

# Building an AI Farm Advisor for O'Sullivan Farms: Comprehensive Research Report

The Australian sheep industry benchmark for successful breeding operations is 150% scanning, 130% marking, and 125% weaning, (Evergraze +3) but top-performing Murray River operations achieve these targets through five critical levers: precise body condition management at joining (BCS 3.0-3.5), (Local Land Services +2) strategic ram fertility testing showing 30% failure rates without screening, (Agriculture and Food) differential nutrition for twin-bearing ewes requiring 75% more energy in late pregnancy, (Meat & Livestock Australia +4) mob sizes under 100 ewes for twins where each additional 100 ewes reduces survival by 2-3%, (Australian Wool Innovation) (agriculture) and shelter provision reducing cold-weather lamb mortality by 30%. (Evergraze) These interventions deliver return on investment between 400-500% for pregnancy scanning and differential management.

(Agriculture Victoria +4) The Murray River region's unique challenge is matching the 463mm average annual rainfall and extreme summer temperatures (regularly exceeding 40°C) with optimal joining windows in March-May for spring lambing that capitalizes on both natural breeding cycles and spring price premiums of 15-25%.

(Meat & Livestock Australia) (nsw) Understanding that consistent 120% weaning rates place operations in the top 20% for profitability (Meat & Livestock Australia) means the focus should shift from maximizing conception to optimizing lamb survival, (Meat & Livestock Australia) (AgriWebb) where 60-70% of losses between scanning and marking are preventable through nutrition, shelter, and management rather than genetics.

## Victorian benchmarks reveal the profitability equation for Murray River sheep farming

Industry data from Holmes Sackett analyzing top-performing operations shows a counterintuitive finding: you only need consistent 120% weaning rates to achieve top 20% profitability, not the 150%+ rates many producers chase. (AgriWebb) The differential between top performers at \$25 per dry sheep equivalent profit and average operations at \$10 per DSE comes primarily from efficiency and lamb survival rather than absolute conception rates. (Meat & Livestock Australia) (Sheep Central) Merino flocks in Victoria average 150% scanning when ewes reach BCS 3.0 at joining, with top performers pushing to 165%, while crossbred operations routinely achieve 150-170% scanning. (Evergraze) (Evergraze) However, national scanning data across 7 million ewes reveals that 76-84% pregnancy rates indicate most Australian flocks have fertility challenges rooted in inadequate pre-mating nutrition rather than genetic limitations. (NSW Department of Primary In...)

The conversion from scanning to marking percentage represents the profitability battleground. Victorian prime lamb averages show 100% marking rates, (Evergraze) meaning 30-40% of scanned lambs are lost before processing. Target survival rates differ dramatically by birth type and breed: Merino singles should achieve 92% survival while Merino twins target 75%, compared to first-cross operations reaching 97% for singles and 87% for twins. (sheepconnectsa) Understanding that twin lamb mortality of 25% sits within acceptable ranges while single lamb losses above 10% signal management problems allows accurate diagnostic assessment. The marking to weaning period typically loses only 1-3% of lambs, (The Toolbox) indicating that the critical intervention window closes at 6-8 weeks post-lambing when marking occurs.

## Body condition scoring drives every productivity metric in the breeding cycle

Research across Australian flocks demonstrates that each 0.5 unit increase in body condition score at joining

generates approximately 10% improvement in conception rates, translating to 20 extra lambs per 100 ewes per full condition score unit gained. (Awixextensionwa +2) Ewes at BCS 3.0 at joining produce less than 10% dry rates in Merinos and under 5% in crossbreds, while ewes below BCS 2.5 show dramatically increased barrenness and reduced multiple births. (Evergraze +2) The challenge for Murray River operators is that achieving a single condition score unit improvement requires 6-8 weeks on high-quality pasture, (Department of Agriculture, Env...) meaning intervention must begin at weaning for the next joining cycle.

The condition score targets vary precisely by breeding stage and pregnancy status. At joining, all ewes should reach BCS 3.0-3.5 regardless of breed. (Purina +2) During early to mid-pregnancy, maintaining BCS 3.0 minimum prevents early embryo loss. (Meat & Livestock Australia) (Sheepconnectsa) The late pregnancy period demands differentiation: single-bearing ewes should reach BCS 3.0-3.5 at lambing while twin-bearing ewes require BCS 3.5-4.0, reflecting their 75% higher energy demands in the final six weeks of pregnancy. (USU +6) Oregon State research quantified this impact dramatically: ewes at BCS 4.0 at lambing weaned 113 pounds of lamb per ewe compared to just 62 pounds for BCS 2.5 ewes, an 82% improvement driven almost entirely by lamb survival rather than growth rates. (OSU Extension Service) (Oregon State University) Australian research on triplet-bearing Merino ewes confirmed that higher body condition improved both ewe and lamb survival, with study animals at BCS 3.3 showing significantly better outcomes than those below 3.0. (PubMed Central)

The practical conversion shows that one condition score unit equals approximately 13% of live weight at BCS 3.0-3.5, meaning a 60-kilogram ewe needs to gain 8 kilograms to move from BCS 2.5 to 3.0.

(OSU Extension Service) (Department of Agriculture, Env...) Achieving this gain requires either 6-8 weeks on high-quality green pasture or targeted supplementation with grain at 300-500 grams per day for 4-6 weeks.

(Department of Agriculture, Env...) The assessment technique focuses on palpating the lumbar spine behind the last rib, feeling for prominence of spinous and transverse processes: BCS 1 shows very prominent sharp processes, BCS 3 requires pressure to feel smooth rounded processes, and BCS 5 shows a dimple where processes cannot be felt. (Farm Advisory Service +5) Scoring 10-20% of the flock at key decision points—weaning, pre-joining, scanning, and pre-lambing—provides sufficient accuracy for management decisions while remaining time-efficient at seconds per sheep once practiced. (Extension) (USU)

## Ram fertility testing delivers immediate return despite 30% failure rates

Breeding soundness examinations conducted 8 weeks before joining reveal that 30% of rams fail fertility standards even when appearing physically normal, (Ceva) (OSU) making this intervention's 400% return on investment among the highest in sheep production. (Agriculture and Food) The critical timing stems from the 7-week spermatogenesis cycle, meaning any nutritional or health interventions to improve ram fertility must occur well before joining. (Ceva) The "5T" physical examination assesses Teeth for adequate nutrition, Torso for body condition of 3.5-4.0, Toes for soundness to mount and serve, Testes for scrotal circumference above 33 centimeters in mature rams with firm symmetrical texture, and Tossle (penis) for ulcers or inability to exteriorize. (Ceva +3)

Semen evaluation standards require minimum 30% motile sperm, 70% normal morphology, and 2 billion sperm per milliliter concentration. (ScienceDirect) (DOAJ) Rams below these thresholds should be immediately culled from breeding programs as research shows individual rams can naturally serve 160-300 ewes within three weeks when fully fertile, (Ceva) far exceeding the 50-100 ewes typically allocated. The cost of testing at \$50-100 per ram generates \$10-12 profit increase per ewe joined, (Oklahoma State University) meaning a mob of 500

ewes joined to 10 tested rams returns \$5,000-6,000 additional profit compared to using untested rams, paying for the testing cost 10-fold.

Ram to ewe ratios vary dramatically by season and ewe type. Autumn joining during the natural breeding peak from March to May requires only 1% rams plus one spare (one ram per 100 ewes) for mature ewes, rising to 1.5% for maiden ewes whose shorter irregular estrous cycles of as little as 30 minutes versus 24-36 hours in mature ewes demand higher ram presence. Out-of-season spring joining requires 2.5-3% rams due to less synchronized cycling. [Business Queensland +3](#) For O'Sullivan Farms joining 550 ewes composed of 100 maidens, 350 mature, and 100 older ewes in autumn, the calculation shows 1.5 rams for maidens plus 3.5 rams for mature ewes plus 1 ram for older ewes totaling 6 rams minimum plus one spare equals 7 rams required, meaning the current 10 rams provides adequate insurance while 12 rams would offer minimal additional benefit unless shifting to out-of-season joining.

Ram preparation in the 8 weeks before joining significantly impacts performance. Shearing within 6 weeks of joining should be avoided as overheating reduces semen quality. Rams should be jetted and crutched if carrying more than 3 months wool growth. [business](#) Feed supplementation with 500 grams per head daily of lupins for rams over 80 kilograms improves testicle size and tone when started 6-8 weeks early. [Evergraze](#) Target body condition of BCS 3.5-4.0 at joining ensures rams maintain serving capacity throughout the 5-6 week joining period without excessive condition loss. [Agriculture and Food](#)

## Strategic flushing with green feed delivers 10-33 extra lambs per 100 ewes

Agriculture Victoria and MLA demonstration trials across 32 farms with 22,000 ewes established that short-term green feed flushing produces the highest return intervention in the pre-joining period. The protocol requires providing minimum 350 kilograms dry matter per hectare of green feed for one week before rams are introduced and continuing for one week into joining. Green feed options include lucerne, rape, millet, or green pasture following autumn breaks. Results showed 10-33 additional lambs scanned per 100 ewes compared to ewes joined on dry pasture, with both maiden and mature ewes responding. The mechanism works by reducing dry ewe percentage and increasing multiple births through improved ovulation rates on rising planes of nutrition. [Agriculture Victoria](#) [agriculture](#)

The flushing response proves greatest in ewes below BCS 3.0, though ewes above this condition still respond. [Awientensionwa](#) Long-duration flushing with ewes remaining on lucerne for 6 weeks total showed no negative effects and maintained the benefits, though at higher cost. [Agriculture Victoria](#) Lupin supplementation as an alternative proved less consistent than green feed flushing. [agriculture](#) The practical implication for Murray River operators is that where autumn breaks provide green feed, implementing the 2-week flush window around joining provides exceptional value, while in dry years the limited green feed available should be prioritized for flushing over extended lower-quality supplementation. [nsw](#)

Research quantifying body condition score impact at joining shows approximately 7-36% improvement in conception depending on genetics and lambing time, with later lambing showing more response to BCS improvements. [Awientensionwa](#) The economic value of achieving BCS 3.0 versus BCS 2.5 at joining approximates \$20 per ewe in improved scanning rates and subsequent lamb production. [sheepconnectsa](#) Given that achieving one condition score unit costs \$10-15 per ewe in supplementation over 6-8 weeks, the return on investment remains strongly positive for ewes below target condition.

## Joining duration of 5-6 weeks captures optimal conception without extending lambing

The recommended joining period of 5-6 weeks (35-42 days) covers 2-3 estrous cycles at 17 days per cycle, achieving maximum conception in a compact period. Single-bearing ewes show 90% conception within 3 cycles. (Meat & Livestock Australia) Extending joining beyond 6 weeks captures an additional 2-4% conception but creates multiple disadvantages: extended lambing periods complicate management, delayed marking and weaning occur, increased worm burdens develop, a greater "tail" of lighter lambs reduces average sale weights, higher mortality risk affects late-born lambs, and delayed ewe condition recovery before next joining hampers reproduction. (Awieextensionwa) Some progressive operations now use 4-week joining successfully for very compact lambing, though this may miss some ewes especially maidens.

The timing of joining in the Murray River region should target March to May for autumn joining toward winter-spring lambing. This natural breeding season peak achieves 90-95% pregnancy rates without stimulation.

(Business Queensland +2) The alternative spring joining for autumn lambing requires ram effect or teaser rams to stimulate out-of-season cycling, needs higher ram ratios of 2.5-3%, and most critically, forces lambing into the autumn feed gap when pasture growth slows and supplementary feeding costs escalate. Victorian examples from 2024 showed autumn lambing operations feeding continuously from mid-pregnancy through weaning due to poor autumn conditions, dramatically increasing per-head costs. (Agriculture Victoria) (Farm Weekly)

## Pregnancy scanning with differential management generates 400% return on investment

Scanning at 80-90 days after rams are introduced provides sufficient accuracy to identify pregnant versus dry ewes and to differentiate singles from twins or triplets. (Sheepconnectsa +4) The immediate value comes from culling dry ewes, particularly those dry for a second consecutive year, older ewes over 6 years that are dry, or ewes with concurrent health issues. MLA benefit-cost analysis values removing these "passenger" ewes at \$1.85 per ewe scanned through immediate cash flow and feed reallocation to productive animals. (Agriculture Victoria +4)

The differential management value proves even larger. Twin-bearing ewes separated into their own management groups receive the 75% additional energy they require in late pregnancy compared to the 50% increase for single-bearing ewes. (Agriculture Victoria) (agriculture) Physical feed requirements show a 60-kilogram ewe at BCS 3.0 needs 9.5 megajoules per day when dry, rising to 12.2-14.6 megajoules for singles and 13.9-17.0 megajoules for twins in late pregnancy. At peak lactation, singles require 14.4-23.8 megajoules daily while twins demand 16.5-30.5 megajoules, a 28% increase. (Meat & Livestock Australia +5) Feed on offer targets reflect this differential: single-bearing ewes need 1,200 kilograms dry matter per hectare at lambing while twin-bearing ewes require 1,800 kilograms per hectare minimum. (Evergraze +2)

The economic benefits of differential feeding total \$1.00 per ewe in improved twin survival, while optimal paddock allocation for twins to sheltered areas contributes another \$0.95 per ewe in reduced mortality. Identifying twin-born replacement ewes adds \$0.95 per ewe in improved lifetime fertility of replacements. Combined with removing dry ewes, the total pregnancy scanning benefit reaches \$5.55-5.75 per ewe against scanning costs of \$1.20-1.50, delivering the documented 400% return on investment. (Agriculture Victoria +2)

Management protocols post-scanning require separating dry ewes for immediate sale or culling, grouping single-bearing ewes for moderate nutrition maintenance, and prioritizing twin-bearing ewes for best paddocks

with shelter, smallest mob sizes, and highest feed allocation. [Agriculture Victoria](#) Within the twin group, further separation by ewe condition identifies lower-BCS animals for preferential feeding to reach target BCS 3.5-4.0 at lambing.

## Lamb mortality patterns reveal 60-70% of losses are preventable through management

Australian sentinel flock studies tracking 3,198 lambs identified that starvation-mismothering causes 25% of deaths, stillbirths 21%, birth injury and dystocia 19%, exposure 16%, predation 7%, abortion 5-10%, and disease 5%. [Agriculture Victoria](#) [Zoetis](#) The critical finding is that 60-70% of these losses respond to management interventions in nutrition, shelter, mob size, and paddock selection, while only 20-30% stem from largely unpreventable factors like genetic defects or extreme weather events.

The temporal pattern shows 6% of lambs die within 24 hours of birth, an additional 14% by 7 days, 3% between 7-30 days during the marking period, and 8% between marking and weaning from 30-110 days. [PubMed](#) This front-loaded mortality curve means interventions must focus intensively on the first week of life when 20% of all losses occur. Maiden ewes experience 29-36% average loss rates from scanning to marking compared to 20-25% in mature ewes, driven by higher dystocia rates where maidens represent over 60% of difficult births despite being a minority of the flock. [NCBI +2](#)

Target survival benchmarks by birth type show single Merino lambs should reach 92% survival, twin Merinos 75%, while first-cross operations achieve 97% for singles and 87% for twins. [sheepconnectsa](#) When twin survival falls below half of single survival rates, management problems exist beyond the natural vulnerability of twins. For O'Sullivan Farms, a 180% scanning result marking at 140% represents 22% lamb loss, placing performance at the upper end of the normal 20-25% range for mature ewes but indicating substantial opportunity for improvement toward the 10-15% loss achieved by top performers.

## Exposure and hypothermia dominate lamb deaths in Murray River winter lambing

Victorian winter lambing from August to October aligns peak lamb vulnerability with the region's coldest wettest period when overnight minimums average 2°C and frost risk remains high. The combination of cold, wet, and wind proves most lethal, with wet coats increasing heat loss by 13% and wet plus wind by 18%.

[Agriculture Victoria](#) Twin lambs face higher exposure risk due to lower average birth weights typically 500 grams lighter than singles, slower to stand and nurse, and less body fat reserves for thermogenesis.

Shelter provision research quantifies the benefit: pasture height above 10 centimeters reduces lamb mortality by 10% compared to short pasture, tree belts and natural shelter reduce losses by 30% in adverse weather, [Evergraze](#) and even temporary measures like hay bale windbreaks improve survival by 5.3%. [Agriculture Victoria](#) [Meat & Livestock Australia](#) The mechanism works through reducing wind speed at ground level where newborn lambs shelter, allowing them to dry faster and conserve body heat during the critical first 6 hours when they establish feeding and bonding.

Paddock selection priorities for lambing rank shelter as most important for twin-bearing ewes, followed by adequate feed on offer to keep ewes on the birth site for 6-12 hours while bonding occurs, then water access with multiple points preventing congregation that increases mis-mothering. [Zoetis +3](#) Paddock size matters less than mob size, with research showing each additional 100 ewes in a mob decreases twin lamb survival by 2-3%

independent of stocking density. The recommended maximum mob size for twins is 80-100 ewes, while singles can run in groups up to 200-400 ewes. (Agriculture Victoria +4)

For O'Sullivan Farms' scenario of 500 ewes about to lamb with three paddock options, the optimal allocation would place twin-bearing ewes split into two mobs of 80 each in the 50-hectare sheltered paddock using temporary electric fencing to subdivide and separate management groups, assign all single-bearing ewes to the 80-hectare open paddock with excellent feed since they tolerate exposure better and need less shelter, and reserve the 45-hectare hilly paddock with water at the bottom as last resort since water placement at low points forces ewes away from birth sites increasing mis-mothering risk. If weather forecasts show incoming cold fronts, priorities shift entirely to shelter over feed quality, accepting supplementation costs to prevent catastrophic losses.

## Nutrition-driven metabolic diseases concentrate in the final six weeks of pregnancy

Pregnancy toxemia (twin lamb disease) represents the most common and costly metabolic disease, primarily affecting ewes carrying twins or triplets in the last 4-6 weeks of gestation. (Farm Health Online +2) The condition develops when energy demands of rapid fetal growth—70% of total fetal growth occurs in the final 6 weeks—exceeds dietary intake, forcing mobilization of body fat that produces ketones causing neurological dysfunction. (Local Land Services) (SlideShare) Mortality reaches 80% if untreated, with death occurring 2-10 days after symptom onset. (Local Land Services +2)

Risk factors include twin or triplet bearing, body condition below BCS 2.5 or paradoxically over-fat ewes above BCS 4.0 where abdominal fat reduces rumen capacity, sudden feed reduction from weather or paddock changes, poor quality feed below 8.5 megajoules metabolizable energy per kilogram dry matter, and stress from yarding or excessive movement. (Farm Health Online) (Local Land Services) Symptoms progress from early signs of dullness, lagging behind the flock, teeth grinding and labored breathing to late-stage inability to stand, apparent blindness, walking in circles, and recumbency. (Local Land Services) Early intervention proves critical with propylene glycol at 200 milliliters orally four times daily or intravenous dextrose at 25 milliliters of 20% sterile glucose solution, (NADIS) while advanced cases require veterinary intervention and carry poor prognosis.

(Lamb Care Australia)

Prevention protocols focus on achieving and maintaining target body condition scores of BCS 3.0-3.5 for single-bearing ewes and BCS 3.5-4.0 for twin-bearing ewes throughout late pregnancy, with high-energy diet providing the increased megajoules required. Analyzing forage quality ensures metabolizable energy exceeds 9.0 megajoules per kilogram, avoiding sudden feed changes or stressful handling in late pregnancy, and keeping emergency feed readily available for rapid intervention when conditions deteriorate. (Farm Health Online)

Hypocalcemia (milk fever) often occurs concurrently with pregnancy toxemia, triggered by sudden increases in calcium demand during late pregnancy and early lactation exceeding dietary supply. (Local Land Services +3) Treatment with 4-in-1 intravenous fluids containing glucose, phosphorous, magnesium, and calcium shows rapid response if caught early. (Flockandherd) (Lamb Care Australia) Prevention requires adequate but not excessive calcium supplementation before lambing—less than 50 grams per day—then significant increases post-lambing when milk production demands peak, utilizing the calcium-rich clover pastures common in spring.

## Mob size impacts twin survival more than stocking density

Research separating mob size effects from stocking density effects revealed that the number of ewes running

together influences twin survival more than how many sheep per hectare occupy the paddock. Studies showed 3% decrease in twin survival per additional 100 ewes in mob size, meaning a mob of 300 ewes achieves 6-9% lower survival than mobs of 100 ewes even when both run at identical stocking densities.

(Australian Wool Innovation +2) The mechanism relates to increased disturbance, greater difficulty in ewes maintaining birth site territories, higher mis-mothering as newborn lambs encounter wrong ewes, and reduced observation ability for producers to identify and assist difficult births in very large groups.

The practical recommendations set maximum mob sizes for twin-bearing ewes at 80-100 head, with some research suggesting the common industry recommendation of 100-150 runs too high for optimal outcomes. Single-bearing ewes tolerate larger mobs up to 400 head without significant survival decrements.

(Agriculture Victoria) (agriculture) During lambing, ewes naturally cluster utilizing only 34-43% of available paddock area regardless of total paddock size, meaning subdividing paddocks with temporary electric fencing to create multiple smaller management units improves outcomes even when total stocking density remains constant.

The stocking density during lambing should target 5-8 ewes per hectare, though this matters less than mob size.

(Australian Wool Innovation) The key driver is ensuring adequate feed on offer—1,800 kilograms dry matter per hectare for twins, 1,500 for singles—to prevent ewes from needing to walk long distances from birth sites while establishing bonds. (Agriculture Victoria) (agriculture) Movement timing requires placing ewes in final lambing paddocks 7-10 days before lambing begins to allow settling and territory establishment, then never moving mobs once lambing starts as disturbance causes abandonment and increased mortality.

## Dystocia rates increase with cold weather two weeks before lambing

Birth difficulty (dystocia) causes 19% of lamb deaths through direct birth injury, particularly meningeal lesions and presentation difficulties that account for 66.6% of dystocia deaths. (Meat & Livestock Australia) Maiden ewes represent over 60% of dystocia cases despite being a minority of flocks, (Agriculture Victoria) driven by smaller pelvic dimensions, first-time maternal behavior, and higher proportions of malpresentation. (UKEssays +2) Research identified an unexpected finding that cold weather 2 weeks before lambing increased dystocia rates more than cold weather during the actual lambing period, possibly through effects on ewe metabolism and cervical preparation. (Local Land Services) (nsw)

Risk factors include maiden ewe status, over-fat ewes above BCS 3.5 where abdominal fat may interfere with lambing mechanics, large single lambs above 6 kilograms birth weight from excessive feeding of single-bearing ewes, and twin or triplet presentations where multiple lambs complicate delivery. The 67% of fetal causes trace to malpresentation while 64% of maternal causes involve ringwomb where the cervix fails to dilate despite labor contractions. (Science-line) (PubMed)

Intervention timing requires assessment when membranes rupture without progress for more than one hour, abnormal presentation becomes visible, or ewes show obvious distress. (UKEssays) (Sale Creek) Assistance protocols demand strict hygiene with arm-length gloves and approved scrub solutions, cleaning the ewe's vulva and anus thoroughly, liberal lubrication, gentle manipulation only without forcing, and never attempting to force open a ringwomb cervix. (NADIS) Applying traction only with the ewe's contractions while considering epidural anesthesia at 0.5 milligrams per kilogram lignocaine to block straining allows repositioning. (UKEssays) Calling veterinarians becomes necessary when no progress occurs after 30 minutes of skilled effort, lamb orientation cannot be determined, ringwomb doesn't respond, or dead lambs remain retained. (Sale Creek)

Prevention focuses on maintaining optimal body condition rather than over-conditioning, with singles fed to reach BCS 3.0-3.5 but not higher to avoid oversized lambs. Genetic selection using "Lambing Ease" Australian Sheep Breeding Values identifies rams producing easier births. Calcium and magnesium supplementation in late pregnancy, particularly on lush green feed or cereal crops, helps maintain normal cervical function.

Local Land Services NSW

## Vaccination timing at 4-6 weeks pre-lambing provides colostral immunity

The single most important vaccination for sheep operations involves 6-in-1 clostridial vaccines covering pulpy kidney, blackleg, black disease, tetanus, malignant oedema, and cheesy gland (caseous lymphadenitis).

Agriculture Victoria The 6-in-1 formulation proves superior to 5-in-1 by including cheesy gland protection, a disease causing abscesses, decreased wool production, and major carcass condemnations at slaughter. Vff Ewe vaccination must occur 4-6 weeks before lambing to allow adequate antibody response while avoiding the period within 6 weeks of lambing where vaccine reactions can cause mastitis if administered in the flank region.

Agriculture Victoria OSU Vaccination in the neck area 5 centimeters from the base of the ear avoids valuable meat cuts and reduces reaction risks. Vff +2

The critical value of pre-lambing ewe vaccination lies in transferring immunity to lambs via colostrum, providing protection for 6-8 weeks post-birth during their most vulnerable period. Vff This maternal immunity bridges to the lamb's first vaccination at marking around 6-8 weeks, followed by essential second dose 4-6 weeks later typically at weaning. Sheepconnectsa The second dose proves critical as protection from the first dose lasts only 4-6 weeks, with full immunity requiring the two-dose initial series plus a 12-month booster, after which annual boosters maintain protection. Sheepconnectsa Think Livestock

Lamb vaccination programs require 6-in-1 at marking, second dose at weaning, then annual boosters for life. Weaners on high-quality pasture or grain face heightened pulpy kidney risk and may need additional protection every 3-4 months. Vff Sheepconnectsa Special considerations include vaccinating introduced rams before joining, ensuring all rams receive annual boosters, and remembering that tetanus and blackleg provide lifelong immunity after the initial two-dose course plus one 12-month booster while pulpy kidney, black disease, and malignant oedema require annual boosters indefinitely.

## Parasite management shifted from calendar drenching to strategic WormTest-guided programs

The WormBoss program developed by University of Melbourne Mackinnon Project and Australian Wool Innovation transformed Australian sheep parasite control from fixed-schedule blanket drenching to strategic testing and targeted treatment. wormboss Agriculture Victoria The shift occurred because approximately 90% of tested Victorian properties now show drench resistance to older benzimidazole (white) and levamisole (clear/yellow) chemical families, requiring preservation of newer monepantel (orange) and derquantel combinations (purple) through judicious use. Farmers Weekly +2

The five-component WormBoss strategy combines smart grazing management to access low worm-risk paddocks after spelling, breeding for worm resistance by selecting rams with negative worm egg count ASBVs, strategic WormTests to guide decisions rather than routine treatments, strategic drenching only when necessary based on testing, and drench resistance management through DrenchTests every 2-3 years to identify which chemical groups remain effective. Meat & Livestock Australia +2 Victorian winter rainfall region recommendations

specify conducting WormTests 4-6 weeks after weaning drench for weaners, during January-February if barber's pole worm signs appear, in late January-early February before second summer drench, after autumn breaks at 2-6 week intervals through winter, during July-August for highest risk mobs, and pre-lambing for ewes especially those with BCS below 2.5 or pasture below 1,200 kilograms dry matter per hectare. (wormboss)

The critical drenches that remain mandatory regardless of testing include first summer drench for all sheep including rams in November-December, all lambs at weaning using effective drenches, all introduced sheep using combinations of four or more unrelated chemical groups including monepantel or derquantel, and sheep moving onto low worm-risk paddocks. (wormboss) (WormBoss) Other drenching should follow WormTest results and Drench Decision Guides rather than calendar dates.

Effective drenches must achieve greater than 95% reduction in worm egg counts and preferably greater than 98% in DrenchTest evaluations. (Sheepconnectsa +2) Using multi-active combination drenches with multiple chemical groups slows resistance development. Rotation among all effective drench groups rather than fixed patterns, restricting long-acting products to specific high-risk times, calibrating drench guns accurately, dosing to the heaviest sheep in the mob, and following label instructions precisely all contribute to preserving drench effectiveness. (Meat & Livestock Australia +2)

## Flystrike prevention requires integrated management from breeding to chemical protection

Australian FlyBoss resources identify that flystrike risk peaks when temperatures exceed 17°C, wind drops below 30 kilometers per hour, and fleece remains moist from rainfall for several days, conditions common in Murray River spring to summer periods. (CSIRO PUBLISHING +3) The integrated prevention strategy layers multiple approaches beginning with breeding and selection for low wrinkle score, low dag accumulation, and reduced breech cover that minimize moist skin folds attractive to flies. (CSIRO PUBLISHING +2)

Management interventions include strategic shearing and crutching timed for high-risk periods, dag control through nutrition and parasite management, breech modification procedures performed with pain relief, and most critically for commercial operations, early-season chemical prevention applied before fly activity begins. (Agriculture Victoria +2) Long-acting preventatives provide 8-20+ weeks protection depending on product formulation, with timing planned so shearing or crutching occurs as protection ends, minimizing treatment applications while maintaining coverage through the high-risk spring-summer period. (FlyBoss) (Elanco)

Chemical options include various insect growth regulators and adulticidal compounds applied as backline treatments, jetting, or plunge dipping. (Vff) The key principle involves treating the entire flock before strike season rather than spot-treating struck sheep, shifting from reactive treatment to proactive prevention.

Properties without preventative programs must inspect all sheep every 2 days minimum during risk periods, a labor-intensive approach compared to whole-flock prevention. (FlyBoss) (Agriculture Victoria)

Treatment of struck sheep requires removing all affected wool, applying registered insecticides, solarizing removed wool in black bags left in sun to kill maggots, marking treated sheep for monitoring, and isolating them from the main mob for intensive observation. (Agriculture Victoria +2) The economic and welfare costs of treating strikes far exceed prevention costs, making integrated prevention strategies the industry standard.

## Lice treatment timing at off-shears or within 24 hours post-shearing achieves highest efficacy

Australian LiceBoss guidelines establish that lice treatment proves most effective immediately after shearing when wool length measures under 25 millimeters, allowing chemical contact with lice before they retreat deep into regrowth. The critical timing windows are off-shears within 24 hours after shearing when most products achieve near-complete eradication, or short wool 2-6 weeks post-shearing offering good but reduced efficacy compared to off-shears treatment. (LiceBoss) (N & W Livestock) Long wool treatments reduce lice populations but rarely eradicate them except with the oral fluralaner drench that achieves eradication at any wool length.

(LiceBoss +2)

Treatment methods include backline products applied within 24 hours of shearing, plunge dipping or shower dipping, and oral drenches. (Sheepconnectsa) (LiceBoss) Eight chemical groups provide options as of 2023, though resistance has emerged to some groups requiring rotation similar to worm control. (LiceBoss) (LiceBoss) Monitoring involves checking for lice at least twice yearly and particularly watching for rubbing behavior that serves as a powerful indicator of infestation. (LiceBoss)

Special timing considerations include avoiding treatment of pregnant ewes within 6 weeks before lambing unless newborn lambs will also be treated, since lice transfer from ewes to lambs during nursing. (LiceBoss) (LiceBoss) The prevention approach emphasizes treating all sheep on the property simultaneously to prevent rapid reinfestation from untreated groups, with some operations treating every sheep at each shearing to maintain lice-free status rather than waiting for problems to emerge.

## Murray River region climate creates specific management challenges and opportunities

The Echuca and broader Murray River region's 463-465 millimeter average annual rainfall (Climate Data) places it in Victoria's lower rainfall zone, below the 650-1000 millimeter Western District high rainfall zone but above the 350-450 millimeter semi-arid Wimmera. (Evergraze +2) This intermediate position with access to Murray irrigation infrastructure creates the region's defining characteristic: ability to intensify production through irrigation during dry periods while maintaining lower-cost dryland operations during favorable years. (nsw) The climate pattern shows winter rainfall dominance with 100-120 millimeters June through August, spring peak of 100-130 millimeters September through November during critical lamb growth periods, summer low of 80-100 millimeters December through February, and autumn 90-110 millimeters March through May with high unreliability in autumn break timing.

Temperature extremes exceed most other Victorian sheep regions with summer maximums averaging 31-33°C but regularly reaching 35-40°C and exceeding 45°C during extreme heat events, creating heat stress risk for pregnant ewes. (Weather and Climate) Winter maximums average 12-15°C with minimums around 2°C and significant frost risk, establishing the cold stress challenge for August-October lambing periods.

(Weather and Climate) The heat stress threshold of 32°C gets regularly exceeded January through February, the period when autumn joining programs place rams with ewes, requiring shade, water, and minimal handling as heat stress increases embryo mortality 26-fold and reduces lamb birth weights.

Pasture growth patterns follow the rainfall with peak spring growth of 40-80 kilograms dry matter per hectare per day on good improved pastures, winter rates of 10-25 kilograms, summer decline to 5-15 kilograms creating the significant 3-4 month feed gap, and autumn recovery to 20-40 kilograms if adequate moisture arrives. The unreliable autumn break represents a major challenge specific to the region, creating uncertainty in joining and lambing planning as feed availability at critical times becomes unpredictable year to year.

## **Irrigation access differentiates Murray River operations from comparable rainfall zones**

The Murray River region's unique advantage over similar-rainfall areas in the Wimmera or South Australian Murray Mallee lies in established irrigation infrastructure from Hume Dam and Murray Irrigation Areas. This water access allows intensification with improved pastures, summer-active species, and tactical irrigation during drought, dramatically lifting carrying capacity from dryland 10-25 dry sheep equivalents per hectare to irrigated 25-30+ DSE per hectare. The water trading system provides flexibility to sell allocations during drought when destocking occurs, generating cash flow, then purchasing water during favorable years when full stocking requires irrigation support.

Soil fertility on riverine alluvial plains ranks among Victoria's highest, supporting diverse mixed farming enterprises integrating sheep with rice, cereals, and irrigation crops impossible in specialized sheep regions. Market access benefits from equidistance to Melbourne at 171 kilometers and Albury-Wodonga major processing centers, plus access to NSW markets across the state border that functions as a single agricultural region around Echuca-Moama.

The climate change projections for the region show increasing temperatures, decreasing rainfall particularly in autumn and winter, and more extreme heat events, indicating the region will become more challenging for dryland operations while irrigation access becomes an increasingly critical differentiator separating viable from marginal enterprises. Competition for water from high-value permanent plantings like almonds and vineyards drives up water costs, forcing sheep enterprises to justify irrigation use economically or shift to more drought-tolerant extensive grazing models.

## **Seasonal price patterns reward spring lambs with 15-25% premiums**

Victorian lamb marketing data shows young lamb supply peaks during July-August in NSW and mid-November through mid-December in Victoria, with price peaks occurring during low supply periods in the last week of July through end of August for young lambs. The seasonal pattern places highest per-head prices in late May through end of July for older lambs, creating a 15-25% price premium during peak spring demand compared to autumn supply glut pricing. In 2025, spring lamb prices reached unprecedented levels above \$11 per kilogram dressed weight compared to typical ranges of \$7-9 during summer-autumn supply peaks.

This price premium strongly favors autumn joining for winter-spring lambing, allowing lambs to hit market during peak spring prices. The alternative spring joining for autumn lambing forces marketing during the supply glut when prices typically run 15-25% below annual peaks. Additionally, autumn lambing requires lambing into the autumn feed gap when pasture growth slows, necessitating significant supplementary feeding through lambing and early lactation. Victorian examples from 2024 showed continuous feeding from mid-pregnancy through weaning in autumn lambing systems due to poor autumn conditions, dramatically increasing per-head costs compared to spring lambing operations utilizing spring flush pasture growth.

The strategic implication for Murray River operations is that autumn joining during March-May for August-October lambing aligns natural breeding season peak fertility, spring flush feed availability for lactating ewes, and optimal market prices, creating the triple advantage that explains why this timing dominates successful operations. The joining period duration of 5-6 weeks during March-May, scanning at 80-90 days in May-June, differential management through winter, lambing in August-October onto spring flush growth, marking at 6-8

weeks in September-December, and weaning in December-February creates the annual cycle optimizing both biological and economic factors.

## Predator control requires integrated management starting pre-lambing

Fox predation accounts for 5-10% of lamb losses on average but can reach 20% in high fox density areas, with distinction between primary predation of live lambs and secondary scavenging of already-dead lambs complicating diagnosis. The Murray River region harbors variable fox densities plus wild dogs in some areas, requiring continuous management rather than sporadic control efforts. Eagles contribute additional predation pressure particularly on newborn lambs in open paddocks without shelter.

Effective predator control begins with coordinated baiting starting 4-6 weeks before lambing and continuing through the lambing period, recognizing that single-property efforts show limited success when surrounding properties don't participate. Canid Pest Ejectors provide valuable tools for targeted wild dog control in areas where dogs pose significant threats. Guardian animals including Maremma dogs, alpacas, or llamas provide non-lethal alternatives or supplements to lethal control, though requiring training and ongoing management.

Carcass removal of dead lambs and stillbirths reduces secondary predation by eliminating food sources that concentrate predators in lambing paddocks, and prevents the difficulty of distinguishing primary kills from scavenged carcasses during diagnostic investigations. Post-mortem examination can identify predation through characteristic signs: crow predation shows eyes, tongue, and anus pecked while body remains, fox predation typically involves carcass removal or caching, and eagle predation leaves talon marks on the back and skull.

## Data collection requirements focus on decision-enabling metrics at key timepoints

The essential data points to collect that enable AI advisory recommendations concentrate on specific measurements at key breeding cycle stages rather than continuous comprehensive monitoring. At weaning, record total lambs weaned, average weaning weights, ewe body condition scores, and mob composition by age class. Pre-joining at 8 weeks before rams introduced, record ewe body condition scores separated by age groups, ram breeding soundness exam results, final mob composition, and paddock feed on offer assessments.

At joining, record joining date, rams used with ages and identifiers, ewes joined by age class, ram to ewe ratios, flushing method if used, and paddock assignments. At scanning 80-90 days post-joining, record scanning date, dry ewes count, single-bearing ewes, twin-bearing ewes, triplets, total scanning percentage, and any health issues noted. Pre-lambing at 4 weeks before, record ewe body condition scores by pregnancy type, paddock allocations, supplementary feeding commenced, and weather forecasts. During lambing, record dates spanning first to last lambing, weather conditions during peak lambing, dead lambs with post-mortem findings if conducted, dystocia cases and interventions, and any disease outbreaks.

At marking 6-8 weeks post-lambing, record marking date, lambs marked separated by sex, marking percentage calculation, lamb weights if available, weather conditions, vaccination details, and treatments applied. At weaning, record weaning date, lambs weaned by sex, average weaning weights, ewe condition scores post-weaning, pasture conditions, and any health issues in lambs or ewes.

The Livestock Production Assurance requirements mandate recording all chemical treatments within 48 hours including date, animal identification, product name and batch number, expiry date, dose given, withholding period and export slaughter interval, reason for treatment, and person administering. Records must be

maintained minimum 3 years or duration livestock remain on the Property Identification Code, whichever proves longer. Digital recording options include spreadsheets, farm management software, or online LPA accounts, all providing advantages over paper for analysis and decision support.

## **Scenario-based recommendations demonstrate practical application of research**

When O'Sullivan Farms encounters scanning results of 125% against a 150% target in a mob of 500 ewes joined to 10 rams, the diagnostic investigation should first assess ram fertility through breeding soundness examination results conducted 8 weeks pre-joining, given that 30% of rams fail fertility standards even when appearing normal. Second, evaluate ewe body condition at joining since the target BCS 3.0 minimum generates 20 extra lambs per 100 ewes per condition score unit, with each 0.5 BCS unit approximately equaling 10% conception improvement. Third, analyze the ram to ewe ratio of 10 rams for 500 ewes yielding 50:1 or 2%, adequate for autumn joining of mature ewes but insufficient if substantial maiden ewe percentages exist. Fourth, determine ewe age structure as percentages of maidens plus aged ewes above 30% combined explain poor performance since maidens require 1.5% rams minimum. Fifth, review joining timing and duration to ensure the 5-6 week period occurred during March-May peak fertility season.

The immediate interventions during current pregnancy focus on differential management by selling dry ewes immediately, providing twins BCS 3.0-3.3 with feed on offer 1,800+ kilograms dry matter per hectare in best shelter paddocks, and maintaining singles at BCS 3.0-3.5 with 1,500 kilograms per hectare feed on offer. Expected outcomes predict marking percentage of 100-110% from the 125% scanning, achievable since Holmes Sackett research shows only 120% weaning needed for top 20% profitability, emphasizing survival over conception. Changes for next season mandate ram fertility testing 8 weeks pre-joining delivering \$10-12 per ewe profit increases, supplementing rams to BCS 3.5-4.0 from 4 weeks pre-joining, using 1% rams for mature autumn-joined ewes but adding 2-3 rams if over 100 maidens exist, and considering vasectomized teasers 14 days before joining to synchronize estrus.

When scanning shows 180% but marking achieves only 140% representing 22% lamb loss, the assessment determines this sits at the upper end of normal 20-25% range for mature ewes but offers substantial improvement opportunity toward the 10-15% loss of top performers. The diagnostic protocol requires post-mortem examination of 10-20 dead lambs to identify causes through external examination for birth weight under 3 kilograms and membrane presence on feet indicating stillborn versus walked then died, plus internal examination where lungs floating and pink indicate breathing occurred meaning born alive while lungs sinking and dark indicate stillborn, and stomach contents showing milk indicate fed then died from exposure or mismothering while empty stomachs indicate starvation.

The most likely causes at 22% loss rank as starvation-mismothering at 25%, stillbirths 21%, birth injury-dystocia 19%, exposure 16%, and predation 7% based on Australian data across 3,198 lambs. Prevention for next season implements moving twins to best paddocks 4 weeks pre-lambing, starting calcium-magnesium supplementation, targeting twin BCS 3.0-3.3 and singles 3.0-3.5, creating small mobs under 100 for twins and under 200 for singles, conducting daily checks without disturbance, and removing dead lambs promptly to prevent predator concentration.

## **Technology integration opportunities enable precision management**

Remote monitoring technologies becoming commercially viable include GPS collars tracking mob locations and movement patterns, water trough sensors monitoring fill levels and consumption rates to identify issues

before sheep go thirsty, and pasture biomass sensors providing objective feed on offer measurements eliminating estimation errors. These systems enable monitoring without daily physical paddock visits, particularly valuable for large properties or distant paddocks, while generating data streams that machine learning models can analyze for pattern recognition.

Precision agriculture applications include satellite imagery providing NDVI (Normalized Difference Vegetation Index) assessments of paddock condition, allowing prioritization of paddock inspections and feed budgeting adjustments. Drone-based mob counting eliminates the labor and sheep disturbance of traditional mustering for counts, providing accurate numbers for feed budgeting and mob size compliance. Automated weigh scales at water points capture individual sheep weights repeatedly over time without handling stress, tracking growth rates, identifying poor performers, and optimizing sale timing.

Data analytics opportunities for AI systems include machine learning models predicting lamb survival based on ewe condition, weather forecasts, paddock assignments, and mob sizes, providing quantified risk scores guiding intervention decisions. Pattern recognition algorithms analyzing historical mob performance identify correlations between management practices and outcomes that may not be obvious, suggesting improvements for future seasons. Genetic trait analysis integration with performance data helps breeding decisions by identifying which ram lines produce progeny with superior survival, growth, or fertility.

The integration pathway starts with basic data collection of key metrics at critical timepoints, establishing baseline performance and data quality. Phase two adds weather data integration from Bureau of Meteorology automatic feeds, eliminating manual recording while enabling weather-performance correlation analysis. Phase three implements selective monitoring technologies where return on investment proves clearest, typically starting with water monitoring in distant paddocks or satellite imagery for large properties. Advanced phases layer predictive modeling once sufficient historical data accumulates, requiring minimum 3-5 years for distinguishing true patterns from random variation.

## Critical success factors for Murray River sheep operations

The research synthesis identifies that successful operations in the Murray River region master five interconnected management domains. First, body condition management throughout the annual cycle, beginning at weaning with assessment and grouping, continuing through strategic supplementation achieving BCS 3.0-3.5 at joining, maintaining condition through pregnancy with differential feeding post-scanning, and recovering ewe condition post-weaning before the cycle repeats. Second, ram management including breeding soundness examinations 8 weeks pre-joining with culling of subfertile rams, appropriate ram ratios adjusted for season and ewe age class, and ram nutrition supporting BCS 3.5-4.0 at joining.

Third, differential nutrition for pregnancy types after scanning, separating twins for 75% additional energy in late pregnancy, ensuring feed on offer targets of 1,800 kilograms dry matter per hectare for twins versus 1,500 for singles, and supplementing calcium and magnesium on lush feed to prevent metabolic diseases. Fourth, lamb survival management through small mob sizes under 100 for twins, shelter provision reducing exposure losses by 30%, paddock selection prioritizing shelter over feed quality for twins, and predator control starting pre-lambing and continuing through marking. Fifth, seasonal timing optimization joining in March-May for natural peak fertility and spring price premiums, lambing in August-October onto spring flush pasture growth, and marketing in peak spring price windows capturing 15-25% premiums.

The economic returns from mastering these domains show pregnancy scanning with differential management delivering 400% ROI at \$5.55 per ewe benefit, ram fertility testing generating \$10-12 per ewe profit increases, ewe body condition optimization worth \$20 per ewe in improved reproductive performance, and smaller mob sizes improving survival 3-5% worth \$10-15 per ewe at current lamb prices. The cumulative impact places operations in the top 20% profitability bracket at \$25 per dry sheep equivalent versus average operations at \$10 per DSE, driven more by efficiency and survival than absolute conception rates.

The Murray River region's specific challenges of 463 millimeter average annual rainfall, summer temperatures regularly exceeding 40°C, unreliable autumn breaks, and 3-4 month summer feed gaps require either irrigation access to intensify production or acceptance of lower carrying capacities with drought management capability. The opportunities from irrigation infrastructure, fertile riverine soils, mixed enterprise diversification, water trading flexibility, and dual state market access create competitive advantages over comparable rainfall zones, explaining the region's significance in Victorian and Australian sheep production despite climatic challenges.