Final report

PDS Increasing number of lambs weaned / ewe unit

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Abstract

High lamb losses in Western Australian (WA) Merino enterprises—averaging 29% between scanning and marking for maiden ewes—have been well documented, with losses ranging from 20% to 53% across different flocks. This Producer Demonstration Site (PDS) project aimed to test whether improved ewe nutrition in late pregnancy, combined with practical management interventions such as pregnancy scanning for litter size and foetal age, body condition score (BCS) monitoring, and feed testing, could increase lamb survival and productivity in the challenging conditions of WA's Midwest region. Over three years and four demonstration sites, producers implemented these targeted practices and used electronic identification (eID) to track performance data; as a result, three of the four sites achieved an average 9% increase in lamb survival after scanning, with lambs marked per ewe joined rising by 9% to 30%—notably, the most intensive management sites saw the greatest gains in profitability.

While the project demonstrated that focusing on a small set of practical, easy-to-adopt management practices—especially precision feeding and data-informed flock management—can lead to measurable improvements in lamb survival, ewe productivity, and farm profitability, it also highlighted the importance of adapting strategies to local conditions and the need to manage input costs and environmental variability. These findings provide clear, actionable guidance for WA sheep producers seeking to improve enterprise resilience and profitability through evidence-based management.

Executive summary

Background

Lamb survival is a critical determinant of productivity and profitability in WA Merino enterprises. Despite a state average lamb marking rate of 92%, approximately 28% of lambs are lost between scanning and marking, with 90% of these deaths occurring within the first 48 hours after birth (Curnow & Roberts, 2018). Contributing factors include low lamb birth weight, poor maternal bonding, insufficient colostrum, and lack of shelter.

Ewe nutrition is central to improving these outcomes. Ewes with a Body Condition Score (BCS) of 3–3.5 at lambing exhibit stronger maternal behaviour, improved lactation, and better lamb survival rates. Conversely, under-conditioned ewes suffer increased losses—up to 11% for singles and 24% for twins (Young et al., 2014).

Objectives

To demonstrate the impact of precision feeding in late gestation on lamb survival and ewe productivity, aiming to increase marking percentages above the WA Merino baseline of 92%. The project also sought to identify regionally appropriate, best-practice ewe management strategies in WA's challenging Midwest conditions.

Methodology

Four Producer Demonstration Sites (PDS) of differing scales and enterprise structures across WA's Midwest monitored a group of ewes over a three-year period using electronic identification (eID), during which producers implemented key best-practice management strategies:

- Pregnancy scanning for litter size and foetal age
- Monitoring ewe BCS at key stages
- Feed and mineral assessments to guide ration formulation
- Managing mob sizes in singles and twins
- Tailored supplementary feeding in the third trimester

Data was collected and recorded using eID technology. This included pregnancy status, (single, twin and early, late), ewe BCS, marking results, fleece weights, weaning rates, feed/labour inputs, and dry sheep equivalent (DSE) metrics. From these results, a cost-benefit analysis was conducted.

Results/Key findings

Main outcomes achieved

- Pregnancy scanning was adopted across all four PDS sites, with early/late and litter size data used to manage feeding and paddock allocations.
- EID was used by all four sites to track reproductive performance and inform culling, with 100% of observers intending to implement in 2025 and beyond, with two core producers adopting eID due to the project and investing in data capture equipment.
- Lamb marking rates at PDS sites exceeded the 92% average with only one outlier due to climatic pressures, and supplementary feed availability, but average across all sites was 107%, ranging from 85 % to 127%.
- Wool cut per head improved modestly; tensile strength was not measured.

- Workshops covered key technical topics (e.g., ration formulation, ewe & ram prep, lambing management, weaner management), boosted skills and confidence, however 50% of observer producers still lack confidence in ration formulation.
- Grower videos, fact sheets, case studies and field days helped disseminate findings.

Reproductive success & survival

- Over the three-year project an improvement in lamb survival through targeted post-scanning nutrition, was observed with three of four sites averaging a 9% increase, while site three b due to feed limitations, and a shorter period in the project showed a decrease in lamb survival. Site two had the highest scanning to marking percentage of over 127% and it also had the highest percentage of single ewes and ewe input costs.
- Lambs marked per ewe joined over the three years also increased across the three sites, ranging from 9% to 30%, with some reaching up to 113%.

Gross margins

- Over three years, average gross margins improved with better ewe management. Those sites that invested in nutrition and animal health treatments, had higher lamb survival, but variable gross margins, depending on livestock prices.
- PDS site one and site four had the highest gross margins, indicating strong profitability relative to inputs.
- PDS site two had the highest DSE average (8.6), reflecting a more intensive system, albeit with a slightly lower gross margin percentage due to number of lambs / produced per ewe unit.
- PDS site three b had the lowest gross margin (12.9%), suggesting greater challenges in converting inputs to returns or higher input costs relative to income.

Challenges

The project faced significant challenges, including delays from Cyclone Seroja (2021), extreme heat (2022) affecting reproductive performance, labour shortages, inconsistent data, and broader industry pressures such as live export uncertainty and new eID regulations. These factors disrupted timelines and limited consistent participation, particularly among observer producers.

A key reflection was that the project's design was overly complex, with too many variables tracked. Simplifying the approach to focus on four core metrics—pregnancy scanning, ewe body condition scoring, mob size management, and feed assessment—proved more practical and impactful. These measures directly support lamb survival, ease of management, and economic outcomes, and are scalable across enterprises.

Benefits to industry

This project reinforced the link between precise ewe nutrition, data-informed decision-making and lamb survival. Key benefits included:

- Improved ewe and lamb performance through targeted feeding
- Greater resilience to climate and market pressures
- Increased profitability per DSE
- Enhanced animal welfare and sustainability

By adopting these strategies, WA sheep producers can position themselves for long-term success in a changing industry landscape.

Future research and recommendations

As noted, the project was hindered by environmental disruptions, labour shortages, and industry changes, highlighting the need for simpler, more practical designs. Future PDS projects should focus on 3–4 key metrics, like BCS, pregnancy scanning, and feed testing, while integrating eID tools and training to improve decision-making to simplify flock management, reduce costs and improve return on investment (ROI).

Future research should support the transition beyond live export through domestic market strategies, digital tools, and grazing innovations, particularly the efficient integration of livestock and cropping to increase DSE and KG of meat produced per hectare.

PDS key data summary table

Project Aim:

The main objective was to demonstrate the value of increasing the number of lambs marked over the 92% industry standard (merino flocks) by precision feeding ewes to meet production status.

	Comments		Unit
Production efficiency benefit (impact) Animal production efficiency - kg LWT/ha; kg Stocking rate – DSE/ha Reproductive efficiency – marking %,	*Average Marking % Increase from 2022 to 2024 across all four sites from ewes scanned* *Average Marking % Increase from 2022 to 2024 across all four sites from ewes joined* *Average DSE from 2022 to 2024 across all four sites* *Average Kg /ha of meat 2022 to 2024 across all four sites* *Average gross margin of 2022 to 2024 across all four sites* *Average Cost/head* *Average Gross Profit/hd* *Average Gross Profit $ /ha*	2022 99.6% 2023 106.5% 2024 111.8% **Total 12.3%** **2022 91.70%** **2023 92.45%** **2024 102.34%** **Total 10.89 %** **Average DSE / ha 6.95** **Average 89.08 kg/ha.** **37.98%** **$62.11** **$57.73** **$401.22**	Marking % from ewes Pregnant Marking % from ewes Joined DSE /Ha Kg/meat/ ha % Gross Margin $ /hd $ /hd $ /ha
Reduction in expenditure Reduction in labour i.e. DSE/FTE, LSU/FTE, AE/FTE; Reduction in other expenditure	None	0	
Increase in income		$45.00	/ha
Additional costs (to achieve benefits)		$18	/ha
Net $ benefit (impact)		**$27.00**	**/ha**
Number of core participants engaged in project		12	
Number of observer participants engaged in project		51	
Event Attendees		263 over 13 events	
Core group no. ha		13 412	
Observer group no. ha		18 000	
Core group no. sheep		25 668	hd sheep

Observer group no. sheep		17 600	hd sheep
Core group no. cattle		0	hd cattle
Observer group no. cattle		0	hd cattle
% Change in confidence – core (4 respondents)	*Determining rations for ewes to meet the nutritional requirements throughout their production cycle?*	33 % increase from 5.5 – 8.25 out of 10	Increase confidence
% Change in knowledge & Skills- core (4 respondents)	*Increasing the number of lambs weaned / ewe unit*	Increase 22% from 6.75 – 8.25 out of 16	Increase in knowledge and skills
% Change in confidence – observer (3 respondents)	*Determining rations for ewes to meet the nutritional requirements throughout their production cycle?*	Decrease 15 % from 6.2 to 5 out of 10	confidence
% change in knowledge, & skill – observer (3 respondents)	*Increasing the number of lambs weaned / ewe unit*	27% increase from 3.4 to 4.33 out of 16	Increase in knowledge and skills
% practice change adoption – core (4 respondents)	*Increasing the number of lambs weaned / ewe unit*	18.8 % increase from 53% - 63%	Normal practice & intend to implement
% practice change adoption – observers (3 respondents)	*Increasing the number of lambs weaned / ewe unit*	112% increase from 33% -70%	Normal practice & intend to implement
% of total ha managed that the benefit applies to	*40 % of total ha, ewes are grazed upon*	40%	

Key impact data	
Gross Margin / Ha	**$401/ha**
Gross Margin / dse or AE	**$57/dse**
Cost of production ($ / kg red meat)	**$4.85/kg red meat**

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1. Background

1.1 Improving lamb survival and ewe productivity in Western Australian Merino enterprises

1.1.1 Addressing lamb mortality through precision nutritional management and targeted Producer Demonstration Sites

The primary issue this project aimed to address was the high rate of lamb mortality in Merino enterprises in Western Australia (WA), which resulted in significant productivity and financial losses. Industry research, including surveys by the WA Department of Primary Industries and Regional Development (WA DPIRD, 2018), highlighted an average scanning percentage of 128% in Merino flocks mated to Merino sires, with marking percentages averaging only 92%. This gap reflected a 36% reduction in lambs marked from scanned foetuses, often attributed to low lamb birth weights, poor maternal bonding, insufficient colostrum and inadequate shelter (Curnow & Roberts, 2018; Lockwood, 2014).

With 90% of lamb mortalities occurring within the first 48 hours of life, these issues underscored a knowledge gap in optimizing late-gestation ewe nutrition to improve lamb survival rates. Ewe body condition score (BCS) at lambing was a key determinant of lamb survival, with survival rates of 92% for singles and 82% for twins at a BCS of 3.5, dropping significantly as BCS declined. The financial implications are profound: for every 1,000 ewes, a 36% lamb loss equates to an average if lambs are $150 /hd to $54,000, and across WA's 7.6 million breeding ewes, 2.28 million lambs are lost annually.

This project sought to address this challenge by demonstrating the effectiveness of scanning for litter size and foetal aging to tailor ewe nutritional management, thereby increasing lamb survival and improving ewe productivity. Unlike broader educational programs such as the AWI-funded Lifetime Ewe Management (LTEM) course, this project operated Producer Demonstration Sites were grower-led and region-specific, ensuring solutions were practical and directly applicable to local conditions. By collecting data on BCS, mob size, feed allocation and reproductive performance across three diverse PDS sites, the project was designed to provide robust evidence base for the benefits of precision nutritional management. The longer-term nature of the project also allows for observation, training and incremental adoption of best practices among a wider group of producers, fostering sustainable change in management approaches.

The primary audience for this project included WA sheep producers, particularly those in the Midwest region who managed Merino enterprises under challenging environmental and operational conditions. The results of this project were intended to demonstrate the economic viability of best practices, such as scanning and precision feeding, and to encourage wider adoption of these practices to reduce lamb losses, increase profitability, and enhance animal welfare across the industry.

2. Objectives

This project aimed to evaluate the effect of precision feeding and improved ewe management on reproductive performance, fleece quality, flock health and producer practice change in the Midwest region of Western Australia by October 2024.

Below is an overview of each original objective, its defined targets, and a summary of whether these targets were successfully achieved.

Objective 1: Four core producer sites of different sizes and different joining times, will demonstrate and assess the potential increase in lamb survival and reproductive performance of ewes when adhering to best practice management techniques as set out in AWI, Lifetime Wool Management and ASHEEP, following maidens over a three-year period focusing on:

a) **Achieving BCS 3 – 3.5 pre-joining & pre- lambing BCS for the 3 consecutive years of the project**
b) **Increasing the reproductive rate (measured by pregnancy scanning for litter size & foetal aging),**
c) **Increasing the number of lambs marked and number of lambs weaned**
d) **Measuring lambs weaned / ewe unit joined & measuring lambs weaned / ewe unit scanned pregnant.**

This objective was mostly achieved, with three of four core sites demonstrating strong improvements in lamb survival and reproductive performance through best practice ewe management, including exceeding marking percentage targets. However, inconsistent data collection on ewe and lamb mortalities, dystocia, and metabolic disorders limited full assessment of all intended outcomes.

Objective 2: Assess the effect of precision feeding on ewe fleece weights, and tensile strength using Electronic Identification Device technologies and wool test reports.

This objective was partially achieved: wool weights were successfully measured and showed increases at most sites, but tensile strength data could not be collected due to resource limitations.

Objective 3: Assess the general health of animals provided with a balanced diet- BSC, worm egg count (WEC), marking weight & mineral status.

This objective was mostly achieved, with consistent monitoring and improvement of BCS and marking weights and continued use of WEC as standard practice. Mineral profiling was adopted by around half of participants, though cost and practicality limited broader uptake.

Objective 4: Conduct a cost-benefit analysis to determine the return on investment on the total feed & labour costs compared to an increase in reproductive performance, number of lambs weaned.

This objective was achieved, with most sites demonstrating a positive return on investment through improved reproductive performance and ewe management. Economic data, including gross margins and cost of production, supported financial gains, although returns varied across sites due to seasonal and market fluctuations.

Objective 5: Implement a series of skills and training development activities to increase the knowledge skills and confidence of 75 core and observer producers in ewe nutrition and management.

Objective 5 was achieved for core producers and partially met for observers. While training activities were successfully delivered with strong attendance across 11 workshops and field days, observer engagement was limited due to external factors, and the broader impact could not be fully measured.

Objective 6: Produce a series of demonstration fact sheets and guidelines from the project (6 in total) – for producers to utilise to adopt practices.

This objective was achieved through a set of fact sheets, videos, and four case studies developed for the project. See Appendix 7.5.

Objective 7: 75 per cent of core producers will have adopted scanning to determine litter size to enable precision feeding requirements, and 25% of observers intend to.

Objective 8: 30 % of core producers will have adopted EID technologies in their flock, using the data to inform culling decisions

Objectives 7 and 8 were fully achieved among core producers, with 100% adopting pregnancy scanning for litter size and EID technologies to inform culling decisions. Additional practices such as feeding to body condition score and assessing feed sources were also adopted or intended by most, though mineral profiling saw limited uptake due to cost and uncertainty around its value.

Objective 9: Conduct an annual field day and other activities to showcase the demonstration site results and encourage adoption of key practices by 75 attending producers.

Objective 9 was largely achieved, with annual field days successfully delivered throughout the project and strong attendance at two of the three events, particularly when aligned with broader regional extension activities. While one independently runs event saw lower turnout due to seasonal pressures, a total of 263 participants attended across 13 events, demonstrating effective engagement and showcasing of demonstration site results.

Despite significant challenges such as prolonged dry seasons, cyclone damage and ongoing industry disruption, the project achieved most of its core objectives. Reproductive performance improved significantly at three of four PDS sites, with strong adoption of precision nutrition and EID practices among core producers. Economic and productivity gains were demonstrated. Observer engagement and broader impact were limited but provided valuable insights where data was captured.

3. Demonstration Site Design

3.1 Methodology

3.1.1 Study design and location

The MLA PDS project was established to evaluate the reproductive performance of maiden ewes under commercial conditions across four sites in the Midwest region of Western Australia. These sites were located near Northampton, Chapman Valley and West Binnu.

The participating properties varied in size and faced individual challenges, including differences in labour availability, access to capital investment and cash flow. All operated mixed cropping and sheep enterprises, running commercial Merino flocks which is typical of production systems used by sheep producers in the region.

The project was designed to implement a consistent set of protocols, adapted where necessary to accommodate differences in joining dates and mob sizes. The trial commenced in January 2021 but was temporarily suspended following Cyclone Seroja in April 2021. It recommenced in 2022 with the inclusion of a new site (PDS Site 3) to maintain continuity.

The primary objective was to assess the impact of precision ewe management practices on reproductive efficiency, lamb survival and overall flock productivity. Standardised protocols were based on the ASHEEP Lambing Planner, AWI guidelines, and Lifetime Ewe Management (LTEM) principles. EID technology was implemented at all sites to track individual ewe performance across reproductive, health and nutritional parameters.

The performance of the project was evaluated using a structured set of engagement, productivity, and profitability metrics. Grower engagement was measured through pre- and post-project assessments of producer knowledge, skills and confidence, alongside records of the number and demographics of producers directly and indirectly involved. Practice change was assessed by capturing both intended changes, through surveys and workshop feedback, and actual changes observed or documented on farm. Productivity outcomes included key indicators such as reproductive efficiency (lambs weaned per ewe joined and per ewe scanned), ewe and lamb mortality rates (where available), and greasy fleece weight per head. Profitability was assessed through enterprise, level indicators, including cost of production per kilogram of red meat produced and gross margin per DSE. These metrics collectively provided a comprehensive view of the technical, behavioural, and economic impacts of the Producer Demonstration Site project for the Mid West in WA.

3.1.2 Site specifics

The participating sites: Sandhurst (Northampton), Mt Erin (Chapman Valley), the Greenwood (Northampton), Blackboy Hill (West Binnu), and Mulga Springs (Northampton)—represented a range of enterprise sizes, management systems, and genetic backgrounds. Across the project, 200 to 1042 maiden ewes per site were tracked, with most sites contributing three years of full reproductive data and four years of scanning data. All flocks utilised or adopted EID systems and applied best-practice joining, scanning and nutritional strategies. Average 10-year marking percentages ranged from 98.6% to 115%, highlighting the production potential of Merino systems under commercial conditions when supported by data-driven decision-making and targeted nutrition.

PDS Site 1 Northampton (PDS1):

Sandhurst, located in Northampton WA and managed by Daniel Gill, is a well-established mixed enterprise spanning 1,200 hectares with approximately 1,200 breeding ewes. The operation runs on a 70:30 crop-to-livestock ratio and is strongly focused on genetic improvement, targeting over 100% weaning rates, increased body weights and fine wool production. Involvement in the PDS project began with the selection of 200 maiden ewes, which were tracked over four years of scanning data and three years of full repro data.

Joining occurs in November without teasers, and ewes are scanned for pregnancy and litter size to inform nutrition strategies. The flock, comprising Sandhurst Merino bloodlines, is managed with efficient labour and supported by industry tools and planning resources to enhance productivity and resilience to seasonal pressures. The ten-year average marking percentage was 100%.

PDS Site 2 Chapman Valley (PDS2):

Mt Erin, managed by Jason Stokes in Chapman Valley, WA, is a large-scale mixed enterprise spanning 5,200 hectares with a 60:40 crop-to-livestock ratio and 5,600 breeding ewes. Jason contributed 1042 maiden ewes to the PDS project, which were tracked over four years of scanning data and three years of full repro data. Jason implemented split joining beginning in mid-November (rams in for 21 days, out for 10 and in for 21 days). The enterprise focuses on maximising lamb survival through precision feeding, high-efficiency management, and a strong emphasis on genetics. The flock

comprises Leahim-bloodline Merinos, selected using both Australian Sheep Breeding Values (ASBVs) and visual traits, with artificial insemination (AI) and in-house sire development supporting breeding goals. EID technology has been in place since 2018, with performance data collected on pregnancy status, litter size, lamb weights, fleece characteristics and condition scoring. The ten-year average marking percentage was 98.6%.

PDS Site 3 Northampton (PDS3a):

Deon and Farrah Gould manage a 1,500-hectare mixed cropping and sheep enterprise in Northampton, WA, running approximately 1,000 Merino ewes. As part of the PDS project, in 2021, 400 maiden ewes were tracked over one year, with joining taking place on December 2024. The Goulds' flock is based on Multi-Purpose Merino (MPM) bloodlines and is selected for large frame size and high body weight (BW), using ASBVs to guide ram selection. EID technology was already established on farm prior to the project, enabling efficient individual animal performance tracking. The ten-year average marking percentage for the enterprise was 106%.

Replacement site commenced 2022 October

PDS Site 3 West Binnu (PDS3b)

Lloyd Cripps manages a 3,800-hectare mixed farming enterprise near West Binnu, WA, integrating 2,300 livestock hectares and 1,000 hectares of cropping. As part of the PDS project, Lloyd tracked 287 maiden ewes over two years, joining in mid-December for six weeks. EID technology, adopted through the project, enabled more precise data collection on ewe performance, including pregnancy status, litter size, growth rates, and fleece weight. Lloyd implemented scanning from 2022 and now splits mobs post-scan for targeted feeding. His flock, based on Mulga Springs and homebred Merino lines, is selected using visual traits focused on wool yield, staple strength and growth. Average marking percentage across ten years was 100%.

PDS Site 4 Northampton

Mulga Springs is a 3,212-hectare mixed farming enterprise in Northampton, WA, managed by Jessica Horstman and Chris Hasleby. With a 70:30 crop-to-livestock ratio and approximately 3,500 adult sheep, the operation runs both a commercial Merino flock and a registered stud. The enterprise joined the PDS project, with 200 maiden ewes which were tracked for scanning data for four years and full repro data for three years. A six-week joining period begins on December 24 at a 2.5% ram rate. Pregnancy scanning has been in place for over eight years, and the use of eID technology since 2017, enables detailed tracking of individual ewe performance, including early vs. late lambing, fleece weight, and visual classing outcomes. Ewes are split into single- and twin-bearing mobs at day 90 of pregnancy to tailor nutritional management. Average marking percentage across ten years was 115%.

3.1.3 Ewe and ram selection

All initial trial sites selected a cohort of maiden ewes, between August and October in 2020, for participation within the project. With West Binnu Site 3b selecting ewes for participation in the project in October 2022. The maiden ewes were selected for soundness and breeding suitability using flock profiling data (if available) and visual assessment, to ensure maiden ewes suited the individual breeding objectives of each grower's flock. When assessing ewes initially for selection in the project growers focused on structural soundness, BCS, genetic potential, weight for age, wrinkle score, health and parasite status and black wool.

Table 1: AWI Best Practice Guidelines for Ewe Selection

Selection Criterion	Best Practice Guideline
Structural soundness	Select ewes with correct feet, legs, teeth, and udder conformation; free of structural faults.
Body Condition Score (BCS)	Target BCS 3.0–3.5 at joining to optimise conception and reduce embryonic loss.
Reproductive history	Where available, retain ewes with a consistent lambing history and high lamb survival.
Genetic potential	Prioritise ewes from bloodlines with high ASBVs for reproduction and wool traits.
Wrinkle score	Select ewes with low breech and body wrinkle to reduce flystrike risk and improve lambing.
Temperament	Avoid ewes with excitable or difficult temperaments that hinder handling and flock behaviour.
Health & parasite status	Choose ewes with low worm egg counts (WEC) and no history of chronic health issues.
Weight-for-age	Ensure ewes meet target weight ranges appropriate to their age and breed.

Adapted from Lifetime Ewe Management (AWI, 2021) and Australian Wool Innovation extension resources.

In consecutive years the ewes were culled on reproduction status (dry at scanning), wool traits, BCS and structural soundness. Culling would usually occur after scanning, shearing or at next ewe selection pre-joining.

Rams were selected based on breeding objectives, structural soundness, flock profiling outcomes and low body and breech wrinkle scores as outlined in table 2, AWI Best Practice Guidelines for Ram Selection. Rams were assessed at least 12 weeks pre-joining, to ensure joining success. Workshops on ram soundness were also held to educate growers on key tips to assessing ram health pre breeding.

Table 2: Best Practice Guidelines for Ram Selection

Adapted from AWI

Selection Factor	Best Practice Recommendation
Australian Sheep Breeding Values (ASBVs)	Use ASBVs to select for traits aligned with enterprise goals: growth (e.g. Yearling Weight (YWT), Yearling Clean Fleece Weight (YCFW), worm resistance Worm Egg Count (WEC), fertility Number of Lambs Weaned (NLW), and fat/muscle traits Yearling Fat, Yearling Eye Muscle Depth (YFAT, YEMD).
Index Selection	Select rams using relevant indexes such as Dual Purpose (DP) Dual Purpose Plus (DP+), Merino Production (MP), Merino Production Plus (MP+), Fibre Production (FP), or Fibre Production Plus depending on whether wool, dual-purpose, or maternal traits are prioritised.
Structural Soundness	Visually assess rams for strong feet, legs, backline, and jaw structure to ensure longevity and mating ability.
Wool Quality	Choose rams with bright, white wool free of black spots, appropriate crimp definition, and length for your target micron.

Temperament & Behaviour	Avoid rams with aggressive or overly nervous temperaments to reduce handling issues and improve mating success.
Reproductive Health	Check for two firm, even-sized testicles with no lumps or deformities. Ensure sheath and penis are clean and functional.
Disease Status	Purchase rams from accredited sources free of major diseases (e.g. Brucellosis-free, OJD vaccination status).
Condition Score	Rams should be in Body Condition Score 3–3.5 at joining for optimal mating performance.

Adapted from Australian Wool Innovation extension resources Ram Select and Best Practice Guidelines.

3.1.4 Pre-Joining Preparation

Joining dates varied across sites, ranging from November to January, resulting in autumn lambing to align with the region's milder winters and shorter growing seasons. So, pre-joining preparations began in August each year (12 weeks prior to joining), with ram assessments and pre-joining health checks on ewes and rams. Ewe selection on each site was conducted from breeding objectives, flock profiling, visual assessment and previous years data after year 1 of project, as outlined in ewe selection section.

All ewes were tagged with EID tags to track performance. Assessment of BCS and weights were recorded against each animal via EID with the use of scanner wands, weigh scales and data monitors (trutest) with data exported into excel workbooks. Most of the data collected pre-joining was collected with the assistance of Project managers- Bronwen Bird and Steph Rose. This was important to ensure reliability and consistency of data, to further develop core growers' expertise and to alleviate the extra labour created by collecting data.

At this time the current FOO was assessed on all four sites. Feed plans were created to match BCS, energy requirements and current FOO to ensure ewes and rams were between BCS 3 -3.5 at joining. Maintaining an optimal BCS of approximately 3 for both ewes and rams at the time of joining is crucial for maximising reproductive success. For ewes, a BCS of 3 or higher is associated with increased ovulation rates, higher conception rates and improved lamb survival, as ewes in better condition are more likely to conceive twins and produce lambs with optimal birth weights. Conversely, ewes with a BCS below 2.5 may experience reduced fertility and lower lamb survival rates (Sheep Connect South Australia (n.d.))

Serology testing was conducted during this period if there were concerns about reproductive diseases such as brucellosis. This was undertaken to confirm that all rams were free of brucellosis prior to joining. All test results confirmed negative status across sites that tested.

Approximately eight weeks prior to joining (between September and November), scheduled animal health treatments were carried out for both ewes and rams. These typically included WEC, drenching if required, and preventative fly treatments. Although not a direct objective of the project, ensuring optimal animal health prior to joining was essential to minimise confounding factors that could impact reproductive outcomes and to support overall flock fertility.

FOO and BCS were also assessed at this time to ensure ewes and rams would reach optimal BCS pre-joining.

Ewes were isolated from rams 40 days prior to joining to ensure a clear return to oestrus and to maximise the effectiveness of synchronisation strategies, such as the use of teaser rams. This separation helps reset the reproductive cycle, increasing the likelihood of a more compact and successful joining period.

Teaser wethers were used at site 2 to help synchronise oestrus in ewes prior to joining, due to an early November joining. Standard preparation involved administering testosterone via intramuscular injection approximately 7–10 days before introduction to the ewe flock. Teasers were then introduced 14 days prior to joining at a ratio of 1 per 100 ewes and removed once rams were introduced. This practice aims to stimulate ewes into cycling earlier and more synchronously, thereby tightening the lambing period and improving conception outcomes (NSW DPI, 2022; AWI & Sheep CRC, 2020).

3.1.5 Joining

Of the five sites involved in the project, three adopted a standard 35-day joining period. Site 2 implemented a split joining strategy (21 days in, 10 days out, followed by another 21 days), while Site 3 extended joining to 42 days. For non-split joining periods, 35 day joining period is recommended as it covers two full oestrus cycles to maximise conception rates and maintain a tight lambing window. Ram percentages typically range from 1.5–2% for mature ewes and up to 2.5–3% for maidens or in more challenging conditions (AWI & Sheep CRC, 2020; NSW DPI, 2022). All sites joined ewes and rams within the recommended ram % rates for maidens.

3.1.6 Pregnancy Scanning

Pregnancy scanning was conducted between day 80 -90 after the start of joining to determine each ewe's pregnancy status, litter size and whether conception occurred in the first cycle or the second cycle. Best practice recommends scanning ewes between 80 and 90 days after the start of joining to optimise the accuracy of foetal aging and litter size detection (NSW DPI, 2021). Results were recorded directly against each animal using EID and a Tru-Test monitor connected to the ultrasound scanner. Rebecca Martin of Ewe Scan was engaged to perform scanning across all sites and years, ensuring consistency and data integrity. At the time of scanning, BCS and FOO were also assessed, and rations were developed to match energy demands according to the ewe's stage of pregnancy and litter size. Following scanning, mobs were separated by pregnancy status to enable targeted feeding based on nutritional requirements.

In addition, serology testing was conducted on a subset of ten representative animals per site annually on most sites, to assess the mineral and vitamin status of the flock—critical factors influencing reproductive success and ewe health. The primary objective of the testing was to evaluate key macro and micro-minerals (including calcium, phosphorus, magnesium, zinc, copper, and iron) and essential vitamins such as vitamin A and vitamin E, plus methylmalonic acid (MMA) vitamin B12 deficiency and glutathione peroxidase (GSHPx) to determine whether the existing diet provided adequate nutritional support. This biochemical assessment offered a two-week snapshot of macro nutrient availability in the animals' system and was used alongside feed analysis to guide targeted supplementation strategies.

While a broader panel of biochemical markers was measured, these were not the primary focus of the project and were therefore not reported in detail. Approval for blood sampling was obtained from the Animal Ethics Committee, and all procedures were conducted in accordance with animal welfare standards.

3.1.7 Nutritional Management

Following pregnancy scanning at approximately day 90, ewes were grouped by reproductive status into dry, single and twin-bearing mobs. This enabled a targeted nutrition strategy, with feed rations allocated according to BCS, body weight (BW), FOO, and stage of pregnancy. Supplementation included key macro-minerals—such as calcium (Ca) and magnesium (Mg) and vitamins A, D, and E, to support ewe and foetal health.

Representative samples of hay, stubbles, cereal grains and legumes (including barley, corn rye, wheat, lupins and oats) were submitted to a certified forage laboratory. Analyses included Dry Matter (DM), Crude Protein (CP), Acid and Neutral Detergent Fibre (ADF/NDF), Metabolisable Energy (ME), Water Soluble Carbohydrates (WSC), starch, fat, ash and essential macro-minerals (Ca, P, Mg, Na, K, and S). These values were entered into the UltraMix ration formulation program to create tailored diets specific to each production group. Energy requirements were calculated using guidelines from the Nutrient Requirements of Small Ruminants (NRC, 2007) and Lifetime Ewe Management (AWI & Sheep CRC, 2020). Rations were reviewed and adjusted every ten days to reflect changes in BCS and BW, ensuring consistent nutritional support throughout gestation.

To support on-farm application, producers were provided with a customised Excel-based ration tool. This tool used the on-farm feed inventory to generate a full pregnancy-to-lactation feed budget, adjusting for FOO and calculating the total feed required and estimated supplementation cost. This practical resource enabled producers to plan effectively and manage feed inputs with greater confidence and precision.

3.1.8 Pre-lambing

Pre-lambing ewe management followed best practice protocols as outlined by AWI and LTEM, including targets for BCS, nutrition, parasite control, vaccination and lambing paddock preparation. These protocols are summarised in Table 3: AWI Best Practice Guidelines for Pre-Lambing Management.

Table 3.0 AWI Pre-Lambing Best Practice Guidelines

Category	Recommendation
Body Condition Score (BCS)	Target BCS 3.0–3.3 at lambing for twin-bearing ewes, and BCS 2.7–3.0 for singles to maximise lamb survival and reduce dystocia.
Ewe Separation	Separate ewes based on scanned litter size (singles vs twins) to allow for targeted nutrition.
Nutrition	Increase energy intake during the final 6 weeks of gestation. Twin-bearing ewes may require up to 1.8x maintenance energy. Balance for energy, protein and minerals.
Feed On Offer (FOO)	Aim for 1,200–1,500 kg DM/ha for lambing paddocks to reduce risk of lamb mortality due to chilling/starvation.
Mineral Supplementation	Ensure adequate calcium, magnesium and vitamin ADE to support metabolic function and immune status.
Vaccinations	Administer 5-in-1 or 6-in-1 vaccine (clostridial diseases) 2–4 weeks pre-lambing. Use GlanEry 7-in-1 if also covering for erysipelas.
Worm Management	Perform Worm Egg Count (WEC) and drench if required to reduce parasite burden during lambing.

Category	Recommendation
Sheltered Lambing Paddocks	Allocate paddocks with shelter, low predation risk and good pasture cover. Avoid mob sizes over 400 (singles) and 250 (twins).
Stress Reduction	Avoid unnecessary handling during the final 4 weeks of gestation. Maintain consistent feeding routines.

While mob size was recognised as an important management strategy, maintaining smaller groups proved challenging across the four sites due to paddock size limitations and the demands of dual-purpose cropping systems. Where possible, mob sizes were restricted to a maximum of 400 single-bearing ewes and 150 twin-bearing ewes, in line with best practice guidelines aimed at reducing lamb mismothering and improving survival (Thompson et al., 2012; AWI & Sheep CRC, 2020).

While ewe and lamb mortalities, along with cause of death, were initially identified as key metrics with targets set for measurement throughout the project, consistent and accurate recording at lambing proved impractical across all sites. As a result, mortality data and cause-specific outcomes were not formally captured during the project.

3.1.9 Marking

Lamb marking was carried out approximately eight weeks after the commencement of lambing. Where feasible, ewes were scored for BCS, weighed and FOO was assessed to guide ongoing ration adjustments. Wet/dry assessments were performed to evaluate lactation status. Lambs received standard animal health treatments, including vaccinations and pain relief and were permanently identified with EID tags. Relevant data that was recommended to be collected, included ewe BCS and weights, lamb sex, dry ewe status and treatments, which was to be recorded against individual EIDs, with any visible abnormalities noted for further management.

Data collection varied by site and timing. Site 2, for example, captured individual lamb weights using a lamb weigh crate and recorded lamb sex and health treatments administered, supporting Livestock Production Assurance (LPA) compliance and contributing to the cost-benefit analysis.

However, most sites operated under significant time and labour constraints and were unable to collect the full suite of recommended data without the addition of an extra labour unit. As a result, basic information was prioritised, including the total number of lambs marked per mob and a breakdown of ewe lambs and future wether lambs, ensuring that essential production metrics were still captured for broader flock performance evaluation.

3.1.10 Shepherd collars & parentage

Smartshepherd collars were initially planned for deployment to track maternal performance in twin-bearing mobs, aiming to identify ewes that failed to raise both twins. However, after trialling the collars on two properties, the process proved too complex and time-consuming for effective administration and data collection. Additionally, parentage testing was trialled on one property, but it was deemed too expensive for the return on investment in commercial operations, making it challenging to accurately assess twin-raising performance within the scope of this project. Consequently, underperforming ewes that failed to meet breeding and structural objectives were designated for culling based on alternative performance evaluation methods.

3.1.11 Weaning and post weaning management

Weaning was scheduled between July and August, aligned with best practice guidelines from the AWI & Sheep CRC's LTEM program (2020), which recommend weaning at 12–14 weeks of age or when lambs reach a minimum of 18–20 kg liveweight. In practice, weaning timing varied across sites depending on paddock and fodder availability.

At weaning, producers were encouraged to record lamb numbers, individual weights, and ewe BCS. Lambs received appropriate vaccinations and an effective drench. Ewes were also monitored via WEC and drenched when thresholds were exceeded. Fly preventative treatment was also administered at this time on sites if required. Data collection varied across sites, with some being able to capture detailed individual records, including weight performance comparisons between lambs raised in single versus twin mobs, and others recording just the numbers weaned.

3.1.12 Shearing data

Shearing across the sites occurred at different times of the year and sites were provided with data collection support at this time through extra labour and data capturing equipment. Individual ewe fleece weights each year were captured and monitored over the three-year period, providing valuable metrics to fleece production and wool value for that ewe. Other wool traits like tensile strength, fibre diameter etc were not measured individually as a part of this project, however they were deduced from shearing results.

To enable accurate data collection at shearing, required equipment including an EID wand reader, barcode scanner, barcode printer, load bars, weighing crate or board and monitor, as pictured below at shearing time at Greenwood Farm & Sandhurst Farm. As only two sites initially had access to this setup, Nutrien provided a complete equipment kit for shared use across all sites. In addition, training and a dedicated labour unit were supplied by Nutrien at shearing to assist producers with data capture and ensure consistency across the project. At shearing time on most sites where possible were encouraged to record BCS for ewes.

Image 1. Fleece weighing at Greenwood Farm and Sandhurst.

Post-weaning, maiden ewe fleece weights were assessed at shearing to evaluate productivity outcomes and inform future flock management decisions.

3.1.13 Data collection and recording

Key performance data collected included ewe BCS, BW, expected foetuses, joining and marking percentages, litter size, early versus late conceptions, weaning weights, health treatments, feed usage, ha grazed, DSE and cost of production. This information was used to evaluate reproductive performance, productivity and the return on investment of precision ewe management practices.

3.2Economic analysis

To evaluate the economic impact of the PDS project, both production and cost data were collected from each participating site. Core production metrics included BCS, number of foetuses scanned, ewes joined and scanned pregnant, marking and weaning percentages (from both ewes joined and scanned pregnant), lamb weaning weights, fleece weights and mob classifications (singles vs. twins). Where available, ewe and lamb mortalities were also documented.

A detailed per-head breakdown of direct input costs was also undertaken to support economic evaluation. These included scanning, supplementary feeding and mineral supplementation, EID tags, animal health treatments, and labour associated with body condition scoring and fleece weighing. Additional operational costs such as travel, shearing and crutching, were also included. Feed and supplementation represented the largest expenditure, reflecting the significant cost of maintaining ewe nutrition during pregnancy and lactation. These costs were then used in site-level gross margin and ROI calculations.

Each site received a customised feed budget workbook incorporating results from lab fodder testing, enabling producers to estimate total feed tonnes required and associated costs across the reproductive cycle. This also allowed calculation of feed cost per ewe and per kilogram of lamb produced.

Gross margins were calculated using the formula:

Gross Margin = (Income from lamb and wool sales) – (Direct input costs)

This was assessed per ewe, per hectare, and per DSE for the period 2022–2024. The cost of production per kilogram of liveweight was calculated using prevailing market prices for each year $3.57/kg in 2022, which then declined significantly to $2.00/kg in both 2023 and 2024. This sharp price drop had a substantial impact on ROI, reducing the financial benefit of improved lamb survival and productivity relative to the increased cost of targeted management practices and supplementary feeding.

3.3 Extension and communication

This project targeted sheep producers in Western Australia's Mid-West and Northern Agricultural Region, with a particular focus on mid- to late-stage adopters of pregnancy scanning and precision feeding. Early adopters were also engaged, particularly around the integration of EID for tracking reproduction metrics, informing culling decisions and enabling data-driven feeding strategies.

A communication and extension plan (Appendix 7.4) was developed as part of milestone 1 of this project to outline the intended activities to be delivered to engage with core and observer producers.

Peer-to-peer learning was identified as the most effective method to drive adoption. Accordingly, extension activities were built around on-farm demonstrations, practical workshops, core producer case studies and Q&A sessions. Direct access to industry professionals: veterinarians, researchers, and agronomists, enhanced technical credibility and reinforced messages across different adopter groups.

Across the project, nine on-farm workshops, three annual field days, and one livestock-specific Q&A event were delivered. These sessions were designed to build producer confidence and encourage the adoption of best-practice ewe management. Topics included scanning, pre-lambing, pre-

breeding ram checks, lamb autopsy, eID data collection & Smartshepherd collars, agronomy integration, confinement feeding strategies, split joining, ration formulation, ram and ewe soundness, weaning protocols and pre-joining ram preparation. Presenters included core producers (Jason Stokes, Daniel Gill, & Jessica Horstman), Bronwen Bird (Nutrien), Stephanie Rose (Nutrien), Kelly Gorter, Ken Hart, Nick Ayres, Dr Felicity Wills, Dr Adrian Baker, Dr Bridie Luers (Nutrien), and stock agents Chad Smith, Murray Patterson, and Craig Walker.

3.4Monitoring and evaluation

The monitoring and evaluation process for the PDS project involved the development of a monitoring and evaluation reporting (MER) plan (Appendix 1) at the commencement of the project. This included systematic data collection at each stage of the ewe reproductive cycle to assess both practice change and production outcomes. Data was collected directly from producers and trial sites using EID, survey responses, feed budgeting tools and field observations. Key production metrics included the number of lambs marked per ewe joined, DSE /ha, kg of meat / ha produced, and greasy fleece weight (GFW) per head.

The summary below highlights the key Knowledge, Skills and Aspirations of core and observer growers who participated in the project.

Summary: Knowledge and Skills Survey

This section of the survey explored producer understanding and decision-making around key management practices in sheep enterprises. Key questions growers were asked to answer were as follows.

Pregnancy scanning
Respondents were asked to identify the most valuable outcomes from pregnancy scanning: determining dry ewes, estimating foetal numbers, assessing joining success, and / or informing nutritional strategies.

Feeding and supplementation decisions
Identify what determines the need for summer supplementation while running on stubbles, the question involved assessing FOO, falling ewe BCS, and dry matter levels below 800 kg DM/ha.

Identify what determines the feed sources selected for the supplementation program: including availability of homegrown fodder, energy and protein cost-efficiency, feed safety, labour requirements, and alignment with ewe nutritional needs.

Mineral supplementation
Identify the key reasons for providing minerals pre-lambing were prevent metabolic disorders (particularly on high-phosphorus diets), improve lambing outcomes, and / or enhance feed efficiency.

Pre-lambing mob management
When separating ewes into mobs, producers identify criteria to use from: BCS, body weight, and pregnancy status (singles vs. twins or early/late lambers), and / or mob size limits (≤150 for twins, ≤400 for singles).

Electronic Identification (EID) Use
EID is application was questioned, asking growers to determine where eID application has the most benefits? Is it for tracking reproductive performance, capturing individual animal data (e.g. BCS, BW,

fleece weight), supporting LPA compliance, and / or recording lifetime performance to aid culling and ROI evaluation.

Key Competencies to Implement

To improve flock performance and enterprise profitability, a core set of best-practice competencies were identified. These included the regular use of EID data for reproductive decision-making, conducting comprehensive pre-joining checks (including ram soundness and ewe condition), and adopting pregnancy scanning for both litter size and conception timing. Regular BCS and body weight monitoring was also emphasised as essential for adjusting feeding strategies.

Differentiated feeding for single- and twin-bearing ewes, use of sheltered lambing paddocks with controlled mob sizes, and strategic serology testing to assess mineral status were also highlighted as key competencies. The adoption of smart technology, such as Smart Shepherd collars, was initially encouraged to monitor ewe-lamb interactions and improve lamb survival outcomes, however the labour and time required made this technology not practical to implement on farm, so was not recommended for future adoption for growers participating in this project

Success was benchmarked against the industry standard of 92% lamb marking for Merino flocks, with a target to exceed this percentage across all sites. To assess core and observer producer knowledge, skills, confidence and practice change, pre- and post-project surveys (Appendix 7.2, 7.3) were used, with targets set for at least 7 out of 10 or 70% of producers to demonstrate adoption of key management practices. These included pregnancy scanning (with litter size and conception timing), use of WEC monitoring to inform drenching programs, feeding ewes according to BCS and pregnancy status, and evaluating feed sources alongside mineral profiling to inform supplementation decisions. This mixed-methods M&E approach ensured both quantitative performance outcomes and qualitative behaviour change were captured across the project duration.

4. Results

4.1 Demonstration site results

Across the PDS sites from 2022 to 2024, reproductive performance was measured using key metrics including joining numbers, scanning results (singles, twins, and dries), and the number of foetuses expected.

Table 4.0 Demonstrates repro success across all four sites

Repro at Scanning	***PDS1 2022 Nov***	***PDS1 2023 Nov***	***PDS 1 2024 Nov***	***PDS2 2022 Nov***	***PDS2 2023 Nov***	***PDS 2 2024 Nov***	***PDS 3b 2023 Dec***	***PDS 3b 2024 Dec***	***PDS42022Dec***	***PDS 4 2023 Dec***	***PDS 4 2024 Dec***
Ewes Joined Number	*185*	*143*	***120***	*1085*	*981*	***962***	*287*	***286***	*455*	*428*	***543***

Single Ewes %	*49.19%*	*41.96%*	***40.34%***	*68.94%*	*57.08%*	***48.4%***	*44.25%*	***45.80%***	*61.32%*	*38.79%*	***45.12%***
Twin Ewes %	*24.32%*	*44.76%*	***52.94%***	*19.17%*	*29.97%*	***35.6%***	*51.57%*	***47.55%***	*32.97%*	*57.94%*	***48.02%***
Dries %	*26.49%*	*13.29%*	***7.56%***	*11.89%*	*12.95%*	***16%***	*4.18 %*	***6.64%***	*5.71 %*	*3.27%*	***6.81%***
Number Expected Foetus	*173*	*188*	***174***	*1164*	*1148*	***1150***	*423*	***403***	*579*	*662*	***767***

Over the duration of the project, a total of 5,142 maiden ewes were joined across the five PDS sites. The reproductive data collected over the three years demonstrated notable improvements in key performance indicators including twin conception rates, dry ewe percentages and total reproductive output.

Twin conception rates increased substantially across most sites, reflecting enhanced ewe nutrition and improved pre-joining management practices. Notable results include PDS1 in 2024, where 52.94% of ewes scanned as twin-bearing, PDS4 in 2023 with 57.94%, and PDS3b in 2023 reaching 51.57%. These outcomes demonstrate effective implementation of precision feeding and body BCS management strategies.

Dry ewe percentages showed a consistent decline, indicating improved reproductive success and reduced joining failures. At PDS1, dry rates decreased markedly from 26.49% in 2022 to just 7.56% in 2024. Similarly, PDS4 reported only 3.27% dry ewes in 2023. These reductions highlight the success of targeted ewe selection, health checks and pre-joining condition management.

Single-bearing ewes exhibited variability across sites and seasons; however, positive trends were observed in several locations where a shift from single to twin conceptions was achieved. PDS2 and PDS4 demonstrated this shift, correlating with improved energy and protein provision during the joining period and greater attention to mineral balance.

Across the project, the total number of expected foetuses recorded was 6,628, resulting in an average of 1.29 foetuses per ewe joined. This figure is considered strong for commercial Merino systems and reflects significant gains in reproductive efficiency underpinned by data-driven management interventions.

Table 5.0 Results across sites from scanning to weaning

Results from Scanning to Marking	***PDS1 2022***	***PDS1 2023***	***PDS 1 2024***	***PDS2 2022***	***PDS2 2023***	***PDS2 2024***	***PDS3b 2023***	***PDS3b 2024***	***PDS4 2022***	***PDS4 2023***	***PDS4 2024***
Total Marking % from Ewes Pregnant	*113.2%*	*100.81%*	***122.5%***	*109.4 %*	*101.64%*	***127.39%***	*94.85%*	***85%***	*102.1 %*	*106.5%*	***112.5%***
Total Marking % from Ewes Joined	***83.24%***	***87.41%***	***113.3%***	***96.41 %***	***88.48%***	***111.39%***	***90.88%***	***79.3%***	***96.26 %***	***103.04%***	***105.36%***
Lamb / ewe kg @ $ BW	*$104.01*	*$34.97*	***$45.33***	*$120.46*	*$36.81*	***$46.34***	*$39.08*	***$34.12***	*$120.28*	*$41.21*	***$41.18***
Fleece $ / hd	*$66.42*	*$83.58*	***$61.02***	*$49.47*	*$56.77*	***$46.78***	*$54.98*	***$43.46***	*$71.16*	*$58.74*	***$62.12***
Yearly Income/hd	*$170.43*	*$118.5*	***$106.36***	*$169.93*	*$93.58*	***$93.12***	*$94.05*	***$77.59***	*$191.44*	*$99.95*	***$103.3***
Cost / hd	*$54.51*	*$63.01*	***$76.20***	*$37.42*	*$64.37*	***$79.98***	*$41.80*	***$95.88***	*$40.76*	*$51.12*	***$78.11***
Return	*$115.92*	*$55.54*	***$30.16***	*$132.51*	*$29.20*	***$13.14***	*$52.18*	***$-18.29***	*$150.69*	*$48.83*	***$25.19***

Across the project duration, reproductive performance varied notably between sites and years. Marking percentages from ewes scanned pregnant ranged from a high of 127.39% (PDS4, 2023) to a low of 85% (PDS3, 2024). Most sites maintained or improved marking rates above 100%, meeting project requirements of marking over 92 %, except for PDS3b, which experienced a marked decline in 2024, potentially reflecting reproductive or nutritional stressors.

When assessed by ewes joined, marking percentages improved across all sites by 2024. PDS1, for example, increased to 113.3%, while PDS3b again demonstrated a decline to 79.3%, reinforcing the likelihood of underlying performance challenges at that site.

Lamb production value, expressed as lamb income per ewe, declined across all sites from 2022 to 2024, largely due to the significant drop in the $/kg liveweight market price for lamb. PDS1 dropped from $104.01 per ewe in 2022 to $45.33 in 2024, while PDS3 recorded the lowest lamb income in 2024 at $34.12.

Fleece income per head remained relatively stable, with some minor reductions observed at PDS2 and PDS3b, while PDS4 sustained stronger fleece returns throughout the project. Total yearly income per head peaked at $191.44 in PDS4 (2022), yet both PDS1 and PDS2 showed notable declines in income by 2024.

Cost per head varied significantly across sites, ranging from $37.42 to $95.88. The highest cost was recorded at PDS3b in 2024, which corresponded with its negative return and poor reproductive performance. This was related to extensive supplementary feeding as West Binnu had severely dry conditions. Return per head followed similar trends, with PDS1 declining from $115.92 in 2022 to $29.64 in 2024. PDS3b returned a negative value of -$18.29 in 2024, indicating a loss-making outcome, which may be expected due to supplementary feeding.

In summary, PDS4 consistently demonstrated the strongest economic performance and stability across all measured years. In contrast, PDS3b showed a decline in both reproductive and financial metrics, suggesting site-specific feed cost stressors were at play. These findings highlight the critical impact of ewe condition, precision feeding, timely scanning, and input cost control on reproductive efficiency and overall enterprise profitability.

4.1.1 PDS site 1

Started with 236 maiden ewes in 2021, but the project was suspended until 2022. In 2022, after culling dries and any other visual traits, 185 ewes were joined, and followed for three years. This property had a November joining and the average marking % over the last 10 years, sat at 100%. This property didn't use teasers, which would be considered normal practice for a November joining. This site has used WEC to drive drenching decisions prior to commencement of the project, however they had not used eID, fodder testing or serology testing to determine ration and mineral requirements of ewes. This site had the capacity to run smaller mob sizes, and was able to trail feed, with a mix of barley and lupins three times a week, it also had good quality oaten hay on hand. This property fed a calcium mix when feeding high grain diets.

The extreme heat event in January 2022 severely impacted the repro results for 2022. With an unusually high number of dry ewes noticed at scanning in February.

Table 6. PDS Site 1 Reproduction & Gross Margins

Repro at Scanning	PDS1 2021	PDS1 2022	PDS1 2023	PDS 1 2024	4 yr average
Joining Time	**Nov**	**Nov**	**Nov**	**Nov**	
Ewes Joined Number	236	185	143	120	**171**
Single Ewes %	53.50%	49.2%	42.0%	40.3%	**46%**
Twin Ewes %	30.30%	24.3%	44.8%	52.9%	**38%**

Dries %	15.10%	26.5%	13.3%	7.6%	**16%**	
Number Expected Foetus	269	173	188	174	**201**	
Repro Success	114%	94%	131%	145%	**121%**	
Results from Scanning to Marking		**PDS1 2022**	**PDS1 2023**	**PDS 1 2024**	**3 yr average**	
Marking % from expected foetuses		85.08%	66.49%	78.16%	**77%**	
Scanning to Marking Losses		14.9%	33.5%	21.8%	**23%**	
Total Marking % from Ewes Pregnant		113.20%	100.81%	122.50%	**112%**	
Total Marking % from Ewes Joined		**83.24%**	**87.41%**	**113.30%**	**95%**	
Lamb / ewe kg @ $ BW		$59.44	$34.97	$45.33	**$46.58**	
Fleece $ / hd		$66.42	$83.58	$61.02	**$70.34**	
Yearly Income		$125.85	$ 118.55	$106.36	**$116.92**	
Cost / hd		$54.51	$63.01	$76.20	**$64.57**	
Return		$71.34	$55.54	$30.16	**$52.35**	
Income from Ewes Pregnant						
Total Marking % from Ewes Pregnant		113.20%	100.81%	122.50%	**112%**	
Lamb / ewe kg @ $ BW		$80.68	$40.32	$49.01	**$56.67**	
Fleece $ / hd		$66.42	$83.58	$61.02	**$70.34**	
Yearly Income		$147.10	$123.91	$110.03	**$127.01**	
Cost / hd		$54.51	$63.01	$76.20	**$64.57**	
Return		$92.59	$60.90	$33.83	**$62.44**	
Gross Margin						
DSE Ave 1.8 over year		5.2	9.6	9.6	**8.1**	**DSE**
Kg / HA meat produced		47.4	71.4	77.7	**65.5**	**kg**
Gross Margin %		62.94	48.75	30.28	**47.32%**	

Heat stress can significantly impair ewe reproduction by reducing ovulation and fertilisation rates, compromising embryonic development and decreasing blood flow to the uterus. It also contributes to oxidative stress, suppression of the immune system, and disruptions in progesterone production, which are all critical for maintaining pregnancy (Lu, 2021; Sejian et al., 2018). Ewes bred outside the natural breeding season are particularly vulnerable to these effects (Davies Research Centre, 2021).

Analysis of pregnancy scanning results from 2021, involving the same ewe cohorts at Sites 1 and 2 within the project, revealed notably higher percentages of dry ewes, reduced twin pregnancies, and a decrease in the total number of expected foetuses. These findings underscore the importance of factoring in extreme heat events when evaluating reproductive performance. Therefore, when interpreting project outcomes, it is essential to include the heat stress context to ensure accuracy and clarity.

Table 4 provides a summary of PDS1 reproduction for 2021, 2022, 2023 & 2024 and financial data over three years (2022, 2023, 2024) with the data set average included.

When assessing mob performance, the percentage of twin pregnancies and marking efficiency from ewes joined has improved, and the number of dries has decreased due to culling dry ewes. This has resulted in better reproductive and animal welfare outcomes. Dries have significantly decreased, indicating better fertility management.

The input costs hd for this site included animal health treatments, scanning, shearing / crutching, labour costs, travel costs, eID tag costs, and supplementary feeding costs. Animal health treatments such as vaccines, drenches, which were fairly consistent at $3.80 / hd, scanning costs at $1.05 / hd covered eID capture $0.20, early / late identification $0.20 and scanning costs $0.85. Shearing costs were allocated at award rates for a contracting team at $11.50 / hd. Travel costs / ewe were allocated for scanner distance at $1.81c / ewe and labour costs were allocated for the extra labour unit required for fleece weighing, and eID capture at shearing, scanning, pre-joining at $2.16 / ewe. Supplementary feed costs were determined from feed test conducted, cost of feed on farm and then calculated into a least cost ration, and the cost of ration fed /ewe over the number of days fed. The supplementary feeding cost was the highest cost at $0.34 c/ day /ewe for grain mix and in 2024 feeding for 160 days, cost per ewe $54.40, compared to 2022 & 2023, where due to more FOO being available and the price of commodities were lower feeding was on average 123 days ,and supplementary feeding costs reduced to on average $38 / hd/ewe. Despite better reproduction, financial returns per ewe have fallen, primarily due to increased feeding costs, linked to longer seasonal challenges and the price of raw commodities, coupled with volatile lamb prices, dropping from $3.57 / kg LW to $2 / kg LW. Making it a challenging environment to operate in, where improved animal welfare and production, doesn't guarantee increased profitability.

4.1.2 PDS Site 2

PDS Site 2 also carries out November joining but operates a split joining system and had a ten-year average marking of 98.6%. Jason started in 2021 by joining 1,042 maiden ewes, selected to suit his breeding enterprise and objectives. This site uses teasers in the breeding program to ensure ewes are demonstrating signs of cycling as rams are introduced, which is an essential component of split joining, where ewe performance is measured based on conception in the first cycle. The site also incorporates winter cereal grazing post-lambing and provides a range of supplementary feed options pre- and post-lambing to encourage ewes to remain at the birthing site (AWI & MLA, 2017).

This site demonstrated a positive upward trend in reproductive scanning outcomes over the four-year period, as reflected in Table 7. The percentage of twin-bearing ewes increased significantly, from 4.22% in 2021 to 35.6% in 2024, with a corresponding decline in single-bearing ewes from 83.6% to 48.4%. This shift suggests improved pre-joining / joining management, particularly nutrition, leading to enhanced ovulation and conception rates.

However, dry ewe percentages increased from 5.57% in 2021 to 16% in 2024. This trend may have reflected environmental pressures such as heat stress, and poor seasonal feed availability. Despite this, the overall reproductive success rate (foetuses per ewe joined) increased steadily from 92% in 2021 to 120% in 2024, averaging 115% across the period.

Marking rates from pregnant ewes remained relatively stable, averaging 106% across the three years. Marking from ewes joined also increased from 96.4% in 2022 to 111.4% in 2024, indicating gradual improvement in lamb survival from conception through to marking.

Lamb income per ewe dropped sharply between 2022 and 2024, from $68.83 to $37.54, primarily due to a decline in lamb prices (from $3.57/kg liveweight in 2022 to $2.00/kg in 2023–24). This had a major impact on enterprise profitability, despite stable or slightly improved production performance.

Fleece income remained relatively stable, averaging $51.01/head, providing an important buffer to offset declining lamb returns. However, overall yearly income per head declined, from $118.31 in 2022 to $84.32 in 2024.

Fleece testing at PDS Site 2 incurred a cost of $3.50 per head, and animal health treatments were more comprehensive, costing $9.15 per head, significantly higher than other sites, which reported no fleece testing expenses and only $3.50 per head for animal health. Feed costs also rose markedly over the project period, increasing from $10 per head in 2022 to $50 per head by 2024 due to challenging seasonal conditions. Consequently, total input costs rose from $37.42/head in 2022 to $79.98/head in 2024. This escalation in expenses contributed to a sharp decline in net returns, which dropped from $80.89/head in 2022 to just $4.34/head in 2024.

Gross margin percentage declined from 62.9% in 2022 to 12.6% in 2024, reflecting the combined effects of increased costs and lower market returns. Although meat production per hectare held steady at 140 kg/ha in the final two years, this was insufficient to offset falling income.

Reproductive outcomes at PDS Site 2 showed marked improvement over the project period, particularly in twin conception rates, reflecting the successful adoption of best practice joining and nutritional strategies (AWI & Sheep CRC, 2020). The losses between scanning and marking were the lowest across all sites, due to this site having the highest single ewe average, converting to greater lamb survival. While fleece income remained consistent and provided some financial stability, declining lamb prices and rising input costs substantially reduced overall profitability. To ensure sustainable performance, future efforts should prioritise improving lamb survival post-scanning, particularly among twin-bearing ewes.

Table 7. Site 2 Reproduction data

Repro at Scanning	PDS 2 2021	PDS2 2022	PDS2 2023	PDS 2 2024	4 yr average
Joining Time	**Nov**	**Nov**	**Nov**	**Nov**	
Ewes Joined Number	1042	1085	981	962	**1009**
Single Ewes %	83.59%	68.94%	57.08%	48.40%	**58.1%**
Twin Ewes %	4.22%	19.17%	29.97%	35.60%	**28.2%**
Dries %	5.57%	11.89%	12.95%	16%	**13.6%**
Number Expected Foetus	**959**	1164	1148	1150	**1154**
Repro Success	**92%**	**107%**	**117%**	**120%**	**115%**
Results from Scanning to Marking		PDS2 2022	PDS2 2023	PDS2 2024	3 yr average
Marking % from expected foetuses		89.86%	75.61%	75.48%	**80.3%**
Scanning to Marking Losses		10.14%	24.4%	24.52%	**19.7%**
Total Marking % from Ewes Pregnant		109.40%	101.64%	107.43%	**106%**

Total Marking % from Ewes Joined		**96.41%**	**88.48%**	**111.39%**	**99%**	
Lamb / ewe kg @ $ BW		$68.83	$36.81	$37.54	**$ 47.73**	
Fleece $ / hd		$49.47	$56.77	$46.78	**$ 51.01**	
Yearly Income		$118.31	$93.58	$84.32	**$ 98.74**	
Cost / hd		$37.42	$64.37	$79.98	**$ 60.59**	
Return		$80.89	$29.21	$4.34	**$ 38.15**	
Income from Ewes Pregnant						
Total Marking % from Ewes Pregnant		109.40%	101.64%	107.43%	**106%**	
Lamb / ewe kg @ $ BW		$78.12	$42.28	$44.69	**$ 55.03**	
Fleece $ / hd		$49.47	$56.77	$46.78	**$ 51.01**	
Yearly Income		$127.60	$99.05	$91.47	**$ 106.04**	
Cost / hd		$37.42	$64.37	$79.98	**$ 60.59**	
Return		$90.18	$34.68	$11.49	**$ 45.45**	
Gross Margin						
DSE Ave 1.8 over year		9.6	11.5	10.5	**10.5**	**DSE**
Kg / HA meat produced		178.6	140	140	**152.9**	**kg**
Gross Margin %		62.94	48.75	12.56	**41.4**	**%**

4.1.3 PDS Site 3b

PDS site 3 entered the project in October 2022, and on entry into project implemented eID technologies on farm, and pregnancy scanning. This site tagged 287 maiden ewes to track for the two-year cycle. PDS Site 3 demonstrated consistently strong reproductive scanning outcomes over the two-year assessment period, averaging 144% expected foetuses per ewe joined as outlined in Table 8. Site 3 Reproduction data. This performance was supported by high twin conception rates, averaging 50%, and relatively low dry ewe percentages (5%). These results suggest that joining management, including ewe selection, pre-joining nutrition and the timing of mating, was effective in optimising ovulation and conception rates.

Despite strong scanning performance, lamb survival posed a significant challenge. The marking percentage from expected foetuses dropped from 61.66% in 2023 to just 56.33% in 2024, averaging 59% across the two years. These figures reflect high scanning-to-marking losses—averaging 41%—which likely resulted from mismothering, lamb abandonment, or insufficient shelter and paddock conditions, particularly affecting twin-bearing ewes. The total marking percentage from ewes joined also declined, from 90.88% in 2023 to 79.3% in 2024, indicating that early-life lamb losses materially affected productivity.

Financially, the site's profitability declined sharply across the two years. While fleece income remained relatively stable, averaging $49.22 per head, lamb income fell from $39.08 in 2023 to $34.12 in 2024. This decline was influenced by both reduced lamb survival and a drop in market prices for lamb. Overall yearly income dropped from $94.05 to $77.59 per head. At the same time,

input costs increased dramatically, from $41.80 to $95.88 per head, largely due to higher feed costs increasing from $20 to $75 /hd during the difficult 2024 season.

As a result, the site shifted from a profitable return of $52.25 per head in 2023 to a loss of –$18.29 in 2024. Gross margin performance reflected this decline, falling from 56.3% in 2023 to –19.8% in 2024, with an average of only 18% across the period. Meat production per hectare also declined from 66.4 kg to 57.8 kg, underscoring the combined impact of reduced lamb survival and rising costs.

In summary, PDS Site 3 demonstrated strong reproductive potential through effective joining practices, as evidenced by consistently high scanning results. However, the site faced significant challenges in translating these reproductive gains into marked lambs, underscoring the critical importance of pregnancy scanning not only to identify conception success but also to pinpoint where reproductive losses occur within the system. The primary constraint identified was low lamb survival—particularly among twin-bearing mobs—which contributed to substantial scanning-to-marking losses. Although wool income remained steady, escalating input costs and declining lamb returns ultimately led to negative profitability by 2024. Going forward, strategies should prioritise improving lamb survival, particularly through enhanced lambing paddock management, and focus on cost containment to strengthen the enterprise's resilience under variable seasonal and market conditions (Ferguson et al., 2011).

Table 8. Site 3b Reproduction data

Repro at Scanning	PDS 3b 2023	PDS 3b 2024	2 yr average	
Joining Time	**Dec**	**Dec**	**Dec**	
Ewes Joined Number	287	286	**287**	
Single Ewes %	44.25%	45.80%	**45%**	
Twin Ewes %	51.57%	47.55%	**50%**	
Dries %	4.18%	6.64%	**5%**	
Number Expected Foetus	423	403	**413**	
	147%	141%	**144%**	
Results from Scanning to Marking	**PDS 4 2023**	**PDS 4 2024**	**2 yr average**	
Marking % from expected foetuses	61.66%	56.33%	**59.00%**	
Scanning to Marking Losses	38.34%	43.67%	**41.01%**	
Total Marking % from Ewes Pregnant	94.85%	85%	**110%**	
Total Marking % from Ewes Joined	**90.88%**	**79.3%**	**104%**	
Lamb / ewe kg @ $ BW	$ 39.08	$ 34.12	**$ 36.60**	
Fleece $ / hd	$ 54.98	$ 43.46	**$ 49.22**	
Yearly Income	$ 94.05	$ 77.59	**$ 85.82**	
Cost / hd	$ 41.80	$ 95.88	**$ 68.84**	
Return	$ 52.25	-$ 18.29	**$ 16.98**	
Gross Margin				
DSE Ave 1.8 over year	6.2	5.4	**5.8**	DSE

Kg / HA meat produced	66.4	57.8	**62.1**	KG
Gross Margin %	56.3%	-19.83%	**18%**	%

4.1.4 PDS Site 4

PDS Site 4 commenced participation in the PDS project with a cohort of 355 maiden ewes. Prior to involvement in the project, the site had already been actively collecting production data including pregnancy scanning results, fleece weights and body weights, reflecting a strong baseline commitment to performance monitoring. This site has consistently used a pellet and hay-based ration as the preferred feeding strategy, selected for its nutritional safety and reliability, particularly during critical periods such as late gestation and early lactation.

Over the course of the project, PDS Site 4 demonstrated strong reproductive performance, achieving an average reproductive efficiency of 141%, as measured by foetuses per ewe joined refer to Table 9. Site 4 Reproduction data

Twin conception rates were notably high, peaking at 57.94% in 2023 and maintaining 48.02% in 2024, which reflects the success of pre-joining nutrition, genetic selection and strategic mating management. Single-bearing ewe rates fluctuated, while dry ewe percentages remained low (average 5.3%) but increased slightly in 2024, potentially due to seasonal variability impacting BCS pre-joining.

Despite excellent scanning outcomes, lamb losses between scanning and marking averaged 28%, highlighting a critical challenge in lamb survival. Marking percentages from pregnant ewes averaged 107%, and from ewes joined, 102%, indicating good overall reproductive output but also reinforcing the need for targeted interventions to reduce neonatal loss.

Table 9. Site 4 Reproduction data

Repro at Scanning	PDS 4 2021	PDS 4 2022	PDS 4 2023	PDS 4 2024	3 yr average
Joining Time	**Nov**	**Nov**	**Nov**	**Nov**	
Ewes Joined Number	358	455	428	543	**475**
Single Ewes %	53.35%	61.32%	38.79%	45.12%	**48.4%**
Twin Ewes %	43.85%	32.97%	57.94%	48.02%	**46.3%**
Dries %	2.79%	5.71%	3.27%	6.81%	**5.3%**
Number Expected Foetus	505	579	662	767	**669.33**
Repro Success	141%	127%	155%	141%	141%
Results from Scanning to Marking		PDS 4 2022	PDS 4 2023	PDS 4 2024	3 yr average
Marking % from expected foetuses		75.65%	66.62%	72.88%	72%
Scanning to Marking Losses		24.35%	33.38%	27.12%	28%
Total Marking % from Ewes Pregnant		102.10%	106.50%	112.50%	**107%**

Total Marking % from Ewes Joined	96.26%	103.04%	105.36%	**102%**
Lamb / ewe kg @ $ BW	$ 68.73	$ 41.21	$ 41.18	**$ 50.38**
Fleece $ / hd	$ 71.16	$ 58.74	$ 62.12	**$ 64.01**
Yearly Income	$ 139.89	$ 99.95	$103.30	**$ 114.38**
Cost / hd	$ 40.76	$ 51.12	$ 78.11	**$ 56.66**
Return	$ 99.13	$ 48.83	$ 25.19	**$ 57.72**
Income from Ewes Pregnant				
Total Marking % from Ewes Pregnant	102.10%	106.50%	112.50%	**107%**
Lamb / ewe kg @ $ BW	$ 72.90	$42.6	$44.18	**$ 53.23**
Fleece $ / hd	$ 71.16	$58.7	$62.12	**$ 64.01**
Yearly Income	$ 144.06	$101.34	$06.31	**$ 117.24**
Cost / hd	$ 40.76	$ 51.12	$ 78.11	**$ 56.66**
Return	$ 103.30	$ 50.22	$ 28.20	**$ 60.58**
Gross Margin				
DSE Ave 1.8 over year	5.5	4.8	5.8	**5.4**
Kg / HA meat produced	58.4	58.8	74.5	**63.9**
Gross Margin %	71.7	49.56	26.53	**49.3**

Economically, the site averaged $114.38 in annual income per ewe, supported by stable fleece income ($64.01/head) and variable lamb returns influenced by fluctuating market prices. Costs increased over time, reaching $78.11/head in 2024, resulting in a decreased net return of $25.19/head. These costs included animal health treatments, scanning, shearing / crutching, labour costs, travel costs, eID tag costs, and supplementary feeding costs, supplementary feeding costs being the most variable and the largest impactor to costs /hd. Animal health treatments such as vaccines, drenches, which were fairly consistent at $3.80 / hd, scanning costs at $1.05 / hd covered eID capture $0.20, early / late identification $0.20 and scanning costs $0.85. Shearing costs were allocated at award rates for a contracting team, and applied evenly across the project at $11 / hd. Travel costs / ewe were allocated for scanner distance at $.40 c / ewe and labour costs were allocated for the extra labour unit required for fleece weighing, and eID capture at shearing, scanning, pre-joining , where supplementary feed costs were determined from cost of ration fed /ewe over the number of days fed . The supplementary feeding cost was the highest cost at $0.51 c/ day /ewe for pellets and in 2024 feeding for 80 days severely impacted gross margin. Gross margin percentages declined across the project (from 71.7% to 26.53%), despite improved meat production per hectare, due to the increased supplementary feed costs and decrease in market prices for lamb.

In summary, PDS Site 4 leveraged its strong data collection systems and consistent feeding strategy to deliver excellent reproductive performance. However, to improve profitability, future efforts should prioritise reducing scanning-to-marking lamb losses and enhancing cost efficiency, particularly in variable seasonal and market conditions.

By the project's conclusion:

- Improved lamb survival and ewe performance were demonstrated across four core sites in alignment with AWI, LTEM and ASHEEP guidelines.
  - *Achieved*
- A cost-benefit analysis was conducted, comparing feed and labour costs against reproductive outcomes and lambs weaned.
  - *Achieved*
- Six practical fact sheets and technical guides were developed for broader producer use.
  - *Achieved*
- The goal of building nutrition and management knowledge among 75 core and observer producers was only partially met, due to external challenges including seasonal pressures and limited observer engagement.
  - *Not fully achieved on average 18 attendees at workshops*

Despite challenges in achieving full observer engagement, the project achieved its primary outcomes: demonstrating increased lamb survival and productivity, delivering economic analysis tools, and developing technical resources for broader adoption.

4.2 Economic analysis

The economic evaluation of the PDS project (2022–2024) was based on key engagement, productivity and profitability metrics across four demonstration sites. Improvements in reproductive efficiency were observed, notably increased twin conception rates and reduced dry ewe percentages. For example, PDS1 achieved 52.94% twin-bearing ewes in 2024, while PDS2 consistently increased foetal numbers, reflecting the benefits of precision feeding and sound joining practices.

However, scanning-to-marking losses remained a constraint, particularly at PDS3b, where lamb survival averaged only 59%, largely due to mismothering and suboptimal lambing paddock conditions. While fleece income remained steady ($49–$70/hd) and helped buffer declining lamb prices, overall profitability was heavily influenced by external market pressures. Lamb prices fell from $3.57/kg liveweight in 2022 to $2.00/kg in 2023–2024, causing lamb income per ewe to decline—PDS3 reporting just $34.12 in 2024.

Rising input costs, especially for feed (increasing from $10/hd to over $75/hd), also impacted returns, with some sites, like PDS3b, experiencing negative returns in 2024. Gross margins varied: PDS4 maintained strong profitability (>49% average gross margin), while PDS3b fell to –19.83%. After implementation of the project, it became apparent that measuring ewes mothering ability didn't prove to be cost effective for the return on investment. It was noted that assessing flock mineral status annually, which costs approximately $1,100 per mob (10 ewes), was not cost effective when compared to feed testing, which averages just $67 + GST per test.

Testing feed sources and formulating rations to correct known deficiencies of feed on hand proved to be a more efficient and economical approach. Across all sites, the average marking percentage from scanned ewes improved from 99.6% (2022) to 111.8% (2024), and from joined ewes, from 91.7% to 102.3%. With an average stocking rate of 6.95 DSE/ha and 89.08 kg/ha of meat produced, the average gross profit was $57.73/hd or $401.22/ha. These results confirm that increasing lambs weaned per ewe improves profitability—but only when lamb survival and input costs are well-managed. Moving forward, greater emphasis should be placed on reducing early lamb losses and

optimising feed efficiency to enhance enterprise resilience under variable seasonal and market conditions.

4.3 Extension and communication

As per the project communication plan (Appendix 7.4), a series of on farm workshops were planned to develop observer grower knowledge, skills and encourage growers to adopt best practices. To increase lamb survival and increase number of lambs weaned per ewe unit.

The seven best practice principles below were the core focus of the workshops, designed to build knowledge and skills among both core and observer producers throughout the project.

a) Maintain pre-joining ewe Body Condition Score (BCS) of 3 to optimise lamb survival.
Ewes with a BCS of 3 at joining have improved conception rates and lamb survival outcomes (Lifetimewool, 2007; Ferguson et al., 2011).

b) Conduct ram and ewe health checks at least eight weeks prior to joining.
Pre-joining health checks improve reproductive efficiency and reduce risk of failed matings (AWI & MLA, 2017; McCulloch, 2015).

c) Scan for litter size and early/late conceptions to allocate feed appropriately and manage mob sizes (≤150 for twins, ≤400 for singles).
Scanning for litter size and conception timing enables precision feeding and mob management to maximise survival (AWI, 2020; Ferguson et al., 2011).

d) Feed to match BCS, pregnancy status, and Feed On Offer (FOO) to maximise returns.
Feeding strategies aligned with BCS, and pregnancy stage improve reproductive outcomes and productivity (NRC, 2007; AWI & Sheep CRC, 2020).

e) Monitor WEC (Worm Egg Count) to inform timely drenching and reduce lambing losses.
WEC monitoring is a key strategy in controlling parasites and preventing production losses (Meat & Livestock Australia, 2022; Suter et al., 2011).

f) Use EID to track reproductive performance, fleece weights and BCS for strategic culling.
EID enables individual animal tracking for better management decisions and flock profitability (Barnett & Behrendt, 2016; AWI, 2021).

g) Test feed and minerals to create cost-effective rations that meet nutritional needs.
Feed and mineral testing supports formulation of balanced, cost-effective rations to meet ewe requirements (Robertson & Kearney, 2015; NRC, 2007).

The first workshop of the PDS project was held on-farm at PDS Site 3a, hosted by Deon and Farrah Gould at their property on Tuesday, 23 March 2021, from 8:00 - 11:00 AM. The session was designed to facilitate peer-to-peer learning through a series of practical producer-led discussions. Key topics included pregnancy scanning practices presented by producer Jason Stokes, considerations for mob size at lambing shared by hosts Deon and Farrah Gould, and nutritional strategies for pre-lambing, delivered by Bronwen Fowler from Nutrien. The workshop was attended by 18 producers and provided an interactive platform for discussion around best-practice ewe management, with a strong focus on applying local, data-driven insights.

The second workshop was conducted on farm at Daniel Gill's property on 23 August 2021. This session centred on hands-on learning and featured a practical demonstration on pre-joining ram assessments. Participants were actively involved in evaluating ram soundness, with a focus on the

five T's: teeth, toes, testicles, torso, and temperament. Presentations were delivered by Dr Bridie Luers and Bronwen Bird, who provided guidance on identifying key reproductive indicators and potential issues affecting ram fertility. Attendance was lower than anticipated, with 10 producers present, largely due to ongoing recovery efforts following recent cyclone damage in the region. Despite this, the workshop provided valuable technical knowledge and practical skills relevant to joining preparation

The third workshop was held at Mt Erin on Monday, 28 March 2022, and was well attended with 17 participants. The session focused on confinement feeding, nutrition, and animal health management. Jason Stokes, the host producer, led a Q&A discussion, sharing insights into the practical application of confinement systems on his property. Bronwen Bird from Nutrien Ag Solutions presented key considerations for setting up and managing confinement, including infrastructure, timing, and animal welfare. Adrian Baker from Raw Animal Health provided a technical overview of ration formulation and animal health strategies for sheep in confinement. The workshop facilitated knowledge sharing among producers and delivered practical strategies for maintaining ewe condition and performance during feed-limited periods.

The fourth PDS workshop was held on Tuesday 28th June 2022 at the Nutrien Ag Solutions branch in Geraldton and was attended by 20 producers. The workshop focused on improving lamb survival and identifying on-farm mortality risks. Key presentations included an interactive lamb autopsy session delivered by Ken Hart of Ewetopia Consulting, which provided practical insights into identifying causes of lamb mortality. Izzy Drage from the Department of Primary Industries and Regional Development (DPIRD) presented on biosecurity measures and the risks associated with exotic animal diseases. Bronwen Bird from Nutrien Ag Solutions provided an overview of embryonic losses and delivered updates on the ongoing PDS trial outcomes. The session offered attendees a combination of hands-on learning and technical updates to support improved reproductive performance and animal health outcomes on farm.

The fifth PDS workshop was held on Friday, 11th November 2022 at Lloyd Cripps' property, located on Binnu West Road. This open gate demonstration focused on the practical application of EID technology. Tagging of 300 ewes occurred with electronic tags and the use of Tru-Test equipment to scan, record weights and assess body condition scores. The demonstration showcased tools including a Prattley weigh crate, Tru-Test scanning wand, and scale head. The session provided a hands-on opportunity for producers to understand the value of EID in tracking individual ewe performance and improving data-driven flock management. Unfortunately, due to timing, it was poorly attended with only one grower attending.

The sixth PDS workshop was held on Monday, 3rd April 2023 at Nutrien Ag Solutions in Northampton. "Grazing Opportunity Workshop," the event focused on optimising and improving grazing strategies to enhance feed value for livestock and support integrated cropping-livestock systems. Key topics included improved grazing management in mixed enterprises, pain relief protocols, and the application of EID in sheep production. Presentations were delivered by: Nick Eyers (Greenough Specialty Ag) on improved grazing in mixed enterprises, Pete Beard (Dechra) covering pain relief in livestock, and Steph Rose (Nutrien Ag Solutions), who led a brief revisit on EID implementation. The workshop also featured a producer-led open discussion on experiences with legume and improved pastures, providing valuable peer-to-peer insights. A light lunch and refreshments were provided, and the session was well attended, fostering meaningful dialogue around practical strategies for boosting productivity and animal welfare.

The seventh workshop, titled "A Whole Systems Approach," was held on 13 March 2024 from 2:30 pm to 5:00 pm and was attended by 13 participants. Hosted in collaboration with core producer

Jason Stokes and his agronomist, the session focused on the integration of livestock and cropping systems through a holistic management lens. Discussions centred on Jason's approach to balancing feed production, grazing pressure and animal performance within the broader context of his mixed enterprise. The workshop provided practical insights into system-wide decision-making, highlighting the importance of aligning agronomic planning with livestock nutritional demands and production goals. This event strengthened the knowledge exchange between producers and advisors and reinforced the value of integrated whole-farm management strategies.

The eighth workshop, "Livestock Update," held on Wednesday, 12 June 2024, at the local hotel from 4:30 pm to 6:00 pm, was attended by 17 participants. The session was designed to provide crucial updates and guidance for producers facing a volatile livestock market. Chad Smith from Chamies Livestock delivered a market overview, discussing recent price trends, supply dynamics, and buyer behaviour. Bronwen Bird from Nutrien Ag Solutions presented updated weaning protocols, offering strategies to maintain lamb health and performance in challenging seasonal conditions. The event encouraged peer discussion and knowledge exchange and was well received by attendees seeking clarity and confidence in their livestock management decisions during an unpredictable time.

The ninth workshop, titled "Assessing Ewes & Rams for Repro Success", was held at Mulga Springs, Northampton WA, on Thursday 15th August 2024. The session was attended by 10 participants and focused on practical, hands-on learning to support best-practice reproductive management ahead of joining. Led by Dr Felicity Wills from Coopers Animal Health, the workshop provided participants with veterinary insight into pre-joining assessments for both rams and ewes, covering key factors such as body condition scoring, reproductive soundness, and preventative health strategies.

Participants were also given a guided tour of the newly constructed shearing shed at Mulga Springs, with a Q&A session led by host producer Jessica Horstman, who discussed the shed's design and operational benefits. This session reinforced the importance of pre-joining preparation and infrastructure planning in improving reproductive efficiency and labour efficiency across sheep enterprises.

In addition to workshops, three annual field days and a combined WALRC day were participated in.

WALRC day in 2021 visited Mulga Springs, where an update of the project was facilitated by Andrew Ritchie, and a demonstration of the smart shepherd collars was provided by Kelly Gorter of KG Livestock services. Over 50 people attended this event, and plenty of discussions were engaged in with our core PDS growers.

Annual Field Day in 2022 saw Steph Rose and Caitlin Farrel from Nutrien, provide an update of projects results year to date, at the Northern Agri Group, attended by over 50 growers.

"Livestock Q&A: Current Market Outlooks and Least Cost Rations," was held at the Nabawa Tavern in September 2023 and attracted 19 attendees. The event provided timely insights into market trends and cost-effective feeding strategies, supporting producers navigating ongoing economic pressures in the livestock industry. The agenda included a market outlook and open Q&A session delivered by Craig Walker, Livestock Agent at Midwest Agribusiness, followed by a session on least cost ration development led by Bronwen Bird from Nutrien Ag Solutions. The workshop concluded with a brief data update from the PDS project, summarising key findings from the 2022–2023 period. The session promoted practical discussion and helped strengthen grower confidence in an uncertain market with live export ban being topical

The final PDS Field Day, titled "It's a Wrap", was held on Monday, 21st October 2024, at the Nabawa Tavern and was attended by 19 participants. This concluding event brought together producers,

industry professionals, and service providers to reflect on the outcomes of the three-year MLA-funded project, *Precision Feeding of Ewes to Increase Lamb Survival*. The field day featured a comprehensive review of project insights and key take-home messages. A highlight of the session was a Q&A panel discussion featuring a diverse panel of stakeholders including:

- Rob Campbell – Nutrien Agronomy
- Llyod Cripps – PDS Grower, West Binnu
- Craig Walker / Chad Smith – Midwest Livestock Team
- Bronwen Bird – Nutrien Nutritionist and PDS Project Facilitator

Additional insights were shared by PDS core producers Daniel Gill, Jess Horstman, and Jason Stokes, who provided reflections on implementation challenges, management changes, and productivity outcomes across their respective sites.

This capstone event reinforced the value of peer-to-peer learning and evidence-based decision-making, summarising the project's contributions to improved lamb survival, precision ewe management, and enhanced economic returns for WA sheep enterprises.

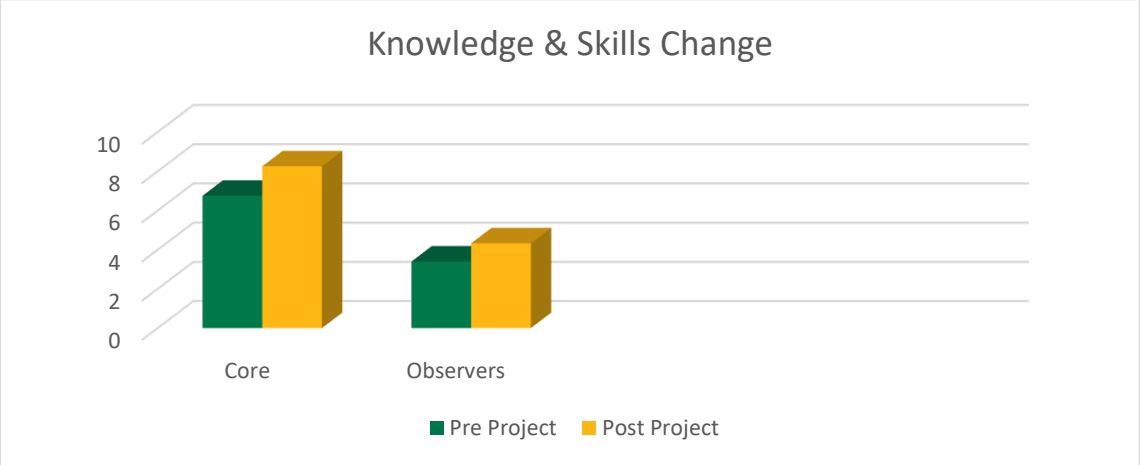
In addition to these workshops and field days, a set for producer fact sheets, videos and case studies (Appendix 7.5) have been created to demonstrate the seven key messages for growers to increase their knowledge set and adopt practice change.

4.4 Monitoring and evaluation

The PDS project aimed to support improvements in lamb survival, animal welfare, and long-term commercial sustainability within mixed-enterprise systems. Grower practice change was assessed across four categories: those who implemented change during the project, those intending to implement, those with no intention to change, and those who had already adopted the practices prior to project commencement.

Pre- and post-project evaluations were conducted through surveys completed by core and observer producers. A total of seven post-project surveys were returned (four core and three observer), while nine pre-project surveys were completed at the commencement of the project.

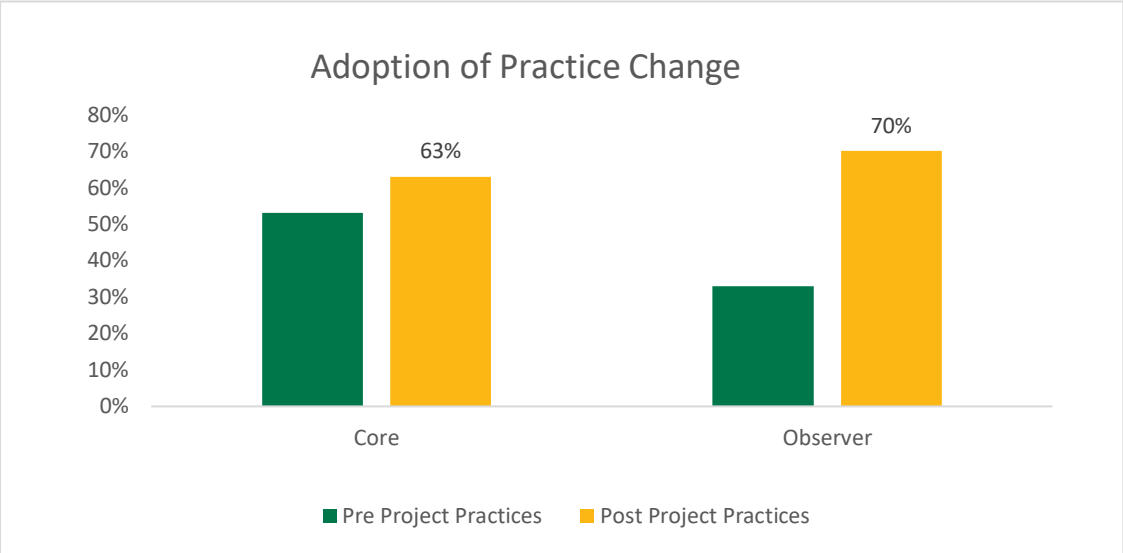
Figure 1 Core & Observers Knowledge and Skills Change Pre and Post Project



Despite the value delivered through workshops and practical demonstrations, collecting comprehensive grower feedback via surveys proved challenging. Survey response rates were low, limiting the ability to fully quantify shifts in knowledge, confidence, and practice adoption across the

broader cohort. Barriers included time constraints during peak operational periods, survey fatigue, and varying levels of Despite the value delivered through workshops and practical demonstrations, collecting comprehensive grower feedback via surveys proved challenging. Survey response rates were low, limiting the ability to fully quantify shifts in knowledge, confidence, and practice adoption across the broader cohort. Barriers included time constraints during peak operational periods, survey fatigue, and varying levels of digital engagement.

Figure 2 Adoption of Practice Change Core and Observers



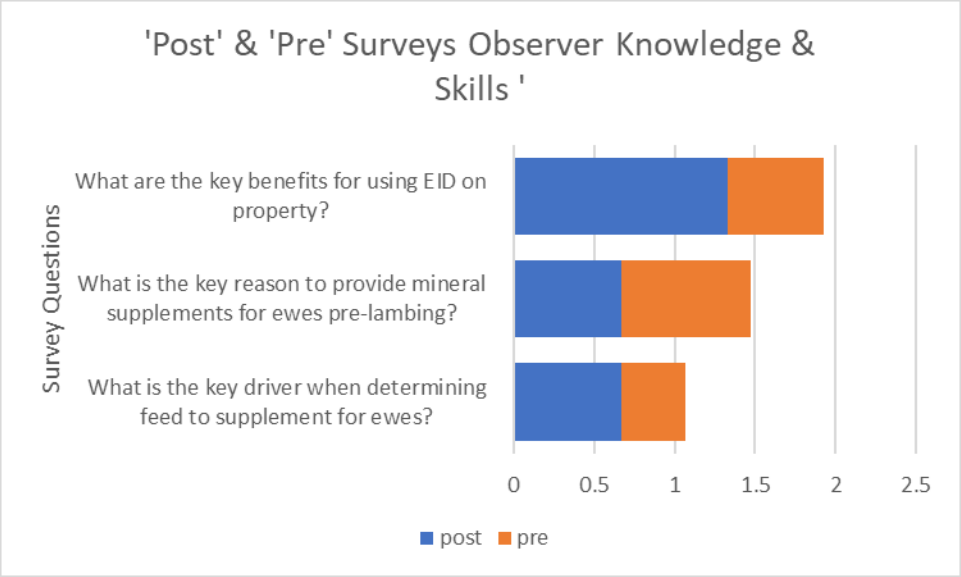
Survey results demonstrated in figure 1, showed that among core producers, there was a 22% increase in knowledge and confidence, with scores rising from 6.75 to 8.25 out of a possible 16 points. Observer producers showed a 27% improvement, increasing from 3.4 - to 4.33, out of a possible 16 points. The low scores are reflective of the poor survey design where in some cases it was unclear to participants, to select all correct answers that apply.

In terms of practice change, demonstrated in figure 2, core producers reported an 18.8% increase in adoption of practices aimed at lifting lambs weaned per ewe unit (from 53% to 63%), while observer producers demonstrated a 112% increase, rising from 33% to 70%. This shift reflects strong intent to implement and transition toward best-practice management across both groups.

Observer producers demonstrated strong intent to implement several key best-practice management strategies. Notably, 100% of observers reported they either had implemented or intended to implement the following: EID for flock performance tracking, pregnancy scanning, mineral supplementation programs three months prior to lambing, and mob size recommendations (≤150 for twins and ≤400 for singles). These outcomes reflect strong alignment with the core objectives of the PDS project.

Adoption intent was lower in more advanced or resource-intensive practices. For instance, only 33% of observers indicated plans to conduct fodder testing to design balanced rations, with 67% having no intention to adopt. Similarly, the use of Smart Shepherd collars and serology testing for mineral status were considered low priority, with just 33% of observers indicating any intention to adopt. Time limitations were the most frequently cited barrier to adoption, noted by 56% of observers.

Figure 3 Post & Pre Observer Knowledge and Skills



In terms of knowledge gains, demonstrated in Figure 3, observer producers reported a 40% increase in understanding the benefits of EID and a 20% increase in understanding key drivers for feed selection when supplementing ewes. However, further support is needed to improve comprehension around the importance of mineral supplementation when feeding high-grain diets as 33 % are still unsure of the purpose of providing mineral supplementation

The increase in knowledge and practice change among core producers was more modest compared to observers, largely due to the baseline capacity and early adoption status of participating sites. Two of the four core PDS sites had already implemented several key best-practice strategies prior to the commencement of the project. As a result, their reported gains reflect refinement and optimisation of existing practices rather than the introduction of entirely new approaches. This prior engagement in practices such as pregnancy scanning, EID use, and targeted feeding explains the smaller percentage increase in knowledge and skills recorded during the project period. However, the core producers demonstrated an increase in their knowledge of assessing stubbles, assessing feed sources to choose for ewe supplementation, the importance of mob size and the benefits of eID. Like the observer group there was still a misunderstanding of the importance of Ca on high grain diets.

PDS site 3b indicated that they had no intention of testing fodder or testing minerals as they are unsure of the benefits and get their grain tested at harvest. There is still some grower growth and understanding to develop around developing least cost rations. This is also highlighted in the observer responses on their confidence to create rations with survey responses indicating a decrease in confidence since pre project surveys with observers reporting a confidence of 5 out of ten at their post project surveys compared to the start of project where they scored 6.2 out of ten. Core growers have reported an increase in confidence of developing rations from 5.5 to 8.25 out of ten. All growers ranked the project on assisting with building their knowledge and skills and assisting in building their confidence, the average of these scores were 6.9 and 6.8 out of ten.

Feedback from core producers engaged in the PDS project indicated a strong shift towards adopting more targeted and data-informed breeding practices. One producer noted that their enterprise remains predominantly focused on breeding rather than finishing lambs, and the tools trialled during the project, particularly pregnancy scanning and tailored feeding, have reinforced that model. As a result, they now regularly pregnancy scan and feed ewes according to their reproductive status, improving condition management across different ewe classes.

There was also growing consideration for refining reproductive efficiency. Producers expressed interest in culling dry ewes based on scanning data and delaying weaning to enable faster lamb growth where appropriate. The integration of weight monitoring using EID has allowed for the tracking of animal performance against pasture types, enhancing feed allocation decisions.

Mob size was consistently highlighted as a critical factor influencing lamb survival. One producer acknowledged its significance and indicated they would adapt mob size thresholds seasonally to optimise outcomes. Importantly, the project revealed that previous feeding strategies were often under-delivering on nutritional needs; several producers reported an increase in feeding costs per head, but this was viewed as necessary to meet production targets. Despite improved management inputs, some noted that lamb marking and weaning rates remained steady, suggesting external seasonal factors also play a significant role.

These insights highlight the practical adjustments core producers are making because of the project, particularly in aligning feeding strategies with scanning outcomes and leveraging EID data to inform breeding and management decisions.

Workshop participation also fluctuated over the project. Attendance was heavily influenced by seasonal workloads, weather conditions, and competing priorities, particularly in cropping-dominant regions where livestock-focused events were sometimes deprioritised. While engagement from core producers remained consistent, reaching a broader audience beyond directly involved sites was more difficult and required carefully timed delivery around key decision-making periods.

Overall, the PDS project delivered strong value and satisfaction to participants, with both ratings averaging 8.14 out of 10. A majority (71%) indicated they would recommend other producers get involved in MLA's PDS program, while the remaining 29% were unsure, highlighting opportunities for refinement. Participant feedback underscored the program's practical benefits, particularly in enhancing understanding and management of eID, ewe nutrition, and seasonal decision-making. While the program was praised for being well-managed and well-supported, some noted that data collection was time-consuming and labour-intensive, suggesting future iterations should aim for simpler, more focused project designs. Overall, the PDS was seen as a valuable initiative that contributed meaningfully to improved ewe management, even if full adoption of its features was sometimes constrained by time, labour, and seasonal variability.

5. Conclusion

The MLA PDS project, "Increasing the Number of Lambs Weaned per Ewe Unit," demonstrated that strategic reproductive management and precision nutrition significantly improve lamb survival, ewe productivity, and enterprise profitability in Merino flocks in Western Australia's Midwest region.

Across the four core sites, targeted interventions such as pregnancy scanning (for litter size and foetal age), BCS monitoring, feed testing, and tailored supplementation programs led to measurable improvements in lamb marking percentages and overall gross margins. The average marking percentage from ewes scanned increased from 99.6% in 2022 to 111.8% in 2024, while the gross profit averaged $57.73 per head and $401.22 per hectare.

While economic benefits were evident, results were variable between sites, with profitability closely tied to feed availability, market volatility, and management intensity. Three out of four sites saw improvements in lamb survival and economic return, though one site experienced negative returns in 2024 due to climatic and input cost challenges.

Extension activities, including nine workshops, three field days, and a producer Q&A event, were well-attended and provided valuable opportunities for hands-on learning. However, collecting comprehensive survey feedback and achieving consistent observer engagement proved difficult. Factors such as time constraints, labour shortages, and survey fatigue limited the quantitative measurement of practice change beyond the core producer group.

Despite these challenges, this project successfully demonstrated that adopting a few high-impact practices namely pregnancy scanning, feeding to production status, BCS monitoring and strategic use of eID can lead to significant improvements in lamb survival and enterprise resilience.

5.1 Key Findings

- Reproductive improvement: Marking percentages from ewes scanned increased by 12.3% on average over the project, with three sites exceeding the industry benchmark of 92%.
- Economic benefit: Gross margins averaged $401.22/ha with an average gross profit of $57.73/hd. Sites with greater adoption of best practices saw the highest returns.
- eID adoption: 100% of core producers used eID to inform reproductive and culling decisions; 100% of observer producers intend to adopt eID systems.
- Practice change: Core producers showed an 18.8% increase in adoption of best practices. Observers reported a 112% increase in intended practice change.
- Key constraints: Labour intensity, seasonal pressures, and market volatility limited the consistency of implementation and wider grower participation.
- Knowledge gains: Observer producers showed a 55% increase in knowledge around weaning more lambs per ewe unit. Core producers increased knowledge by 22%, with many already implementing practices pre-project.

5.2 Benefits to industry

The PDS project provided significant benefits to the sheep industry through practical, on-farm learning opportunities. Through workshops, Q&A sessions and live demonstrations, the project facilitated peer-to-peer knowledge exchange, enabling producers to observe, question, and implement best-practice strategies tailored to their enterprise needs. These activities promoted the adoption of improved animal welfare practices, enhanced productivity, and greater resilience to market and seasonal pressures.

Several key outcomes were identified throughout the project that directly benefit growers:

- Pregnancy scanning enabled producers to optimise feeding strategies, paddock allocation, mob size, and marketing decisions, particularly during challenging seasonal conditions.
- eID technology allowed for precise tracking of individual animal performance, supporting more informed decisions around culling, reproduction, and flock management.
- Sustainable production practices were promoted through maintaining lamb output with fewer ewes, helping to alleviate grazing and water pressure on the land.
- Profitability gains were realised through increases in gross margin per DSE, even during a period of lamb price volatility and rising input costs.

The conclusion of the project coincided with growing uncertainty in the WA sheep industry, largely due to the impending phase-out of live exports by 2030. This context highlighted the urgency for producers to adopt best-practice tools and techniques such as precision feeding, pregnancy

scanning, and eID performance monitoring as a means of adapting to future industry conditions and policy changes.

Looking ahead, the adoption of practices demonstrated in the PDS is expected to offer the following strategic benefits for the industry as it adjusts to a post-live export environment:

- Maximising returns through domestic processing – Implementing targeted finishing strategies to produce heavier, higher-quality lambs for the domestic market.
- Reducing overstocking risks – Using scanning and feeding data to efficiently manage surplus stock, preventing overgrazing and preserving ground cover.
- Building more resilient flocks – Leveraging eID technologies and data-driven decision-making to enhance flock productivity and adaptability to seasonal and market fluctuations.
- Efficiency – Lowering overall feed and labour costs while sustaining production through better allocation of resources and more precise nutritional planning.

By integrating these practices, producers will be better positioned to adapt to structural changes in the market in preparation for 2028, to maintain profitability, and ensure the long-term viability of their operations.

5.3 Challenges and reflection

The project faced several significant challenges that impacted its delivery and outcomes:

- Cyclone Seroja (2021) damaged infrastructure and delayed the project start.
- Prolonged heatwaves (2022) affected reproductive performance.
- Labour shortages, data consistency issues, and an overly complex project scope.
- Broader industry pressures, including uncertainty around live export and regulatory changes such as mandatory eID.

The project design proved too complex, with too many variables measured simultaneously. This created difficulties in maintaining consistent engagement from core growers and reliable data collection. It became evident that future PDS projects, would benefit from a narrower focus on a few high-impact, easy-to-implement metrics, such as:

- Pregnancy scanning for litter size and foetal age
- Ewe BCS at joining, scanning and pre-lambing
- Maintaining separate mob sizes for singles and twins
- Assessing food on offer (FOO), feed testing to determine energy/protein supply and develop tailored rations to match production status and BCS

These four practices directly influence lamb survival, ease of management, and economic outcomes. They are also relatively easy to implement and scale across enterprises, supporting broader adoption.

While core producers contributed strongly and provided strong support, several factors limited consistent participation from observer producers. As a result, only three observer surveys were completed, making it difficult to assess broader practice change across the wider group.

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7. Appendix

7.1 Monitoring, evaluation & reporting plan

MER Plan: Producer Demonstration Sites

Project name __Increasing the Number of lambs weaned per ewe unit _L.PDS.2107_____

Date: 19/2/2021_____

Evaluation level [1]	**Generic Performance Measures (example)**	**Project Performance Measures** *(Please fill in and delete example)*	**Evaluation Methods** *(Please fill in and delete example)*
Inputs – What did we do? *Describe the planned and expected inputs involved in your project*, including *funds, resources, development & projects structures*	• Number of core producers involved in demonstration sites & their demographics • Number of producers observing demonstration sites & their demographics • Number of head of livestock involved • Area (ha) involved • Project steering committee decisions and notes • Investments ($'s) from MLA and other parties (cash and	• **4 Core Producers PDS sites**: **PDS site 1** has 225 maiden ewes to follow for 3 yrs– joining on the 14th of Dec- Northampton- Average marking % over the last 10 yr 100% **PDS site 2** has 1044 maiden ewes to follow for 3 yrs– joining on the 11th of Nov (carrying out split joining)- Northampton- Average marking % over the last 10 yr 98.6% **PDS site 3** has 424 maiden ewes to follow for 3 yrs- joining on the 24th of Dec- Northampton- Average marking % over the last 10 yr 106% **PDS site 4** has 209 maiden ewes to follow for 3 yrs- joining on the 6th of Jan- - Northampton- Average marking % over the last 10 yr 115%	• Pre Grower Surveys • Pre- Core producer Surveys • Baseline Data Questions from Producers • Invoices • PDS project balance sheet • PDS Data record book

	in-kind contributions) and what was purchased – professional time, project inputs	• 16 Observer Producers • Total sheep 47440 • Ha 42496	
Outputs - What did we do? *Describe the outputs planned/expected from your project, including engagement activities & products from demonstration sites*	• Outputs from demonstration sites (new knowledge & data) (e.g. reproduction rate, weaning rate, mortality rate, gender, management methods, cost of vaccine, extra labour and cost of production) • Field days held, demographics collected, and M&E conducted • Media events/outputs	By December 2023, in the Midwest region of Western Australia: • 4 core producers' sites of different sizes and different joining times, will demonstrate and assess the potential increase in lamb survival and reproductive performance of ewes, when adhering to best practice management techniques as set out in AWI, Lifetime Wool, and Asheep, following maidens over a 3-yr period focusing on: o Achieving BCS 3 – 3.5 pre-joining & pre- lambing BCS for the 3 consecutive years of the project o Increasing the reproductive rate (measured by pregnancy scanning for litter size & foetal aging), o Increasing the number of lambs marked and number of lambs weaned o Measuring lambs weaned / ewe unit joined & measuring lambs weaned / ewe unit scanned pregnant. • Assess the effect of precision feeding on ewe fleece weights, and tensile strength using Electronic Identification Device technologies and wool test reports.	• Pre core and observer Surveys • PDS project balance sheet • PDS Data record book • Increase in number of lambs weaned • Ewe cost analysis • ROI • Mortality Rate • Attendance at Workshops • Views of fact sheets / videos Measuring and recording: • ewe mortalities at lambing • dystocia and metabolic based disorders • Wool cut and tensile strength • Gross margins • DSE • Measuring COP

		• Assess the general health of animals provided with balanced diet- BSC, WEC, marking weight & mineral status. • Conduct a cost benefit analysis to determine the return on investment on the total feed & labour costs compared to an increase in reproductive performance, number or lambs weaned. • Implement a series of skills and training development activities to increase the knowledge skills and confidence of 75 core and observer producers in ewe nutrition and management. • Produce a series of demonstration fact sheets and guidelines from the project (6 in total) – for producers to utilise to adopt practices. • Conduct producer experience webinars to share learning from Project • Conduct an annual field day and other activities to showcase the demonstration site results and encourage adoption of key practices by 75 attending producers.	• Measuring ROI
Changes in knowledge, attitudes and skills - How well did we do it? *Describe the changes in KASA that you are planning to achieve*.	• Change in knowledge/attitudes/skills of **core and observer** participants before and after project/activity • Experience of producers involved in the PDS – extent to which they found the	• Four PDS sites participating in the project currently scan for litter size, BCS and feed accordingly, with one currently also scanning for foetal aging. All four PDS are of different sizes and have different physical, and labour resources available, which provides a good cross section of the sheep producers in the area. • Increase knowledge, skills and the need to implement management practices including:	• Pre core and observer Surveys • Workshop and field day Surveys

	project/ activity useful or of value.	○ scanning to determine days of pregnancy to balance rations ○ early mineral supplementation to prevent metabolic disorders and drive production ○ implementing rigid animal health program, vaccines etc when run in confinement for precision feeding requirements ○ determining BCS pre-joining to improve reproduction ○ maintaining a BCS, to ensure most cost-effective feeding strategy ○ testing fodder to assist in balancing ration and creating a least cost ration C/Mj ○ Using WEC to determine drenching thresholds, to keep animal health treatments effective and cost efficient ○ measuring data – fleece weights, Number of foetus expected, number of foetus raised, amount of feed / hd to determine ewe's profitability, to aid in culling decisions.	
Practice changes – Has it changed what people do? *Describe the practice changes that you are expecting to achieve*	• Producer (core & observer) practice (relevant to the topic/project) before and after project • Influence the project had on practice change achieved	• 75 per cent of core producers will have adopted scanning to determine litter size to enable precision feeding requirements and 25% of observers intend to. • 30 % of core producers will have adopted EID technologies in their flock, using the data to inform culling decisions **Measured by 12 out of the 16 core producers:**	• Pre core and observer Surveys • Workshop and field day Surveys

by the end of your project		• Producers preg scanning, early/ late, & litter size every year • Producers utilizing WEC monitoring, to determine worm thresholds • Producers feeding to BCS & production status • Producers using EID technologies to assist in assessing ewe performance & informing culling strategies • Producers assessing feed sources and mineral profiling to determine supplementation requirements and providing adequate nutrition	
Benefits – Is anyone better off? *Describe the benefits that you are expecting to achieve as a result of the project*	• Benefits / impacts from practice change (e.g. $ value of decreased mortality rate compared to baseline) • Costs to achieve outcomes (e.g. increased inputs, labour) • Benefit Cost and Sensitivity analyses at the business level	• At least a 5 % Increase in number of lambs marked over the PDS individual 10 yr average marking % PDS1- 100%, PDS2- 98.6%, & PDS3- 106%, & PDS4 115% • A 5 % decrease in ewe mortalities at lambing & decrease in lamb carcases found at lambing compared to other mobs run on PDS properties, for the three years • A 10 % decrease in dystocia and metabolic based disorders at lambing. • A 5 % Increase in KG/ hd wool cut & Increase in tensile strength from previous data • 5 % Increase in gross margin / DSE from previous data • 5 % Decrease in cost of production /kg red meat from previous data	• Increase in number of lambs weaned • Benefit cost analysis • ROI • Mortality Rate • Workshop and field day Surveys

		• Increase on ROI when using informed culling techniques	
General observations / outcomes – Is the industry better off?	• Potential impacts (practice change & productivity) at the end of the project and well after the project has concluded (e.g. 2 years later) for the broader target audience • What are the unintended/unexpected benefits or consequences? • Project learnings, barriers / enablers to adoption	• An increase in the number of lambs weaned, allows for flock mob growth, and or harsher culling to improve genetic potential, • Allows for transparency in industry, showing best practice to increase animal health and well-being, by reducing incidence of disease and mortalities • Wider industry adoption of EID to increase flock productivity, and improve overall, record / data management • Use EID data to demonstrate the difference in productivity within a flock from the highest performers i.e. high wool producing, continually raising 2 lambs to the lowest performers, lower fleece weights, scan pregnant but fail to raise, and putting a dollar value on this data • Increasing overall animal health, by taking more measurements, and ensuring nutritional status is being met to decrease mortalities and disease • Capital cost of EID technologies to set up, can be seen as a barrier for the late adopters, which will impact grower uptake, provides an opportunity for growers to co-invest in data management gear / or hire out • Labour / time required for EID data set up and management can be seen as a barrier for adopters, without appropriate support and training provided, provides an opportunity for professionals in this space to upskill, and provide support to growers	• Steering committee survey question to measure 'What are the unintended/unexpected benefits or consequences? And Project learnings, barriers / enablers to adoption' • PDS project balance sheet • Applicability of findings to other areas • Post project surveys

		• Testing fodder, can also be a useful tool to look at current cropping management practices / varieties etc, and make informed decisions to drive production • Regular WEC to determine internal parasite thresholds, will not only decrease costs /hd, but also decrease drench resistance risks on property • Allows growers in a crop focussed location to show case what can be achieved in livestock enterprises, and provides support and a network to other livestock growers, improving on social and emotional well being	

7.2 Pre-project survey template

7.2.1 Core pre-project survey template

MLA Producer Demonstration Sites

Pre-project Survey - Core Participants

PDS Name: *Increasing number of lambs weaned per ewe unit*

PDS Project Code: *L.PDS.2107*

The following questions are used to determine your level of understanding of *[insert topic]*. The knowledge and skills audit are used at the start and completion of the program to allow individuals to track their skill development and adoption of new practices. It will also be used:

1. To improve the content of future project meetings; and
2. As part of the evaluation process for the project

The information will be completely confidential, and individuals will not be identified in the analysis of data.

Participant Name: _____

Date: / /

MLA may contact me to further assess the impact of their programs? ☐ Yes ☐ No

MLA may send me newsletters and inform me of future events? ☐ Yes ☐ No

I have read, understood and accept the terms of MLA's "PDS Participant Consent & Release" (see appendix 1) ☐ Yes ☐ No

Participant Signature: -

_____

Section A – Demographic Information

A1. Your contact details

a. Property name _____

b. Business / trading name_____

c. Property address_____

d. Postal address _____

e. Email address _____

f. Phone _____

g. Mobile _____

A2. What area do you manage? *(please write the number of hectares that you managed)*

a. Hectares_____

A3. What numbers of livestock do you run? *(please write the number of head against each of the categories of livestock that you run)*

a. Number of beef breeders_____

b. Number of cattle turned off per year_____

c. Total number of cattle_____

d. Number of ewes_____

e. Number of lambs turned off per year_____

f. Total number of sheep_____

g. Number of goats turned off per year_____

h. Other_____

Section B – Knowledge and Skills *(If you do not know, please select the 'Unsure' option)*

B1. From your perspective, what is the most important information received from pregnancy scanning? *(Tick the box that applies)*

a. Determine number of dry sheep……..☐

b. Determine Number of Foetuses expected…….☐

c. Determine joining success……☐

d. Determine pregnancy status to manage ewe nutritional requirements……☐

e. It's not necessary, the information received is not cost effective……☐

B2. How would you determine when it's time to start supplementary feeding ewes in Summer running on stubbles ?*(Tick the box that applies)*

a. Assessing FOO, after grains and green shoots fall below critical thresholds……..☐

b. After end of January once stubbles are eaten out……☐

c. When BCS of ewes begins to decline……☐

d. When Dry matter/ ha falls below 800 kg DM /Ha……☐

e. Unsure……☐

B3. What is the key driver when determining feed to supplement for ewes? *(Tick the box that applies)*

a. Home grown fodder on hand……☐

b. Cost c/mj of energy & $ / kg protein of feed source……☐

c. Safest complete feed, least labour required……☐

d. Least labour intense feed……☐

e. Protein , energy, fibre and starch requirements of ewes……☐

f. Other……☐

B4. What is the key reason to provide mineral supplements for ewes pre-lambing? *(Tick the answer that applies)*

a. Prevent metabolic disorders on high P diets……☐

b. Increase number of lambs weaned……☐

c. Improve feed efficiency……☐

d. Unsure……☐

B5. If separating ewes into mobs pre-lambing what criteria would you use?

(Tick all the answers that apply to you)

a. BCS ……☐

b. Mob size, twins 150 -singles 400 max……☐

c. BW……☐

d. Singles & Twins , Early & Late……☐

e. Unsure

B6. What are the key benefits for using EID on property? *(Tick the answer that applies)*

a. Track a ewe's reproductive performance over a breeding season ……☐

b. Record individual traits against a ewe like BCS, BW, FLCW,……☐

c. Record animal health treatments etc which assists in LPA compliance……☐

d. Record lifetime data against a ewe to allow for drafting, culling, determining ROI / ewe……☐

e. Unsure / Other……. ☐

B7. Have you attended a lifetime Ewe Management course? *(Tick the answer that applies)*

a. Yes ☐

b. No ☐

Section C – Confidence and Practices

C1 How confident are you in making nutritional rations and understanding nutrient requirements for your ewes through their reproductive cycles?

(please rate out of 10, with 1 being poor and 10 being very good, by circling your choice below)

1 2 3 4 5 6 7 8 9 10

Poor Excellent

C2 Do you currently use the following practices?

	Normal practice	Sometimes	Rarely	Never	Not Applicable
Using EID information to make informed decisions regarding reproductive viability of a ewe and culling strategies for mob					
Carry out 12 week pre-joining checks- Ram Soundness, 5 t's, BCS & BW					
Regularly BCS & BW					
Start mineral Ca, Mag etc 3 months prior to lambing					
Feed single and twins a different ration, increasing to match production requirements and FOO					
Provide sheltered lambing paddocks and mobs sizes over 150 twins and under 400 singles					
Use smart shepherd collars for assessing twins raised					
Collect serology to test mineral status in ewes					

C3 For the key metrics you are seeking to demonstrate in this PDS, please advise what is your current performance

Metric	**Current performance**
Reproductive Efficiency- Number of foetus expected from ewes joined	
Reproductive Efficiency- % Lambs marked from ewes Joined	
Reproductive Efficiency- % Lambs weaned from ewes Joined	
Mortality rate ewes mid pregnancy weaning %	
% Dystocia assisted births	
% Metabolic Disorders in lambing mobs	
Lamb mortality rate from birth until weaning %	
Cost of Production ($/kg)	
Dry Sheep Equivalent (DSE) / ha	

7.2.2 Observer pre-project survey template

MLA Producer Demonstration Sites

Pre-project Survey - Observers

PDS Name Increasing Number of Lambs Weaned / Ewe Unit through Precision Feeding

PDS Project Code LPDS 2107

The following questions are used to determine your level of understanding of *[insert topic]*. The knowledge and skills audit are used at the start and completion of the program to allow individuals to track their skill development and adoption of new practices. It will also be used:

3. To improve the content of future project meetings; and
4. As part of the evaluation process for the project

The information will be completely confidential, and individuals will not be identified in the analysis of data.

Name: -

_____

Date: / /

MLA may contact me to further assess the impact of their programs? ☐ Yes ☐ No

MLA may send me newsletters and inform me of future events? ☐ Yes ☐ No

Section A – Demographic Information

A1. Your contact details

a. Property name .....

b. Business / trading name .....

c. Property address.....

d. Postal address.....

e. Email address.....

f. Phone.....

g. Mobile.....

A2. What area do you manage? *(please write the number of hectares that you managed)*

a. Hectares.....

A3. What numbers of livestock do you run? *(please write the number of head against each of the categories of livestock that you run)*

a. Number of beef breeders .....

b. Number of cattle turned off per year .....

c. Total number of cattle .....

d. Number of ewes .....

e. Number of lambs turned off per year .....

f. Total number of sheep .....

g. Number of goats turned off per year .....

h. Other.....

Section B – Knowledge and Skills (If you do not know, please select the 'Unsure' option)

B3. From your perspective, what is the most important information received from pregnancy scanning? *(Tick those that apply)*

a. Determine number of dry sheep ..... o

b. Determine Number of Foetuses expected..... o

c. Determine joining success ..... o

d. Determine pregnancy status to manage ewe nutritional requirements ..... o

e. It's not necessary, the information received is not cost effective ..... o

B4. WEC are useful when monitoring Worm Burdens to : *(Tick all that apply)*

a. To prevent drench resistance.....o

b. To carry out 10 day drench check tests on farm ..... o

c. To determine critical thresholds when to drench ..... o

d. Not relevant for my area ..... o

e. Unsure..... o

B5. How would you determine when a maiden ewe is ready to join? *(Tick the answer that applies to you)*

a. Liveweight ..... o

b. Over 8 months of age..... o

c. Condition score of 3.0..... o

d. Second oestrus cycle ..... o

e. Unsure..... o

B6. How would you determine when it's time to start supplementary feeding ewes in Summer running on stubbles? *(Tick the answer that applies to you)*

a. Assessing FOO, after grains and green shoots fall below critical thresholds..... o

b. After end of January once stubbles are eaten out..... o

c. When BCS of ewes begins to decline ..... o

d. When Dry matter/ ha falls below 800 kg DM /Ha ..... o

e. Unsure..... o

B5. What is the key driver when determining feed to supplement for ewes? *(Tick the answer that applies to you)*

a. Home grown fodder on hand..... o

b. Cost c/mj of energy & $ / kg protein of feed source ..... o

c. Safest complete feed, least labour required..... o

d. Least labour intense feed..... o

e. Protein , energy, fibre and starch requirements of ewes…… o

f. Other ..... o

B6. What is the key reason to provide mineral supplements for ewes pre-lambing? *(Tick the answer that applies to you)*

a. Prevent metabolic disorders on high P diets ..... o

b. Increase number of lambs weaned..... o

c. Improve feed efficiency ..... o

d. Unsure ..... o

B7. What are the key benefits for using EID on property? *(Tick the answer that applies to you)*

a. Track a ewe's reproductive performance over a breeding season..... o

b. Record individual traits against a ewe like BCS, BW, FLCW, ... o

c. Record animal health treatments etc which assists in LPA compliance ..... o

d. Record lifetime data against a ewe to allow for drafting, culling, determining ROI / ewe o

e. Unsure / Other ..... o

B8. What are the key concerns for using EID on property? *(Tick the answer that applies to you)*

a. Cost of capital investment in purchasing EID gear..... o

b. Lack of IT support ..... o

c. Too much data to collect, increases work load ..... o

d. Lack of data management support ..... o

e. Unsure about ROI for initial investment ..... o

f. Unsure / Other ..... o

Section C – Confidence and Practices

C1 How confident are you in *determining rations for ewes to meet the nutritional requirements throughout their production cycle?*

(please rate out of 10, with 1 being poor and 10 being very good, by circling your choice below)

1 2 3 4 5 6 7 8 9 10

Poor Excellent

C2 Do you currently use the following practices?

	Normal practice	Sometimes	Rarely	Never	Not Applicable
Using EID information to make informed decisions regarding reproductive					

viability of a ewe and culling strategies for mob					
Carry out 12 week pre-joining checks- Ram Soundness, 5 t's, BCS & BW					
Carry out Pre-joining animal health treatments- rams 8 weeks prior- Multimin rams, booster vaccination Check WEC					
Isolate Rams and Ewes 40 days pre-joining, BCS, BW *Gives ewes pre-joining multlimin, check WEC*					
Use teasers pre-joining					
Flush with lupins 7 days prior to mating and continue for 7 days whilst mating has begun 750g					
Vaccinate for Campylobacter joining at joining BCS, BW					
Preg Scaning for Multiples, early and late					
Pre-Lambing Activities, vaccinations, drench, etc (max. 6 weeks prior)					
Regularly BCS & BW					
Start mineral Ca, Mag etc 3 months prior to lambing					
Separate mobs into twins and singles at scanning time					
Feed single and twins a different ration, increasing every 10 days to match production requirements and FOO					
Provide sheltered lambing paddocks and mobs sizes					

over 150 twins and under 400 singles					
Record Mortalities, difficulties and remove carcases from paddocks at lambing					
Mulesing (breech modification) at marking time					
Use of pain relief, at marking time					
Vaccinate at marking for clostridials, Arthitritis, OJD, Scabby mouth					
Record marking weights of lambs at marking time with EID tech					
Use smart shepherd collars for assessing twins raised					
Test Fodder to design rations,					
Collect serology to test mineral status in ewes					
Collate data to determine top achievers, cost /hd, & ROI					

C3 For the key metrics you are seeking to demonstrate in this PDS, please advise what is your current performance

Metric	**Current performance**
Reproductive Efficiency- Number of foetus expected from ewes joined	
Reproductive Efficiency- % Lambs marked from ewes Joined	
Reproductive Efficiency- % Lambs weaned from ewes Joined	
Mortality rate ewes mid pregnancy weaning %	
% Dystocia assisted births	

% Metabolic Disorders in lambing mobs	
Lamb mortality rate from birth until weaning %	
Cost of Production ($/kg)	
Dry Sheep Equivalent (DSE) / ha	

7.3 Post-project survey template

Post-Project Survey – {Core/Observer} Participants

PDS Project Code: *L.PDS.2107* **PDS Project Name :** *Precision Feeding Ewes to Increase to Number of Lambs Weaned*

The following questions are used to determine your level of understanding of *[insert topic]* following your participation in the above producer demonstration site project. The knowledge and skills survey are used at the start and completion of the program to allow individuals to track their skill development and adoption of new practices. The information will be used as part of the evaluation process for the project and MLA's PDS program. The information will be completely confidential, and individuals will not be identified in the analysis of data.

Participant Name: _____

Company/Business Name: _____

Section A - Your thoughts on the PDS

Please rate each of the questions below out of 10 (where 1 is negative and 10 is positive)

A1. Overall, how **satisfied** are you with this PDS? _____/10

A2. How **valuable** was this PDS in assisting you manage your livestock enterprise? _____/10

Please tick your response and provide short answer responses for the below questions

A3. Would you **recommend** MLA's PDS program to others? ☐ Yes ☐ No ☐ Not Sure

_____

_____

_____

_____

A4. Please provide any feedback to help us improve the PDS program:

_____

_____

_____

_____

Section B – Knowledge and Skills (If you do not know, please select the 'Unsure' option)

B1. Overall, how well has this PDS project increased your knowledge of Increasing number of lambs weaned per ewe unit

Please rate out of 10 by marking your choice below, 1 = No Increase, 10 = very large increase

1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

B2. Overall, how well has this PDS project increased your skills Increasing number of lambs weaned per ewe unit

Please rate out of 10 by marking your choice below, 1 = No Increase, 10 = very large increase

1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

B3. From your perspective, what is the most important information received from pregnancy scanning? *(Tick the box that applies)*

a. Determine number of dry sheep ..... o

b. Determine Number of Foetuses expected..... o

c. Determine joining success ..... o

d. Determine pregnancy status to manage ewe nutritional requirements ..... o

e. It's not necessary, the information received is not cost effective ..... o

B4. How would you determine when it's time to start supplementary feeding ewes in Summer running on stubbles ?*(Tick the box that applies)*

a. Assessing FOO, after grains and green shoots fall below critical thresholds..... o

b. After end of January once stubbles are eaten out..... o

c. When BCS of ewes begins to decline ..... o

d. When Dry matter/ ha falls below 800 kg DM /Ha ..... o

e. Unsure..... o

B5. What is the key driver when determining feed to supplement for ewes? *(Tick the box that applies)*

a. Home grown fodder on hand..... o

b. Cost c/mj of energy & $ / kg protein of feed source ..... o

c. Safest complete feed, least labour required..... o

d. Least labour intense feed..... o

e. Protein , energy, fibre and starch requirements of ewes..... o

f. Other..... .o

B6. What is the key reason to provide mineral supplements for ewes pre-lambing? *(Tick the answer that applies)*

a. Prevent metabolic disorders on high P diets ..... o

b. Increase number of lambs weaned ..... o

c. Improve feed efficiency..... o

d. Unsure..... o

B7. If separating ewes into mobs pre-lambing what criteria would you use? ***(Tick all the answers that apply to you)***

a. BCS ..... o

b. Mob size, twins 150 -singles 400 max..... o

c. BW..... o

d. Singles & Twins , Early & Late..... o

e. Unsure..... o

B8. What are the key benefits for using EID on property? *(Tick the answer that applies)*

a. Track a ewe's reproductive performance over a breeding season..... o

b. Record individual traits against a ewe like BCS, BW, FLCW,..... o

c. Record animal health treatments etc which assists in LPA compliance ..... o

d. Record lifetime data against a ewe to allow for drafting, culling, determining ROI / ewe o

e. Unsure / Other ..... o

B9. Have you attended a lifetime Ewe Management course? *(Tick the answer that applies)*

a. Yes ..... o

b. No ..... o

Section C – Confidence and Practices

C1 How confident are you in making nutritional rations and understanding nutrient requirements for your ewes through their reproductive cycles?

Please rate out of 10 by marking your choice below, 1 = Not at all confident, 5 = somewhat confidence, 10 = very confident

1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

C2 As result of participating in this PDS have you adopted any of the following practices relevant to [Insert Topic]:

Practices	Practice Implemented?	Indicate on what % of your enterprise this practice has been adopted	Frequency of use? (if not adopted leave blank)

<table>
<tr><td></td><td></td><td>(if not adopted leave blank)</td><td></td></tr>
<tr><td rowspan="2">Using EID information to make informed decisions regarding reproductive viability of a ewe and culling strategies for mob
Carry out 12 week pre-joining checks- Ram Soundness, 5 t's, BCS & BW</td><td>☐ Yes, practice implemented
☐ I intend to implement
☐ No, I have no intentions to
☐ Adopted prior to PDS
☐ Not applicable</td><td>☐ Less than 25%
☐ Between 25% - 50%
☐ 50%
☐ Between 50% - 75%
☐ Greater than 75%
☐ 100%</td><td>☐ Normal Practice
☐ Sometime
☐ Rarely</td></tr>
<tr><td colspan="3">What are the reasons you have not implemented this practice on your property?
☐ Not a significant issue on my property ☐ Lack of confidence ☐ Lack of skills
☐ Limited funds ☐ Limited time ☐ Other (please specify)</td></tr>
<tr><td rowspan="2">Preg Scaning for Multiples, early and late Regularly BCS & BW</td><td>☐ Yes, practice implemented
☐ I intend to implement
☐ No, I have no intentions to
☐ Adopted prior to PDS
☐ Not applicable</td><td>☐ Less than 25%
☐ Between 25% - 50%
☐ 50%
☐ Between 50% - 75%
☐ Greater than 75%
☐ 100%</td><td>☐ Normal Practice
☐ Sometime
☐ Rarely</td></tr>
<tr><td colspan="3">What are the reasons you have not implemented this practice on your property?
¨ Not a significant issue on my property ¨ Lack of confidence ¨ Lack of skills
¨ Limited funds ¨ Limited time ¨ Other (please specify)</td></tr>
<tr><td rowspan="2">Start mineral Ca, Mag etc 3 months prior to lambing</td><td>☐ Yes, practice implemented
☐ I intend to implement
☐ No, I have no intentions to
☐ Adopted prior to PDS
☒ Not applicable</td><td>☐ Less than 25%
☐ Between 25% - 50%
☐ 50%
☐ Between 50% - 75%
☐ Greater than 75%
☐ 100%</td><td>☐ Normal Practice
☐ Sometime
☐ Rarely</td></tr>
<tr><td colspan="3">What are the reasons you have not implemented this practice on your property?
¨ Not a significant issue on my property ¨ Lack of confidence ¨ Lack of skills
¨ Limited funds ¨ Limited time ¨ Other (please specify)</td></tr>
</table>

Separate mobs into twins and singles at scanning time	☐ Yes, practice implemented ☐ I intend to implement ☐ No, I have no intentions to ☐ Adopted prior to PDS ☐ Not applicable	☐ Less than 25% ☐ Between 25% - 50% ☐ 50% ☐ Between 50% - 75% ☐ Greater than 75% ☐ 100%	☐ Normal Practice ☐ Sometime ☐ Rarely
	What are the reasons you have not implemented this practice on your property? ¨ Not a significant issue on my property ¨ Lack of confidence ¨ Lack of skills ¨ Limited funds ¨ Limited time ¨ Other (please specify)		
Feed single and twins a different ration, increasing to match production requirements and FOO	☐ Yes, practice implemented ☐ I intend to implement ☐ No, I have no intentions to ☐ Adopted prior to PDS ☐ Not applicable	☐ Less than 25% ☐ Between 25% - 50% ☐ 50% ☐ Between 50% - 75% ☐ Greater than 75% ☐ 100%	☐ Normal Practice ☐ Sometime ☐ Rarely
	What are the reasons you have not implemented this practice on your property? ¨ Not a significant issue on my property ¨ Lack of confidence ¨ Lack of skills ¨ Limited funds ¨ Limited time ¨ Other (please specify)		
Provide sheltered lambing paddocks and mobs sizes over 150 twins and under 400 singles	☐ Yes, practice implemented ☐ I intend to implement ☐ No, I have no intentions to ☐ Adopted prior to PDS ☐ Not applicable	☐ Less than 25% ☐ Between 25% - 50% ☐ 50% ☐ Between 50% - 75% ☐ Greater than 75% ☐ 100%	☐ Normal Practice ☐ Sometime ☐ Rarely
	What are the reasons you have not implemented this practice on your property? ¨ Not a significant issue on my property ¨ Lack of confidence ¨ Lack of skills		

	¨ Limited funds ¨ Limited time ¨ Other (please specify)		
Use smart shepherd collars for assessing twins raised	☐ Yes, practice implemented ☐ I intend to implement ☐ No, I have no intentions to ☐ Adopted prior to PDS ☐ Not applicable	☐ Less than 25% ☐ Between 25% - 50% ☐ 50% ☐ Between 50% - 75% ☐ Greater than 75% ☐ 100%	☐ Normal Practice ☐ Sometime ☐ Rarely
	What are the reasons you have not implemented this practice on your property? ¨ Not a significant issue on my property ¨ Lack of confidence ¨ Lack of skills ¨ Limited funds ¨ Limited time ¨ Other (please specify)		
Collect serology to test mineral status in ewes	☐ Yes, practice implemented ☐ I intend to implement ☐ No, I have no intentions to ☐ Adopted prior to PDS ☐ Not applicable	☐ Less than 25% ☐ Between 25% - 50% ☐ 50% ☐ Between 50% - 75% ☐ Greater than 75% ☐ 100%	☐ Normal Practice ☐ Sometime ☐ Rarely
	What are the reasons you have not implemented this practice on your property? ¨ Not a significant issue on my property ¨ Lack of confidence ¨ Lack of skills ¨ Limited funds ¨ Limited time ¨ Other (please specify)		
Test Fodder to design rations,	☐ Yes, practice implemented ☐ I intend to implement ☐ No, I have no intentions to ☐ Adopted prior to PDS ☐ Not applicable	☐ Less than 25% ☐ Between 25% - 50% ☐ 50% ☐ Between 50% - 75% ☐ Greater than 75% ☐ 100%	☐ Normal Practice ☐ Sometime ☐ Rarely
	What are the reasons you have not implemented this practice on your property?		

	¨ Not a significant issue on my property	¨ Lack of confidence	¨ Lack of skills
	¨ Limited funds	¨ Limited time	¨ Other (please specify)

C2.1 Have you made/do you intend to make any other changes to your business as result of participating in this PDS? *If yes, please advise what changes*

_____

_____

_____

C3 is only application where practices change/adoption has occurred as a result of participating in the PDS.

C3 what impact did implementing the above practices have on *(Please do not answer if you are unsure)***:**

Reproductive Efficiency- Number of foetus expected from ewes joined_____
Reproductive Efficiency- % Lambs marked from ewes Joined _____
Reproductive Efficiency- % Lambs weaned from ewes Joined _____
Mortality rate ewes mid pregnancy weaning % _____
% Dystocia assisted births _____
% Metabolic Disorders in lambing mobs _____
Lamb mortality rate from birth until weaning %_____
Cost of Production ($/kg) _____
Dry Sheep Equivalent (DSE) / ha_____

7.4 Communication plan

Communications plan – LPDS 2107

PROJECT TITLE- Increasing number of lambs weaned / ewe unit

This communications plan template provides guidance for Meat & Livestock Australia's program partners who have been requested to develop a communications plan as part of their project deliverables.

Prepared by: Bronwen Fowler, Bronwen.Fowler@nutrien.com.au, 0447 678 457

Background

Ewe reproductivity and lamb survival is a hot topic, and there are many programs already in place. AWI & MLA have funded initiatives like the Lifetime Ewe Management course, Making More from Sheep modules, Sheep's Back, etc. DPIRD & local universities have invested significant time and research in developing tools and educating growers in best practice management. The key problem

has been demonstrating the significant increase in farm profitability, and productivity to the growers, who are yet to adopt the practices or see the need to improve their current practices. This PDS project, allows growers to witness over time, how by measuring Food On Offer (FOO), mineral status, Body Condition Score (BCS), Body Weight (BW), fleece weight (FW), number of foetus's expected, and then managing to best practice recommendations, outlined by Department of Primary Industries and Regional Development, an increase in number of lambs weaned can be achieved. It also showcases the use of Electronic Identification Devices technologies to measure data and make informed culling decisions to increase the productivity of the flocks and increase profitability. The PDS will allow those growers who are at the forefront, to implement best practice, and show case to other growers.

Scanning ewes to determine nutritional requirements, set mob size, allocate paddocks, measure joining success, and evaluate ewe reproductive history, is crucial in managing the ewe flock. Within WA… "only 17% of producers or 30% of the WA flock is currently scanned for litter size to determine the number of foetuses per ewe. A further 25% of the flock is scanned just to determine pregnancy status (pregnant or not) which doesn't show the impact of multiple births on the reproduction rate" (DPIRD, 2019). In this project we aim to demonstrate the benefit of scanning for litter size and foetal aging to determine ewe nutritional requirements and manage fodder sources more efficiently.

All four sites in the PDS are of different sizes and have different physical, and labour resources available, which provides a good cross section of the sheep producers in the area. This allows the project to demonstrate to growers that with a solution focus, best practice recommendations can be adopted on a range of sheep enterprises in their local environment, to increase profitability in the sheep enterprise, by increasing the number of lambs weaned /ewe unit.

Challenge/opportunity

Projects like these are important for sharing information, providing a space for networking and support to growers. Allowing growers to trial and demonstrate their findings to the greater community is a crucial extension activity, encouraging other adopters to improve animal welfare outcomes and production levels. By using a range of platforms, social media, linking in with other grower groups, webinars, case studies and face to face workshops allows for a wider audience to be reached. The types of opportunities and positive results which are expected to be achieved by the project are listed below and can be classified as social and economic impact.

Social Impact:
There is a huge social and emotional pressure of witnessing lamb deaths. It can be taxing on the producer's emotional well-being, to observe livestock deaths, but also causes distress and concern amongst the wider community.
By being able to increase number of lambs weaned / ewe unit producers:

- Sees less livestock losses on farm, provides an internal satisfaction for growers
- Creates transparency for growers to demonstrate to the wider community
- Ensures animal welfare standards are adhered to

This project aims to gives growers a sense of control of their sheep enterprises by planning for a worst-case scenario of autumn lambing, by monitoring stock closely and removing / managing as many elements of risk as possible, to get live lambs on the ground.

Economic Impact:
There is extra pressure to build flock numbers up in WA after the mass exodus in early 2020, of around 1.2 million sheep out of WA. Producers need to increase number of lambs weaned each year to continue to drive genetic selection and rebuild flock numbers to meet existing WA markets.
By being able to increase number of lambs weaned / ewe unit producers can:

- Maintain higher culling rates to meet their breeding objectives to maintain genetic pressure,
- Run less ewes, to attain the same amount of lambs, ideal for growers with water or grazing limitations
- Demonstrate how it's possible to Increase the Gross Margin / DSE which is beneficial for entire industry

Target audience

The main target audience for this project in relation to scanning for litter size and feeding to production status is sheep producers in the mid west /northern agricultural region, who are the mid /late adopters. The early adopters are also targeted for the use of EID technologies in flocks to inform culling decisions, foetal aging, and precision feeding to production status to increase numbers of lambs weaned.

The most powerful tool, for adopting new technology is for growers to witness first-hand from other growers and learn from their experiences. So, information sessions, case studies, webinars, short videos with Q & A from the PDS core producer perspective will be all be valuable tools to utilise to communicate to growers. Growers also rely on social medias channel such as twitter, to keep informed of what other growers are implementing on farm. Also having access to industry professionals, research scientists, vets, etc will also a valuable resource particularly for the early adopters.

This Producer Demonstration Site (PDS) will give producers an opportunity to see lamb survival practices in action. The project will look at ways to make effective decisions for lamb and ewe management based on pregnancy scanning and the collection and analysis of information such as Mineral status , BCS, number of foetuses expected, FW, FOO and fodder sources

Key messages

1. Ewes require a pre-joining BCS of 3, to ensure optimum ewe and lamb survival at lambing.
2. Ewe and ram health checks are carried out at least 8 weeks prior to prevent poor reproductive rates at joining
3. Ewes are scanned for total number of foetus , early/ late, & litter size, to allocate adequate feed to ensure BCS 3 is maintained to achieve optimum lamb survival & mob sizes are kept below 150 for twins and 400 for singles to increase lamb survival.
4. Performance feed ewes to BCS & production status, from the data collected and the FOO to increase profitability
5. Importance of utilizing WEC monitoring, to determine worm thresholds and informing drench programme and prevent production losses from parasite infestations, particularly over the lambing period
6. EID technologies to capture BCS, BW, FW, and reproduction performance can be used to assist in assessing individual ewe reproduction and production performance to inform culling strategies and increase sheep profitability across all enterprise sizes
7. Testing feed sources and mineral profiling is an important tool in providing a least cost ration and should be implemented with new feed sources, whilst meeting livestock requirements to maintain a BCS.

Outcome/KPIs

By December 2023, in the Midwest region of Western Australia:

1. 4 core producer sites of different sizes and different joining times, will demonstrate and assess the potential increase in lamb survival and reproductive performance of ewes, when adhering to best practice management techniques as set out in Australian Wool Innovation (AWI), Lifetime Wool, and Asheep, following maidens over a 3 yr period

focusing on:

2. Conduct a cost benefit analysis to determine the return on investment on the total feed & labour costs compared to an increase in reproductive performance, number or lambs weaned. Implement a series of skills and training development activities to increase the knowledge skills and confidence of 75 core and observer producers in ewe nutrition and management.
3. Produce a series of demonstration fact sheets and guidelines from the project (6 in total) – for producers to utilise to adopt practices.

Channel/timing matrix

Timing	Communications tactics (e.g. written producer case study, video)	Communications channel (e.g. Feedback magazine, media release)	Messages
March 2021	Scanning/ Fodder/ Mob size **Workshop**- producer presentation& Q.A, & Industry presentations and demonstration	Twitter NAG/ WMG/ MIG/Liebe – email Nutrien FB WALRC- channels MLA events calendar	**Key Messages 3 & 4**
June 2021	**Core Producer Webinar 1-** Scanning & Precision Feeding	Twitter NAG/ WMG/ MIG/Liebe – email Nutrien FB WALRC- channels MLA events calendar	**Key Messages 3 & 4**
July 2021	**Workshop** Tissue Test / Lamb Autopsy/ Ewe repro Agronomist / Vet	Twitter NAG/ WMG/ MIG/Liebe – email Nutrien FB WALRC- channels MLA- Media release MLA events calendar	**Key Messages 4 & 7**
August 2021	**Core Producer Video & Fact Sheet** -Scanning & Feeding No1 of series of 6	Twitter NAG/ WMG/ MIG/Liebe – email Nutrien FB WALRC- channels MLA Friday Feedback	**Key Message 3 & 4**
September 2021	**Annual Field Day-** Producer Presentation Producer Q & A Industry Presentation	Twitter NAG/ WMG/ MIG/Liebe – email Nutrien FB WALRC- channels MLA- Media release	**Key Messages 1 - 7**
October 2021	**Newsletter** update on project year 1	NAG/ WMG/ MIG/Liebe – email	**Key Messages 1 - 7**
October 2021	Ram / Ewe reproduction **Workshop** producer presentation & Q.A, & Industry presentations	Twitter NAG/ WMG/ MIG/Liebe – email Nutrien FB WALRC- channels MLA- Media release	**Key Messages 1, 2 & 3**
December 2021	**Core Producer Video & Fact Sheet** - ewe / ram reproduction No2 of series of 6	Twitter NAG/ WMG/ MIG/Liebe – email Nutrien FB WALRC- channels MLA- Media release	**Key Message 1 & 2**

Feb 2022	Confinement & Minerals **Workshop**- producer presentation& Q.A, & Industry presentations	Twitter NAG/ WMG/ MIG/Liebe – email Nutrien FB WALRC- channels MLA- Media release	**Key Messages 4 & 7**
June 2022	**Core Producer Webinar 2-** Mineral supplementation & rations	Twitter NAG/ WMG/ MIG/Liebe – email Nutrien FB WALRC- channels	**Key Messages 4 & 7**
July 2022	Weaner Potential **Workshop** producer presentation& Q.A, & Industry presentations	Twitter NAG/ WMG/ MIG/Liebe – email Nutrien FB WALRC- channels MLA- Media release	**Key Messages 3,4 & 5**
August 2022	**Core Producer Video & Fact Sheet** -Internal Parasites WEC & Mineral Nutrition No 3 of series of 6	Twitter NAG/ WMG/ MIG/Liebe – email Nutrien FB WALRC- channels MLA- Media release	**Key Message 4 & 6**
September 2022	**Annual Field Day**- Producer Presentation Producer Q & A Industry Presentation	Twitter NAG/ WMG/ MIG/Liebe – email Nutrien FB WALRC- channels MLA- Media release	**Key Messages 1 - 7**
October 2022	**Newsletter** update on project year 2	NAG/ WMG/ MIG/Liebe – email	**Key Messages 1 - 7**
October 2022	Split Joinings **Workshop**- producer presentation& Q.A, & Industry presentations	Twitter NAG/ WMG/ MIG/Liebe – email Nutrien FB WALRC- channels MLA- Media release	**Key Messages 1 -4**
December 2022	**Core Producer Video & Fact Sheet** -Split Joinings No 4 of series of 6	Twitter NAG/ WMG/ MIG/Liebe – email Nutrien FB WALRC- channels	**Key Message 1 - 4**
Feb 2023	EID **Workshop**- producer presentation& Q.A, & Industry presentations	Twitter NAG/ WMG/ MIG/Liebe – email Nutrien FB WALRC- channels MLA- Media release	**Key Messages 3 & 6**
March 2023	**Core Producer Video & Fact Sheet** -EID No 5 of series of 6	Twitter NAG/ WMG/ MIG/Liebe – email Nutrien FB WALRC- channels	**Key Message 6**
June 2023	**Core Producer Webinar 3**- EID	Twitter NAG/ WMG/ MIG/Liebe – email Nutrien FB WALRC- channels	**Key Messages 6**

July 2023	Smart Shepherd Collars **Workshop** producer presentation& Q.A, & Industry presentations	Twitter NAG/ WMG/ MIG/Liebe – email Nutrien FB WALRC- channels MLA- Media release	**Key Messages 6**
August 2023	**Core Producer Video & Fact Sheet** -Using data No 6 of series of 6	Twitter NAG/ WMG/ MIG/Liebe – email Nutrien FB WALRC- channels	**Key Message 1 - 6**
September 2023	Annual Field Day- Producer Presentation Producer Q & A Industry Presentation	Twitter NAG/ WMG/ MIG/Liebe – email Nutrien FB WALRC- channels MLA- Media release	**Key Messages 1 - 7**
October 2023	Newsletter update on project year 3	NAG/ WMG/ MIG/Liebe – email	**Key Messages 1 - 7**
October 2023	Written Producer Case Study x 4	WALRC- channels MLA- Final Report NAG/ WMG/ MIG/Liebe – email Nutrien Newsletters MLA Friday Feedback/Feedback magazine	**Key Messages 1 - 7**
December 2023	PDS Final Report	WALRC- channels MLA- Final Report NAG/ WMG/ MIG/Liebe – email Nutrien Newsletters	**Key Messages 1 - 7**

Key messages

1. Ewes require a pre-joining BCS of 3, to ensure optimum ewe and lamb survival at lambing.
2. Ewe and ram health checks are carried out at least 8 weeks prior to prevent poor reproductive rates at joining
3. Ewes are scanned for total number of foetus, early/ late, & litter size, to allocate adequate feed to ensure BCS 3 is maintained to achieve optimum lamb survival & mob sizes are kept below 150 for twins and 400 for singles to increase lamb survival.
4. Performance feed ewes to BCS & production status, from the data collected and the FOO to increase profitability
5. Importance of utilizing WEC monitoring, to determine worm thresholds and informing drench programme and prevent production losses from parasite infestations, particularly over the lambing period
6. EID technologies to capture BCS, BW, FW, and reproduction performance can be used to assist in assessing individual ewe reproduction and production performance to inform culling strategies and increase sheep profitability across all enterprise sizes
7. Testing feed sources and mineral profiling is an important tool in providing a least cost ration and should be implemented with new feed sources, whilst meeting livestock requirements to maintain a BCS.

Bronwen Fowler from Nutrien Ag Solutions will be responsible for implementing the communications plan, with Caitlin Farrell from Nutrien Ag Solutions to provide administration and MLA liaison support.

7.5 Extension and communication outputs

7.5.1 Producer case studies

7.5.1.1 Producer case study – Sandhurst

Producer Demonstration Stite, MLA Project Increasing number of lambs weaned / ewe unit Case Study - Sandhurst Property - PDS Site

Introduction

Sandhurst is a well-established mixed family farming enterprise located in Northampton, Western Australia, and is managed by Daniel Gill. The operation is built on a strong focus on genetics, aiming to optimize productivity, improve flock performance, and increase profitability. Daniel's participation in the WA's Midwest Producer Demonstration Site (PDS) project has allowed him to further enhance his practices, with a primary focus on increasing the number of lambs weaned per ewe unit. Sandhurst utilises best-practice industry recommendations in breeding, feeding, and health management. With an efficient labour force and a robust data-driven approach, Sandhurst adapts to market fluctuations and seasonal conditions, ensuring sustainable farming practices for long-term success.

Figure 1 Daniel Gill, primary producer at Northampton WA

Background

Sandhurst is a mixed family farming enterprise located in Northampton, Western Australia. The farm is owned and operated by Daniel Gill, who places a strong emphasis on genetics to drive productivity and profitability. Daniel participated in the WA's Midwest PDS project, which focused on increasing the number of lambs weaned per ewe unit through improved nutrition and the implementation of best-practice industry recommendations.

The enterprise spans 1,200 hectares and operates with a labour input equivalent to 1.5 full-time workers. With a 70:30 crop-to-livestock ratio, Sandhurst runs approximately 1,000 to 1,200 breeding ewes, primarily of the Sandhurst Merino bloodline. On average, sheep graze 50 hectares—a standard maintained across all mobs.

Breeding Program

Daniel has invested considerable focus on genetic improvement to support the enterprise's long-term goals. Sandhurst's primary breeding objectives include achieving a weaning rate greater than 100%, improving body weight at 8–12 months of age, and enhancing wool production with a target of 19-micron fleece.

Ram selection is driven by Australian Sheep Breeding Values (ASBVs), with key traits including:

- Yearling Weight (Ywt)

- Yearling Clean Fleece Weight (YCFW)
- Yearling Eye Muscle Depth (YEMD)
- Yearling Fat (YFAT)

Ewe selection is conducted through visual assessment, focusing on structural soundness and desirable wool characteristics.

Joining and Scanning Practices
Joining occurs in early November, lasting over five weeks. Rams are introduced mid-November, with a 2% ram joining rate and currently no use of teasers. The enterprise has been conducting pregnancy scanning for over eight years, assessing both wet/dry status and litter size to inform management decisions. Scanning has been crucial in evaluating reproductive success and identifying where challenges may arise.

Lambing and Weaning Practices
Following pregnancy scanning, ewes are separated into mobs based on their pregnancy status—singles (50-70%) and twins (30-50%)—to facilitate more efficient feed allocation. Lambing paddocks are well-shaded to protect the ewes and lambs from the elements, and trail feeding is carried out up to three times a week. Target lamb weights at weaning vary depending on seasonal conditions and feed availability, with minimal mortality rates targeted from marking to weaning.

Cull strategies involve assessing ewe lambs at 12 months of age. Dry and cast-for-age (CFA) ewes are culled based on seasonal needs, typically at around 4.5 years of age.

Feeding and Nutrition
Ewes are predominantly trail-fed with a combination of wheaten/oaten hay, pellets, and grain, with the support of a summer loose lick program that extends until near weaning. During the summer months, ewes graze on wheat stubble, while weaners graze on lupin stubble. The feed budget includes an annual rollover of 75 tonnes of lupins and 25 tonnes of wheat seconds/barley. Due to seasonal limitations, the property typically does not rely on winter cereal grazing.

Animal Health Management
A proactive animal health regime is followed to ensure the well-being of the flock. Pre-lambing, ewes are administered vitamin E, GlanEry 7-in-1 vaccine, and drenched as a preventive measure. Lambs are treated at marking with Clik, GlanEry 7-in-1, Scabiguard, and Trisolfen. Weaning procedures include GlanEry 7-in-1 and drenching based on egg count results. Ewes are drenched pre-lambing with rotating spectra, and weaners transition to clean stubbles. Mineral supplementation is provided through cal-mag-salt mixtures, with occasional use of Beachport products to address specific needs.

Challenges and Future Directions
Major challenges for the enterprise include fluctuating market prices and managing seasonal feed demand. The key goals are to enhance management efficiency and increase production. During periods of cash flow constraints, the first strategy is to sell dry sheep rather than reduce supplements or health inputs, as these are considered critical to the flock's success. Ewe supplementation pre-lambing is non-negotiable.

Technology and Tools
Technology plays a vital role in flock management. Sandhurst integrates lambing planners, drought and supplementary feed calculators, and weather forecasting tools to optimize decision-making. The enterprise also utilizes industry apps such as ASHEEP and Lifetime Ewe Management to make informed, data-driven decisions that support improved productivity and sustainability.

Data-Driven Approach
Since joining the PDS project, Daniel has integrated electronic identification (eID) systems to improve data collection and flock management. This technology has allowed for more precise tracking of key metrics, including pre-joining and scanning birth weight (BWT), body condition score (BCS), pregnancy status, litter size, and greasy fleece weight (GFW). The data on BCS, along with pre-joining and scanning information, has proven vital in determining the ewes' nutritional needs. This enables Daniel to manage feed allocation more effectively, ensuring that ewes receive the appropriate nutrition to maximize conception rates and achieve optimal birth weights for the lambs.

Conclusion
Sandhurst represents a progressive and well-managed mixed enterprise that operates with minimal labour availability. Daniel uses tools and leverages strategic breeding, nutrition, and technology to optimize productivity and flock performance. This approach allows Daniel to adapt to market fluctuations and seasonal conditions, ensuring sustainable practices and profitability in an uncertain market. Continued adaptation to seasonal variability and market conditions remains central to the enterprise's ongoing success.

7.5.1.2 Producer case study – Mulga Springs

Producer Demonstration Stite, MLA Project Increasing number of lambs weaned / ewe unit Case Study - Mulga Springs – PDS Site

Introduction
Mulga Springs is a dynamic and progressive mixed family farming enterprise managed by Jessica Horstman and Chris Hasleby, located in Western Australia. Spanning 3,212 hectares with a labour force of 2.5 full-time equivalents, the operation maintains a balanced 70:30 crop-to-livestock ratio and runs approximately 3,500 adult sheep. Jessica and Chris manage both a commercial flock and a Merino stud. The enterprise places a strong focus on improving flock performance through strategic genetic management, nutrition, and the integration of technology. Mulga Springs participated in the Producer Demonstration Site (PDS) project, which aimed to increase the number of lambs weaned per ewe unit through precision ewe feeding.

Figure 2 Jessica Horstman, Primary Producer, Northampton, WA

This case study highlights key elements of the operation's breeding program, lambing and weaning practices, animal health management, and the use of technology to drive productivity and sustainability. It also outlines how Mulga Springs continues to adapt to climate and market variability while improving efficiency and profitability.

Background and Operation Overview
Mulga Springs is a mixed farming enterprise managing 3,212 hectares with 2.5 full-time labour units. The operation maintains a 70:30 crop-to-livestock ratio, running approximately 3,500 adult sheep.

On average, PDS sheep are grazed across 130 hectares, consistent across all mobs. Jessica and her father, Chris, run both a commercial flock and the Mulga Springs Merino stud.

The enterprise's Merino sheep have bloodlines from Glenlea Park, Nepowie, and its own Mulga Springs line. More recently, the flock has been genetically diversified through the inclusion of rams from Glenlea Park, Anderson, and Ella Matta, with a focus on improving traits related to fertility, constitution, meat, and wool quality.

Breeding Objectives and Genetic Management
Jessica targets a balanced focus on both wool and meat production, with a strong emphasis on fertility and constitution. Key Australian Sheep Breeding Values (ASBVs) used to guide ram and ewe selection include:

- Low Worm Egg Count (WEC)
- High Weaning Weight
- Increased Fleece Cut
- Positive Fat ASBVs

Visual assessment criteria for ewe selection include structural features such as feet, shoulders, and jaw structure, as well as wool qualities such as staple length, colour, and crimp. Jessica and Chris regularly conduct flock profiling to ensure their breeding objectives are being met.

Reproduction and Culling
The property follow a 6-week joining period, with rams introduced on December 24 at a 2.5% ram rate. Pregnancy scanning has been implemented for over eight years to assess both pregnancy status and litter size. More recently, with their involvement in the PDS project, data is now also recorded to determine whether ewes are early or late lambers, with this information linked to individual ewes via Electronic Identification (eID).

Figure 3 Scanning at Mulga Springs, Northampton WA

eID has been in place since 2017 and plays an integral role in measuring, recording, and informing decisions on individual animal and flock performance. Key data captured includes pregnancy status, fleece weights, and visual classing results. For stud AI ewes, maternal lineage is recorded at lambing, and ram lambs undergo genomic testing.

In March, at approximately day 90 of pregnancy, ewes are split into single-bearing (180–250) and twin-bearing (200) mobs to ensure nutritional requirements are matched to production status. Lambing occurs in May, with ewes allocated to sheltered paddocks. The milder winters in the Mid-West region and shorter growing season make early lambing essential for setting weaners up for optimal spring growth.

Key culling practices include:

- Dry ewes culled post-scanning
- Ram lambs classed at weaning and re-evaluated in December based on conformation
- Ewes classed and culled in September/October or in line with shearing schedules (Mulga Springs is currently transitioning to a 6–8 month shearing cycle)

Feeding and Pasture Management
Feeding regimes at Mulga Springs are seasonal and closely tied to food on offer (FOO). Ewes are trail-fed pellets every two days and provided a calcium-sulfur loose lick to balance macro-minerals when grazing stubble from late summer through to lambing. Jessica prefers using complete pelleted feeds over straight grain and lupins, working directly with pellet companies to ensure safe, balanced nutrition. This also improves labour efficiency and ease of transition onto feed.

Summer Feed Base:

- **Ewes:** Wheat, barley, canola stubble, clover pasture, saltbush
- **Weaners:** Lupin stubble

Winter cereal grazing has not been used in recent seasons, but is being considered again, pending favourable growing conditions. Confinement feeding is also under review as a potential strategy for managing feed supply during dry periods.

Parasite Management
Jessica employs a proactive, preventative approach to animal health, with a strong emphasis on parasite control. Regular Worm Egg Count (WEC) testing is used to guide drenching decisions and manage drench resistance. Rams are also selected for low WEC ASBVs to help reduce overall parasite pressure.

Enterprise Challenges and Development Goals
The past season saw higher lamb mortalities between marking and weaning due to extreme wet weather, which increased parasite loads and flystrike pressure. Managing parasite control during this period is a key area of focus moving forward.

Current challenges:

- Efficiently managing mob sizes within a mixed farming system
- Ensuring successful weaning outcomes under variable seasonal conditions

Development priorities:

- Improving weaner survival
- Continuing to refine data-driven decision-making
- Exploring confinement feeding and cereal grazing to boost feed efficiency

Cashflow strategy:

- Ram purchases are the first to be reduced under financial pressure
- Pregnancy scanning and supplementary feeding remain non-negotiable pillars of flock management

Technology and Tools
Jessica and Chris use a range of tools and technologies to assist with flock management, nutrition decisions, and labour efficiency:

- Lifetime Ewe Management app
- AgriWebb for digital record keeping and paddock monitoring
- Tru-Test equipment (fleece weighing, body weight)
- Pratley auto-drafter

Conclusion
Mulga Springs demonstrates a thoughtful integration of genetics, nutrition, and technology in a large-scale mixed enterprise. With a clear focus on fertility, wool quality, structural soundness, and data-backed decision-making, the operation is well-positioned to adapt to seasonal and market variability. Through innovation, strategic planning, and a strong commitment to continual improvement, Mulga Springs is building a resilient and productive enterprise for the future.

7.5.1.3 Producer case study – Mt Erin

Producer Demonstration Stite, MLA Project Increasing number of lambs weaned / ewe unit Case Study - Mt Erin - PDS Site

Introduction
Jason Stokes operates Mt Erin, a large-scale mixed farming enterprise located in Chapman Valley, Western Australia. With a focus on maximizing productivity and sustainability, Jason participated in the MLA Producer Demonstration Site (PDS) Project aimed at improving lamb survival through precision ewe feeding. Jason has implemented strategic breeding, feeding, and management practices to enhance flock performance while adapting to the changing market landscape. This case study outlines the integrated approach Jason has taken to livestock management, highlighting his commitment to using precision tools and using data-driven decisions to ensure the success and sustainability of his operation.

Figure 4 Jason Stokes, primary producer at Chapman Valley WA

Background and Operation Structure
Jason Stokes, a producer based in Chapman Valley, WA, participated in the 3-year MLA Producer Demonstration Site (PDS) Project, which aimed to improve lamb survival through precision ewe feeding. Jason started the project with 600 maiden ewes and implanted split joining, with joining commencing in mid-November.

Jason operates Mt Erin, a large-scale mixed enterprise spanning 5,200 hectares, with a 60:40 cropping-to-livestock ratio. The farm currently manages 5,600 breeding ewes and is transitioning from 4.5 to 3 full-time labour units, driving the need for greater efficiency across all areas of operation. The stocking rate is maintained at a sustainable rate of 10 DSE per winter-grazed hectare (wgha), supporting both livestock and cropping success.

Sheep Genetics and Breeding Objectives
Mt Erin runs Leahim-bloodline Merino ewes, selectively bred for early growth, easy-care traits, and high wool and meat production potential. Sires are bred in-house via an AI program, with 90% selected based on Australian Sheep Breeding Values (ASBVs), including growth and fleece traits. Visual selection continues to play a key role, with ewes evaluated for conformation, wool length and brightness, and ease of management.

The enterprise has transitioned from the DP+ index to a combination of Self-Replacing Merino (SM) and Maternal (ML) indexes to align with commercial and maternal lamb production targets.

Reproduction Management
In more recent years, Jason has been implementing split joining (21 days: rams in for 10 and back in for 21 days). He has found this practice allows for tighter lines of lambs to mark, wean, and market, and to track ewe reproduction performance. Being a November joiner, he relies on teasers to ensure ewes are cycling and uses a joining rate of 2.5%. Pregnancy scanning has been in place since 2006, with eID gear introduced in 2018, which has allowed for tracking individual ewe performance. The type of data Jason collects includes:

- Pregnancy status and litter size
- Lamb marking and weaning weights
- Hogget weight, fleece weight, and fleece traits
- Body weight and condition scoring

Mt Erin has set weaning target weights for 20 kg (singles) and 18 kg (twins) at 11 weeks. Post-marking mortality is maintained at approximately 3%, aided by high-input monitoring and animal health protocols.

Flock Selection and Culling Strategy
Each April, post-shearing data, including fleece weights and traits, body weight, and condition scores, are used to index ewe hoggets. The top 10% are selected for AI, the bottom 10% culled, and an additional 3–5% removed based on visual appraisal. Ewes are culled immediately if they:

- Fail to scan in-lamb
- Fail to rear a lamb
- Present udder defects

Feeding System and Nutrition
Jason employs a diverse and structured feeding strategy across the year. Over summer, sheep graze stubbles and are either trail-fed, provided TMR, or have access to self-feeders. Like most mixed growers, Jason uses home-grown commodities and fodder and assesses the cost of energy and crude protein (CP) to determine the most cost-efficient feed sources. Different classes of stock receive different rations depending on the production status and the Food On Offer (FOO). A typical ration would consist of:

- Ewes: 75% wheat, 10% canola, 15% lupin stubbles (shifting toward 40% wheat, 40% lupin, 20% canola)
- Weaners: 80% lupin, 20% oats/barley

Jason confinement feeds from March to May to allow for efficient allocation of feed sources and land allocation to allow for winter crop grazing. In confinement, sheep receive a ration of 60:40 barley to lupin, with ad lib barley straw. Jason places a large emphasis on feed budgeting to ensure enough grain/hay is conserved. Each ewe is budgeted for ~45 kg of grain per year.

Loose licks enriched with calcium and sulfur support pre-lambing and lambing nutrition. Causmag, limestone, and salt are provided when grazing crops. Winter cereal grazing is practiced, contributing to condition recovery before lambing.

Lambing and Management Systems
Mobs are split 15 days prior to lambing into production status, with the emphasis on managing mob size for lambing. With single bearing ewes have a maximum of 400 hd in a mob and twin bearing ewes maximum mob size is 200 hd.

Lambing paddocks are sheltered, and lupins are spread in grassy areas to provide 10 days of feed. Lamb growth is considered critical: “If a lamb or weaner is not putting on weight, it is dying” (Bob Hall). The entire system is designed around ensuring continuous growth.

Animal Health Program
Jason’s approach to animal health programs is a preventative one, with key treatments provided at critical times to ensure the health and productivity of the flock:

- **Pre-lambing:** Long-acting drench, ADE, Glanery 7
- **Marking:** Glanery 7, Trisulfon, Clik
- **Weaning:** Glanery 7 booster, combination drench, lice treatment
- **Parasite control:** Monthly FEC testing; treatment as needed

Technology and Tools
Jason's operation integrates a suite of tech tools, including:

- TruTest Data Link, AgriWebb
- Innovate IoT (for tank, pump, weather monitoring)
- Drought Feed Calculator, LTEM
- Safety Culture (shearing shed audits)
- Lambing Planner (paper version)
- WhatsApp for real-time team communication

Jason has found these tools useful for planning, measuring production, reporting, and managing resources. The data collected through these tools drive Jason’s production and management decisions, helping him optimize performance, improve efficiency, and make informed decisions for the future of the operation.

Challenges and Strategic Priorities
Major challenges include labour availability, managing Barber’s Pole worm, and achieving timeliness of operations. The primary improvement focus is increasing lamb growth from birth to weaning without compromising stocking rates. Under financial pressure, no components are removed from the program. The scale of the operation requires proactive rather than reactive management, especially regarding parasite control. Jason’s non-negotiables, that he believes crucial for his business’s success are:

- Pregnancy scanning
- Achieving target condition scores pre-lambing
- Maintaining uninterrupted lamb growth

Enterprise Change: Focus on Store Lambs
Jason is modifying his enterprise aims to suit the evolving market, to 'produce the best quality store lambs for the feeder market'. He has calculated that the time value of finishing lambs and the current store prices make it hard to make the math work to feed to slaughter. Currently, store lambs are more profitable per kg than finished lamb. When factoring in shearing 1.5 times a year, grain prices, losses, and financing costs, $90 per head in September starts to look appealing compared to $150 per head finished. He believes this strategy will allow Mt Erin to run another 500 ewes.

Conclusion
Jason's operation is an advanced enterprise leveraging precision breeding, structured feeding systems, and integrated technology to drive productivity and sustainability in large-scale sheep production. The combination of rigorous data collection, targeted nutrition, and strict selection delivers consistent lamb growth and reproductive success, positioning Jason's enterprise as a leader in practical genetic application within commercial systems. With the shift to producing high-quality store lambs, Jason is poised to improve operational efficiency while adapting to market conditions, ensuring continued success in the long term.

7.5.1.4 Producer case study – Blackboy Hill

Producer Demonstration Stite, MLA Project Increasing number of lambs weaned / ewe unit Case Study Blackboy Hill - PDS Site

Introduction
Lloyd Cripps operates a mixed farming enterprise spanning 3,800 hectares in Western Australia. This family-run operation is primarily managed by Lloyd himself, with assistance from his parents when required. Contract labour is engaged for key seasonal tasks, including shearing, crutching, and marking. Lloyd participated in the MLA Producer Demonstration Site (PDS) project, which focuses on increasing the number of lambs weaned per ewe unit through precision ewe feeding.

Figure 5 Llyod Cripps, primary producer, West Binnu, WA Fleece Weighing

Enterprise Overview
The farm integrates both cropping and livestock, with approximately 1,000 hectares dedicated to cropping and 2,300 hectares to livestock. The remaining 500 hectares are made up of remnant vegetation. As of January 1, 2025, the livestock population is 2,300 head, although it typically sits closer to 2,500 head. The sheep operate under rotational grazing principles, with PDS mobs averaging 140 hectares across two mobs. The average paddock size is approximately 65 hectares.

Flock Genetics and Breeding Objectives
Lloyd's Merino flock is a cross of his own lines and Mulga Springs genetics. Key breeding objectives include:

- **Wool:** Increase yield, greasy fleece weight (GFW), and staple strength (SS)
- **Meat:** Wean lambs at 30kg; select for yearling weight (YWT)

- **Reproduction:** Eliminate freeloaders, cull dry ewes, and record the performance of single (S) and twin (T) mobs

While Australian Sheep Breeding Values (ASBVs) are not actively used for ram selection, visual assessment plays a critical role. Rams are assessed annually, and weaners are classed prior to data collection based on fleece, fibre, and overall structure.

Reproduction Management
The joining period for ewes at Lloyd's operation begins in mid-December (around the 15th) and continues until the end of January, lasting for six weeks. The ram percentage is set at 3%, ensuring that an adequate number of rams are available for the flock. Pregnancy scanning has been implemented since 2022 to assess pregnancy status and litter size, including singles, doubles, and triplets. This valuable data helps in managing nutritional needs and making informed breeding decisions. Furthermore, electronic identification (eID) was introduced as part of the PDS program, with Lloyd purchasing his own eID equipment in 2024 to improve data collection and flock management.

After pregnancy scanning in late March, ewes are split into mobs based on their pregnancy status—singles and twins. This division allows for better nutrition management and feed allocation. Lambing occurs in sheltered paddocks, ensuring protection from harsh weather and improving lamb survival rates. Ewes are carefully monitored and appropriately fed to ensure optimal conditions for both the ewes and their lambs.

Feeding and Nutrition Management
Feeding regimes are adapted to seasonal conditions and food availability. During the summer months, ewes graze a mixture of crop stubbles and dry pasture, while weaners are provided with dry pasture and some perennial grasses. The feeding system includes lick feeders, and the primary feed sources are lupins and oaten hay for roughage. While loose lick supplementation has not been used previously, Lloyd is considering trialling this practice in the future. Winter cereal grazing was introduced in 2024 using corn rye, and expansion of this practice is planned for the coming seasons.

Animal Health Protocols
Lloyd's animal health protocols aim to minimize health issues and ensure optimal flock performance. Pre-lambing, ewes are vaccinated during crutching to protect them from common diseases. At marking, lambs receive vaccinations, flystrike prevention, and pain relief as part of a comprehensive health management approach. Lambs are given a booster vaccination at weaning. Parasite control is an essential part of the health program, with drenching performed before ewes are moved onto stubbles for grazing. External fly treatments are administered individually as needed. Additionally, trace elements are now included in 20–25% of the top-dressing program due to past copper deficiencies.

Weaning Performance
Lloyd aims for a target weaning weight of 30 kg for both singles and twins, which represents 40% of the standard reference weight (SRW). This target is part of a broader goal to improve lamb growth and survival rates. The mortality rate from marking to weaning is approximately 2%, reflecting the effectiveness of the management strategies and indicating relatively low lamb losses during this crucial growth period.

Data Collection & Technology Adoption
Prior to the PDS project, Lloyd's data collection mainly focused on Greasy Fleece Weight (GFW) and wool test results. Since the introduction of eID technology as part of the PDS, data collection has expanded. Now, in addition to GFW and wool tests, Lloyd collects detailed information on weaning

weights, growth rates, and classification of ewes and lambs into singles (S) and twins (T). He also tracks annual data on D (dry), S (single), and T (twin) lambs, enabling more precise management and decision-making regarding flock health, productivity, and culling.

Culling Strategy
Lloyd employs a rigorous culling strategy to ensure only the most productive animals remain in the flock. Lambs are culled prior to their first shearing if they exhibit obvious defects such as black wool, undershot jaws, tight skin, wrinkles, or small frames. This ensures that only lambs with desirable traits are retained for further growth and breeding. Mature stock is culled for similar reasons: visible defects, poor performance, or health issues. This proactive approach ensures that the flock remains healthy and productive.

Enterprise Challenges and Goals
A primary challenge facing Lloyd's operation is maintaining adequate nutrition between scanning and lambing, particularly during the autumn feed gap. This gap can lead to reduced fetal and lamb survival rates if not managed effectively. Lloyd's improvement priorities include refining autumn feed strategies, better feed budgeting, and experimenting with rumen development in weaners. To support these goals, Lloyd plans to trial feeding starch to weaners and monitor their performance through eID.

Economic Strategies
When cash flow is tight, Lloyd's first strategy is to reduce the number of wether lambs and older ewes, which helps balance the financial situation without compromising the overall productivity of the farm. Despite this, there are key non-negotiables, including the retention of young stock to preserve genetic improvements, particularly within the nucleus flock.

Industry Considerations
Lloyd is a strong advocate for the continuation of live sheep exports and emphasizes the importance of robust industry policy and infrastructure. He believes these factors are essential for the sustainability of the sheep farming industry in Western Australia. He also stresses the need for further industry development, and the creation of viable alternatives should live sheep export be phased out.

Conclusion
Lloyd Cripps' enterprise demonstrates a data-driven approach to sheep production within a mixed farming system. Through participation in the MLA PDS project, he has enhanced flock management through precision feeding and electronic identification, enabling more informed decisions regarding breeding, culling, and overall flock health.
Lloyd's breeding strategy, focused on wool quality, lamb growth, and reproductive efficiency, continues to evolve in response to the challenges of running a low-labour, family-operated farm. His focus on visual assessment, selective breeding, and strategic nutrition underpins his commitment to improving productivity and sustainability.
Despite challenges like managing the autumn feed gap and economic pressures, Lloyd is refining his feed budgeting and exploring rumen development in weaners. He remains an advocate for the sheep industry, emphasizing the need for strong industry support, especially in live export policies. Overall, Lloyd's enterprise demonstrates resilience, adaptability, and a commitment to continuous improvement, positioning it for long-term success in a dynamic agricultural environment.

7.5.2 Project factsheets

7.5.2.1 Project factsheet – Eid & tracking individual animal performance

What is eID

eID tags contain a radio frequency identifier (RFID) microchip that can be read using a handheld wand or panel reader. eID tags do not store data but allow animals to be individually identified. The data is collected and stored by RFID stick readers and indicators, this data can be downloaded as a CSV file, to edit in excel or import into livestock management software.

Each eID has a unique non-visible internal 16-digit electronic microchip number, which is assigned to a NLIS account's Property Identification Code (PIC) when manufactured. When sheep are moved off the PIC, the unique serial number is scanned and uploaded to the NLIS database where a movement record is captured along with the new PIC location of the livestock. EIDs are also printed with a unique set of letters and numbers, which can also be used for visual identification.

Apart from a legislative requirement, what can growers use them for, to get the best return on investment ?

Using Electronic Identification Devices on farm

Tracking individual animal performance to inform culling decisions.
Allows for greater selection pressure to increase genetic gain for the following traits:

- Wool characteristics
- Sire / Dam linkage
- Lamb weights, marking weights, weaning weights
- Pregnancy status, fertility, litter size and foetal aging
- Growth rate monitoring
- Body Condition Scoring
- Visual Classing
- Record Animal health treatments accurately.
- Decrease labour requirements through automation.
- Automedication
- Autodrafting
- Autoweighing
- Monitor growth rates and average daily gains to easily identify saleable animals.
- Increase accuracy on animal health treatments.
- Create mobs and draft mobs on predetermined characteristics when required.
- Track stock movements and biosecurity.

- DPIRD (2024) Electronic identification for sheep and goats. - https://www.agric.wa.gov.au/livestock-movement-identification/electronic-identification-sheep-and-goats

Figure 1 Recording BW and BCS at scanning.

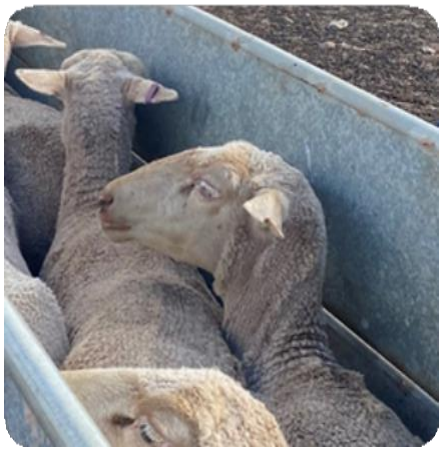


Figure 2 eID tags in PDS ewes.

In Practice

Jason Stokes, Primary Producer in Chapman Valley, WA, runs a 5500 ha broad acre cropping and mixed farming enterprise. With 4000 ha of winter broadacre cropping and mating 5500 merino ewes. Jason Stokes has used some form of EID in his system for 6 or 7 years. Only in the last 3 years all ewes on property have been allocated an EID tag. This has given Jason the ability to gather information on each animal to assist in meeting his breeding objectives. Jason measures BW (Body Weight), BCS (Body Condition Score), Fleece characteristics until the ewes are hoggets, to assist in selecting the future breeding stock. Then records Pregnancy status, BCS for their breeding life to identify best performing animals on the property.

What eID equipment is needed?

To achieve the business and breeding objectives:

- Consider what trait, treatment, or measurement needs to be collected?
- Is it already collected?
- What EID equipment would be needed to collect it and how much would it cost?
- Could a contractor do the task?

Getting started - eID Tags & a handheld scanner that can record traits is all you need.

Equipment	Average Cost	BSC	BW	Visuals	Fleece	Pregnancy Status
eID Tags	**$1.50 - $2.50**	**X**	**X**	**X**	**X**	**X**
eID Stick Reader	**$1,300 - $2,500**	**X**	**X**	**X**	**X**	**X**
Load Bars	**$1,000 - $1,800**		**X**			
Manual Weigh	**$1,000 - $2,000**		**X**			
Indicator	**$1,400 - $5,000**	**X**	**X**	**X**	**X**	**X**
Panel Reader	**$2,400 - $3,800**	**X**	**X**	**X**	**X**	**X**
Automatic Weigh/Drafter	**$10,000 - $30,000**	**X**	**X**	**X**	**X**	**X**
Barcode Printer	**$1,000 - $3,000**				**X**	
Barcode Scanner	**$300 - $400**				**X**	

7.5.2.2 Project factsheet - Ewe & Ram Reproduction

Good nutrition is essential for optimum reproductive performance.

Ewe and ram health checks are carried out at least 8- 12 weeks prior to joining, to ensure stock selected to be joined are healthy and have the capacity to successfully complete – fertilisation, early embryonic growth, gestation, parturition, and lactation to produce viable weaners.

Repro Success Relies Upon:

- Optimum body condition score 3 - 3.5 at joining
- Ram fertility
- Breeding season / teasers
- Correct ratio rams to ewes
- Adequate mineral and vitamins
- Free from internal parasites
- Free from stress, acidosis or events that raise body temperature
- Free from lameness
- Free from reproductive diseases- Brucellosis, Campylobacter, Chlamydia, Toxoplasmosis

Key Actions to Increase Repro Success

- Carry out ewe and ram health checks 8 -12 weeks prior to joining
- Regularly monitor BCS and assess FOO to match ewe and ram nutrient requirements
- Shear at least 12 weeks before joining to allow for cuts etc to heal
- Provide booster vaccinations, drench and lice treatments at shearing
- Provide shade and sheltered paddocks for rams and for the joining period
- Avoid any sudden diet changes, always transition stock onto grains
- Provide mineral supplementation to balance mineral requirements
- For out of season breeding (Nov – Jan) the use of Regulin or Teasers is recommended.
- Teasing for 14 days at a rate of 1 % followed by a 35 day joining is recommended
- If teasers aren't available, flock rams can be used but a longer joining is recommended (45 days)
- Joining Percentage Maiden ewes, the number of rams required 2 % + 1
- Joining Percentage Mature ewes, the number of rams required 1.5% +1
- Allow 20% back up rams 20%

Figure 1 Pictured: Coopers Veterinarian, Felicity Wills carrying out ram breeding checks at Mulga Springs, Northampton, WA.

Figure 2 Pictured: Lloyd Cripps, Grower West Binnu carries out pregnancy scanning to measure repro success.

- Use low stress stock handling techniques when removing rams, avoid excessive dog use or moving stock in the heat of the day
- **Scan to check Repro Success**
- **Consult your veterinarian if poor scanning results, to investigate further**

Carrying out Ewe and Ram Health Checks

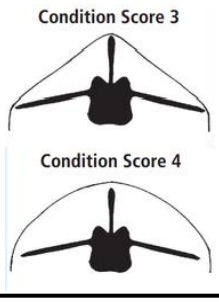
Ewes:

- Overall health checks : for blindness, lameness, cuts, sores or any sign of ill health
- Body Condition Score- if under BCS 2 (consider not joining), BCS 3 is optimal, ewes between 2 & 3 consider flushing with lupins
- Check Teats & Udder- cull ewes with udders showing signs of mastitis , poor teat formation or shearing injuries
- Toes - cull or trim
- Teeth / Jaw - cull if teeth or under shot/ over shot
- Vulva - cull if there are any signs of cancers, lambing or crutching injuries
- Internal parasites - WEC mob to determine worm burdens and drenching requirements

Rams:

Timing is important!

Perform pre-joining checks 8-12 weeks prior to joining to allow for identifying new rams required, if any and also allows time for all activities that could cause stress to rams and a possible increase in body temperature, to be carried out 49 days prior to joining. This allows for spermatogenesis to occur to ensure optimum sperm quality and quantity at joining.

Rams in condition score 3.5		**Consider feeding lupins @750g/hd/day to increase sperm production and output prior to joining**
Inspect general health and appearance		Check for lameness, cuts, sores or any sign of infection around the body, including horns
Check the 4 Ts	Teeth	Sound mouth
	Toes	Trim, if required
	Tackle	Check penis and prepuce for signs of inflammation, infection or injury
	Testes	Firm spring with no lumps Scrotal circumference (>28.5cm immature rams and >32cm mature rams) Scrotum
Shear rams 8 – 12 weeks prior to joining	Limits sunburn, cuts, infection and heat stress at joining	
	Apply effective lice control	
	Apply fly control to poll and body	
Vaccination booster for clostridial disease	Every 6 – 12 months	
Drench with effective drench	WEC prior to drenching WEC – 12 – 14 days post drenching	
Check numbers of rams required and compare to number available	Obtain replacements if needed ASAP to allow time to acclimatise	

Source: Dr Felicity Wills (2019), Coopers Animal Health

7.5.2.3 Project factsheet – Nutrition

Figure 1 Pictured: Bronwen Bird, Nutrien Ag Solutions sampling hay for NIRS testing to develop least cost rations for PDS project.

Why focus on nutrition

Profitability in a sheep enterprise is driven by weaner output. The key to weaner output is to increase the number of lambs weaned per ewe unit. Reaching this goal requires careful nutritional management over the entire reproduction phases of the sheep enterprise.

Optimal nutrition encourages:

- An increase in fertility and repro success
- Effective foetal growth in late gestation, to reach genetic potential
- BCS 3 - 3.5 to reach ideal lamb birth weights 4. 5 - 6 kg
- Increase in lamb survival
- Increase in mothering ability and colostrum production
- Decrease in metabolic disorders – pregnancy toxaemia, hypocalcemia and hypomagnesemia
- Increase in weaning %
- Increase in marketable weaners and culls
- Reach critical mating weights and reduce time to rebreed

Timing critical

- Monitoring and maintaining BCS 3 is most cost efficient
- Pre-joining nutrition
- Late gestation nutrition and BCS
- Weaner Nutrition & BW

Focus on late gestation nutrition

From day 90 – 150 of gestation requires significant energy intake, to be directed towards the growing foetus. Ensuring nutritional needs are meet in this period, is crucial in preventing lamb losses at lambing. Time of lambing and available FOO have a significant impact on the supplementary feed requirements needed to bridge the energy gap.

Scanning ewes to determine litter size and gestation times, proved to be an invaluable tool in the PDS project, to assist in allocating feed sources appropriately. Rations created for the PDS sites were designed to be adjusted every 10 days to suit the FOO, gestation progression, ewe BW & BCS and to ensure minimal wastage.

Precision feeding allows to carefully balance the ration, to address the limited access to energy from FOO, and the reduced the rumen capacity due to large foetal size. Utilising high starch diets, with a lower ADF (Acid Detergent Fiber), coupled with a buffer, key macro minerals- Ca, Mg, & Sodium and effective fibre are key to providing a safe energy source to the ewe.

To determine the least cost ration it is recommended to get a NIRS feed test completed, to work out the available energy, protein, & costs of the feed source. Feeding a ewe on a least cost ration, depending on the commodities available and the energy required, can cost on average 35 c /hd/day. Precision feeding allows to manage this cost, by allocating feed sources to the ewes with highest energy demand.

Eliminating any competition for energy in the ewe's system is also crucial in ensuring all possible energy can be directed at the ewe and the growing foetus. As the ewe moves into "Peri-Parturient Relaxation" the ewe's natural immune response to worms is reduced, ensuring pre-lambing WEC and worm drenching occurs is crucial.

Managing nutrition is crucial in preventing pregnancy toxaemia which is a result from low glucose levels in the blood, in late pregnancy. It occurs due to the ewe's inability to consume enough energy and / or mobilise their fat reserves fast enough to meet energy requirements.

Key take homes for optimal nutrition

- Assess Food On Offer (FOO) regularly
- Test conserved fodder to determine quality & value, and to develop balanced rations
- BCS sheep regularly
- Determine nutritional requirements depending on BCS & production status and feed to this – the more accurate the feed allocation , the more efficient and profitable the system will be.
- Balance the ration - Energy is king, fibre is our friend - 11 MJ / KG DM, 10 -14 % CP (depending on production status), max 40 % NDF (Neutral Detergent Fibre)
- Transition feed sources & monitor rumen health
- Balance minerals – Ca:P 2:1 , K:Mg 4:1, N:S 10:1 & Se, Mn, Zn, Cu, I & Vitamins A, B, D & E
- Prevent worm burdens

7.5.2.4 Project factsheet - Scanning

How much does it cost?

On average, depending on scanner experience and equipment capacity:

- 85 c /hd multiples
- 20 c/ hd foetal aging
- 20 c/hd EID recording

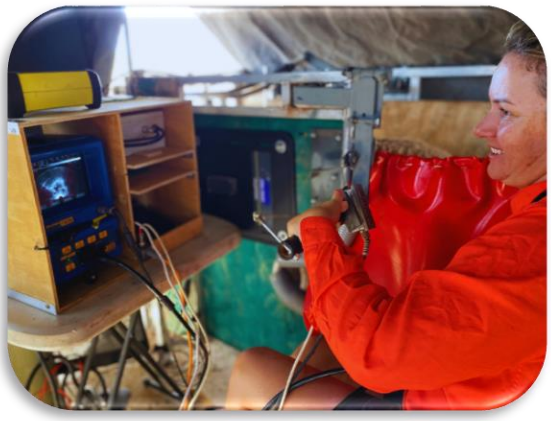


Figure 1 Pictured Bec Martin, Ewe Scan, WA

Possible Financial Benefits

Cost $1.25 / hd on average at 35c /hd /day to supplementary feed a 3.5 days reduction in feeding will start to give a positive ROI for cost of scanning if the data is used to drive feeding decisions.

Identifying the dry or the late single, can reduce feeding costs, if feeding mobs from day 90 to day 150, on average it can save between $10.50 to $21.00 / hd (depending on whether the ewe is dry or a late single). For example: a 2000 ewe flock with an average of 5% dries, would have 100 dry ewes feeding over 60 days = $2100 that could have been saved or allocated elsewhere.

Figure 2 Pictured: Daniel Gill, Northampton Grower, WA

Daniel Gill runs on average 1200 commercial Merino breeding ewes at Northampton in WA. Daniel uses pregnancy scanning to increase efficiencies in his livestock system.

Daniel achieves this by culling dries, particularly in a tough season and allocating the feed sources to meet livestock requirements. Scanning has allowed him to increase lamb survival through, identifying multiples, managing mob size and targeted feeding. Daniel has been pregnancy scanning for 9 years and it has allowed him to monitor ewe repro success, cull the dries, measure more effectively the fertility of his mob.

Jason Stokes, Primary Producer in Chapman Valley WA, runs a 5500 ha broad acre cropping and mixed farming enterprise. With 4000 ha of winter broadacre cropping and mating 5500 merino ewes, Jason uses scanning and split joining to allocate feed sources efficiently, drive mob decisions for winter cereal grazing, confinement systems and track ewe lifetime repro success This is used with fleece data, BCS, lamb marking weights to drive ewe breeding decisions.

Why invest in scanning services to determine fertility, litter size, and foetal age?

- Determines repro success and where losses may have occurred
- Helps determine possible culls in a tight season
- Assists in allocating feed sources depending on pregnancy status and foetal age to improve lamb survival
- Decreases the total cost of supplementary feed when mobs are set in singles early, singles late, twins early, twins late
- Enables planning for mob requirements in confinement systems in a tight season.

- Allocate lambing paddocks and mob sizes to increase lamb and ewe survival.
- Provides for more flexible livestock management and a useful marketing tool when selling ewes.
- Provides opportunity to BCS and or / weigh to determine feed requirements and carry out any animal husbandry activities that may be required i.e., FWEC.
- Uiltilising data with EID, scanning allows to track ewe lifetime repro success and determine culling strategies.
- Assists in providing more accurate data to Sheep Genetics on birth dates and birth types.

When

For accurate scanning of multiples, scanning should occur (for a 35 day joining) 35 – 42 days after rams are removed. On day of scanning allow around 8 hours off feed and water prior to scanning.

7.5.2.5 Project factsheet – Split joinings

The key factors that influence grower joining times are:

- Matching peak nutritional requirements day 30 of gestation and day 50 of lactation to peak FOO (Food on Offer)
- Other farm enterprise activities and the labour availability
- Markets for weaners
- Natural oestrous cycle and the photoperiod
- Breed

Oestrous

The average oestrous cycle for ewes is 17 days, and the first standing heat occurs 17 – 25 days after rams or teasers are introduced and last for around 30 hours. The optimum time to mate ewes 12 -18 hours after the onset of oestrous.

The most commonly adopted practice If joining outside of the peak breeding season, teasing for 14 days at a rate of 1 % followed by a 35 day joining.

What about Split joining? How does it work?

Growers have been using the knowledge of oestrous length and onset to decrease joining times, to control conception times.

How

- Teasers are placed with ewes for 14 days @ 1%.
- Followed by 21 days rams in
  1. Joining percentage for Maiden ewes, rams at least 2 % + 1
  2. Joining percentage Mature ewes, rams at least 1.5% +1
- 10 days rams out
- Then 21 days new rams in at the recommended ram % listed above.

Note: In general, higher ram joining rates of 3 – 4% should be considered in large paddocks with multiple watering points.

Figure 1 Pictured: Jason Stokes, primary producer at Chapman Valley WA, has implemented split joining on his property for the last 4 years.

Why Split Join

- More even lamb weights at marking, reducing stress on lambs and increasing effectiveness of vaccination program.
- More even lines of marketable weaners.
- Weaners ready for market at different times spreads the risk.
- Allows to finish lambs in a short season more cost effectively.
- Manage rotational grazing and winter cereal grazing easier.
- Allocate feed sources more efficiently, due to ewes at similar stage of gestation.
- Supports ease of ewe nutritional management in late gestation to maintain BCS 3.
- Allows to measure and manage genetic gain.
- Allows for pre-lambing drenches and vaccinations to be more targeted and timely.
- Allows to measure and capture more accurate data on lambs in a commercial setting i.e., marking weights are more accurate.
- Spreads labour across the husbandry activities.

Other points to consider at joining to improve fertilisation regardless of joining length:

Ewe lamb puberty only occurs under good nutritional conditions at 6 -8 months of age, the photoperiod is critical in timing of first repro cycle, bodyweight (70% of Mature Weight) & condition score 3 -3.5 & breed dependent.

Maidens - demonstrate shorter less intense oestrous

- Avoid joining inexperienced rams with maiden ewes
- Try to avoid joining maiden ewes in the same mob as with older ewes

Ovulation rate is more related to the body reserves of a ewe, rather than the current plane of nutrition.

In Practice

Jason Stokes, Primary Producer in Chapman Valley WA, runs a 5500 ha broad acre cropping and mixed farming enterprise. With 4000 ha of winter broadacre cropping and mating 5500 merino ewes. He has been implementing split joining's on his property for the past 4 years. With 3-week matings blocks, he removes the rams for 10 days, then uses back up rams for another 3 weeks. He has found it has really evened out his lambing and weaning weights and has helped him manage his pastures intensively. It has allowed for rotational grazing across his winter crops, rather than set stocking which has assisted in getting his lambs up and going.

7.5.2.6 Project factsheet – Using data to drive decisions

Utilising eID allows for collecting individual data that can inform culling decisions and drive profitability. It allows to identify the top performers and the poor performers on meat, wool and fertility traits over time, this data then can be utilized along with visual assessment to make culling decisions in line with the breeding objectives.

Usage of eID data will depend on producers breeding objectives and profit drivers, they could include:

- Wool characteristics - fleece weights and micron
- Health treatments
- Sire / Dam linkage
- Lamb, weaning weights
- Pregnancy status
- Growth rate monitoring
- Visual Classing
- Collating historical data
- Supplements consumed

How much does it cost?

Costs vary depending on data / testing collected and whether equipment is purchased, hired or a service provider is engaged. When starting out engaging a service provider, is a cost-effective way to determine the eID requirements.

Key data collection that drives profitability

What data collection and culling decisions will give the best ROI. It depends on the type of enterprise the breeding objectives and culling decisions that are made. In general, in a commercial merino flock collecting data on higher fleece weights, lower micron, pregnancy scanning results and making culling decision on these traits is a sound starting point. The ROI expected can be between

$3.50 / $4.14 per breeding ewe depending on data collected and culling decisions made. For cross bred mobs focusing on pregnancy scanning results and selecting replacement ewes born from a twin mob increases the chance of more kg / ha Dickson (2019).

Know your breeding objectives

It's easy to collect lots of data and not utilise it, talk to other primary producers and service providers first, before diving in.

- Avoid over capitalising in the wrong equipment.
- Engage a service provider when starting out.
- Backup data and learn how to navigate excel.

Reference: Dickson (2019) MLA Project- Maximising the value of existing technology for sheep producers

The MLA Producer Demonstration Site Growers, based in Midwest of WA, implemented eID in the PDS maiden ewe mobs, the key data recorded against the individual ewes for the 3 year project across the four properties consisted of:

- Body Condition Score and Body weights at joining
- Preg scanning data- (pregnancy status, litter size, and foetal age), BCS & BW
- Fleece weights at shearing

Other information recorded on one or more of the properties:

- Lamb marking weights
- Parentage testing / Smart Shepherd Collars
- Fleece micron testing
- Weaning weights

This data was used to track ewe repro performance and wool value, and measure against the cost of production.

Figure 2 Martins Ewe Scan, Preg Scanning unit equipped to record Preg Status, litter size and foetal aging using eID.

Figure 2 Fleece weighing at Goulds Property, Northampton WA

7.5.3 Videos

7.5.3.1 eID & tracking individual animal performance

https://youtu.be/6Y8KSZIDLJc

7.5.3.2 Ewe & Ram reproduction

https://youtu.be/73iDhq1DmjM

7.5.3.3 Scanning & feeding

https://youtu.be/fhgMleWd8H4

7.5.3.4 Split Joinings

https://youtu.be/oneOtXi4lto

7.5.3.5 Using WEC to drive drenching decisions

https://youtu.be/zzXVRdoJB-s