Department of Primary Industries and Regional Development
GOVERNMENT OF WESTERN AUSTRALIA

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# Ovine Observer

**Issue number 103**
**June 2024**

## Contents



Editor: Ashleigh Lydon
ashleigh.lydon@dpird.wa.gov.au

## The impact of changing joining rates on the Western Australian sheep flock

**Kate Pritchett (DPIRD, Albany WA)**

Author correspondence:
Kate.Pritchett@dpird.wa.gov.au

### Executive Summary

Given the poor seasonal conditions and low prices experienced in 2023-24, the Western Australian (WA) sheep industry is experiencing a period of very poor industry sentiment often compared to that seen in the 1990s following the collapse of the wool reserve price scheme.

These difficult times mean producers have had to make production decisions for their businesses which may have flow-on effects for the entire state flock.

One commonly discussed option by industry and consultants was to join less ewes to reduce the feed burden on-farm and help mitigate losses due to low prices.

Computer modelling was used to investigate the impact of reduced joining rates on the WA flock over 3 years.

The results ranged from a 12% flock reduction from 11.96 million sheep to 10.52 million sheep over 3 years when the joining rate declined from 91% to 85% for one year, to a 35% reduction to 7.79 million sheep if the joining rate was reduced to 70% for all 3 years modelled.

This modelling found that the longer and more severe the reduction in ewe joining rates, the more severe the impacts on the state flock. This is also likely to occur simultaneously with a period of high turn-off and high loss rates which will exacerbate the impacts on the flock and make it very difficult for the flock to recover. This will have long lasting ramifications on the sheep industry and will impact all segments of the industry as well as supporting industries and regional communities in the long term.

When making joining decisions for the year ahead, producers have considered current seasonal conditions including their feed, water and cashflow availability, as well as the implications for their own flock structure which will, in turn, impact turn-off and the ability to re-build in future.

## Introduction

The year 2023 was challenging for the WA sheep industry, with these conditions continuing in 2024. With the announcement by the Australian Government to phase out live sheep exports, coinciding with poor seasonal conditions in many regions; difficulty getting sheep to processors due to lack of kill space and very poor prices; industry sentiment and confidence is very low.

Some consultants and producers considered not mating all or part of their ewe flock for 2023 – 2024 in response to the market and seasonal conditions.

This may have longer term ramifications than just for the 2024 lamb drop, as it can affect the ability of the state flock to self-replace with less lambs born. It will also impact the wider industry with less animals for processing and exporting, and less wool produced, as well as impacting secondary industries such as shearing, transport and feed providers.

This computer modelling investigates the impact of reduced ewe joining rates on the flock size over the short term, between 2023-24 and the end of 2025-26.

## Scenarios

To investigate the impact of reduced rates of ewe joining, multiple scenarios were run with different joining rates and for varying lengths of time. A baseline model was created to compare the results.

In addition to changing joining rates, adjustments were made to the length of time in the following scenarios:

- Scenario 1 – the joining rate was altered for one year (2023-24) then returned to 91%.
- Scenario 2 – the joining rate was altered for 2 years (2023-24 and 2024-25) then returned to 91% for the following year.
- Scenario 3 – the joining rate was altered for all 3 years (2023-24 to 2025-26).
- Scenario 4 – the joining rate was altered for 2 years, then returned to 91% for 2025-26, along with an increased loss rate in 2023-24 of 7% to account for the possibility of sheep being euthanised on farm.

The proportion of ewes joined was calculated by dividing the number of ewes joined by the number of ewes on hand. The joining rate was then altered in 5% increments as listed below. Each of these joining rates was examined in each scenario:

- Baseline model – joining rate 91% for all 3 years.
- Joining rate 85%
- Joining rate 80%
- Joining rate 75%
- Joining rate 70%.

## Discussion

As the joining rate declined, the impact on the flock increased, becoming more pronounced the longer it occurred.

In comparison to the baseline scenario, where the joining rate was unchanged at 91%, Scenario 1 had the smallest impact on flock size going forward. When the joining rate only declined for one year before returning to normal, the flock declined 12% from 11.96 to 10.52 million over the 3 years under an 85% joining rate (Figure 1).

In comparison, when the reduced joining occurred for 2 consecutive years (Scenario 2) the flock declined 15% from 11.96 million to 10.22 million by the end of 2025-26 under 85% ewe joining.

When the joining rate was reduced for all 3 years in Scenario 3 the flock declined 17% from 11.96 million to 9.93 million over that time under 85% joining.

When the loss rate was increased from 4% to 7% in 2023-24 while the joining rate was reduced from 91% to 85% for one year in Scenario 4, the results were quite similar to Scenario 3 with the flock declining 17% to 9.87 million sheep.

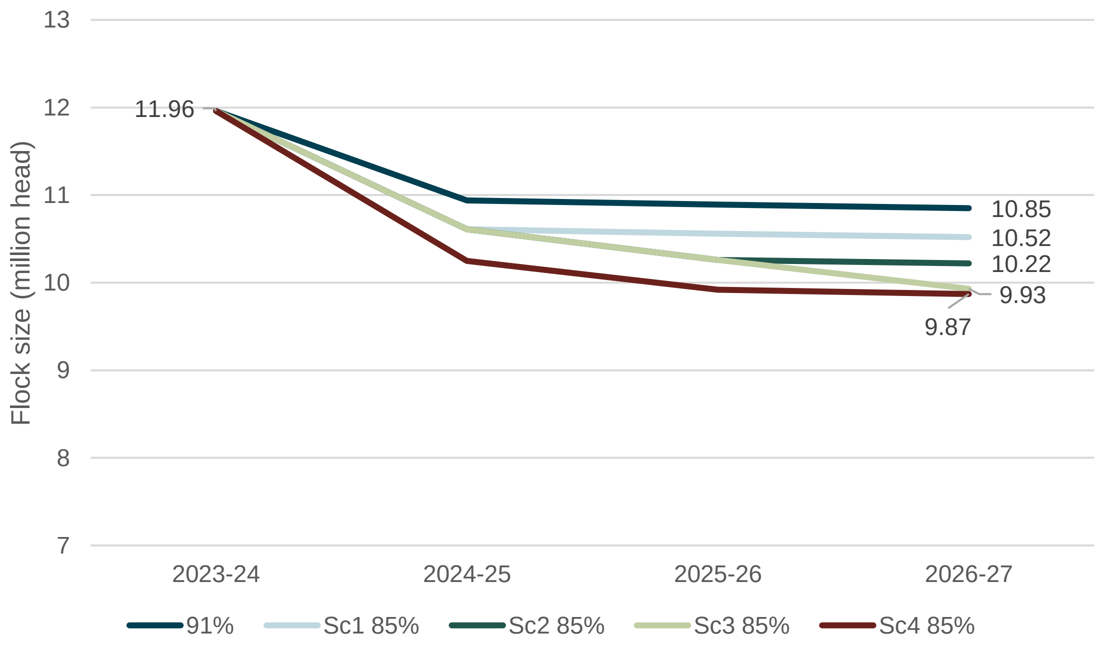


Figure 1: Comparison of the flock size of the baseline (91%) to each of the scenarios (Sc) at an 85% ewe joining rate.

As illustrated in Figure 2, the results become more extreme when the joining rate is reduced further, to 70%.

In Scenario 1, the flock declined 19% from 11.96 million to 9.65 million sheep over the 3 years under a 70% joining rate.

Scenario 2, where the joining rate was reduced to 70% for an extra year, resulted in the flock declining 27% to 8.67 million, whilst Scenario 3, where the joining rate was reduced to 70% for all 3 years, resulted in the flock falling 35% from 11.96 million to 7.79 million.

The extra year of reduced joining also had a more detrimental effect than increasing the loss rate from 4% to 7% in the first year combined with 2years of reduced joining (Scenario 4) at a 70% joining rate. In that instance, the flock declined from 11.96 million to 8.35 million, a fall of 30% rather than 35% which was seen when the joining rate stayed low for all 3years (Figure 2). This was because in Scenario 4 the joining rate returned to 91% in 2025-26 allowing the flock to plateau, whereas in Scenario 3 it didn't get this opportunity as the joining rate stayed at 70% for the final year modelled.

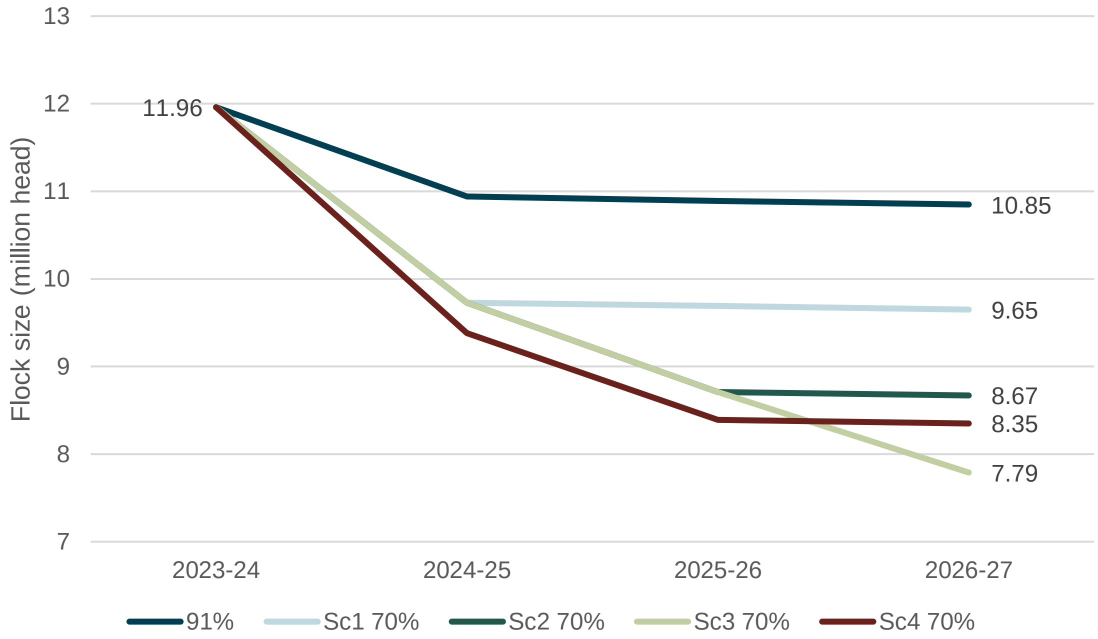


Figure 2: Comparison of the flock size of the baseline (91%) to each of the Scenarios at a 70% ewe joining rate.

## Conclusion

This modelling investigated the impact of reduced ewe joining rates on the WA sheep flock over the short term, between 2023-24 and 2025-26.

The longer the reduced rate of ewe joining occurred and the lower the rate of joining, the more severe the impact on the state flock. This was compounded by high turn-off rates and high loss rates which made it very difficult for the flock to recover.

At best, when the joining rate declined for one year to 85% before returning to baseline, the flock declined 12% from 11.96 to 10.52 million over the 3 years modelled.

The worst-case scenario occurred when the joining rate was reduced for all 3 years to 70% rather than 91%, which resulted in a 35% flock decline from 11.96 million sheep to 7.79 million sheep by the end of 2025-26.

Despite the current pessimism in the industry, it is likely that after 1 – 2 years of reduced ewe joining rates and high levels of turn-off, producers may start looking to rebuild flocks. Seasonal and market conditions may have improved, allowing producers to feel more confidence in the industry. It is also likely that producers who intended to exit the industry would have done so by this time.

Possible avenues to grow the flock include increasing joining rates and reducing turn-off by either keeping older ewes that would normally be sold, keeping more ewe lambs/hoggets and/or keeping more wethers.

Regrowing flocks when conditions improve may be a slow process due to the loss of replacement ewes in the short term, and may also involve reduced income if producers need to reduce the number of animals turned-off. This is on top of the reduced turn-off they may experience whilst reducing joining rates due to a declining flock.

The decision whether to reduce joining rates is highly dependent on the individual enterprise. While this modelling provides indications of possible sheep numbers going forward under various scenarios at the state level, enterprises will have considered their individual circumstances including feed and water supplies at hand, cashflow constraints and long term objectives in the decision-making process.

For up-to-date information on the production, consumption and trade (domestic and international) of sheep meat and wool in Western Australia see the West Australian sheep and wool industries webpage.

# Transformation of saltland areas at Katanning Research Station

**John Paul Collins (DPIRD, Katanning WA)**

Author correspondence: John.Collins@dpird.wa.gov.au

## Introduction

Setting a target for Katanning Research Station (KRS) to become carbon neutral by 2030 created an opportunity to revegetate the salt-affected areas at KRS. This came at a time when station management were planning solutions to address the expansion of salinity. This also created an opportunity to demonstrate a range of techniques for rehabilitation of the salt affected land at KRS including the establishment of salt-tolerant pastures for providing out of season feed to reduce the amount of supplementary feed required during autumn and to defer graze annual pastures.

## Key findings

- This was land of low opportunity cost – unable to be economically cropped, growing unproductive barley grass, samphire and bare scald. There is a shallow, saline watertable, and the paddock was often waterlogged in winter/spring.
- There was no rain between when the Anameka® old-man saltbush was planted in September 2023 until the first grazing on 17 April (6 months), yet the Anameka® tapped into the water table and was able to be grazed.
- Supplementary feeding has been reduced by 30% and other annual pastures paddocks are protected from over-grazing. There is also the added benefit of the Anameka® providing vitamin E and protein to weaners.
- The implementation has been costly but has improved the current value of land and is an investment in the future – these paddocks will be grazed in the Autumn for the next 20 years.

## Site preparation

30 ha at the north-east corner of KRS had previously been used as a saltbush trial in the early 1990s. These were old selections of saltbush species, some no longer grazed and as such had become woody and unpalatable.

We commenced in March 2022 by slashing the saltbush areas with a heavy-duty slasher to break up and mulch the woody material.

In April 2022 we employed a contractor with a heavy-duty disc plough to plough the entire 80 ha to further break-up and incorporate the woody material as well as help aerate the soil profile.

As soil dispersion tests indicated that the site was sodic, in May 2022 we employed a contractor to apply 1.3 t/ha of gypsum and further cultivate the soil several times with prickle harrows to break-up the clumps of clay and incorporate the gypsum.

Due to a high level of Guildford bulb which needed to be controlled, the whole area was seeded to oats in June – July 2022 to be used as standing fodder.

Conditions at seeding during June – July were wet and completing seeding in a timely manner was a challenge.

In September 2022 we employed a contractor to spray the site with 20 g/ha of Chlorsulfuron to control the Guildford bulb and then in October 2022 we sprayed the site with Glyphosate to provide a hay freeze effect and prevent seed shedding and future volunteer oats emerging. Weaners grazed the site between November 2022 – January 2023.

## Site characteristics

A whole of farm EM38 survey was conducted in February 2021 and May 2022, producing a colour thematic map showing the salinity classes (Figure 1).

The paddocks outlined in black show those that have been planted to saltland pastures.

Salinity in the surface soil horizon (0 – 50 cm) is mostly in the moderately saline range of 100 – 200 mS/m (green areas on map) with some highly saline areas shown as yellow, these are in the 200 – 250 mS/m range. These areas are bare or growing a sparse cover of samphire and barley grass.

There are some mildly saline areas (50-100 mS/m range) which are generally associated with slightly elevated sandy rises (shown as light blue in Figure 1).

Given the high soil salinity it was decided an alley system of deep-rooted saltbush was required with salt tolerant species in the interrow.

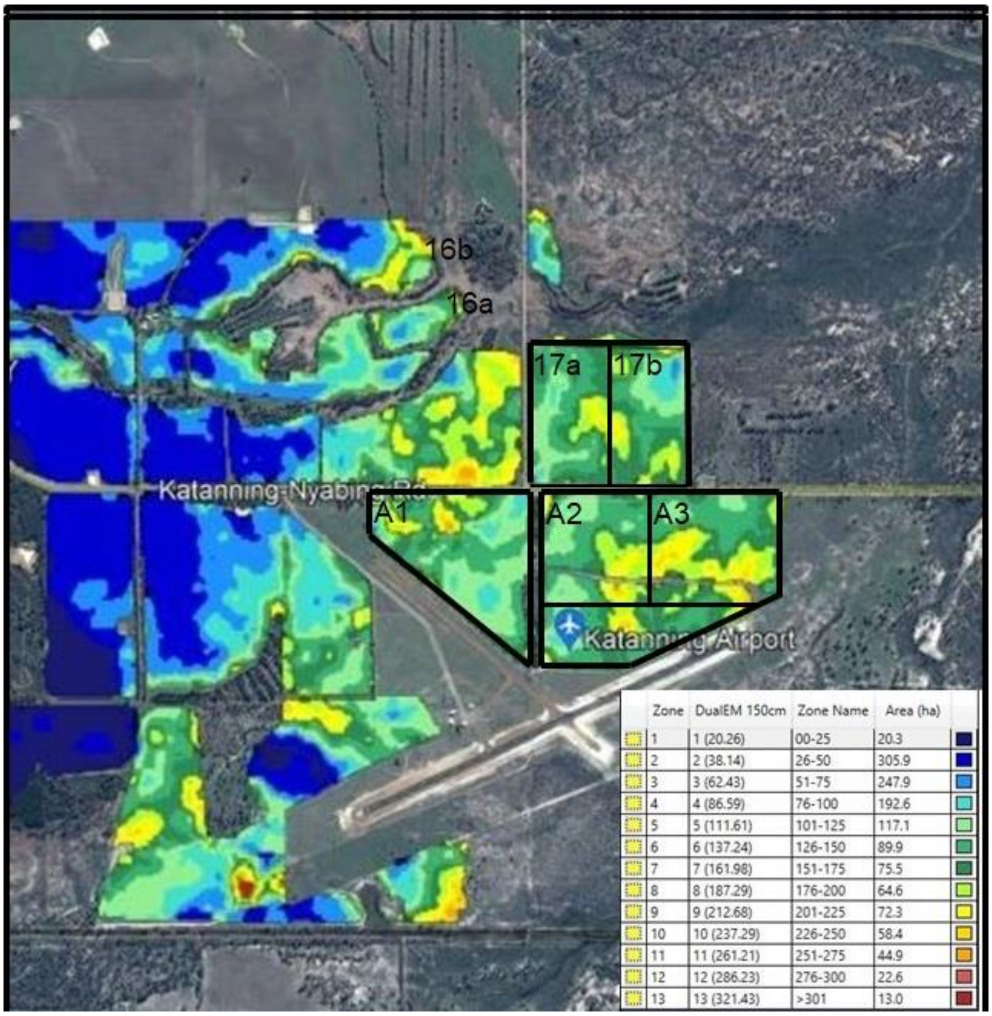

Figure 1: EM38 survey of the eastern end of Katanning Research Station in the 0 – 50cm depth range. 16b (3ha), 16a (5ha), 17b (14ha) A1 (21ha), A2 (17ha), A3 (17ha) paddocks were all sown to Anameka saltbush, 17a (14ha) was direct seeded.

There are 3 piezometers in paddock 17 (north-eastern paddock in Figure 1 outlined in black) ranging from west (P17W) to east (P17E).

Water levels are measured quarterly in these piezometers.

The water level ranged from between -0.15 to -0.3m below the ground surface in September 2023 to between -0.7m and -1.5m in March 2024 (Table 1).

The presence of this shallow watertable in winter – spring suggested belts of deep-rooted saltbush were required to reduce and maintain the watertable at a lower depth.

The salinity of the water ranged from 1500 mS/m (approximately 30% sea-water) to 5500 mS/m (sea-water).

Table 1: Water level and salinity data collected from 3 piezometers in paddock 17 at Katanning Research Station

| | 7 Jun 2023 | 4 Sep 2023 | 1 Dec 2023 | 5 Mar 2023 | Salinity (mS/m) 4 Sep 2023 |
|---|---|---|---|---|---|
| P17W | -0.43 | -0.32 | -0.82 | -1.53 | 1554 |
| P17M | -0.13 | -0.15 | -0.35 | -0.74 | 5580 |
| P17E | -0.3 | -0.38 | -0.75 | -1.2 | 1812 |

## Soil testing

A soil profile description was conducted as part of the baseline soil assessment  to measure changes in organic carbon due to revegetation. The soil description at the eastern end of Paddock 17 showed the soil consisted of a gritty coarse sand in the topsoil over a sodic clay starting at 40 cm (Figure 2).


| Horizon | Depth (cm) | Description |
|---|---|---|
| A1 | 0-10 | Dark grey (7.5YR 4/1 moist) gritty coarse sand (KS); loose dry consistence; apedal, single grain structure; sandy fabric; water repellent; gradual boundary to |
| A2 | 10-20 | Dark greyish brown (7.5YR 4/2 moist) loamy coarse sand (LKS); loose dry consistence; apedal, massive structure; sandy fabric; abrupt boundary to |
| B21t | 20-40 | Dark greyish brown (7.5YR 5/2 moist) sandy clay loam (SCL); weak moderately moist consistence; pedal, weak structure; earthy fabric; clear boundary to |
| B22tg | 40-80 | Light brown (7.5YR 6/4 moist) sandy light clay (SLC); few distinct reddish yellow (5YR 6/6) redox mottles; firm moist consistence; pedal, moderate structure; rough-ped fabric; common ferruginous soft segregations; acidic, pH 5.1; moderately slow permeability; partial dispersion; sodic, ESP 28; gradual boundary to |
| B23aw | 80-120+ | Reddish brown (5YR 5/4 moist) sandy light medium clay (SLMC); common distinct reddish yellow (5YR 6/6) redox mottles; very firm moist consistence; pedal, moderate structure; rough-ped fabric; slightly sticky; many ferruginous soft segregations; strongly acidic, pH 4.4; moderately slow permeability, partial dispersion; sodic, ESP 26. |

**Saline wet soil**
(KRS, Paddock -17b)

Figure 2: Soil profile description in paddock 17b at Katanning Research Station

A soil analysis was done on each profile layer and organic carbon ranged from 1.11% in the 0-10cm layer down to <0.1% in deeper layers (Table 2).

Soil pH was 5.4 in $CaCl_2$ at the surface and was 4.4 (acidic) in the 80-120cm layer.

We used Saltland Genie tool to convert the Electrical Conductivity (EC) reading from a 1:5 unit to an extract (ECe). This converted the 204 mS/m EC1:5 to 1600-3200 mS/m ECe (severely saline).

The exchangeable sodium percentage (ESP) ranged from 5 at the surface to 28 at depth. Soils are considered sodic when the ESP is >6 and highly sodic when the ESP is >15.

Table 2: Soil chemical properties of the soil types in each layer in the soil pit in paddock 17b at Katanning Research Station.

| Soil depth (cm) | OC (WB %) | pH ($CaCl_2$) | EC (mS/m) | Total CEC (meq %; prewash) | N (mg/kg) | P (mg/kg) | K (mg/kg) | ESP | Ca:Mg |
|---|---|---|---|---|---|---|---|---|---|
| 0-10 | 1.11 | 5.4 | 204.3 | 4.16 | 34 | 40 | 62 | 5 | 1.57 |
| 10-20 | 0.69 | 5.8 | 61.9 | 3.13 | 12 | 44 | 50 | 8 | 1.12 |
| 20-40 | 0.22 | 6.2 | 67.6 | 1.83 | 4 | 13 | 51 | 22 | 0.57 |
| 40-80 | 0.06 | 5.1 | 104 | 5.09 | 2 | 7 | 44 | 28 | 0.34 |
| 80-120+ | 0.06 | 4.4 | 98 | 3.84 | 2 | 6 | 51 | 26 | 0.32 |

## Species selection and layout design

Due to the variable soil salinity conditions across the site (Figure 1) a mix of Tall Wheat Grass (10 kg/ha), Puccinellia (1 kg/ha) and Kikuyu (1 kg/ha) was drilled in early September 2023 using a Bourgault airseeder. The seed was blended with 50 kg/ha of a mix of 70% Mono-ammonium Phosphate (MAP) and 30% Muriate of Potash (MOP) to enable the required seeding rate.

Following the seeding, a contractor was employed to plant twin rows (2.5 m apart) of Anameka® old-man saltbush with 2.5 m between shrubs within the row and a 10 m interrow between the twin rows.

The site was ripped to a depth of 30 cm and the nursery seedlings were planted as deep as possible with a shallow mound created to harvest water.

A smaller paddock (13 ha) was also established using the direct-seeding method as a comparison.

An experienced contractor was employed to direct-seed a mix of old-man and river saltbush using a Kimseed saltland seeder, with a seed/vermiculite mix placed 2 m apart directly on a shallow mound followed by a press-wheel.

Due to the dry spring of 2023, the interrows across the whole site were re-seeded with a mix of 10 kg/ha Tall Wheat Grass and 5 kg/ha of Neptune Messina from 22 – 29 May 2024.

As a comparison, some of the moderately saline interrows in one paddock have been sown with Kraken barley to be used as a standing fodder and to enable further grazing in spring 2024.

## Establishment

There was a 19 mm rainfall event during planting on the 14 September 2023 and then a smaller 5 mm rainfall event on 18 January 2024. The next substantial rain event was 14 mm on 2 and 3 May 2024.

Due to the dry spring of 2023 and limited summer rainfall the majority of the Tall Wheat Grass, Puccinellia and Kikuyu had died or failed to germinate because of the dry conditions. Despite this, the survival of the Anameka® forage shrubs has been excellent with 80 – 90% survival. However, the direct-seeded saltbush has been patchy where germination was poor and these will be in-filled with nursery seedlings in August 2024.

## Grazing management

The site has been fenced into 5 separate paddocks ranging from 13 ha to 20 ha each with laneway access and separate troughs. A mob of approximately 600 weaners has been grazed in each paddock for about a week before being moved onto the next paddock when there was 10-20% leaf material remaining on the shrubs (Figure 3). Grazing occurred from mid-April till the end of May 2024 (6 weeks).

Hay was provided at the opposite end to the paddock to the water trough, as was the supplementary trail feed, to encourage the weaners to move away from the trough and graze the saltbush in a uniform manner.

During grazing, the normal grain supplement was able to be reduced by 30% compared to what they would have normally been fed on a dry, annual pasture.

Further refinements to the trough location and trough capacity will be made to improve the uniformity of the grazing.

Other benefits provided by the saltland pasture include the protein and Vitamin E provided by saltbush, and the ability to defer other pasture paddocks and preserve ground cover.

In summary, our plan has been to transform this area at the eastern end of KRS into a saltland pasture grazing system that can support sheep through the autumn feed gap.

We have selected land of low opportunity cost that was unable to be economically cropped and was previously bare scald and unproductive barley grass, samphire and woody/rank saltbush.

Provided the grazing management practices are followed, then the station management can expect to get 10 – 20 years of out of season autumn sheep feed from this investment in the saltland pastures on previously unproductive land.

Figure 3: Anameka saltbush at Katanning Research Station which had just been grazed. Sheep were moved from the paddock when there was 10 – 20% of leaf remaining.

# Identifying high-value tactical livestock decisions on a mixed enterprise farm in a variable environment

**Michael Young (University of Western Australia, WA), John Young (Farming Systems Analysis Service, WA), Ross Kingwell (UWA and DPIRD, WA), Philip Vercoe (UWA, WA)**

Author correspondence: Michael.young@farmoptimisation.com

## Introduction

Australia is renowned for its climate variation that includes droughts and floods that cause significant production and profit variability (Trompf et al. 2014; Laurie et al. 2019; Feng et al. 2022). This variation can be challenging for farmers (Heberger 2011), particularly for livestock farmers who must adhere to animal-welfare standards. In mixed-farming systems, livestock and associated pasture production complement cropping activities by utilising crop residues, providing disease and pest breaks, providing weed-management options and improving labour and machinery use efficiency during the year. As such, livestock and pasture production are key components of many farm businesses and farming systems in Australia.

To handle climate variation, farmers can alter their ‘big-picture’ strategic management to set up a more versatile and diversified enterprise mix of their farm business (Azam-Ali 2007; Kandulu et al. 2012). However, Kandulu et al. (2012) suggested that, in many locations, a sole focus on diversification does not wholly mitigate the financial effects of climate variation. An alternative management method is to implement short-term tactical adjustments in response to unfolding conditions (Anderson et al. 2020).

Tactical management is most valuable within systems where farmers have a wide portfolio of tactics for use in response to an external change (Cowan et al. 2013). This is the case in mixed-farming systems (Young et al. 2022). In mixed crop and livestock businesses, farmers can adjust enterprise allocation, their interactions and relevant tactics to better suit unfolding climate conditions. Furthermore, as outlined by Young et al. (2023a), tactical management generates opportunities to boost farm profit and/or avoid losses. However, the large array of possible tactics within mixed-enterprise farm systems can complicate management, especially when combined with the changing and evolving nature of farming systems.

In this paper, we apply a whole-farm optimisation model that, first, represents year-to-year variation and, second, includes an extensive array of tactical management options tailored to that variation. The model is used to identify and quantify optimal tactical livestock management for different weather-years.

## Key findings

- A ‘set and forget’ management approach is far from optimal.
- Managing farming systems dynamically in response to unfolding weather conditions is highly profitable, increasing the expected profit by $128,000 (16%).
- The economic value of implementing an additional tactic varies, in the 8 scenarios tested in this paper, an additional tactic was worth between $7,704 and $53,171.

## Materials and methods

### Model description

This study employed the Australian farm-optimisation model (AFO) to analyse a representative mixed enterprise farm located in the Great Southern region of Western Australia. The model represents the economic and biological detail of a farming system, including modules for rotations, crops, pastures, sheep, crop residues, supplementary feeding, machinery, labour and finance. Furthermore, it includes land heterogeneity by considering enterprise rotations on a range of soil classes/land-management units (LMU) (Figure 1).

Weather variation can be represented in multiple ways using AFO. Importantly, based on the findings of Young et al. (2023a) and Young et al. (2023b), we adopt the four-stage single-sequence stochastic program with recourse (4-SPR) model, housed within AFO, which represents the farm system with multiple states where each state represents a different weather-year that can have separate inputs to reflect different prices and weather conditions. Full descriptions of the AFO model description are available in the full paper.

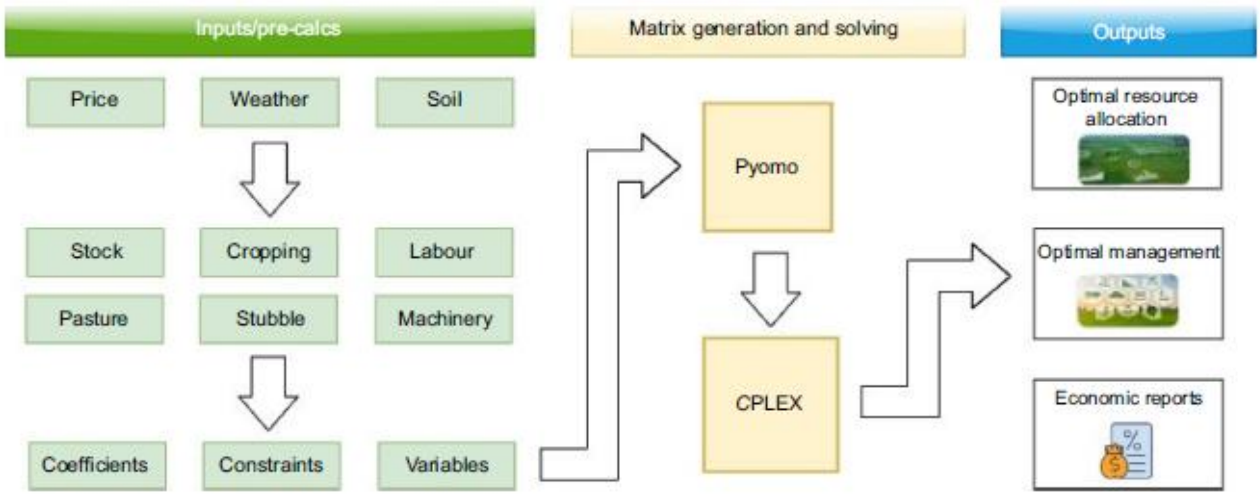


Figure 1: Visual representation of AFO

### Overview of the farm system

AFO was calibrated to represent a typical farm in the medium-rainfall zone of the Great Southern region of Western Australia. The Great Southern region in Western Australia is characterised by winter-dominant rainfall (400–650 mm) and a 6-month growing season that supports a mix of cropping and livestock enterprises. Weather variance in the region was approximated by 8 discrete states of nature (weather-years) (see Table 1). The model represents a typical 2,130 ha farm that includes 3 LMUs (Table 2). Other key features of the modelled farm are shown in Table 3. The standard prices for wool, meat and grain used in the analysis were based on the 70th percentile prices received over the past 13.5 years for wool, 18.5 years for meat and 14 years for grain (Source: Mecardo 2023). A full description of the AFO inputs is available in the full paper.

Table 1: Summary information for each weather-year represented in the Kojonup version of the AFO model.

| Code for weather-year | Definition of each weather-year | Probability of occurrence (%) | Growing season rainfall | Crop yield scalar |
|---|---|---|---|---|
| z1 | Early break with follow up rains and a good spring. | 24 | 447 | 1.2 |
| z2 | Early break with follow up rains and a poor spring. | 20 | 346 | 1.0 |
| z3 | Early break that turns out to be a false break, but is followed by a good spring. | 8 | 416 | 1.22 |
| z4 | Early break that turns out to be a false break and is followed by a poor spring. | 4 | 294 | 0.87 |
| z5 | Medium break with follow-up rains and a good spring. | 14 | 448 | 1.05 |
| z6 | Medium break with follow-up rains and a poor spring. | 16 | 392 | 0.83 |
| z7 | Late break with follow-up rains and a good spring. | 4 | 477 | 0.95 |
| z8 | Late break with follow-up rains and a poor spring. | 10 | 337 | 0.65 |

Yield scalar is the relationship between yield in the given weather-year and the average yield. This was calculated using the output of APSIM modelling using Kojonup climate and soil data from 1970 to 2019. Early break (i.e. start of the growing season): before 5 May; medium break: between 5 May and 25 May; late break: after 25 May. Good spring, above the median (86 mm) rainfall for September and October; poor spring, below the median rainfall. False break, pasture feed on offer reaches 500 kg/ha, followed by 3 weeks of no growth.

Table 2: LMU definitions for a typical farm in the Great Southern region of Western Australia.

| Soil class | Description | Arable (%) | Grazing area (ha) |
|---|---|---|---|
| Deep sands | Deep sands, but not waterlogged. Over mottled clay. | 100 | 150 |
| Sandy gravels | Gravels and sandy gravels down to 50 cm over clay or gravelly clay. | 80 | 1230 |
| Sandy loams | Sandy loam, loamy sand over clay rock outcropping in landscape. | 80 | 750 |

Table 3: Key features of the modelled farm.

| | |
|---|---|
| Farm size (ha) | 2130 |
| Time of lambing | 'Spring' lambing (lambing starts mid-July) |
| Pregnancy scanning management | Scanning for pregnancy status only |
| Sheep liveweight | Nutrition profile is optimised by AFO |
| Sheep genetics | Medium-frame Merino |
| • Standard reference weight (kg) | 55 |
| • Fibre diameter (μ) | 20 |
| Canola yield (t/ha)[A] | |
| • Roundup-ready | 2.6 |
| • Standard (non-GM) | 2.2 |
| Wheat yield (t/ha)[A] | 4.5 |
| Barley yield (t/ha)[A] | 5.0 |
| Oat yield (t/ha)[A] | 4.5 |
| Hay yield (t/ha)[A] | 8.0 |
| Lupin yield (t/ha)[A] | 2.5 |
| Faba bean yield (t/ha)[A] | 3.0 |

[A] Reported yield is on LMU 4 (best-performing areas of the farm) in a canola–cereal or pulse–cereal rotation weighted across all weather-years.

### Tactics Comparison

Using this model, we investigated the economic significance of 5 key livestock management tactics. These included:

1. Sale quantity and timing – additional classes of sheep can be sold or retained in response to the unfolding years condition.
2. Pasture area and rotation – the area of pasture can be adjusted based on the time of break and pasture can be established in paddocks with different land-use histories that affect germination (e.g. continuous pasture has a higher germination than pasture following multiple years of crop).
3. Grazing management – depending on the unfolding year, stock can follow different grazing management (e.g. pasture can be deferred for longer in weather-years where pasture growth is limiting).
4. Crop grazing – crops can be grazed early in the growing season when pasture is limiting, or to allow pasture to be deferred.
5. Stock nutrition profile – animals can gain more weight in a good year and lose more weight in a poor year.

To understand the value of each tactic, we compared the profitability of the farm with the tactic versus a farm with a 'minimal' level of the tactic. A minimal level of each tactic was used as the comparison because it is impossible for a farmer not to change some part of their management in response to changing conditions among years.

## Results

### Value of tactics and strategic impact

Dynamically managing farming systems in response to unfolding weather conditions increases expected profit by $128,000 (16%) (Table 4). Tactical management has a large impact in early break years that have no follow-up rain (z2 and z3) (Table 4). This is largely because in the Great Southern region of Western Australia, false breaks do not affect crop production (Table 1). However, pasture production during the false-break period is significantly reduced. Thus, tactical adjustments have the potential to significantly boost profit in those years.

A farm managed with a full complement of tactics has a different overall strategy from a farm managed with minimal tactics. For example, with tactics, the optimal overall stocking rate is increased by 30% (Table 5). Thus, the change in profit reported in Table 4 is not necessarily a reflection of the importance of including tactics in a given weather-year. For example, other results (not included here) show that the value of tactics in z7 is $90,000 (105%). Utilising tactics in z7 (a poor weather-year) allows the profit to remain similar, while the strategic stocking rate is increased.

Table 4: Weather-year profit (AUD) with full tactics versus minimal tactics.

| Weather-year | Full tactics (×1000) | Minimal tactics (×1000) | Change (×1000) (% in parentheses) |
|---|---|---|---|
| Expected | $904[A] | $776[A] | $128 (16%)[A] |
| z0 | $1,345 | $1,164 | $181 (16%) |
| z1 | $990 | $872 | $118 (14%) |
| z2 | $1,068 | $767 | $301 (39%) |
| z3 | $370 | $106 | $264 (250%) |
| z4 | $931 | $876 | $56 (6%) |
| z5 | $624 | $527 | $98 (19%) |
| z6 | $836 | $778 | $59 (8%) |
| z7 | $187 | $183 | $4 (2%) |
| Minimum[A] | $186[B] | $105[B] | $81 (44%)[B] |
| Maximum | $1,344[B] | $1,164[B] | $180 (13%)[B] |

[A] Weighted average of weather-years.
[B] Minimum and maximum profit across the weather-years.

Table 5: Summary of farm strategy with full tactics and minimal tactics.

| Tactic | Full tactics | Minimal tactics |
|---|---|---|
| Profit (×1000) | $903.5 | $775.7 |
| Stocking rate (dry-sheep equivalents/winter grazed area, DSE/ha) | 18.6 | 14.3 |
| Supplement fed (t) | 937.3 | 829.8 |
| Pasture area (%) | 35.6 | 39.2 |
| Cereal area (%) | 39.4 | 38.7 |
| Canola area (%) | 25.0 | 22.1 |

## Key tactical decisions

In early break years, it is optimal to increase the canola area by up to 55% and in late-break years, it is optimal to decrease canola area by 55% (Table 6). All the tactical-rotation adjustments occur on the productive soils (LMU 3 and LMU 4). Sandy soils (LMU 2) are never tactically adjusted and always remain in continuous pasture (Table 6). The difference in rotation selection based on the presence or absence of follow-up rains in early breaks shows that in years with an early break, it is optimal to delay the rotation decision on a proportion of the area until follow-up rains are received. The results in this paper report only the changes in land-use area on each soil type. However, the adjustments are fine-tuned based on the rotation history. This is accounted for in AFO, but, for simplicity, we have not reported the full rotation changes.

Table 6: Optimal land-use choice on each LMU for each weather-year.

| Weather-year | Pasture (ha) | | | Cereal (ha) | | | Canola (ha) | | |
|---|---|---|---|---|---|---|---|---|---|
| | LMU2 | LMU3 | LMU4 | LMU2 | LMU3 | LMU4 | LMU2 | LMU3 | LMU4 |
| Expected [A] | 150[A] | 108[A] | 500[A] | 0[A] | 720[A] | 119[A] | 0[A] | 402[A] | 130[A] |
| z0 | 150 | 95 | 424 | 0 | 537 | 100 | 0 | 598 | 227 |
| z1 | 150 | 95 | 424 | 0 | 537 | 100 | 0 | 598 | 227 |
| z2 | 150 | 107 | 475 | 0 | 612 | 209 | 0 | 511 | 67 |
| z3 | 150 | 107 | 475 | 0 | 612 | 209 | 0 | 511 | 67 |
| z4 | 150 | 132 | 620 | 0 | 920 | 84 | 0 | 178 | 46 |
| z5 | 150 | 132 | 620 | 0 | 920 | 84 | 0 | 178 | 46 |
| z6 | 150 | 99 | 506 | 0 | 956 | 182 | 0 | 175 | 62 |
| z7 | 150 | 99 | 506 | 0 | 956 | 182 | 0 | 175 | 62 |
| Minimal tactics[B] | 64 | 498 | 271 | 86 | 424 | 315 | 0 | 308 | 164 |

[A]Weighted average of weather-years.

[B]All weather-years are the same without tactics.

Under minimal tactics, all pasture is grazed at a similar intensity and all paddocks have a similar level of Feed on Offer (FOO). Optimal management employs rotational grazing, and grazing low-FOO paddocks lightly to maximise growth (see full paper). In early break weather-years, it is optimal to graze pastures heavily early and then defer them by grazing crops.

The optimal level of crop grazing correlates with the break of season timing, where early break seasons have the highest level of crop grazing (Table 7). After an establishment period, crops can be grazed. However, it is optimal to further delay grazing to increase relative availability of the feed. At low FOO levels, the relative availability of pasture is low, which reduces intake and nutritive feed values for sheep. At low nutritive value, the yield penalty outweighs the value of grazing. Hence, in late-break and false-break years, some of the crop available for consumption is not grazed (Table 7). Crop grazing is economical even in favourable weather-years because the stocking rate is increased, which outweighs the negative impact of yield loss.

Table 7: Tonnes of crop grazing in each weather-year.

| Weather-year | Crop consumed (t) | Available proportion consumed (%) |
|---|---|---|
| Expected[A] | 386[A] | 85[A] |
| z0 | 543 | 100 |
| z1 | 543 | 100 |
| z2 | 395 | 89 |
| z3 | 395 | 89 |
| z4 | 329 | 100 |
| z5 | 329 | 100 |
| z6 | 4 | 4 |
| z7 | 4 | 4 |
| Minimal tactics[B] | 0 | – |

[A]Weighted average of weather-years.

[B]All weather-years are the same without tactics.

Most sales that differ based on weather-year conditions are related to stock less than 18 months of age. Additionally, there are some smaller tactical sales of sheep that include the oldest age group of ewes. Adjusting only the youngest and oldest age group of animals allows the breeding strategy to remain constant, suggesting that destocking of ewes in a poor year is not profitable because of the opportunity cost caused by being understocked in the subsequent years.

The farm strategy (minimal tactics) is to sell the heavy proportion of wethers at 8 months of age and the remainders after the second shearing at 18 months of age (Figure 2). With tactical management included, the general strategy is similar. However, in years with a false break or a poor spring; a large proportion of the wethers are sold after shearing at 5.5 months of age. In years with a false break, a greater proportion of wethers are sold at 8 months of age.

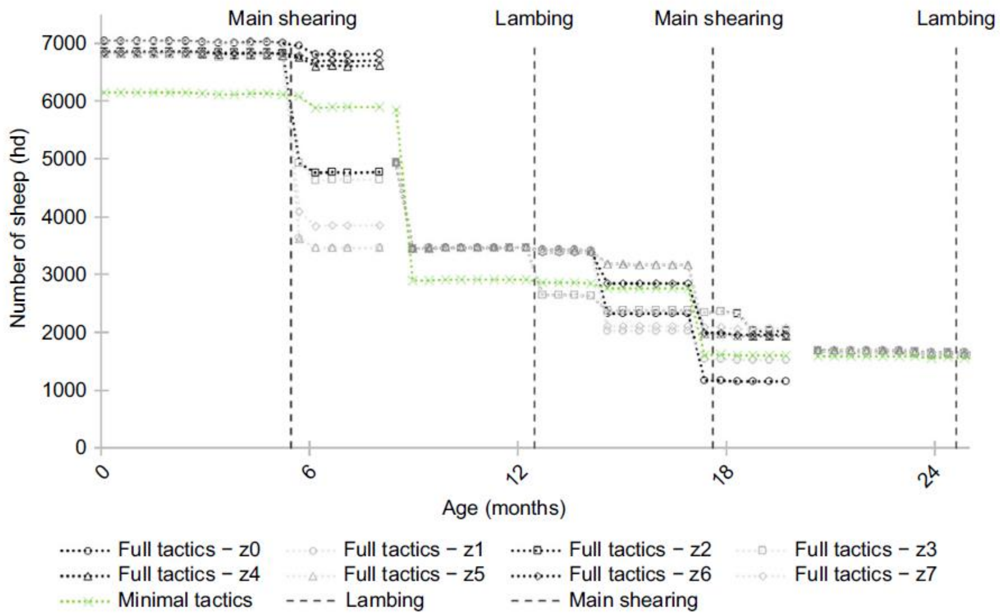


Figure 2: Sheep numbers by age group in each weather-year.
Note: There is a gap in the graph at 8 and 20 months, which is the beginning of the next weather-year, at which point all weather-years have the same opening numbers and they can then diverge again.

Implementation of the short-term tactical management increases the optimal winter stocking rate (Table 8), while reducing supplement fed per dry sheep equivalent (DSE) in 5 of 8 weather-years (Table 8).

Table 8: Winter stocking rate in each weather-year and supplement fed in each weather-year with full tactics versus minimal tactics.

| Weather-year | Stocking rate (DSE/Winter grazed Ha) | Full tactics | | Minimal tactics | |
|---|---|---|---|---|---|
| | | Total (t) | kg/DSE | Total (t) | kg/DSE |
| Expected[A] | 18.6[A] | 1053[A] | 80[A] | 963[A] | 82[A] |
| z0 | 21.1 | 1173 | 87 | 1065 | 90 |
| z1 | 21.1 | 889 | 69 | 620 | 53 |
| z2 | 18.3 | 1010 | 78 | 1255 | 107 |

| | | | | | |
|---|---|---|---|---|---|
| z3 | 18.3 | 1614 | 122 | 1989 | 171 |
| z4 | 15.3 | 898 | 68 | 795 | 68 |
| z5 | 15.3 | 1011 | 77 | 963 | 83 |
| z6 | 18.0 | 1095 | 84 | 782 | 67 |
| z7 | 18.0 | 1173 | 87 | 1065 | 90 |
| Minimal tactics[B] | 14.3[B] | NA | NA | NA | NA |

## Discussion

Australia's variable climate results in the need to manage its dryland farming systems dynamically to maximise profitability. This paper utilises a current up-to-date farm-optimisation model, to identify the optimal complement of tactical adjustments to apply and their associated profitability. The findings indicated that managing farming systems dynamically in response to unfolding weather conditions is highly profitable, increasing the expected profit by 16% (Table 4). This concurs with the few previous studies that have examined the mixed-enterprise farming system of Western Australia. From a farmer's point of view, the key message from all these studies is that a 'set and forget' management approach is far from optimal. However, the value of implementing the optimal tactical management will vary among producers, depending on their current management.

The implementation of tactics can potentially be complex. Farmers must consider that as they implement tactics into their system, their underlying strategy must also be adjusted (Table 5). The added complexity of each category of tactic being made up of many sub options means that the farm manager must be skilled to identify the type of unfolding season and implement the correct tactic (monitoring tools such as Pastures from Space™ may assist farmers in identifying the weather-year being experienced). In this analysis, there was no economic cost incurred for the additional skill required to implement tactics. However, it may warrant consideration. Additionally, no cost has been attributed to the potential need to store additional inputs to facilitate management adjustments. Given these factors and each farmer's unique circumstances, they may want to implement a subset of the available tactical options. The economic value of implementing an additional tactic varies depending on the complement of tactics being applied (Table 6). However, in the 8 scenarios, an additional tactic was worth between $7,704 and $53,171. This indicates that a farmer can improve farm profitability and by implementing only a subset of the available tactics.

This study was based on a 'typical' farm in the Great Southern region of Western Australia. Like the study region, many farming regions within Australia have significant weather variation. Therefore, we expect that implementing tactical management can increase profit will be applicable to a range of farm systems, provided those regions have variation in weather among years. The value of different tactics is likely to vary across regions and farms, so results need to be implemented with care. However, the modelling method could be used to generate customised results.

## Conclusion

Short-term adjustments to the overall farm strategy in response to unfolding weather conditions can result in substantial improvements in expected profit on dryland mixed-enterprise farms in the Great Southern region of Western Australia by approximately 16%. Benefits stem, first, from capitalising on knowledge about the profitability of different decision tactics tailored to the unfolding weather conditions. Second, the benefits accrue from more optimally selecting the underlying farm management strategy of the farm business. Deterministic models and even stochastic models that do not include activities for tactical adjustments miss this key feature of the system and may incorrectly identify optimal activities.

## Full Paper

## Acknowledgements

**Declaration of funding.** The authors thank the Department of Primary Industries and Regional Development, WA for financial support through the Sheep Industry Business Innovation project.

**Acknowledgements**. The authors thank Katelyn Bruinsma for final edits. This paper forms part of the PhD thesis of Michael Young (2023).

**Data availability**. All data used in this paper have been referenced and is publicly available. The model/code used for this paper can be licensed to others on request.

# Assessing economic benefits of confinement feeding

**Samantha Cullen (Stirlings to Coast Famers, WA)**

Author correspondence: samantha.cullen@scfarmers.org.au

## Introduction

Late winter breaks are becoming more frequent in the Albany region of Western Australia and stubbles are depleted before the next growing season starts. As such, livestock producers identify the importance in providing feed for livestock in late autumn and immediately after the season break. Confinement feeding allows producers to maintain ewe condition score by reducing energy expenditure and allowed pasture growth to be maximised. The purpose of this MLA-funded, Producer Demonstration Site (PDS) project was to demonstrate a range of sheep confinement feeding systems that optimise sheep management and supplementary feeding programs, by achieving appropriate pregnant ewe condition scores and increasing Feed on Offer (FOO) in deferred pastures, for a profitable and sustainable sheep enterprise. The condition scores measured were used to show the sheep were not declining in confinement, and pasture cuts were used to demonstrate how pastures that were allowed to establish produced more feed, other than those immediately stocked at the break of season.

## Key findings

- Six producer hosts worked with Stirlings to Coast Farmers (SCF) to closely record costs, measure pasture growth and monitor their individual confinement feeding systems to establish whether confinement feeding was economically beneficial.
- Confinement feeding was profitable in all 6 cases, varying from $6,500 to $25,300 profit in the year it was implemented, analysis not including any infrastructure costs.
- Pasture deferment makes up approximately 80 – 90% of the economic value of confinement feeding.
- Labour saved from confinement feeding offsets approximately 17-31% of the cost of additional supplement.
- Confinement feeding before the break of season is less profitable because pasture is not being deferred.

## Materials and methods

A core producer group was created, consisting of 11 SCF producer members who had already or were interested in developing a confinement feeding program for their sheep production system. Three core producers were asked to host producer demonstration sites in each year of the project, with 6 sites across the 2 years (Table 1).

Table 1: Details of the 6 producer demonstration sites confinement and utilised different rations to feed their sheep.

| Producer | Location | PDS year | Confinement feeding set up | Number of sheep confined | Period of confinement |
|---|---|---|---|---|---|
| 1 | Green Range, WA | 2022 | Communal feed troughs | 4,179 | 41 days |
| 2 | Tenterden, WA | 2022 | Trail feeding | 2,100 | 56 days |
| 3 | Gairdner, WA | 2022 | Fence mounted feed troughs | 600 | 25 days |
| | | | | 1,400 | 43 days |
| 4 | Kojonup, WA | 2023 | Trail feeding | 7,000 | 76 days |
| 5 | Ongerup, WA | 2023 | Communal feed troughs | 1,500 | 28 days |
| 6 | South Stirlings, WA | 2023 | Fence mounted feed troughs | 1-740 | 19 days |

1. Producer 1 runs a 2,400 ha mixed farm operation, running a merino flock. 4,179 ewes were confined for 41 days, March to mid-May 2022. Feeding a full mixed ration and ad-lib hay, 3 times a week into a communal feed trough pen.
2. Producer 2 has a 2,500ha mixed farm operation, running a self-replacing merino flock. 2,100 head were confined for 56 days, April to mid-June and another 2,277 head were confined for 76 days, April to end of June 2022. Ewes were trail fed a lupin-barley-oats mix that had been treated with Home n' Dry Alkasystems product and ad-lib hay, 3 times a week.
3. Producer 3 runs a 7,500ha mixed farm operation, running a self-replacing merino flock. 600 head were confined for 25 days and 1,400 head were confined for 43 days, from the start of April until mid-May 2022. Feeding a grain mix daily into fence mounted troughs in each pen. Ad-lib straw was given 3 times a week.
4. Producer 4 runs a 1,431ha mixed farm operation, running 41% crop with Merino and Dohne flock. 7,410 ewes, ewe lambs and wether lambs were confined (all livestock numbers) for 76 days, from mid-April to late-June 2023. Sheep were trail fed barley and lupins 3 times a week, in addition they added lime and salt mix into half tyres and fed barley straw on the ground in each pen once a week.
5. Producer 5 runs a 5,600ha mixed farm running 73% crop with a self-replacing Merino flock. 1,500 ewes were confined for 28 days, from the end of April to end of May 2023. Ewes were fed pellets into communal troughs twice a day, whilst adding barley straw on the ground to each pen 3 times a week.
6. Producer 6 runs a 4,800ha mixed farm operation, running 69% crop with Merino and Dohne flock. 1,740 ewes were confined for 19 days, from end of May until mid-June 2023. Ewes were rationed pellets daily, via mounted troughs on each pen. In addition, barley, hay and calcium lick blocks were placed on the ground in each pen 4 times a week.

All producers were supplying water through water troughs in each pen. The confining periods varied mainly due to lambing dates, producer farming schedules (seeding, spreading etc.), and variation of the season between locations.

### Data collection

All information was collected from the host producers by the project facilitator. This included existing confinement feeding set-ups such as pen size, stocking density and class, shade type, water supply, feeding schedule, ration type and feeding method. The producer hosts decided how many, what kind of sheep, and the duration of confinement.

Hosts supplied an outline of their feed schedule (frequency, type, volume) and a final value of the total feed fed for the confinement period for both the contained and control (if applicable) mobs. Any hay, straw or silage fed was measured on a 'number of bales' basis. Hosts feeding through feeders (lick/self/adlib feeders) recorded how much feed was provided through the feeders to give a total weight fed.

SCF conducted pasture cuts of the paddocks that were set aside for grazing when the sheep were released from confinement. For producers who had confined all their sheep, the first cuts were performed when the producer indicated they would generally have to put sheep on winter grazed pastures if they were not confinement feeding. For those with a control mob, the first cuts were done when the control mob were moved on to their winter grazed pasture paddocks. The second cut was taken as sheep were released from confinement and put onto their winter grazed pasture paddocks.

When the producer was ready to remove sheep from confinement, a minimum of 10% of the animals were condition scored to give a mob average.

### Economic Analysis

Data for the PDS was collected from producers by the SCF Project Officer and used by Michael Young at Youngs Farm Analysis to perform the economic analysis.

The analysis used a whole farm economic model to evaluate the profitability of confinement feeding on 6 mixed sheep and crop farm businesses in Western Australia. The economic analysis provided an understanding of the economics behind confinement feeding strategies and how factors within the farming system effect the economics of confinement feeding.

Farm data collection was conducted to acquire crucial information about each farm's structure, including pasture area and stocking rate, and to assess its alterations resulting from confinement feeding practices. This data served as the foundation for calculating the additional supplement requirements during confinement (accounting for factors such as waste reduction and the decreased energy needs of livestock in confinement), and labour efficiency gains associated with supplement feeding in confinement versus paddock feeding.

To determine the quantity of extra FOO at the conclusion of the confinement period, SCF conducted 8 repetitions of pre and post-pasture cuts across 2 paddocks on each producer's property. For the 2022 analysis, regional expected pasture production data was used to examine the FOO increase for the 3 producer host sites as there was limited pasture cuts data for this round of analysis.

The economic value of the additional FOO resulting from deferment during the confinement period was determined for each of the case study properties using the advanced whole-farm model known as Australian farm-optimisation (AFO). This calculation necessitated a comprehensive whole-farm, whole-year feed budget, that considered the biological aspects of pasture growth and quality, as well as livestock energy requirements and farm management, including factors such as stocking rates.

## Results and discussion

The confinement feeding set ups/systems saved between 3.75 to 24 hours a week on labour, compared to running their livestock under a conventional pastures/trail feeding system (Figure 1). This time saved could enable mixed producers to spend more time on their cropping program, other jobs or allowing them to maintain a better work/life ratio.

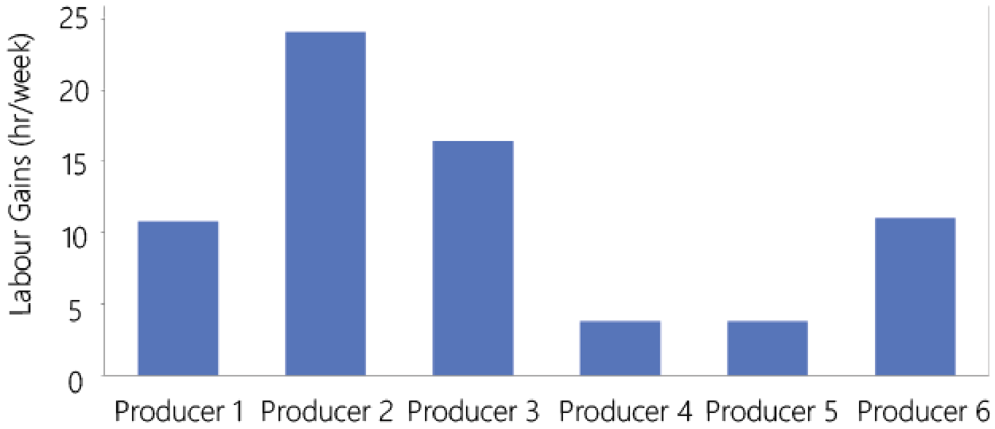


Figure 1: PDS host increases in individual labour gains (hrs/week).

Each host confined their livestock for different periods of time and at different times of the season. Pasture was productive in all cases varying from 64 kg DM/ha to 1,507 kg DM/ha (Figure 2). By confining their stock, all producers were able to defer large amounts of pasture hectares. On a whole farm scale with the deferred hectares, pasture production over the confining period can be quite substantial, enabling livestock to benefit majorly when released from confinement.

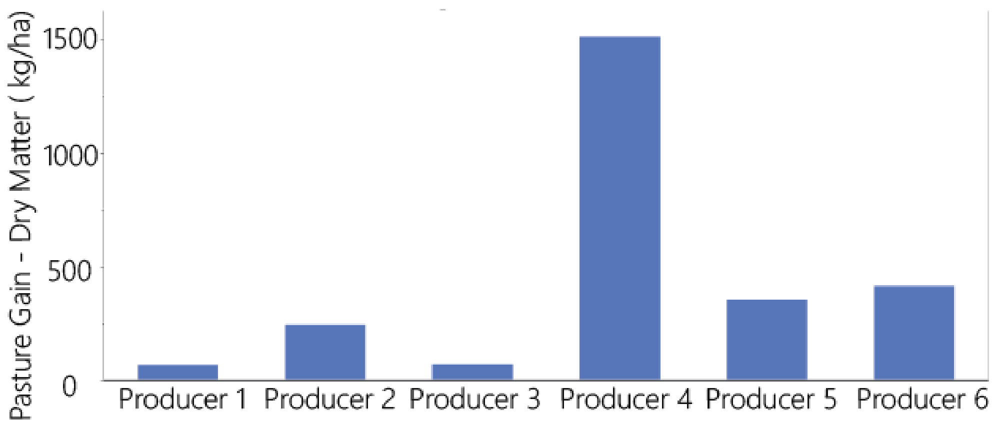


Figure 2: PDS host increases in individual pasture gains (kg DM/ha).

The performance metrics for each PDS host for the period of confinement is shown in Table 2. Livestock condition was either maintained or slightly increased, due to less energy expenditure, resulting in energy efficiency gains to vary between 0.73-0.8 megajoules/head/day (MJ/hd/day). Time spent feeding livestock in confinement compared to a non-confinement practice was reduced in all scenarios and varied in reduction between 30%-75%. This directly correlated with labour efficiency, with an increase across all demonstration sites varying between 3.75 hours/week (hrs/week) – 24 hrs/week. Therefore, producers could better spend their time elsewhere on their farm by reducing their time spent feeding livestock.

Table 2: All PDS host performance metrics.

| Performance metrics in confinement | Producer 1 | Producer 2 | Producer 3 | Producer 4 | Producer 5 | Producer 6 |
|---|---|---|---|---|---|---|
| Condition score in | 2.8 | 2.6 | 2.7 | 2.8 | 4 | 3.3 |
| Condition score out | 3 | 3 | 3.1 | 2.8 | 4.2 | 3.4 |
| Reduced feeding time | 35% | 54% | 75% | 30% | 50% | 61% |
| Labour efficiency gains (hrs/week) | 10.75 | 24 | 16.4 | 3.75 | 3.75 | 11 |
| Hectares deferred (ha) | 960 | 570 | 550 | 851 | 274 | 350 |
| Pasture production gains (kg/DM/ha) | 64 | 241 | 67 | 1507 | 350 | 410 |
| Energy efficiency gains (MJ/hd/day) | 0.8 | 0.73 | 0.76 | 0.76 | 0.8 | 0.78 |
| Mortality rate reduction | 1% | No change | 0.5% | No change | No change | No change |
| **Cost (-) and benefits (+) in confinement** | | | | | | |
| (-) Additional supplement/feed | $0 | -$30,591 | -$13,750 | -$105,300 | -$16,940 | -$13,134 |
| (+) Pasture deferment | $19,034 | $32,376 | $19,449 | $126,797 | $25,150 | $26,101 |
| (+) Labour reduction (@$40/hr inc super & WC) | $2,520 | $4,800 | $4,040 | $800 | $600 | $1,280 |
| (+) Mortality reduction | $739 | $0 | $369 | $0 | $0 | $0 |
| Gross Margin (GM) | $22,293 | $6,585 | $10,108 | $25,300 | $8,800 | $14,200 |
| GM/DSE | $3.6/DSE | $1.0/DSE | $3.4/DSE | $2.3/DSE | $0.83/DSE | $1.14/DSE |
| GM/WGHa | $23.20/ WGHa | $11.90/ WGHa | $5.62/ WGHa | $30.00/ WGHa | $5.80/ WGHa | $8.00/ WGHa |

Note *DSE – Dry Sheep Equivalent
*WC – Workers compensation
*WGHa – Winter grazed hectares

### Economic analysis

The value of confinement feeding is primarily due to:

- reduced labour and cost of supplementary feeding
- reduced supplement wastage
- increased energy efficiency of stock
- increased pasture production due to deferring.

The economic value of confinement feeding varies due to both external market and climate conditions and internal management practices including:

i) time of lambing
ii) stocking rate
iii) pasture area
iv) grazing management prior to adopting confinement feeding
v) confinement set up
vi) confinement period.

For example, Table 3 shows that the value of deferred pasture varies by up to 72% depending on seasonal conditions in 2022 and Table 3, shows that the value of deferred pastures varies by up to 99% depending on seasonal conditions in 2023.

The reason the value of deferment changes by season type is because of the inflexible nature of farming systems. For example, farmers must feed a similar number of stock irrelevant of the seasonal conditions. So, in a poor year, when the grazing pressure is high, additional feed has a higher value.

Table 3: Value of pasture deferment in different seasons for 2022-23 host farms. Results show average of case study farms.

| | Good season | Medium season | Poor season |
|---|---|---|---|
| Pasture deferment 2022 | $5,854 | $16,834 | $20,683 |
| Pasture deferment 2023 | $584 | $36,278 | $82,420 |

In this analysis, we did not complete any sensitivity analysis (other than the season type sensitivity) to examine how varying the above factors affects the profitability of confinement feeding.

However, some key findings include the fact that confinement feeding was profitable in all cases, pasture deferment makes up approximately 80-90% of the economic value of confinement feeding, labour saved from confinement feeding offsets approximately 17-31% of the cost of additional supplement, and confinement feeding before the break of season is less profitable because pasture is not being deferred.

## Conclusion

Confinement feeding systems have allowed local producers to retain stock whilst deferring grazing. This in turn, maximised the value of improved pastures by also having the option to produce high-quality conserved fodder such as hay, straw, or silage and to feed this out during confinement.

Allowing pasture deferment by confinement feeding enables a sustainable amount of ground cover to grow without disturbance from sheep grazing. This ensures that land degradation and soil erosion is at a minimum in these deferred paddocks. When paddocks are bare (by not deferring pastures) the soil surface is exposed and loosened and at risk of wind and water erosion. Higher dust levels in the air can also pose a health risk to humans and animals.

Energy expenditure for livestock is decreased when placed in a confinement system, by preventing sheep ‘chasing the green pick’ they are expending less energy, and more easily maintaining their condition. In scenarios where ‘green pick’ is low, sheep can drastically lose condition when in larger paddocks. In addition, monitoring stock is much harder to do. However, when in confinement, closer observations of stock (especially of those in poorer condition) is possible.

Confinement feeding systems can also be used as the most cost-effective way of finishing out-of-season lambs and ewes to meet market specifications.

## Acknowledgements

Grateful acknowledgement goes towards MLA for funding this project through the Producer Demonstration Sites (PDS) program. Stirlings to Coast Farmers would also like to acknowledge Bridie Luers (Nutrien Ag Solutions) for her assistance with the extension of the project, Michael Young (Farm Optimisation Group) for his work on the economic analysis and all the host farmers for the generous contribution of their time.

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