OPTIMAL SOIL AND WATER MANAGEMENT INCREASES DROUGHT RESILIENCE — FROM THE PLOT TO THE PADDOCK

Drought is an inevitable part of farming in Australia, but outcomes from the *Improved drought resilience through optimal management of soils and available water* project are equipping farmers with a host of additional strategies with which they can prepare for the inevitable.

Numerous small-scale field trials across southern NSW have shown that early sowing of slower-maturing crops, diverse legume rotations and nitrogen banking can all increase profitability and productivity by increasing soil moisture availability and preventing carbon and nutrient loss under drought conditions. But proving these practices are profitable on a paddock scale is key to ensuring grower adoption.

Using on-farm demonstrations, this project has demonstrated how growers can apply the theoretical strategies profitably on a paddock scale, across different soil types, environments and land uses.

Charles Sturt University, under the Southern NSW Drought Resilience Adoption and Innovation Hub, led the project in partnership with Farming Systems Groups Riverine Plains, FarmLink Research, Central West Farming Systems and Southern Growers, in collaboration with CSIRO and the NSW Department of Primary Industries. The collaboration saw management strategies that had been tried and tested by researchers, over six years on four sites, validated on farm with growers and advisors.

The project was supported through funding from the Australian Government's Future Drought Fund Drought Resilient Soils and Landscapes Grants Program and is co-funded by the Grains Research and Development Corporation.

EARLY SOWING OF LONGER-SEASON VARIETIES

Research carried out by CSIRO in small-scale plot trials indicates early sowing of longer-season varieties can provide multiple benefits depending on the weather and type of enterprise. Early sowing can:

- **utilise residual soil moisture from late summer or an early season break.**
- **match crop phenology with the sowing date, capturing optimal flowering windows and reducing the risk of adverse seasonal conditions**
- **offer dual-purpose options, such as integrating grazing into the farming system**
- **provide logistical advantages by lengthening the sowing window.**

EARLY SOWING REDUCES RISK, INCREASES OPTIONS FOR LARGE-SCALE CROPPING

Farmer:	Sam Kellock
Location:	Mulwala, NSW
Soil type:	Sandy clay loam
Rainfall (annual):	504 mm
Growing season rainfall:	304 mm
Enterprises:	Cropping (wheat, canola)

Management strategy:	Early sowing
Treatments	Comparing early sown wheat (Illabo) — irrigated and dryland with timely sown wheat (Scepter)
Sowing date:	7 April 2023 (Illabo); 1 May 2023 (Scepter)
Sowing rate:	90 kg/ha (Illabo) and 70 kg/ha (Scepter)
Crop species:	Wheat
Variety:	Illabo and Scepter wheat
Row spacing:	12 inch (30.48 cm)

AT A GLANCE

- **Early sown crops provide diversification in the system — opportunities for grazing, hay and silage and grain harvest.**
- **Early sowing allows crops to be sown during the optimal sowing window, reducing the risk of seasonal events, such as frosts.**

Although Mulwala farmer Sam Kellock routinely implements early sowing as a risk-management strategy in his large-scale cropping operation, a better understanding of the agronomics that sit behind the innovative approach has refined his decision-making when it comes to variety and paddock selection.

The biggest benefits of early sowing for Sam are the timeliness of operations and logistics for his cropping program — getting the crop in during the optimal sowing window.

"I'd rather start sowing earlier than finish sowing late and outside the ideal sowing window," Sam said.

"We have been caught out before in drier years where we have finished sowing too late, so if we have varieties that allow us to sow early, keep the seeder going and still reap the rewards, it's a no brainer," Sam said.

The Kellock family crops 2,225 hectares across three properties at Mulwala and Barooga, NSW and Katandra and Lake Rowan, Victoria. The cropping rotation is typically wheat-canola-wheat, with the inclusion of dual-purpose wheat varieties to provide opportunistic grazing, hay and silage options.

"We always commence our wheat program early due to the scale of our operation, and the number of hectares we have to get across, to ensure paddocks are sown within the optimal sowing window. But if we can understand the agronomic benefits better, this adds another tool to our toolkit we can use for our decision making."

"Early sown dual-purpose varieties allow us to drought-proof our operation and it's a value add for our grazing program."

Sam has a small herd of black baldy cows and opportunistically trades lambs — depending on the season.

"Having dual-purpose crops in our program provides us with options if we need them and offers us flexibility in our system," he said.

ASSESSING THE BENEFITS OF EARLY SOWING

During 2023, as part of the Improved drought resilience through optimal management of soils and available water project, Sam and the project team set out to compare the impact of sowing time and irrigation in wheat.

Sam sowed a flood-irrigated paddock to Illabo wheat on 7 April 2023 and sowed a dryland paddock half to Illabo and half to Scepter wheat on 1 May (standard sowing time). With a wetter than expected season, the paddocks were not grazed.

Plant counts were taken at emergence and showed significant differences between the dryland and irrigated paddocks, with the irrigated crop having higher plant counts. There was no notable difference between early and standard sowing times.

Sam explained the main differences between the two varieties was the early growth.

“We didn’t see a difference in the number of plants, but greater vigour was noted in the early varieties. If we have ideal conditions, this means the crop can put on a good amount of biomass early,” Sam said.

“With such a wet start to the season — full moisture profile and warm weather — the early sown Illabo got away pretty quick and had a lot of bulk, but as the season progressed, and being a shorter season variety, the Scepter, sown at the standard time, caught up,” Sam said.

In addition to manipulating sowing time, Sam uses irrigation to mitigate risk, ensuring that in drier seasons he can provide enough in-crop moisture to fill grain and optimise yield. But during 2023, the application of irrigation pre-sowing was followed by substantial rainfall, resulting in severe waterlogging, creating extra headaches for Sam with regards to disease management and paddock access. The spring of 2023 was drier, and the crop benefited from a second irrigation.

“The wet conditions presented some challenges with disease in the early sown crops, in both the irrigated and dryland paddocks, and while we didn’t apply any more fungicide than we would normally (two applications), we did apply it earlier compared with our standard crops, giving us piece of mind and ensuring protection of the crop,” Sam said.

“The rain came later than was ideal for the dryland paddock, but it was sufficient to get us over the line with a decent yield of 8 t/ha for the irrigated crop and 7.5 t/ha for the dryland Illabo and Scepter crops.”

Sam noted that protein levels were lower in 2023 due to seasonal constraints. The year was predicted to be dry and Sam was concerned with ‘loading up’ the crop with nitrogen. He applied 250 kg/ha of urea across each paddock and had a high amount of nitrogen in the soil prior to sowing, giving him the confidence to achieve his yield target of 7.5 – 8 t/ha.

THE DETAIL LIES IN THE DATA

Riverine Plains Project Officer, Rhiannan McPhee, collected a range of data on both paddocks and the early sown and standard sown crops, which paints a clearer picture of what was happening in the two paddocks.

“Having the irrigated paddock right next door to the dryland paddocks — early and standard sowing times — has allowed us to compare three different sowing options, side by side,” said Rhiannan.

To gauge the success of the early sown crops, and potential differences between irrigated and dryland sowing, soil tests for carbon, nitrogen and water holding capacity were taken pre-sowing (early April) and post-harvest (February 2024) (see Table 1).

Biomass cuts were taken prior to harvest from the early sown paddocks to calculate harvest index, yield estimates and seed protein estimates. The dryland Scepter paddock had already been harvested when biomass cuts were taken, so the research team were unable to calculate yield and seed protein estimates for the standard sowing time. Yield measurements were also taken at harvest (see Table 2).

“The visual differences between the management practices during the season were quite distinct and the results were reflected in the soil tests, and yields,” Rhiannan observed.

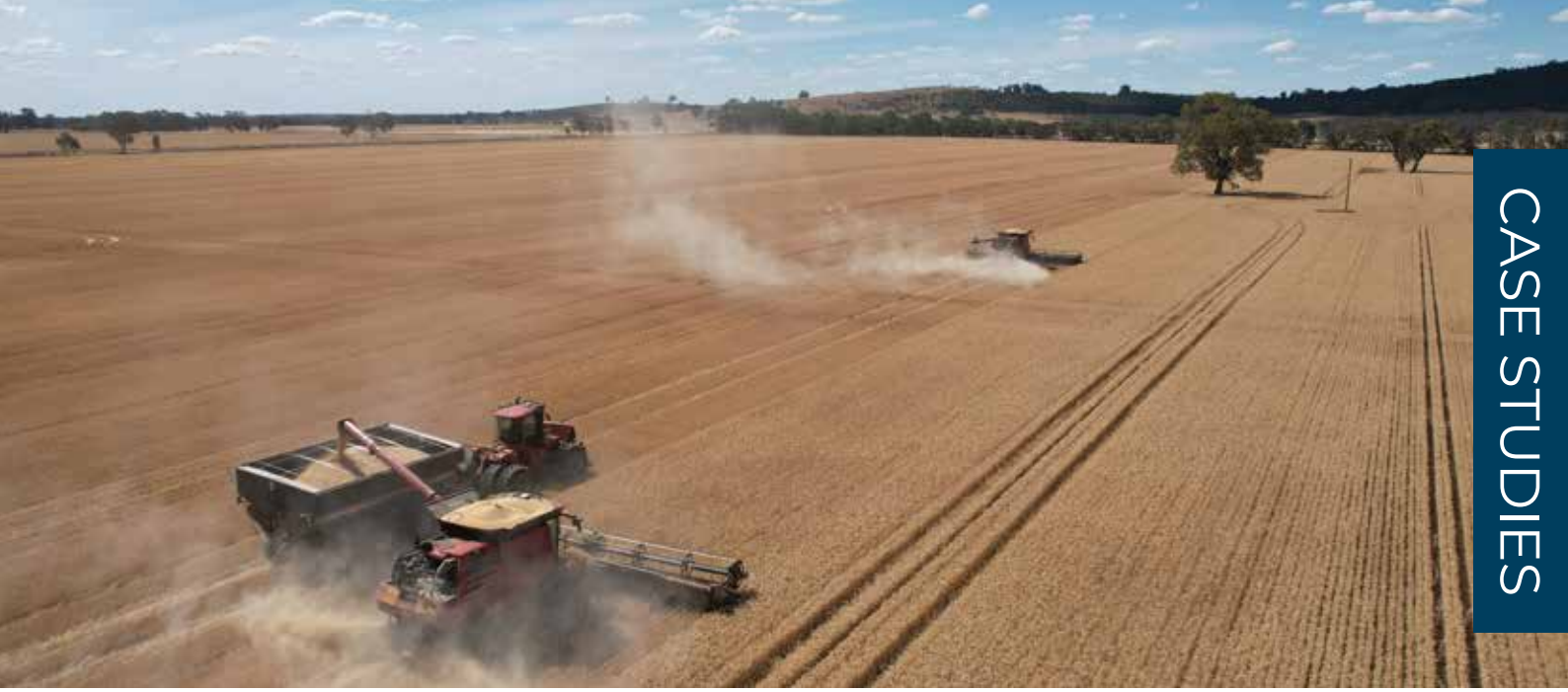

Table 1 Soil test results from wheat sown early and at a standard time of sowing in 2023 at Mulwala, NSW

	DEPTH (CM)	IRRIGATED ILLABO (EARLY SOWING)		DRYLAND ILLABO (EARLY SOWING)		DRYLAND SCEPTER (STANDARD SOWING)	
PROPERTIES		Pre-sowing	Post-harvest	Pre-sowing	Post-harvest	Pre-sowing	Post-harvest
Nitrogen (kg N/ha)	0–90cm	174	45	130	28	130	38
Soil moisture (PAW mm)	0–90cm	235	211	259	240	259	200

*Pre-sowing soil testing was carried out across the paddock, without the knowledge that the paddock was sown to two varieties, while post-harvest soil testing was specific to each variety.

Rhiannan noted the early sown irrigated crop used more nitrogen than the dryland crops, and the early sown dryland crop used more than the standard sown crop.

"Early sowing means crops are in the ground longer and use more nitrogen early to grow biomass. It's important to look at the amount of nitrogen used by the crop and the relevant yields to understand the overall efficacy," she explained.

"Having higher nitrogen levels in the irrigated paddock at the start of the season worked in our favour, reducing the need for additional nitrogen to be applied during the season," Sam said.

"The soil test results confirmed what we were visually seeing across the paddocks. Above the ground, the early sown, longer-season varieties appeared to be sucking the moisture from the profile."

Comparing the soil profile water content from pre-sowing to post-harvest, the results show the early sown Illabo was more efficient at using water compared to the Scepter on the dryland paddock.

Table 2 Yield measurements for irrigated and dryland Illabo sown during early April 2023 at Mulwala, NSW

	ILLABO WHEAT (IRRIGATED)	ILLABO WHEAT (DRYLAND)
Total dry matter (t/ha)	18.7	19.3
Harvest index	0.4	0.4
Estimated grain yield (t/ha)*	8.2	8.3
Actual grain yield (t/ha)	8	7.5

*No biomass cuts were taken for the Scepter wheat, thus no estimations were calculated for this variety.

PRACTICAL APPLICATIONS AND MEASURES OF SUCCESS

The flexibility that early sown dual-purpose crops give the Kellocks cannot be understated — and it's something they will continue to do as part of their farming system.

"In better seasons, if we choose not to graze, we can focus on getting the most out of our cropping operation. But if we need to graze paddocks to reduce or remove the need to supplementary feed, we have the option to do so," Sam said.

"Dual-purpose crops also provide the opportunity to winter clean and/or renovate our pasture paddocks."

For the Riverine Plains project team, the paddock-scale investigations are providing an invaluable opportunity to road test results from plot trials at the paddock scale and offer growers greater confidence to adopt a range of innovative approaches to manage risk.

"We are taking the results from small plot trials conducted by CSIRO and implementing them on farm to assess increases in profitability and productivity, through increases in soil moisture availability and the prevention of carbon and nutrient loss during drought," Rhiannan said.

"If other farmers see these management strategies are boosting profits and productivity, on a paddock scale, under similar environments, soil types and land use to their own properties, the adoption of early sowing and other management strategies will increase."

"This outcome equals project success."

This case study was authored by Toni Nugent as part of the *Improved drought resilience through optimal management of soils and available water project.*

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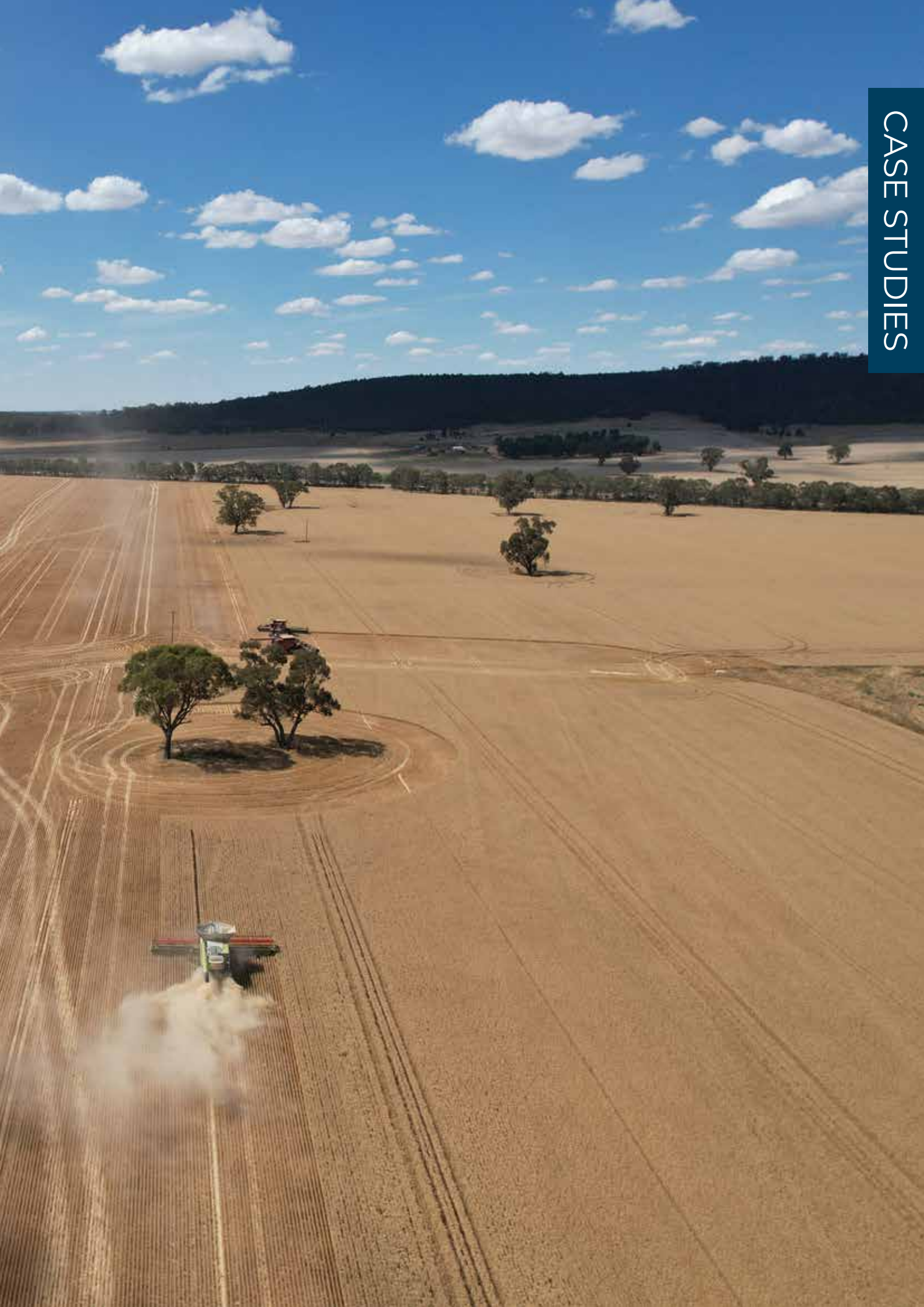

CASE STUDIES