenshots illustrate the statistical spatial zones created based on the data, along with the prescribed soil sampling locations using LHC analysis.v

Source: Charles Sturt University - Global Digital Farm

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