

Tracking profit and risk of cropping systems in the southern region – a preliminary scorecard

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Key findings

- Systems that achieved higher gross margins compared to baseline systems also tended to be less variable.
- System gross margin was primarily determined by the frequency of the most valuable crop in the sequence and its yield, especially in the wetter year (2023).
- Adaptive decision-making regarding variety, sowing time and crop end use resulted in improved gross margins.
- Despite two dry seasons, sequence legacy effects were apparent. Legumes typically left more residual soil water, while yield and gross margin responses varied with nitrogen management and seasonal conditions.

Introduction

The 'Farming Systems South' project

Despite advances in the productivity of individual crops, there remains a need to understand how crops interact within the cropping sequence to influence the profitability of the farming system. The GRDC 'Farming Systems South' (FSS) project was established in 2023 to deliver new insights into the drivers of profitability and sustainability of cropping systems in the southern region, by identifying strategies that improve a range of performance metrics such as system gross margin (GM) and economic water use efficiency (\$WUE).

Nine field trials have been established across South Australia and Victoria following consultation with farming systems groups, agronomists and growers. The trials span a range of environments, from low to high rainfall zones (with varying seasonality) and different soil types. Each field trial is fully phased to avoid seasonal biases.

At each site, a Baseline system was identified, representing the most common practice in the region. The remaining systems differed in the presence, frequency and sequence of cereal, pulse, and canola crops. Some systems also include different N management (based on different rainfall deciles) and time of sowing strategies. Varieties, target plant densities and sowing times are all based on best practice with local adviser recommendations. Nitrogen rates are determined from pre-sowing soil water and N tests (to 60 cm) and estimates of yield potential. Weed, disease and pest management are as per best practice.

A responsive, adviser-led system is also assessed at selected sites, involving adaptive decision-making on crop or variety choice, crop end use, N rates and sowing times in each season. Decisions are made by a local adviser based on available information on current conditions, including starting soil moisture and N, seasonal forecasts and commodity prices.

Methodology

The trial at Hart, located within the medium rainfall zone (MRZ) of the Mid North SA, is one of four large-scale 'core' trials. Other 'core' trial sites are located at Kinnabulla (Southern Vic Mallee), Manangatang (Northern Vic Mallee) and Streatham (South-west Vic).

The range of systems that were identified following consultation with local growers and advisers in the Mid North SA are listed in Table 1. In some of these systems, there are additional tactical N treatments, which are not reported here for brevity.

Table 1. Cropping systems under investigation at the Hart FSS field site. Bold text identified differences compared to the Baseline.

#	System ID	Cropping system
1	Baseline*	Lentil – Wheat – Barley
2	Adviser-led, risk neutral^	Wheat (long-season) – Barley (hay) – Lentil – ?
3	More lentils	Lentil – Wheat – Lentil – Barley
4	Canola*	Lentil – Wheat – Canola – Barley
5	Adviser-led, risk tolerant^	Lentil – Chickpea – Oaten hay – ?
6	Double break	Lentil – Canola – Wheat – Barley
7	Pulse on pulse	Lentil - Field pea – Wheat – Barley
8	More cereals	Lentil – Wheat – Barley – Wheat
9	Winter cover crop	Vetch (brown manure) – Canola – Wheat – Barley
10	Intercropping*	(Canola + Lentil) – Wheat – Barley

This report presents results of selected systems at Hart from 2023 and 2024 (Table 2). System GMs were calculated using 5-year averages of commodity prices and input costs, averaged over all phases within each system. Economic water use efficiency (\$WUE) of each system (for a given year) was calculated as:

$$\text{\$WUE (\$/ha. mm)} = \frac{\text{System GM (\$/ha)}}{\text{Growing season rainfall (mm)}}$$

The variability in GM of a system was estimated using a variability index (VI):

$$\text{VI (-)} = \frac{|\text{System GM}_{2024} - \text{System GM}_{2023}|}{\text{Average System GM}}$$

Table 2. Key climate, soil and cropping system attributes of selected field sites.

Attribute	Hart
Average annual rainfall (mm)	387
Mean growing season rainfall (mm)	273
2023 (Decile)	236 (4)
2024 (Decile)	176 (2)
Soil classification	Calcarosol (clay loam)

Results to date

The 2023 and 2024 growing seasons were dry to very dry, with rainfall well below average (Table 2). Grain yields of all crops were much lower in 2024 due to drought. There was little to no response to N fertiliser rates and carryover of unused N between 2023 and 2024. The results presented below should be considered in the context of these two challenging years.

The Adviser-led system achieved the highest cumulative GM overall (Figure 1). This reflects the very high GM achieved in 2023 (\$681/ha) due to the decision to sow a long-season spring wheat (cv. RockStar[®]) to exploit 125 mm of available soil water after a wetter than average summer, which resulted in a grain yield 27% higher than the Baseline (3.8 t/ha compared to 3.0 t/ha). In 2024, the decision to cut the barley for hay due to extreme drought conditions mitigated economic loss (barley hay GM \$41/ha compared to barley grain crop GM -\$280/ha). The Adviser-led system also displayed a lower GM variability than the Baseline (VI 1.8 compared to 2.5). The superior performance of the Adviser-led system highlights the value of adaptive decision-making to match crop choice, sowing time and crop end use based on available information.

Compared to the Baseline system, increasing the frequency of lentils (More pulses, Figure 1) led to a higher cumulative GM by \$141/ha (\$679/ha versus \$538/ha). Its superior performance was due to two factors: the higher proportion of lentils, a high value grain crop in the system, and the legacy benefits of lentils, which increased yields of subsequent crops. For example, there was an extra 22 mm of soil water and 49 kg/ha of soil N after lentils compared to wheat. This contributed to an extra 1.4 t/ha of barley in 2024 (on average 2.2 t/ha after lentil compared to 0.8 t/ha after wheat). The additional revenue from the higher yield of barley (\$388/ha) and the saving in N fertiliser (\$40/ha) in the barley crop following lentil provide an indication of the rotational value of lentils.

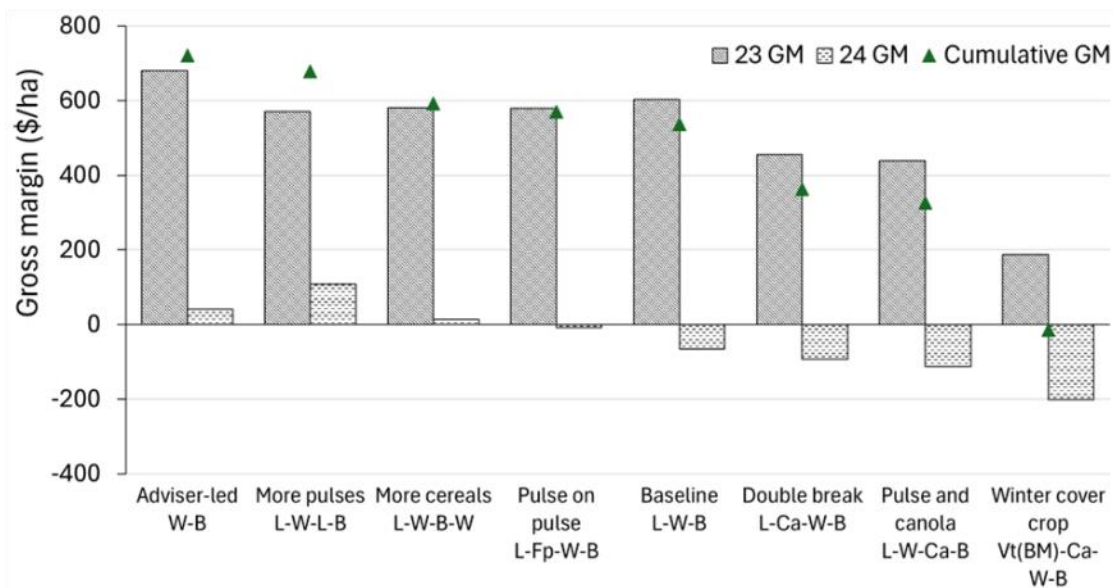


Figure 1. Cumulative (triangle) and individual-year (bar) system gross margins (GM \$/ha) at Hart.

While seasonal variation was high, increasing the frequency of lentils also reduced the variation in GM, with VI decreasing from 2.5 for the Baseline to 1.4. Despite challenging conditions in 2024, the More pulses system returned the highest GM (Figure 1). These results highlight the suitability of lentils in the Mid North of SA, especially in dry years, and their value to subsequent crops.

Although increasing the frequency of lentil improved economic performance overall, the cumulative GMs for other legume-cereal systems were similar to the Baseline (Figure 1). Reducing lentil frequency to one-in-four years (More cereals) and growing consecutive pulses (Pulse on pulse) resulted in cumulative GMs that were within \$56/ha of the Baseline. These results suggest there was reasonable flexibility in decision-making regarding the intensity of pulses within the system.

The potential gains in GM and \$WUE as well as reduced variability that can be achieved are indicated by the comparison between the Baseline and the most profitable system (Table 3). Gross margin and \$WUE of the most profitable system were ~30% higher than those of the Baseline system, combined with their considerably higher reliability in converting rainfall into GM (VI reduction 35%). While achieving both higher cumulative GM and reduced variability suggests that there may be lower risk means to increase system profit, the extent to which this holds needs to be evaluated based on more experimental years to ensure biological pressures are fully expressed, especially following dry seasons.

Table 3: Average gross margin (GM) and economic water use efficiency (\$WUE) in each year, and variability index (VI) between years, for the Baseline and most profitable system. Here, VI is calculated based on \$WUE.

Site and year(s)	GM (\$/ha)		\$WUE (\$/ha/mm)		VI	
	Baseline	Most profitable	Baseline	Most profitable	Baseline	Most profitable
Hart 2023	603	681	2.6	2.9	2.7	1.7
Hart 2024	-65	41	-0.4	0.2		
Cumulative 2023-24	538	722	1.3	1.8		

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