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Contents

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Sheep industry turn-off update

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Western Australia's sheep and lamb turn-off moderated through 2025, reflecting a shift away from the elevated slaughter and movement activity seen in the previous 2 years. Total slaughter for the year reached 4.6 million head, an 11% decline from 2024.

Both sheep and lamb throughput softened, with adult sheep slaughter finishing at 1.9 million head, down 13%, and lamb slaughter falling 11% to 2.8 million head. Despite remaining historically high for a third consecutive year, slaughter volumes trended lower than in 2023 and 2024, and late-year data suggests a potential easing in the processing of adult sheep.

The December quarter did see an uplift in sheep slaughter – up 73% from the seasonal low in September – though volumes remained weaker than the same period in previous years.

Live sheep exports continued their downward trajectory in 2025, with total shipments declining 25% to 317,700 head. Kuwait remained the state's largest market, taking 43% of exported sheep, followed by Jordan and Qatar.

Export activity slowed sharply after the mid-year moratorium, with only a single vessel departing once trade resumed in November. Similarly, interstate transfers dropped significantly, falling 49% to 448,000 head. Movements eastward eased for both adult sheep (down 79%) and lambs (down 24%), although lambs continued to make up the majority of transfers at 81% of total volumes.

Overall, total turn-off – combining slaughter, live export and interstate movements – fell to 5.4 million head, down 17% from 2024 and slightly below the 10-year average. Lamb slaughter remained the largest contributor, accounting for 51% of all turn-off, followed by adult sheep slaughter at 35%, interstate transfers at 8% and live exports at 6%. Despite year-on-year declines across all market pathways, both sheep and lamb slaughter remained above their long-term averages.

Updated data and the introduction of mandatory eID in January 2025 have provided new insights into the size of the WA flock. While the flock was previously estimated at 11.5 million head in July 2024, the sale of 5.5 million white lamb tags across 2025 indicates stronger lambing performance than expected. This suggests the flock may have been underestimated in earlier modelling and could stand closer to 10.5 million head at the end of 2025. The slowdown in turn-off, supported by improved seasonal conditions and firm sheep prices, may be signalling the early stages of flock rebuilding across the state.

Read the full report in the Sheep Industry Update

Sheep enterprise gross margins and emissions in Western Australia: A spatial and structural analysis

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Introduction

The gross value of sheep production in Western Australia (WA) in 2023-24 was $397 million. Sheep production occurs within mixed crop-livestock systems across 14 agroecological zones (Figure 1) defined by 3 annual rainfall environments: low (<350 mm), medium (350-450 mm), and high (>450 mm). Cereals are the dominant land use on most farms, with cereals and other crops, such as canola, grown in rotations that include pasture phases supporting sheep production.

The sheep industry faces the dual challenge of maintaining profitability whilst contributing, alongside the rest of the economy, to state and national emissions reduction targets. The WA state government has committed to achieving net zero emissions across the economy by 2050 (Government of Western Australia, 2023). The sheep industry accounts for approximately 25% of the WA agricultural greenhouse gas emissions — around 3.3 Mt CO_2-e in 2023 (Machon *et al*., 2025). This paper examines sheep enterprise gross margins and related emissions across WA's agroecological zones and analyses the relationships and trade-offs between profitability and emissions.

Method and data

Data sources

Farm-level data were sourced from Planfarm benchmarks records for 2019-23, covering 423-463 clients annually across 14 agroecological zones (Figure 1). Farms were stratified into the top 25%, average, and bottom 25% performance categories based on farm operating surplus per effective hectare per millimetre of growing season rainfall.

Gross margin calculation

Sheep enterprise gross margins were calculated using the standard template. Self-replacing Merino flock models were developed using flock inventory data. Gross margins per winter-grazed hectare ($/wg ha) were the difference between annual revenue and direct variable expenses. Location-specific adjustments for commodity prices and input costs enabled standardised gross margin comparisons across agroecological zones.

Emissions estimation

Emissions were estimated using the Sheep and Beef Greenhouse Accounting Framework (SB-GAF) (Lopez *et al*., 2024), consistent with Australia's National Inventory Report methodology by the Department of Climate Change, Energy, the Environment and Water (DCCEEW, 2025). The framework covers sheep production from cradle to farm gate. Emissions were estimated and expressed as kg CO_2-e using global warming potentials GWP_{100} (Myhre et al., 2013). Total emissions were reported per unit area winter grazed hectare ($/wg ha), while emission intensities were stated as kg CO_2-e per kg liveweight, kg greasy wool (Wiedemann *et al.,* 2015), and per gross-margin dollar. Meat and wool emissions were allocated by protein content. Land-use change emissions were excluded due to data limitations. A 5-year analysis period was applied to account for seasonal variation.

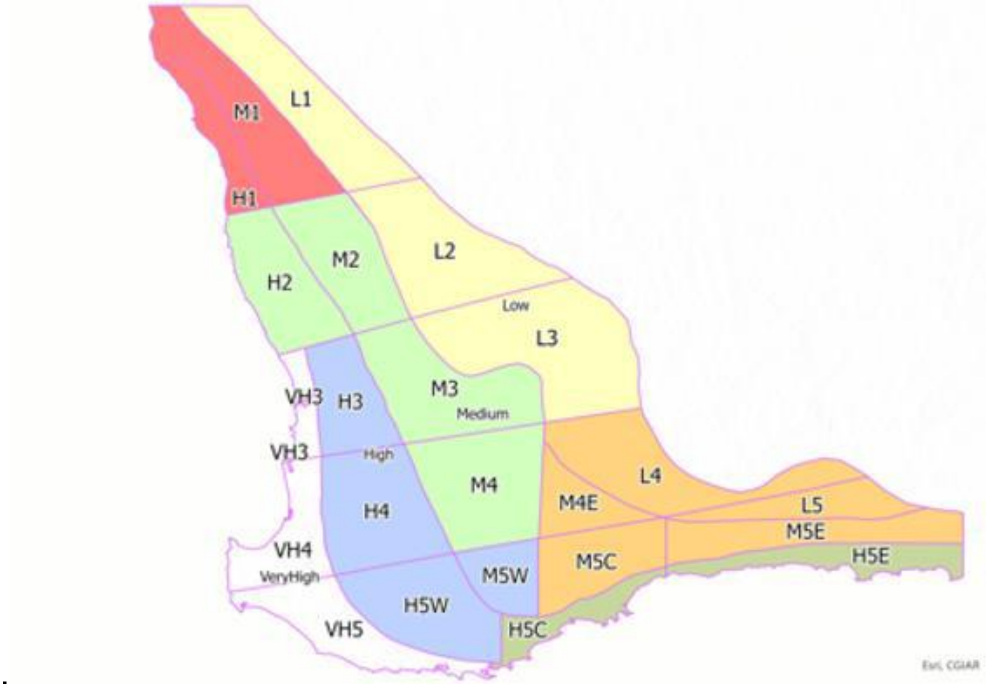

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Figure 1: Agroecological zones of WA's agricultural region

Note: The 14 agroecological zones comprise high-rainfall (H1–H5), medium-rainfall (M1–M5), and low-rainfall (L1–L4) zones. Planfarm data are not available for very high rainfall zones or the L5 zone.

Results and discussion

Farm characteristics

Farm scale, pasture intensity, and stocking rates vary systematically across WA's agroecological zones in line with the rainfall gradient (Planfarm, 2019–23). Farms in the high-rainfall zones are the smallest (3,384 ha on average), with 36% of their farmland in pasture and stocking rates 6.6 DSE/wg ha, on average. It is important to note that these stocking rates may be different from estimates in other studies and benchmarks. Farms in the medium and low-rainfall zones are larger (4,944 ha and 6,480 ha, respectively), with pasture area allocations of 20% and 23%, and stocking rates of 4.2 and 1.7–2.9 DSE/wg ha, respectively. Wool production per sheep increases from north to south across the agricultural region, reflecting longer growing seasons in southerly zones. The full summary of farm characteristics by agroecological zone is provided in the full paper.

Gross margins across agroecological zones

Gross margins exhibit a pronounced north-to-south gradient across both the high and medium-rainfall regions (Figure 2). Southern high rainfall zones (H3–H5) consistently achieve the highest returns, underpinned by higher stocking rates of 6.0–8.0 DSE/wg ha, longer growing seasons, higher lambing percentages, and a greater capacity to turn-off prime lambs. Northern zones (H1, M1, L1) return the lowest and most volatile gross margins, reflecting abbreviated seasons and lower stocking rates (1.7–4.5 DSE/wg ha). In the low-rainfall zones, the north-south gradient is less pronounced.

Performance differentials across farm groups are evident. The top 25% of farms in the high-rainfall zone produce the highest gross margins, about 4 times those of their bottom 25% counterparts. Seasonal variation is also evident: bottom 25% farms in poor years (2019, 2023) recorded near-zero or negative margins; In contrast, in 2021 with its above-average rainfall, sheep prices of $198/head and a record grain harvest of 22+ million tonne, drove exceptional enterprise performance in sheep enterprise.

By 2023, however, sheep prices had collapsed to $97/head amid dry seasonal conditions, illustrating the volatility that characterises all zones but disproportionately affects the northern sheep enterprises.

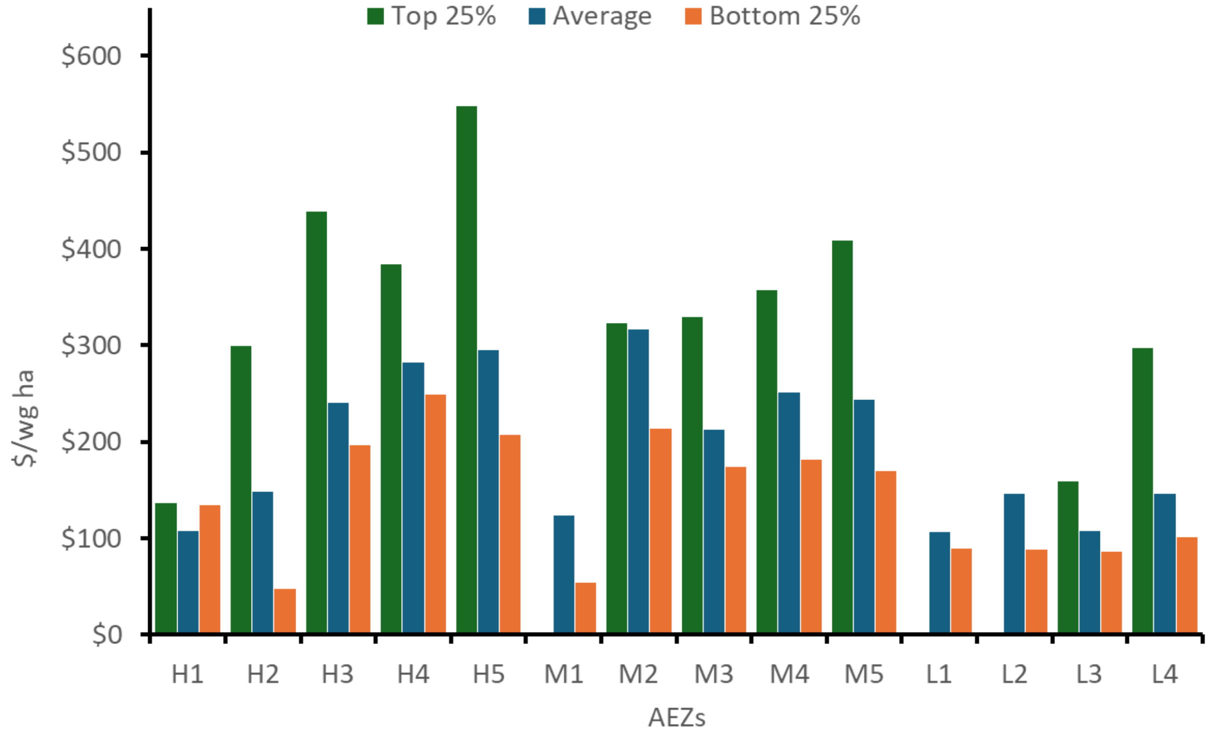

Figure 2: Average yearly (2019–23) gross margins ($/wg ha) by agroecological zone and farm performance category

Emission profiles

Total emissions per winter-grazed hectare

Sheep production emissions vary across agroecological zones and farm performance categories, based on 5-year averages from 2019 to 2023 (Figure 3). Enteric methane dominates the emissions profile, contributing 75–82% of total farm emissions across zones. Nitrous oxide (N_2O) from urine and dung contribute a rising share of emissions in the high rainfall region (6–10%).

Emissions per winter-grazed hectare (kg CO_2-e/wg ha) mirror the profitability gradient driven by stocking rate. A north-south gradient in emissions per winter-grazed hectare is evident, as shown for average farms (blue bars in Figure 3), with southerly zones recording substantially higher emissions than their northern counterparts — ranging from 1,000–1,455 kg CO_2-e/wg ha in H3–H5 compared to 900–1,000 kg CO_2-e/wg ha in H1–H2. Similar trends are observed in medium and low rainfall zones. This gradient is driven primarily by higher stocking rates in southerly subregions, reflecting longer growing seasons that support greater carrying capacities.

However, emissions per winter-grazed hectare vary substantially by farm performance group. Top 25% farms generate 40–70% higher emissions per winter-grazed hectare than average farms across almost all subregions. In southern zones (H3–H5), the contrast is starkest: the top 25% of farms emit the most emissions (1,750-2,300 kg CO_2-e/wg ha), compared to 1,150-1,400 kg CO_2-e/wg ha for the bottom 25% of farms. This reveals a strong structural link between intensification and emissions: higher stocking rates yield higher gross margins but also produce the highest emissions per wg ha.

As Henderson and Kingwell (2002) note, farm performance rankings are rarely stable over time — a farm in the top 25% in one season is unlikely to remain there consistently — meaning that performance group comparisons across zones and time periods reflect a changing sample of farms rather than fixed cohorts.

Northern zones (H1–H2) record lower absolute emissions due to lower-intensity farming systems and lower animal numbers, rather than more efficient production systems. Absolute emissions per hectare reflect intensification but not necessarily efficiency — a high-stocking farm emitting more per hectare may emit less per unit of product. Hence, emissions intensities are estimated in the following section.

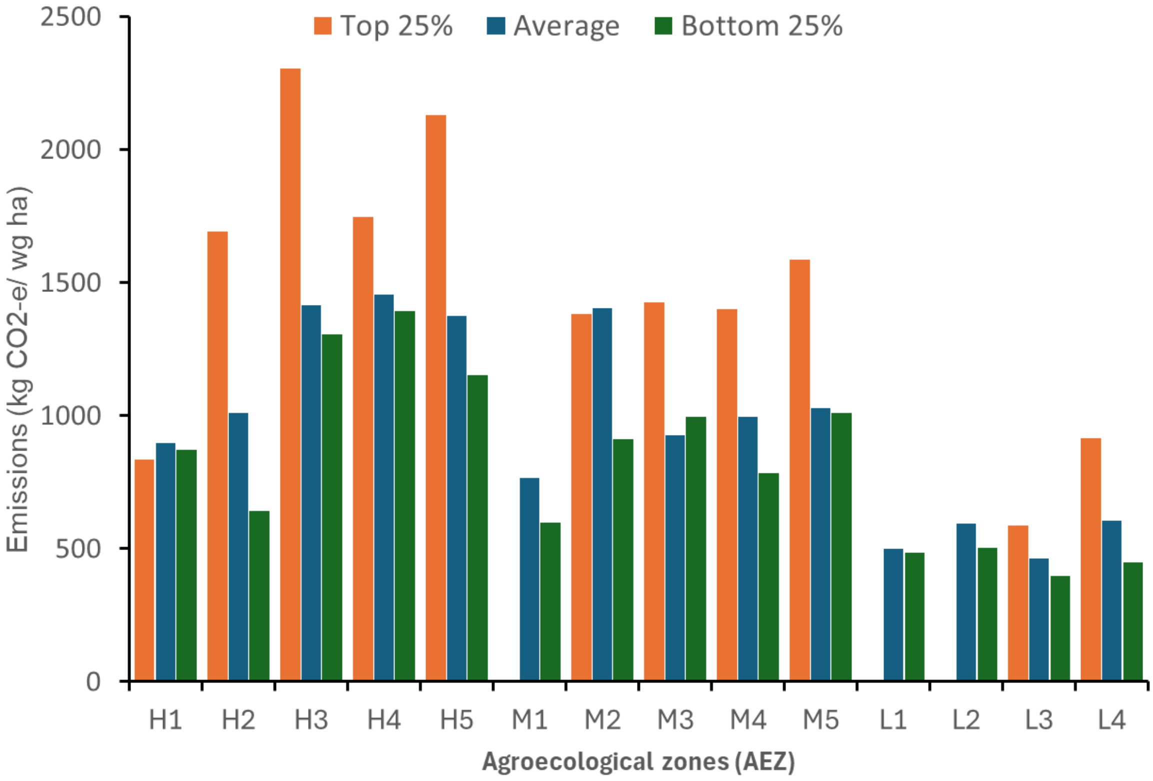

Figure 3: Average yearly (2019-23) emissions per winter-grazed hectare by agroecological zone and farm performance category.

Note: Top 25% data for M1, L1, and L2 are incomplete across most seasons in the Planfarm benchmarks**.**

Emission intensities

Figure 4 presents the average emissions intensities (kg CO_2-e/kg of liveweight sold or kg CO_2-e/kg of greasy wool sold) for average farms in each agroecological zone from 2019 to 2023. Emission intensities are lowest in the medium rainfall southerly zones (M3–M5) and are often highest in the high rainfall southerly zones. For example, emission intensities for liveweight sold (5.6–6.6 kg CO_2-e/kg) and greasy wool (20.1–23.4 kg CO_2-e/kg) are generally lowest in the medium rainfall southern zones (M2–M5). High-rainfall systems tend toward input-intensive management with high stocking rates, whereas medium-rainfall producers set stocking rates more conservatively due to greater seasonal variability. Despite this, gross margins per wg ha across many medium-rainfall zones are comparable to those in high-rainfall zones, indicating competitive economic returns can be achieved while maintaining lower emissions intensity.

The higher emission intensities in H1, M1, and L1 reflect constrained output rather than high stocking rates.

Five-year Planfarm benchmarks production data (2019-23) confirm all 3 northernmost subregions share lower lambing rates, lower fleece weights, and less output per grazed hectare than their southern counterparts. H1 records only 1.7 lambs and 22.2 kg wool per wg ha despite the highest April–September rainfall (304 mm). M1 produces just 13,590 kg greasy wool at 1.4 lambs per wg ha — less than half of M5. L1 records the highest emission intensities in the dataset (6.65 kg CO_2-e/kg LW; 23.3 kg CO_2-e/kg greasy wool) and the lowest wool production (9,672 kg greasy) across all 14 agroecological zones. Shorter growing seasons and climate variability constrain productivity, pushing up emission intensity. Improving reproductive performance and fleece weight through genetics and management is the most direct pathway to reducing emission intensity in these agroecological zones.

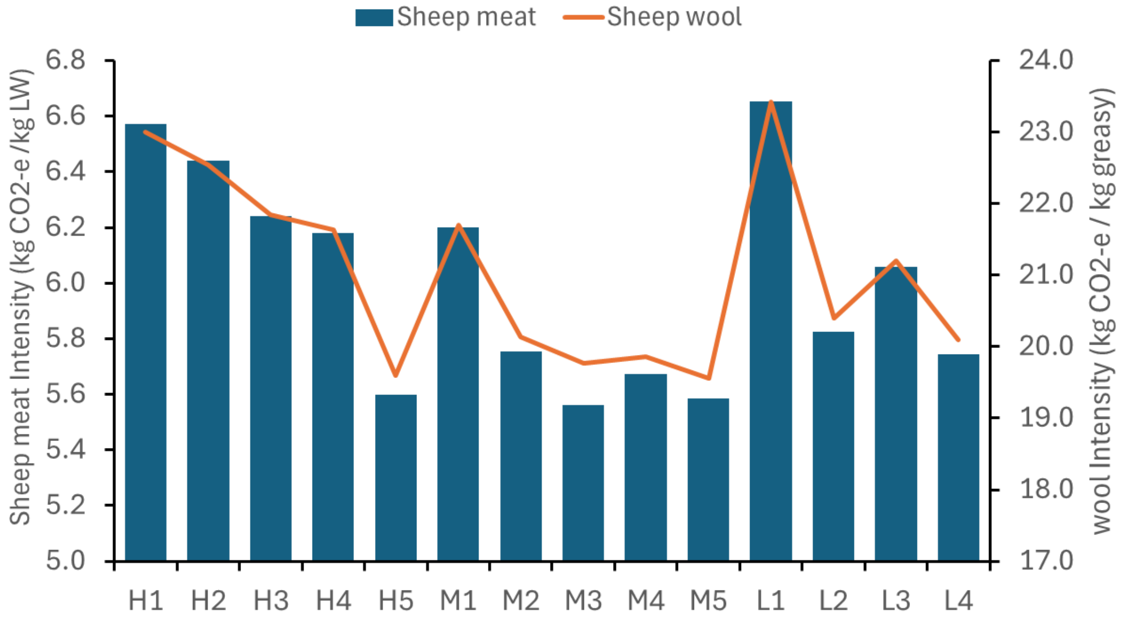

Figure 4: Yearly average (2019-23) emission intensities for sheep meat and wool for an average farm by agroecological zone

The profitability-emissions relationship

Emissions per dollar of gross margin: a key metric

Figure 5 shows the regional variability in emissions per dollar of gross margin across agroecological zones by farm performance group, based on a 5-year average (2019 to 2023). The metric — (kg CO_2-e per dollar gross margin) captures the profitability-emissions trade-off. This measures how many kilograms of CO_2-e are embedded in each dollar of farm income and, conversely, how much emission saving is achievable per dollar of forgone gross margin. For average farms, this ratio ranges from 4.1 to 8.6 kg CO_2-e across all zones.

Average farms in the high-rainfall zones (H1 and H2) record the highest values (8.6 and 6.9 kg CO_2-e per dollar gross margin, respectively). H3 and H4 form a second cluster (5.9 and 5.2 kg CO_2-e per dollar gross margin) while medium and low rainfall zones show consistently lower, uniform values (3.9–4.4 kg CO_2-e per dollar gross margin). Emissions intensities in the high-rainfall zones (H3–H5) record emissions 10–35% higher per dollar of gross margin than their medium-rainfall counterparts. This highlights a greater potential for emissions reductions in high-rainfall zones, where each dollar of forgone gross margin yields comparatively greater emissions savings.

However, importantly, no commercial incentive currently compels farmers to lessen emissions.

There is no carbon price on livestock methane emissions and no verified 'low emission' price premium, so the current economically rational choice is continued or increased intensification — raising absolute emissions even as the industry faces long-run emissions-reduction obligations. It is therefore unsurprising that higher-profit farms tend to generate higher emissions per wg ha, consistent with Gebbels et al. (2022), who found that greater productivity reduces methane intensity but increases total emissions. There is more scope to manipulate diet and shift rumen function in the high rainfall zone and longer exposure to low methane forages.

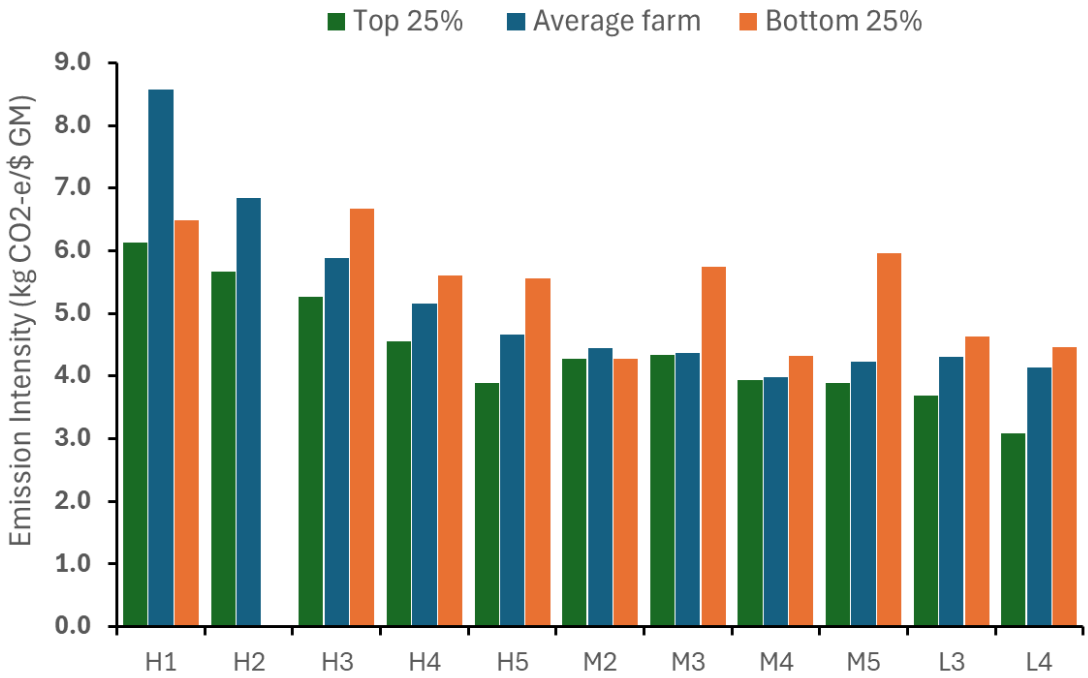

Figure 5: Average yearly (2019–23) emissions per dollar of gross margin (kg CO_2-e/$ GM) for sheep production in each agroecological zone.

Note: H1–H5 = high rainfall zones; M2–M5 = medium rainfall zones; L3–L4 = low rainfall zones. Full seasonal data was not available for all agroecological zones.

Top performers as exemplars of dual efficiency

One important finding qualifies the general trade-off between gross margins and emissions. The top 25% of farms consistently achieve lower emissions per dollar of gross margin than average, and the bottom 25% farms across all agroecological zones. In southern zones, top performers achieve 3.05.0 kg CO_2-e per dollar of gross margin, whereas the bottom 25% farms achieve 4.3–13.4 kg CO_2-e per dollar of gross margin. This suggests that management quality — pasture management, breeding, lambing, and turnoff efficiency — enables top farms to generate superior gross margins whilst constraining their emissions per unit of gross margin. These farms may serve as practical exemplars from which broader industry improvement can be modelled, demonstrating that high profitability and lower emissions intensity per dollar are not always mutually exclusive outcomes.

Conclusion

This study provides a comprehensive set of estimates of sheep production gross margins, emission intensities and examines the relationship between greenhouse gas emissions and sheep enterprise gross margins, drawing on sheep enterprise data from 2019 to 2023 across 14 agroecological zones in WA's agricultural region.

The main findings are firstly, that gross margin results exhibit a pronounced north-to-south gradient in both the high- and medium-rainfall regions. Southern high rainfall zones display the highest sheep enterprise gross margins, whilst the northerly zones display significantly lower returns. Gross margins also vary greatly by farm performance groupings, with the top 25% of farms generating 4 times the gross margins of the bottom 25% of farms.

Secondly, sheep enterprise emissions vary across agroecological zones and farm performance groups. Higher-performing farms generate higher absolute emissions per winter-grazed hectare. This is structurally unavoidable under current production systems, where stocking rate is both the primary driver of gross margin and of enteric methane. Managing for profit necessarily means managing for higher animal numbers and intake, which raises total methane output. The top 25% of farms in southern high-rainfall zones emit nearly twice as much as average farms in the same zones (H3–H5). Innovations in feedbase management — including increased legume content and low-methane supplements — offer partial mitigation of emission intensity. Importantly, improvements in sheep genetics and reproductive efficiency deliver more lambs per ewe and higher fleece weights per head, reducing emission intensity per unit of product and achieving productivity and emissions efficiency gains simultaneously.

Thirdly, outcomes for the top 25% of farms suggest it is possible to jointly reduce emissions intensity from sheep production whilst maintaining gross margins. A future research topic is to examine the sheep management characteristics of the top 25% of farms to gauge whether the quality and nature of their management are key determinants of their ability to jointly deliver high gross margins and reduced emissions in their sheep products.

However, until commercial or regulatory incentives align with environmental objectives, the structural trajectory of WA sheep enterprises is often toward higher emissions alongside higher profitability. That said, the management practices of the top 25% farms reveal it is possible to achieve high gross margins with lower emissions per dollar of output. These farms represent the most promising near-term pathway for joint improvement in gross margins and emission intensities. Future research could examine these management characteristics in detail to determine how easily they might be applied across the broader industry.

Acknowledgements

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Full paper

Sheep Enterprise Gross Margins and Emissions in Western Australia: A Spatial and Structural Analysis

‘Programming’ future performance

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New reproductive biology is often discovered in animals, especially livestock, before being linked to human health. In this case, it was the reverse. In the 1980s, David Barker (University of Southampton, UK) studied people who had been born during and after the ‘Dutch famine’ in WWII. He found that those born to women who were severely undernourished during pregnancy were more susceptible to cardiovascular and other diseases late in life. This phenomenon became known as ‘fetal programming’, later renamed as ‘developmental origins of health and disease’ (DoHaD), a less user-friendly term that I will avoid.

It is no surprise that we now have strong evidence for ‘programming’ of a variety aspects of future health and productivity in sheep, including the quantity and quality of wool, milk and meat produced, cardiovascular health, salt tolerance, thyroid function (metabolic rate), and glucose balance. Interestingly, the ‘programming’ concept began with a focus on the fetus, but it has now been extended back to the period before fertilization, because we now know that the effects of undernutrition on the egg, sperm and embryo can also have consequences for postnatal life.

Nutritional ‘programming’ affects puberty and the development of the ovary in the ewe lamb. A study by Carolina Viñoles in WA took advantage of very long-term studies of ewe nutrition (the ‘Lifetime Wool’ project) to show that the twinning rate in adult ewes is affected by the nutrition of their mothers during pregnancy, even after a delay of 3-5 years. In the ram lamb, ‘programming’ by undernutrition during pregnancy can affect the development of the testis, particularly the number of Sertoli cells. Sertoli cell number is fixed at puberty and is a major determinant of maximum sperm production in the adult.

In addition to undernutrition, stresses imposed on the mother during pregnancy increase the production of adrenal steroids that can affect the developing male fetus. This phenomenon has been studied in the ram lamb by Graciela Pedrana in Uruguay. Her studies suggest that stress in the pregnant ewe will lead to fewer testosterone-producing Leydig cells in the testis when the ram is sexually mature. Are there serious consequences for fertility in rams under farm conditions? We don’t yet know.

The process of ‘programming’ involves genes. We all know that genes in chromosomes are major determinants of health and performance but, in addition to the presence or absence of important genes, we now need to consider whether those genes are active or not. Through the process of ‘epigenetics’, genes can be modified chemically to switch them on and off. According to Kevin Sinclair (University of Nottingham, UK) it is most likely that, in sheep, epigenetic processes during the development of the embryo and fetus will lead to the acquisition of traits that affect the individual and can also be transmitted to future generations.

It is possible that maternal undernutrition and stress during pregnancy explains much of the between-animal variation in twinning and sperm production that typifies sheep flocks on farm, including between-ram variation, a problem that plagues the selection of rams for mating programs. It is still early days, and we need to understand these processes better so we can determine whether they have a commercial impact. If they do, we should be able to devise management strategies to prevent problems or take advantage of outcomes that are beneficial. Meanwhile, we all need to be mindful of the need for good management before mating and during pregnancy, avoiding undernutrition and sources of stress.

Supply Chain Capacity Program

Round 2 of the $40 million Supply Chain Capacity Program is open to Western Australian sheep producers and supply chain businesses.

The funding is an initiative under the Australian Government's $139.8 million Sheep Industry Transition Assistance Package, targeting capital works to support expansion of WA's sheep onshore processing supply chain capacity.

It also seeks to incentivise investment in on-farm and processing supply chain capital infrastructure that will help provide better supply chain capacity in the lead-up to the end of live sheep exports by sea.

Round 2 is open to eligible businesses involved in production and processing in the sheep supply chain. This includes farmers, processors, feed lotters and supply chain capacity infrastructure providers such as cold storage and lairage providers. Round 1 applicants who did not receive funding or received amounts below the maximum available in their stream limit, are eligible to apply for round 2.

Applications for Round 2 close at 5 pm AWST on Friday 24 April 2026.

Visit the Supply Chain Capacity Program webpage for more information.

The program is delivered by the Rural Business Development Commission and supported by the Department of Primary Industries and Regional Development on behalf of the Australian Government.

Kikuyu poisoning risk after summer rain

Kikuyu (*Pennisetum clandestinum*) is a subtropical perennial grass that grows from spring to autumn. While it provides valuable summer feed, kikuyu can occasionally cause poisoning in livestock under certain environmental conditions.

The exact cause of kikuyu poisoning is unknown. The endophyte *Fusarium torulosum* is suspected but remains unproven.

Outbreaks typically occur in summer or autumn following drought conditions broken by rain, when kikuyu grows rapidly. Livestock grazing these pastures 2–3 weeks after rainfall are at greatest risk, particularly in paddocks that have been left ungrazed for extended periods. Plant stress (such as locust or armyworm damage) and stress on the endophyte may also contribute.

Cattle are most affected, though sheep and goats are also susceptible. Animals of any age or condition may be affected.

Clinical signs usually appear 1–8 days after stock are introduced to affected paddocks and may continue for several days after removal. Signs include unusual vocalisation, bloat, drooling, incoordination, sham drinking, recumbency and death.

There is no specific treatment. Early removal from affected paddocks and supportive care – minimising stress and providing good quality feed, water and shelter can lead to recovery in many animals. Severely affected animals that remain down should be humanely euthanised.

Risk can be reduced by closely monitoring livestock after summer rain events and maintaining mixed pastures, as kikuyu-dominant swards present the highest risk.

Some emergency animal diseases not present in WA can show similar signs. Any unusual illness, abnormal behaviour or unexpected deaths should be reported to a veterinarian, DPIRD field veterinary officer, or the Emergency Animal Disease hotline on 1800 675 888.

For more information, see StockedUp issue #6 (May 2025) which features ‘Do you know the signs of kikuyu poisoning in livestock?’ and ‘Kikuyu pasture management tips for the cooler months’.

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