Effectiveness of a Supply Chain on Out-of-Season Lamb Production

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Contents

Executive Summary

The aim of the project is to identify feed profile characteristics that increase the suitability of properties for being part of a supply chain and understand how seasonal variation may affect properties in a supply chain.

The report evaluates the effectiveness of a supply chain at producing out-of-season lambs by providing an analysis of feed allocation for different sheep groups within each part of the supply chain, a grazing pressure sensitivity and an evaluation into the profitability of chaff piles and crop grazing.

The economic analysis was undertaken using MIDAS to evaluate the profitability of the supply chain under different conditions. Two existing MIDAS models were used in this analysis. The first represents a mixed farm in the 550-600mm rainfall zone in the Great Southern and the second represents a farm in the 350-400mm rainfall zone in the Central Wheatbelt.

Complementing the supply chain with crop grazing and chaff piles proved to be very profitable. In the wheatbelt, high-quality feed provided by green crops significantly reduced the need for supplementary feeding and allows a higher stocking rate, providing added value of up to $100 000. Chaff piles provide a feed source that can be easily accessible by sheep, has a lower deterioration rate than normal stubble and is able to be utilised as a deferred feed source, this adds value of up to $30 000. In the great-southern, crop grazing is utilised by both twin ewes and finishing lambs, reducing the supplement fed per DSE (dry sheep equivalent), this adds value of up to $25 000. Chaff piles have similar benefits to the wheatbelt and provide up to $10 000 added value. Although in both regions chaff piles are most economical if they also provide value to the cropping enterprise.

Breeding and selling store lambs in the Great Southern and backgrounding and finishing in the wheatbelt is the most effective supply chain method. This result is different to John Young's initial analysis and is due to the re-calibration of the stubble and chaff pile modules. The result of the re-calibration means that stubble and chaff piles are now represented as a higher quality feed than previously. With stubble and chaff being a better feed source, it then became more profitable to background in the wheatbelt.

The Great Southern system runs a self-replacing flock where ewes and ewe hoggets both consume chaff piles throughout summer and into the beginning of autumn. For the remainder of autumn, they are fed supplements, graze pasture and consume deferred low-quality chaff. By this time there is green feed available which ewes also compliment with crop grazing to maintain condition in late pregnancy. The Central Wheatbelt system runs no ewes and a higher cropping area, the purchased wethers are backgrounded using chaff piles and supplements, then finished on green crop.

Seasonal variation has a similar effect on all out-of-season lamb production systems and hence won't affect farmers' decisions regarding buying or selling time. This can provide confidence that the supply will remain consistent over time.

Background

As part of the "Supplying Out-of-Season Lambs to the World" project John Young completed an economic analysis of the breakeven prices required for farmers to produce out of season lambs, part of that analysis looked at the use of a supply chain to maximise feed utilisation and reduce the break-even price. The conclusion showed that it was most profitable to produce store lambs in the Great Southern and background and finish in the wheatbelt.

The aims of this analysis:

1) Further investigate the effects of crop grazing and chaff pile technology.
2) Analyse feed allocation for different sheep groups
3) Look at the impact of grazing pressure on the utilisation of these feeds in a supply chain producing out of season heavy export lambs.

Method

MIDAS was selected as the appropriate modelling tool to quantify the profitability of the two new feeding strategies and the value of a supply chain for production of out-of-season heavy lambs. This is because it can efficiently examine the optimum utilisation of novel feed resources across the whole farm throughout the entire year.

MIDAS optimises the management of nutrition through the breeding, backgrounding and finishing stages, which includes identifying the optimum stocking rate for the farm and the allocation of the pasture & stubble resources and supplementary feed to the different classes of stock throughout the year. Identifying this optimum utilisation of the feed resource for different production systems ensures that the systems are compared on an equal basis.

MIDAS description

Two existing MIDAS models were used in this analysis. The first represents a mixed farm in the 550-600mm rainfall zone in the western Great Southern and the second represents a farm in the 350-400mm rainfall zone in the Central Wheatbelt.

Table 1: Summary of the management and productivity of the flock in each region

Parameter	Great Southern	Wheatbelt
Average Lambing Date	7 Aug	24 May
Weaning Date	16 Nov	2 Sep
Ewe Wool Production		
Clean fleece weight (kg)	3.4	3.5
Fibre diameter (µm)	19.9	20.2
Heavy Export Lamb Wool Production		
Backgrounded lamb at 10mo or 13mo	1.7 (10 mo)	2.4 (13 mo)
Standard reference weight (kg)	55	55
Liveweight / Dressed weight		
Weaners (kg)	27	27
Backgrounded lamb (kg)	33	38
Finished lamb (kg)	46/21	48/22
Ewe hogget	50/23	48/22
CFA Ewe 5.5yo	56/25	64/29
CFA Ewe 6.5yo	57/26	64/29
Weaning percentage (%)	90	90
Lamb survival (%)		
Single	88	89
Twin	61	70

Prices

A summary of the wool and crop prices used in this analysis are provided in Table 1, the animal sale prices and liveweights are found in Table 2. Prices are based on a medium-term outlook. Current sheep and wool prices are higher than those used in the analysis, however it is expected that the base case prices used in the analysis will not alter the general conclusions which are related to feed demand variation between flocks and feed supply variation between the regions.

Table 2: Wool & crop prices used in the analysis

	Quality	Units	Value
Wool price by fibre diameter	19µ	$/kg clean (sweep the board)	1118
	20µ		990
	21µ		915
Crop Prices	Wheat	$/t gross	295
	Barley	$/t gross	295
	Oats	$/t net on farm	235
	Lupins	$/t gross	305
	Canola	$/t gross	540

Table 3: Saleyard prices for the main line of the sale animals and the net on farm for all animals sold which accounts for selling costs, transportation costs and an allowance for animals that are off-spec that sell for a lower price.

Sheep class	Price of the main line of sheep sold		Average price net on farm
	$/kg DW	$/hd	$/kg DW ($/hd)
Ewe Hogget		105	79
CFA Ewe 5.5yo		85	70
6.5yo		70	59
Store Lamb	3.36		38
Backgrounded Lamb	4.63		57
Finished heavy lamb	5.26		94

Feed Technology

Technology is defined as the inclusion of green crop grazing and chaff piles. With these options enabled the model has the option to include them in the sheep feed optimization. Since the previous analysis of the technology, the model has been recalibrated using some updated research data from Ed Riggall (AgPro Management), leading to a more accurate set of answers.

Stubble and Chaff Calibration Method

This analysis examines utilising chaff piles as a feed source to reduce the cost of backgrounding or finishing heavy, out-of-season merino lambs. Therefore, data was required to quantify the animal production that would be achieved if the animals grazed chaff piles vs stubble. Previously the quality of stubble in MIDAS had been calibrated using the data of Purser (1983) that contained measurement of the digestibility of the components of the stubble (grain, leaf blade, leaf sheath, cocky chaff & stem). However, it did not contain animal production data and therefore the selectivity of animals was estimated using relationships developed for the SummerPak model (Jean-Paul Orsini *pers comm.*)

Stubble and Chaff piles in MIDAS

The stubble and chaff pile modules of MIDAS have the same structure. The difference is that the parameters for the chaff piles represent that the sheep have increased selectivity because of the increased availability of the high-quality stubble components. Also, there is a reduction in the rate of deterioration because the material is more protected from the weather in the chaff piles than when spread in the paddock. For stubble the deterioration is set at 0.4 %/day and for chaff piles it is set at 0.2 %/day.

Sheep preferentially graze, and this is represented in MIDAS by separating the stubble into four categories (A, B, C & D) with differing qualities. Each category represents a certain percentage of the whole stubble and is defined by the amount of each stubble component consumed. For example canola category A, makes up the first 2% of the total stubble and consists of 86% grain, 13% leaf blade, 1% pod and 1% stem, category B is the next 3% and consists of 20% grain, 68% leaf blade, 7% pod and 5% stem, category C is the next 10% and consists of 0% grain, 28% leaf blade, 41% pod and 1% stem and category D which is the next 85% and consists of 0% grain, 0% leaf blade, 18% pod and 82% stem.

Calibration Method using animal production data

For this analysis the stubble quality was calibrated using animal performance data measured by AgPro Management (2018) in on-farm stubble grazing trials that measured sheep liveweight over time when grazing either stubble or stubble that had been harvested with Chaff carts. Six sites had been measured that provided data that was suitable for this calibration, and at these sites the following data was available; starting liveweight, liveweight at set intervals, and harvested crop yield.

To estimate the quality and quantity of feed consumed in the trial, the MIDAS sheep simulation model was used.

i. The feed supply in the model prior to harvest at 18 months of age was adjusted so that the simulated animal weighed the same as the average animal in the on-farm trials (57kg) when the animals were introduced to the stubble or chaff piles.
ii. Liveweight change was calculated for each of the periods measured in the on-farm trial.
iii. The feed quality in the simulation was altered until the model sheep had the same liveweight change as the sheep in the trial. This provided both quality of the feed (DMD) and the intake per sheep per day.
iv. The simulated intake was multiplied by the trial stocking rate and the number of days grazed to provide an estimate of the total amount of stubble grazed by the sheep in the trial.
v. The total intake was then divided by the total stubble to provide an estimate of the quantity of the stubble that had been consumed in the trial during that measurement period.
vi. Total stubble was calculated from the yield of the crop:
    Stubble per kg of grain harvested = 1/(harvest index*proportion harvested)-1
    Harvest index canola: 0.2
    Proportion harvested canola: 0.98
    Harvest index cereal: 0.43
    Proportion harvested cereal: 0.94
vii. The estimated stubble quality was graphed against proportion of the stubble consumed. This shows a decreasing diet quality as the quantity of stubble consumed increases.

viii. The next step was to represent this estimated stubble quality in four stubble categories A, B, C & D represented in MIDAS. The deterioration of grain, leaf, pod and stem differs over time (eg leaf quality deteriorates faster than grain quality), so the quality of the different categories (A, B, C & D) must be represented in terms of each component (grain, leaf, pod and stem). This was done using the stubble simulator.

ix. Using the stubble simulator, both feed preference and stem and leaf component quality were altered to meet the new feed quality of each category (grain quality wasn't altered as the previous measurements of grain were more accurate). This provided the quality of each feed component and the proportions of each component in the different feed categories, which was then inputted to MIDAS. This was repeated for both cereals and canola (there is currently no data for other crop stubbles). Lupin stubble was estimated based on both cereal and canola and given a slightly higher B and C quality to represent the fact that lupin stubble is regarded as the best stubble for livestock.

Results

The results from the on-farm trials indicated that liveweight gain occurred at all sites but only for a short period when the sheep were consuming the first 3 to 5% of the stubble. Therefore, the definition of the A, B, C & D quality in MIDAS has been adjusted. A, B, C and D show the average feed quality for the amount of stubble consumed and are represented by the green rectangles in Figure 1 and Figure 2 for cereal and canola respectively. Category D is not represented on the graph because it is such low quality that it doesn't get consumed, it is just the leftovers in the paddock.

Overall the new calibration means that stubble and chaff piles provide higher quality feed that is utilised quicker than the original calibration. Chaff piles and stubble quality decline at a similar rate as intake increases, but chaff piles have a higher quality to begin with due to increased availability of high-quality feed components.

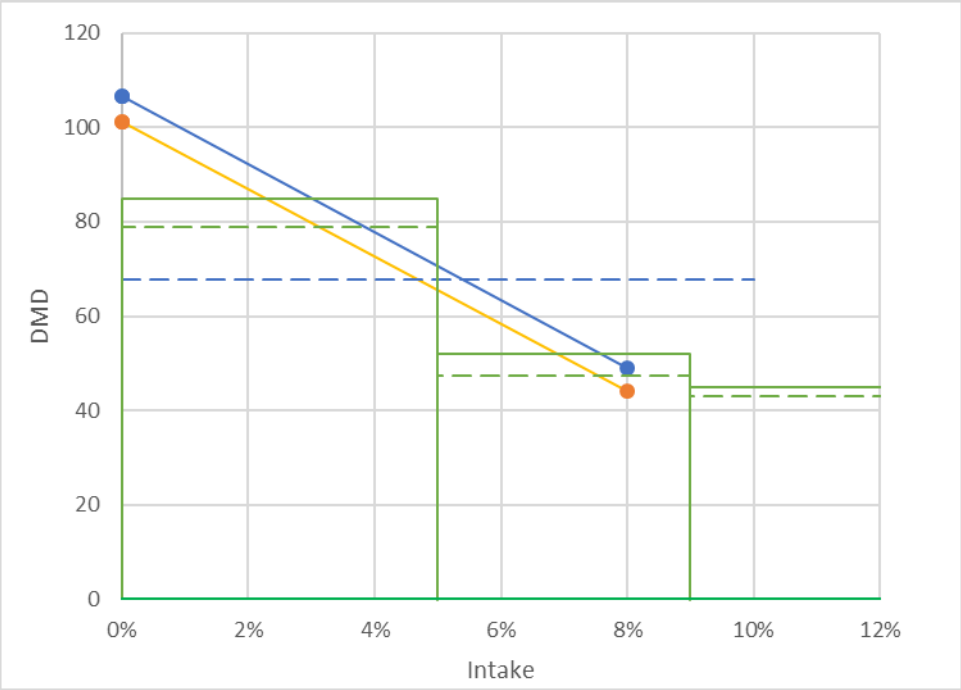

Figure 1: Shows the feed quality of cereal chaff piles (blue) and stubble (orange) as the proportion of stubble/chaff intake increases. The rectangles represent the quantity of each category of stubble (dashed green) and chaff (solid green) and the blue dashed line represents the quality of feed required for maintenance.

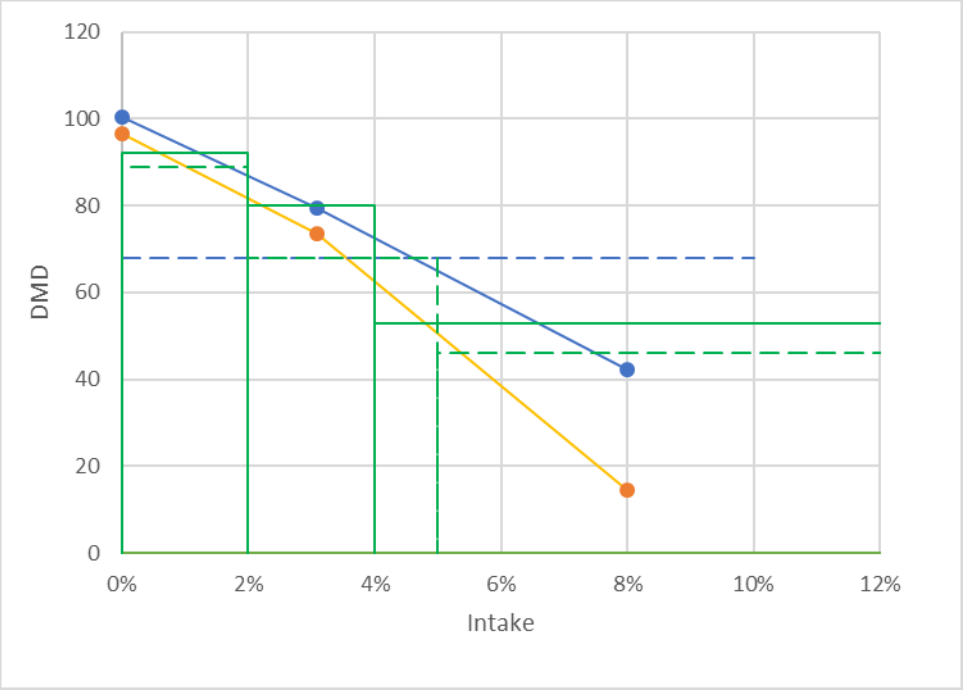

Figure 2: Shows the feed quality of canola chaff piles (blue) and stubble (orange) as the proportion of stubble/chaff intake increases. The rectangles represent the quantity of each category of stubble (dashed green) and chaff (solid green) and the blue dashed line represents the quality of feed required for maintenance.

Chaff piles: Great Southern

Chaff piles are a new option recently added into Midas, the idea is that stubble is collected as a pile. This provides easy access for the sheep and reduces the deterioration factor of the feed.
There are two options:

i) The chaff piles are consumed up until April, when the paddocks are being prepared again for cropping.
ii) The chaff piles are carted to a feed lot and used as a deferred source of feed up until June.

The first option comes at no cost because the benefits of chaff piles to the cropping system such as weed management are not represented in the model. Deferring chaff piles costs $10/tonne to represent the work required to transport the piles.
With this set up chaff piles are more appealing than stubble, shown in Figure 3. The good quality chaff is consumed before April, with the lower quality chaff being deferred until after April.
If there is a $10/tonne cost on consuming chaff piles before April it becomes uneconomical, meaning chaff piles should only be adopted if they are also providing value to the cropping system.

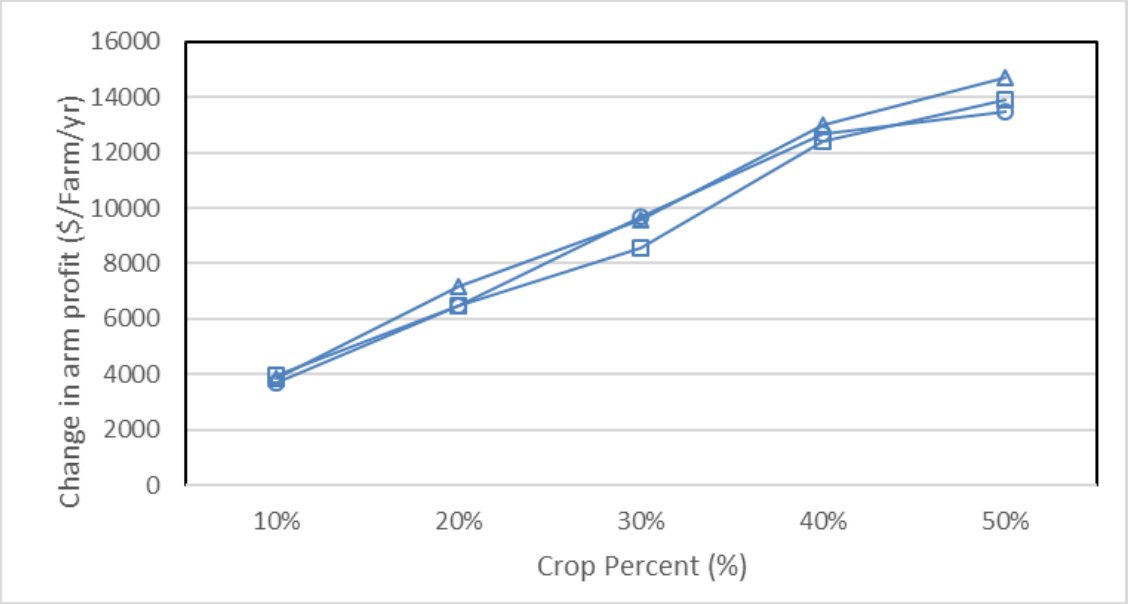

Figure 3: Change in profit when chaff pile technology is available from December to June, for systems based on breeding and selling finished (o), breeding and selling backgrounded (□) and breeding and selling store (Δ).

Chaff piles: Central Wheatbelt

Chaff piles in the wheatbelt have the same set up as the Great Southern, costing $0/tonne to consume before April and $10/tonne to consume between April and June. Chaff piles are consumed by all sheep groups, with 80% - 90% of the chaff piles consumed before April, this includes both high- and low-quality chaff. 10% - 20% of the chaff piles are deferred and utilised through until June with mainly the high-quality chaff being consumed. If there is a $10/tonne cost for consumption of chaff piles before April, chaff piles become less valuable and they are only consumed as a deferred feed source. Although it is still slightly profitable to utilise chaff piles when there is a cost before April, chaff piles are much more economical if they are also providing value to the cropping system.

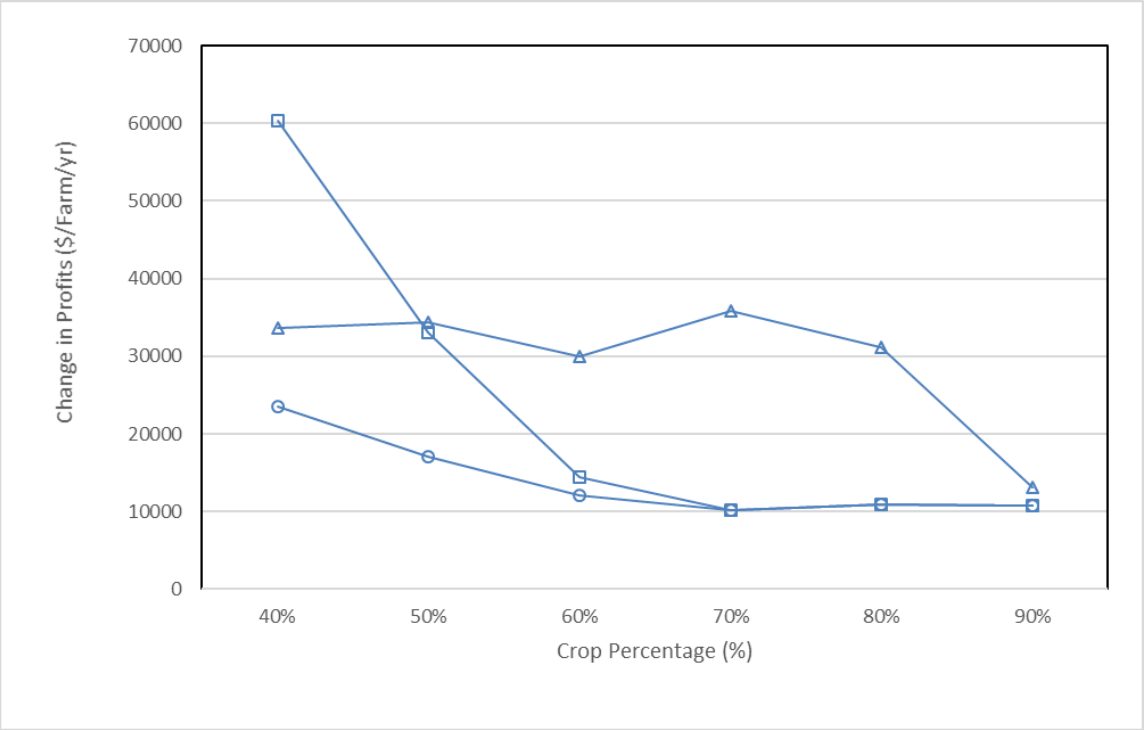

Figure 4: Change in profit when chaff pile technology is included for systems based on breeding and selling finished (o), buying store selling finished (Δ) and buying backgrounded selling finished (□).

Crop grazing: Great Southern

Crop grazing is an option that allows sheep to graze green crop from June until august. Green crops have a higher energy content than green pasture and grow more vertical allowing for easier grazing, meaning a lower crop FOO is required to meet the livestock needs. There is however a yield penalty associated with this activity. Trials have recorded varying yield penalties from -15% to +15% but the consensus is that the yield penalty is minimal if the crop is grazed early and lightly. The model uses a 3% yield penalty, but this should be re-considered as more data becomes available.

The utilisation of crop grazing can allow twin ewes to gain weight at the end of pregnancy leading to bigger lambs with higher chance of survival. Grazing crops can also be particularly profitable when producing out-of-season finished lambs because utilising green crops can significantly reduce the use of supplements.

A sensitivity analysis of yield penalty suggested that it is not profitable to graze twin ewes on crop if the yield penalty is greater than 5% and not profitable to finish lambs on crop if the yield penalty is greater than 10%.

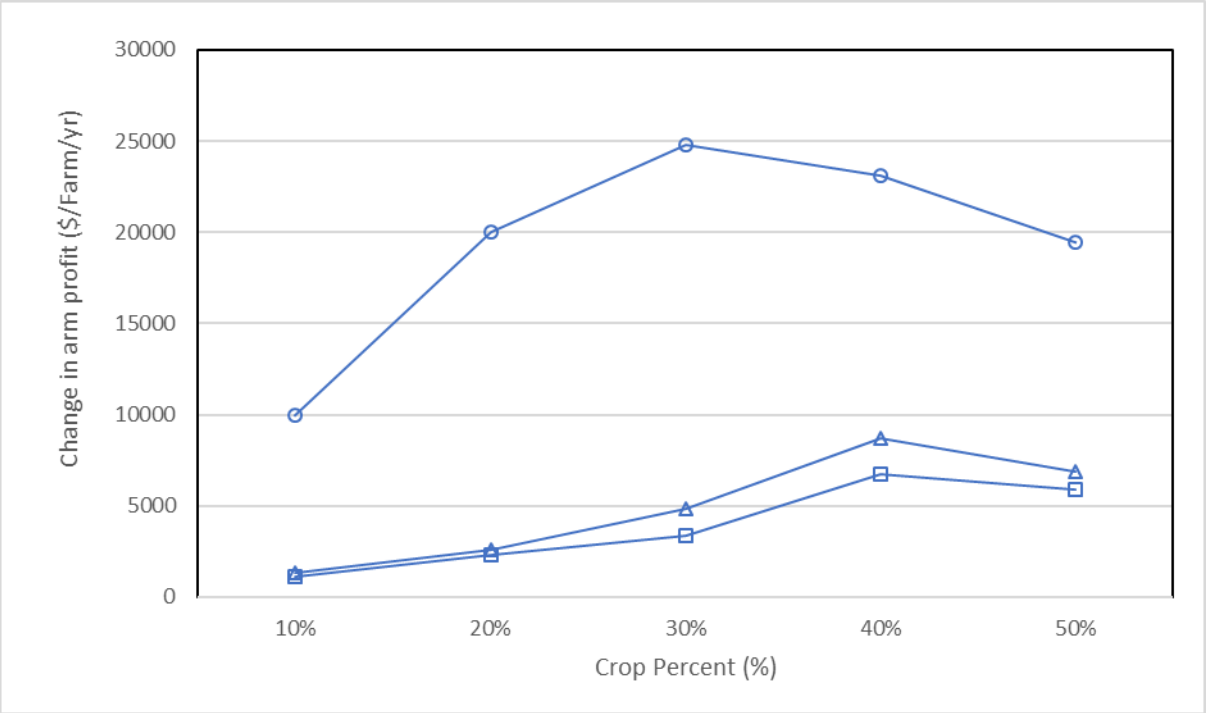

Figure 5: Change in profit when crop grazing technology is included with a 3% yield penalty, for systems based on breeding and selling finished (o), breeding and selling backgrounded (□) and breeding and selling store (Δ).

Crop grazing: Central Wheatbelt

Grazing crop has a significant effect in the wheatbelt especially when combined with a supply chain. Crop grazing is utilized predominately by finishing lambs, this allows lambs to gain the necessary weight in the last month before being sold, without the need for supplements. Although in a self-replacing flock it can also be profitable for ewes to graze crops. For early time of lambing (May) ewes utilise crop grazing as a feed source during lactation, this is profitable when the yield penalty is

below 5%. For late time of lambing (July), twin bearing ewes can benefit from the high-quality feed during mid-late pregnancy which increases twin survival and makes crop grazing more profitable for ewes.

Grazing crops is more valuable for farms with a high cropping percent. This is due to a combination of two factors, the first being that the farms can run a higher stocking rate (DSE/WgHa) due to the large quantity of stubble available during summer, so the addition of crop grazing significantly reduces the supplementary feeding costs during early winter, and the second being that the high crop area provides a non-limiting feed source.

When crop grazing is combined with a supply chain it becomes even more valuable because the feed source can be targeted by finishing lambs which allows a higher lamb turn-over without an increase in the supplementary feed costs (Figure 6).

Crop grazing in the wheatbelt can still provide value for a farm in a supply chain when the yield penalty is 15%, although the benefits for a self-replacing flock are minimal if the yield penalty is greater than 10%.

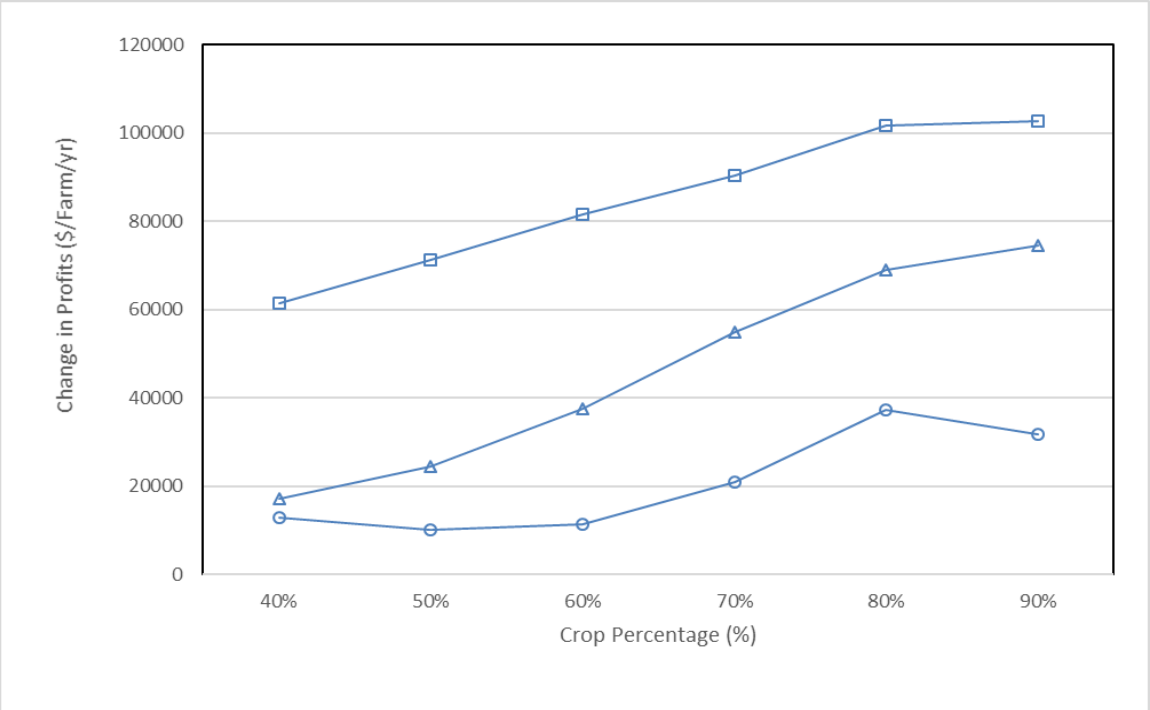

Figure 6: Change in profit when crop grazing technology is included with a 3% yield penalty, for early time of lambing systems based on, breeding and selling finished (o), buying store selling finished (Δ) and buying backgrounded selling finished (□).

Supply Chain vs Self-Replacing Flock

Table 4: Optimal management for farms in the Great Southern with different specialisations. Ewes are counted as 1.7 DSE and both backgrounded or finished lambs are counted as 1 DSE although lambs are primarily grazing stubble or being fed in a feed lot.

Parameter	Breed sell Finished	Breed sell Store	Breed sell Backgrounded
Pasture %	57	58	57
Ewes (hd)	4016	5425	4325
DSE	8.5	9.2	9.2
Proportion of ewes	65	79	65
Supplementary Feed/DSE	16	19	18

Table 5: Optimal management for farms in the Central Wheatbelt with different specialisations. Ewes are counted as 1.7 DSE and finished lambs are counted as 1 DSE although the lambs are primarily grazing stubble or being fed in a feed lot.

Parameter	Breed sell Finished	Buy Store sell Finished	Buy Backgrounded sell Finished
Pasture %	16	5	15
Ewes (hd)	2119	0	1865
DSE	10.2	28.9	27.2
Proportion of ewes (%)	67	0	24
Supplementary Feed/DSE (kg)	23	29	8.4

Table 6: Individual farm profitability and number of lambs purchased and sold for farms in the Great Southern and the wheatbelt for different production systems.

	Profit	Lambs purchased (hd)	Lambs sold (hd)
No specialisation			
Great Southern: breed, sell finished	338 500	-	1 767
Wheatbelt: Breed, sell finished	188 600	-	881
Specialisation: Breed and background in the HRZ, then transfer to wheatbelt for finishing			
Great Southern: Sell backgrounded	334 900	-	2 044
Wheatbelt: Buy backgrounded	254 700	8 650	9 431
Specialisation: Breed and sell weaners in the HRZ, then transfer to wheatbelt for finishing			
Great Southern: sell store	335 900	-	2 564
Wheatbelt: buy store	259 700	4712	4385

Breed and sell store from the Great Southern and background & finish in the wheatbelt

To turn off 100 000 finished lambs using a supply chain that breeds and sells store lambs in the Great Southern and backgrounds & finishes them in the Central Wheatbelt, requires 42 farms in the Great Southern producing 107 457 store lambs and 23 farms finishing the lambs in the wheatbelt. The total profit of these farms when selling finished lambs for $5.26/kg is $20 080 900. This compares to the same farms using self-replacing flocks to produce finished lambs, which has a total profit of $18 554 800. Meaning the value of the supply chain is $1 526 100 or $15.26/lamb.

Breed and sell backgrounded lambs from the Great Southern and finish in the wheatbelt

To turn off 100 000 finished lambs using a supply chain that breeds and sells backgrounded lambs in the Great Southern and finishes them in the Central Wheatbelt, requires 45 farms in the Great Southern producing 91 719 (lower because the wheatbelt farms are also breeding a small number of lambs) store lambs and 11 farms finishing the lambs in the wheatbelt. The total profit of these farms when selling finished lambs for $5.26/kg is $17 872 200. This compares to the same farms using self-replacing flocks to produce finished lambs, which has a total profit of $17 307 100. Meaning the value of the supply chain is $565 100 or $5.65/lamb.

Buying store vs backgrounded in the wheatbelt when pasture area is fixed at 20%

The results above are calculated when the model optimises the crop and pasture area for each system. In the Great Southern the pasture area is similar for all turn off systemS but in the wheatbelt the pasture area varies depending on the system (Table 5). However, if the proportion of pasture on the wheatbelt farms is fixed to 20%, the value of the supply chain that buys stores from the south and backgrounds and finishes in the wheatbelt drops to $537 300 or $5.37/lamb and the value of the supply chain that buys backgrounded lambs from the south and finishes in the wheatbelt drops to $535 200 or $5.35/lamb.

Fixing the cropping area at 20% has a much bigger effect when purchasing store lambs in the wheatbelt because the farms are not running any ewes and therefore can't utilize the extra area effectively throughout the year.

Feed Allocation

Feed Utilisation

Great Southern

Breed and sell store lambs:

For systems producing store lambs, the flock is self-replacing and turns off 3-month-old wether lambs in the middle of November. The wether lambs aren't allocated any feed because they feed off their mothers until they are sold.

Ewes feed on dry pasture and high-quality stubble from the chaff piles during the summer months, consuming 22kg/hd (200g/hd/d) of high-quality chaff. During March and April ewes primarily consume supplementary feed which is bulked out with dry pasture, over this time they consume 28kg/hd (440g/hd/d) of supplement. Ewes are then put onto green pasture, with twin bearing ewes also utilising crop grazing during June and July, consuming 67kg/hd (1200g/hd/d) of green crop.

Ewe hoggets consume dry pasture and a mix of high- and low-quality chaff during the summer months, consuming 37kg/hd (350g/hd/d) of chaff. In March and April, they consume mainly supplementary feed and a bit of dry pasture and low-quality deferred chaff, before being put onto green pasture in May. During this period, they consume 28kg/hd (440g/hd/d) of supplement.

Breed and sell backgrounded lambs

For systems producing backgrounded lambs, the flock is self-replacing and turns off 10-month-old wether lambs at the beginning of June.

During the summer months ewes feed on dry pasture and high-quality stubble from the chaff piles, throughout this period they consume 21kg/hd (200g/hd/d) of high- quality chaff. As the quality of the chaff piles starts to decline, supplementary feed is introduced into their diet, this is utilised between March and May and is complimented by low-quality feed from dry pasture and deferred

chaff piles. Over this period ewes consume 28kg/hd (440g/hd/d) of grain supplement. By the middle of May there is some green pasture available and during June and July twin ewes graze green crop, twin ewes are the only sheep to crop graze and consume 67kg/hd (1200g/hd/d). By this time there is ample pasture available which carries them through until harvest when they are put back onto chaff piles.
Ewe hoggets consume the greatest proportion of chaff per head, the chaff is primarily consumed from harvest through until April, this means ewe hoggets require less supplement during March, overall ewe hoggets consume 22kg/hd (340g/hd/d) of supplement and 50kg/hd (350g/hd/d) of chaff.
Backgrounded lambs consume dry pasture and high-quality chaff during the summer months before switching to a diet consisting primarily of supplementary feed during March and April and then onto green pasture during April and May before being sold. Overall backgrounded wethers consume 19kg/hd (180g/hd/d) of chaff and 17kg/hd (350g/hd/d) of supplement.

Central Wheatbelt

Buy store lambs and sell finished lambs

This system is 100% buy and sell, there are no ewes, store lambs are purchased in the middle of November, then backgrounded and finished and sold in the middle of July.
The lambs utilise high- and low-quality chaff from the middle of November until the end of April, consuming 89kg/hd (560g/hd/d). Between the end of April and the middle of June the lambs feed predominately on supplements, consuming 23kg/hd (470g/hd/d). This is followed by just over a month of crop grazing when the lambs are being finished, consuming 50kg/hd (1400g/hd/d).

Buy backgrounded lambs and sell finished lambs

This system runs a small self-replacing flock that is complimented by buying in backgrounded lambs in the middle of June. All the wethers are then sold in the middle of July as finished lambs.
During November, ewes consume both dry pasture and chaff piles, as the quality of dry pasture decreases they switch to a diet consuming only medium- and high-quality chaff, which is maintained until the end of April. Over this period a total of 164kg/hd (930g/hd/d) of chaff is consumed.
During May ewes are feed supplement, consuming 31kg/hd (630g/hd/d), before going onto green pasture. Ewe compliment this early green pasture with some crop grazing during June and July, consuming 30kg/hd (850g/hd/d).
During November ewe hoggets consume dry pasture and chaff piles, as the pasture quality reduces they switch to a full chaff diet, consuming a mix of low and high-quality feed, which is maintained until the end of April. Throughout this period, they consume 150kg/hd (860g/hd/d) of chaff. For the first half of May, before going onto green pasture, ewe hoggets primarily consume supplementary feed bulked out with deferred low-quality chaff. Over this period, they consume 6kg/hd (430g/hd/d) of supplements.
During November when the wether lambs born on the property are being backgrounded, they consume a mix of dry pasture and chaff piles, as the pasture quality declines they switch to a full chaff diet, consuming a mix of low and high-quality feed, which is maintained until the end of April. Over this period, they consume 160kg/hd (915g/hd/d) of chaff. During May the backgrounded lambs feed primarily on supplement with some green pasture at the end of May, they consume 11kg/hd (335g/hd/d) of supplement. In the middle of June, 8 900 backgrounded lambs are purchased, and all the wethers are put onto green crop to be finished, consuming 49kg/hd (1400g/hd/d).

Grazing Pressure Effect on Turn-off Time

To test the effectiveness of a supply chain at producing heavy export lambs over different years, a stocking rate sensitivity was performed. Changing the stocking rate whilst maintaining the same rotation, represents a change in the grazing pressure which imitates a good or bad season.

Great Southern

The change in profit for different turn off systems in the Great Southern are affected equally when stocking rate is altered from the optimal, illustrated in Figure 7. This result shows that seasonal variation should not alter lamb turn off time in the Great Southern region.

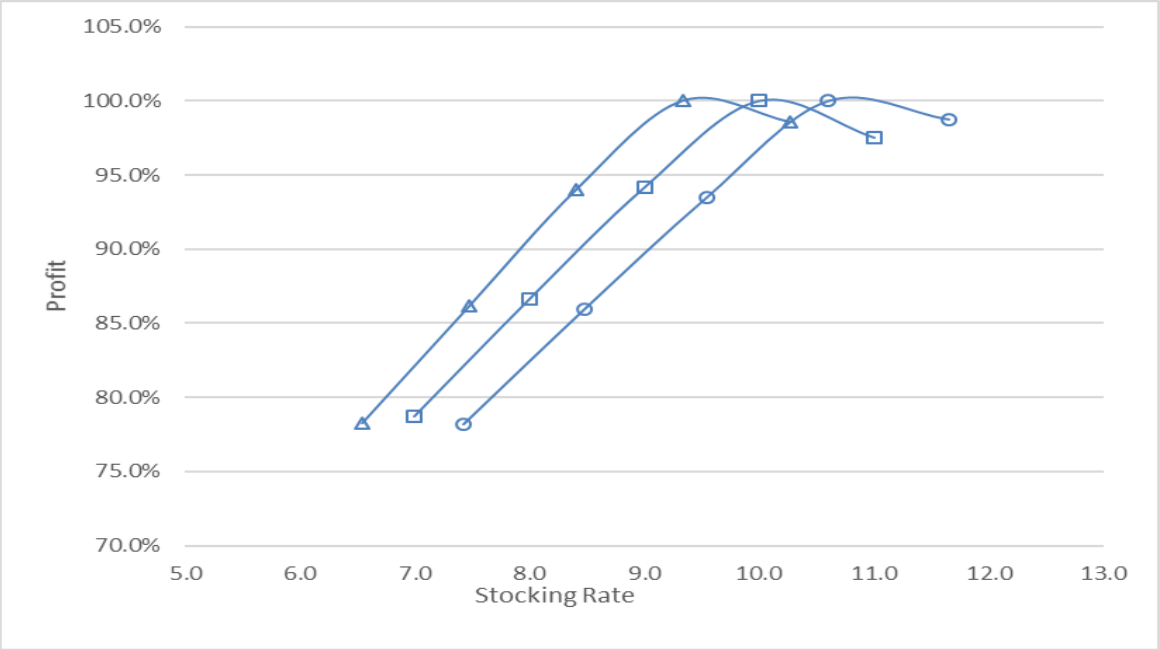

Figure 7: Profit at different stocking rates as a proportion of the optimal, for systems based on breeding and selling finished (o), breeding and selling backgrounded (□) and breeding and selling store (Δ). The stocking rate is altered 10% each time.

Central Wheatbelt

For farms in the wheatbelt, breeding and selling finished lambs is most affected when grazing pressure is altered from the optimum. Both supply chain systems are affected similarly, as grazing pressure is altered. This means the effects of seasonal variation on profit can be minimised through the use of a supply chain, but the difference between supply chain systems is not great enough to warrant a change in the buy-in time of lambs for different seasons.

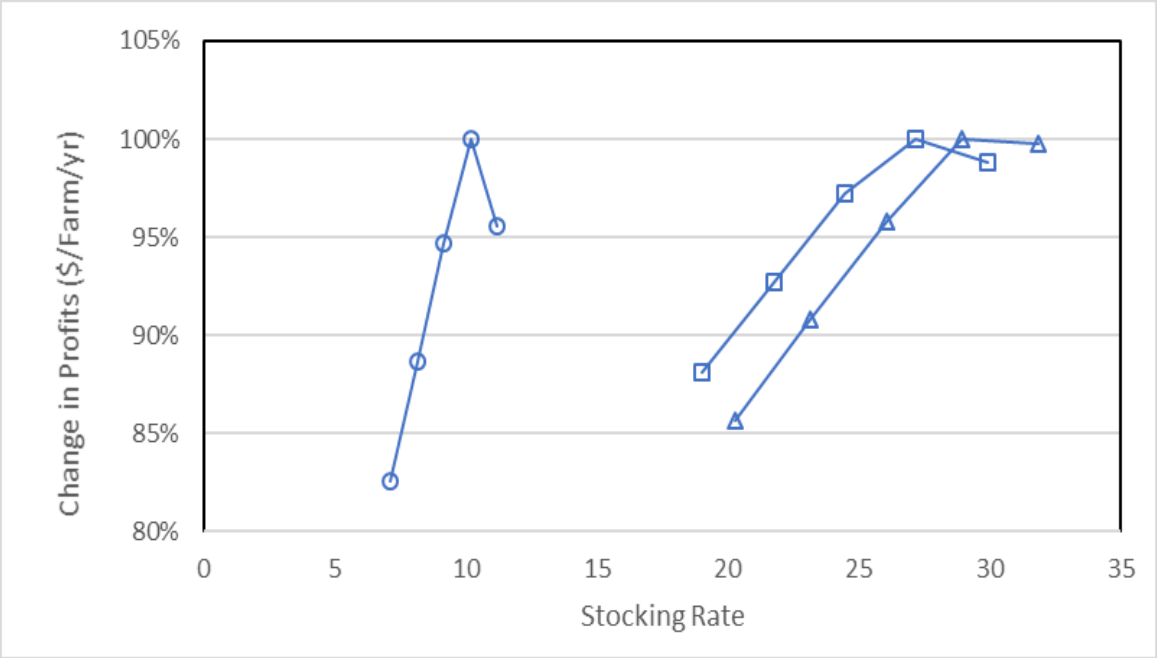

Figure 8: Profit at different stocking rates as a proportion of the optimal, for systems based on breeding and selling finished (o), buying backgrounded lambs and selling finished lambs (□) and buying store lambs and selling finished lambs (Δ). The stocking rate is altered by 10% each time.

Conclusion

The introduction of two new grazing technologies, chaff piles and crop grazing proved to be profitable in a range of systems, particularly when combined with a supply chain, which allowed more for efficient use of farms resources. Although crop grazing provides benefits for twin bearing ewes, it had the biggest effect when it could be utilised as a feed source for finishing wethers, providing gains of up to $100 000. Chaff piles add value of up to $30 000 to the livestock enterprise, providing a feed source which is easily accessible by sheep and deteriorates slower than traditional stubble. Chaff piles are most economical if they are also providing value to the cropping enterprise.

Supply chain between the Great Southern region and the Central Wheatbelt region is the most profitable way to produce out-of-season finished lambs because it allows farms to more efficiently utilizes their feed resources. Farms in the Great Southern can utilise the pasture more effectively by being able to run higher stocking rates and farms in the Central Wheatbelt are able to utilise their stubble and crop grazing potential.

Breeding and selling store lambs in the Great Southern and backgrounding and finishing in the wheatbelt is the most effective supply chain method. This result is different to John Young's initial analysis and is due to the re-calibration of the stubble and chaff pile modules. The result of the re-calibration means that stubble and chaff piles are now represented as a higher quality feed than previously. With stubble and chaff being a better feed source, it then became more profitable to background in the wheatbelt.

The Great Southern system runs a self-replacing flock where ewes and ewe hoggets both consume chaff piles throughout summer and into the beginning of autumn. For the remainder of autumn, they are fed supplements, graze pasture and consume deferred low-quality chaff. By this time there is green feed available which ewes also compliment with crop grazing to maintain condition in late

pregnancy. The Central Wheatbelt system runs no ewes and a higher cropping area, the purchased wethers are backgrounded using chaff piles and supplements, then finished on green crop.

Seasonal variation has a similar effect on all out-of-season lamb production systems and hence won't affect farmers decisions about buying or selling time. This can provide confidence that the supply will remain consistent over time.