final report

Project code: L.PDS.1701

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Date published: 23 October 2019

PUBLISHED BY
Meat and Livestock Australia Limited
Locked Bag 1961
NORTH SYDNEY NSW 2059

Finishing Systems for the Future?

Meat & Livestock Australia acknowledges the matching funds provided by the Australian Government to support the research and development detailed in this publication.

Executive summary

Modelling work conducted for Monaro Farming Systems in 2016 sought to determine the relative profitability of seeking to properly finish lambs on Monaro farms rather than selling animals out as lighter weight stores. Systems tested included simply retaining lambs longer into the autumn, developing specialist Lucerne paddocks to maintain higher growth rates over summer, and the utilisation of brassica forage crops over summer to maintain high growth rates and achieve heavier finished weights. In all cases the systems were assessed as more profitable than selling weaned crossbred lambs as stores at lighter weights.

This Producer Demonstration Site project was developed to ground truth the findings of the modelling by gathering real world data on herbage growth rates and lamb performance on pastures and crops similar to those modelled and also to assess the value of herb species such as plantain and chicory in the Monaro environment as another alternative finishing system.

The data collected showed that the modelled data on pasture and animals' performance was reliable and a partial budgeting approach showed that the adoption of systems to retain lambs and finish them to heavier weights is profitable in most circumstances regardless of the finishing system chosen.

Average net profits per hectare for the nine systems measured within the core group ranged from $305/ha to $1492/ha. In all cases these results were significantly higher than the modelled traditional system of selling store lambs at an average lamb sale weight of 29kg and a total enterprise gross margin of $161/ha.

In terms of industry benefits for the local Monaro grazing industry, if livestock producers adopted some type of lamb finishing system into their business model, the actual profits above the baseline store system would range from $144/ha up to $1,331/ha. On an average farm size of 2500ha with 20% of this area allocated to a prime lamb enterprise, this would equate to an annual income increase per farm of $72,000 up to $665,500. The impacts on the overall farm system would be a significant increase in business profitability. It is important to qualify that these types of profits would be dependent on, and influenced by climate (rainfall), soil type, business structure and management skill.

Additional comparative analysis data from the MFS benchmarking group over the previous six years (2013 – 2019) for prime lamb enterprises, showed average net profit/ha/year for group members ranging from $93/ha up to $269/ha It is important to note that there was a wide variation within this group data and individual business profits consistently ranged from $28/ha up to $498/ha reinforcing the message that finishing lambs is a profitable exercise in the majority of cases and emphasised the significant influence of location, rainfall and management on overall figures.

Results from our post project observer survey indicated 90% of respondent's indicated that this project has increased their confidence, knowledge and skills in finishing lambs and 85% plan to implement changes as a result of the data presented. Of those producers that plan to implement change, the most popular choice was to add more supplementation into the system followed closely by increasing the number of lambs finished, the "type" of finishing pasture and recording more pasture and livestock on-ground data.

As well as the observers, all six of the core producers indicated they will make changes to their current lamb finishing operations as a result of this project and these include more EID animal tracking and pasture measurements as well as increasing the amount of land allocation and number of lambs in this enterprise.

Monaro Farming Systems members should have confidence in the findings of the original modelling and expect significant improvements in farm profits to result from retaining and finishing first and second cross lambs in their breeding enterprise.

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1 Background

1.1 What was the problem?

1.1.1 Why did MFS apply for the PDS funding?

The Monaro is traditionally a wool growing and breeding region, though MFS member surveys indicate meat production enterprises have increased from 10% to 35% of farm enterprise over the last six years. A run of good seasons and greater financial security has generated more interest in expanding the lamb enterprise on many farms as was indicated in an MFS member survey conducted in 2015.

Cold winter temperatures and limited area of high quality pastures, has meant many producers sell crossbred lambs as stores rather than reaching slaughter weights and fat scores.

The traditional base system is to turn off lambs as stores by the end of December each year at an average lamb sale weight of 29kg and an average total enterprise GM of $161/ha.

MFS identified a need to invest in GrassGro® modelling work to quantify the relative profitability ($/ha) of retaining store cross bred lambs on three pasture systems (phalaris/subclover, lucerne, brassica) and in all cases retaining lambs appreciably increased farm profitability.

Modelling work contracted by MFS recently (see below & attached) has indicated that total enterprise GM's of $236/ha (phalaris/subclover), $266/ha (lucerne) and $495/ha (brassica) are achievable.

The modelling suggested considerable scope for improved farm profitability via these finishing systems however we needed pasture/animal trials to validate the modelling results and to ground truth paddock situations across the variable climate and soil types of the Monaro. Initial producer experience suggested the modelling process has overestimated growth of brassicas and underestimated lucerne. In this light some Monaro specific monitoring of lucerne, brassicas & other high quality pasture options would be desirable to help calibrate the modelling and fine tune the conclusions of this work so as to give producers greater confidence in the results.

2 Project objectives

2.1 Project Aim

Can high quality forage crop and perennial pasture systems be utilised to meet target weights and fat scores for finishing lambs on the Monaro and increase overall farm profit relative to the traditional base selling enterprise system.

2.1.1 What we wanted to achieve

By June 2019, in the Monaro region of Southern NSW:

1. Six (6) producer demonstration sites will validate / ground truth the modelling projections demonstrating the relative profitability of the following six (6) finishing pasture systems in sheep meat enterprises;

   (a) Improved grass pasture (phalaris or fescue based)

(b) Improved grass pasture (sub clover or lucerne based)
(c) Lucerne
(d) Brassica (rape)
(e) Brassica (rape)
(f) Plantain
(g) Control / baseline (permanent pasture) – already documented in GrassGro® ® modelling paper

2. Validate on-farm the following metrics for each of the six (6) demonstration systems;

(a) Dry Matter Production (kg DM/ha/year)
(b) Feed quality (DMD, ME etc)
(c) Lamb live-weight gains (g/hd/day)
(d) Condition scores
(e) Percentage (%) of farm area (ha) required for finishing lambs to target weights
(f) Soil fertility (phosphorus, sulphur, PBI, K, Ca, Na, Mg, Al, CEC, EC, pH)

3. Conduct a cost benefit analysis to determine the overall profitability of each system in context of whole farm profit compared to the traditional base selling system (turn-off store lambs).

4. Demonstrate the value of EID sheep tags to monitor performance of one of the lamb treatment groups.

5. Document six years of comparative analysis data for prime lamb enterprises for 15 core farm businesses including the following key performance indicators;

(a) income ($/DSE) and income/HA
(b) enterprise expenses ($/DSE) and per HA
(c) gross margin ($/DSE) and per HA
(d) net profit ($/DSE)
(e) net profit ($/Ha/100mm) and per HA
(f) Lamb Cost of Production ($/Kg Dwt Produced)
(g) Lamb Production (Kg DWt/Ha)
(h) Lamb Production (Kg Dwt/Ha/100mm rain)

6. Deliver a series of educational, training and information activities to showcase the six case study sites to 65 farm businesses incorporating 200 observer producers to increase confidence, awareness and capacity to adopt and integrate lamb finishing systems into their farm enterprise.

7. A target of 15 farm businesses will have adopted some component of lamb finishing systems into their management by the end of the project ie October 2019.

3 Methodology

3.1 Objectives 1, 2 and 3

3.1.1 Paddock Descriptions

A range of different paddocks were chosen across a range of host properties to represent the types of pastures and crops represented in the original modelling. These are listed in detail below.

(a) Lucerne / Phalaris /Cocksfoot mix ("Cobana" –Bibbenluke - Brad Yelds)
The monitor paddock was part of a three paddock rotation on a slate/shale soil with each paddock being 10ha in size and sown to the same pasture composition in the same year. A single paddock was chosen as the monitor paddock with an easterly aspect (36.846°S,149.290°E)

(b) Lucerne (Fishy Lake Rd, Ando – Richard Taylor)
The monitor paddock was part of a two-paddock rotation and was 36ha in size. The paddock was basaltic in origin and had some non-arable stony outcrops which had remnant native pasture representing 7ha of the total while an area of 6ha was predominantly an old phalaris stand. The remaining 26ha was sown to a single species Lucerne stand. The paddock had a westerly aspect and was located at 36.652°S,149.188°E.

(c) Perennial Ryegrass / White Clover ("Lowanna", Cathcart – Michael Shannon)
This was a single 18ha paddock on granite-based soil with considerable use for grazing throughout the year but targeted for finishing pasture over the late spring and summer. The paddock had an easterly aspect and was located at 36.814°S,149.393°E. This paddock was only monitored in the first year of the project as the property converted to 100% beef cattle by the start of the second year.

(d) Hummer Fescue, White Clover and Sub Clover (Bibbenluke – John Murdoch)
The monitor paddock was on basalt soil, just 9ha in size and close to the shearing shed and yards so had considerable grazing by other stock throughout the year. The paddock was reserved for lamb finishing in early summer. The paddock had a generally southerly aspect and was located at 36.801°S,149.283°E

(e) White Clover, Lucerne, Chicory and Plantain (Delegate River – John Jeffries)
The granite soil paddock was 24ha and had minimal grazing from other stock being reserved predominantly as a specialist finishing pasture for lambs. The paddock had a predominantly westerly aspect and was located at 37.096°S,148.793°E. This paddock was only monitored in the first year of the project and was replaced with an adjacent paddock with the same pasture mix in an adjacent paddock of 20ha to the south.

(f) Winfred Forage Brassica ("Lowanna", Cathcart – Michael Shannon)
This single 18ha paddock on granite soil was grown specifically for lamb finishing over summer. The paddock had a south easterly aspect and was located at 36.812°S,149.393°E

(g) Raphno Forage Brassica (Delegate River – John Jeffries)
This paddock on granite soil was 26ha in size and sown specifically for finishing lambs and located at 37.098°S,148.811°E

(h) Leafmore Forage Brassica (Mila – John Murdoch)
This was a single 10ha paddock with a northerly aspect on granite soil in its first year out of a rundown pasture. There was a considerable contamination of the crop with spear thistle

which discouraged the lambs from fully utilising the paddock and causing brassica biomass to be patchy. The paddock was located at 37.057°S,149.187°E. This paddock was only used in the first year of the trial but a second paddock approximately 1km to the south east (37.061°S,149.178°E was sown and monitored in the second year

(i) Plantain / Chicory ("Cobana" –Bibbenluke - Brad Yelds)
The paddock was newly sown in Autumn of 2018 and part of a two-paddock rotation. The sown area was 8 ha in size but the paddock had residual areas under trees of around 5ha that was not sown. The paddock was on a slate/shale soil with a south easterly aspect and located at 36.852°S,149.293E

(j) Chicory / Plantain / White cover (Kybeyan – Richard Taylor)
This was a 31ha paddock with approximately 25ha sown to the specified mix and the balance a mix of native and exotic grasses. On granite soil with a north easterly aspect the paddock was located at 36.414°S,149.402E

3.1.2 Animal Measurements

All paddocks were grazed with a mob of weaned cross bred lambs and 50 of these lambs were tagged as a monitor group for weighing. The lambs were weighed into and out of the monitor paddock each time the paddock was grazed, and the average measured gain applied to the total stocking rate to determine the kg of lamb live weight gained per ha. Despite planning to also record condition scores at entry and exit it soon became apparent that the grazing periods on most paddocks were too short to collect any meaningful data on the change in condition resulting from grazing the measured paddock.

3.1.3 Pasture Measurements

Herbage mass was measured in each monitor paddock each time the lambs entered and exited the paddock. The paddock was sampled using the median quadrat technique outlined in the NSW Prograze manual (2011) whereby a median quadrat was placed 10 times evenly spaced along a representative transect in the sown area of the paddock. Herbage mass was visually assessed in each of the 5 sub quadrats and the middle ranking quadrat cut and placed into a bag. The 10 samples were bagged as an aggregated sample and then weighed wet before being thoroughly mixed and sub sampled for drying in a drying oven to determine the dry matter content of the fresh sample. This dry matter percentage was then applied to the total fresh sample in order to calculate the total herbage mass in kg DM/ha as well as being sorted to provide an estimate of the proportion of green and dead material in the sample.

Prior to the first grazing at the same time as the herbage mass assessment a sample of the green herbage was also bagged and frozen before being sent to the Feed Quality Service at the Wagga Wagga Agricultural Institute for NIR testing for Dry Matter Digestibility, Metabolisable Energy and Crude Protein. This provided useful information to enable the actual animal performance to be compared with the expected performance using the GrazFeed™ decision support tool as well as a point of comparison back to the original GrassGro® modelling.

3.1.4 Cost Benefit Analysis

As the paddocks being monitored represented only a small portion of the area allocated to finishing lambs on each of the host farms a method had to be developed to value the marginal gain which had been achieved through the use of more specialist pastures and crops for the finishing of lambs. In each case the baseline stocking rate and gross margin was assumed to be the average values achieved by the MFS Holmes and Sackett benchmarking group members for the 2017-18 FY. The baseline average stocking rate for the benchmarking group was 8 DSE/ha and the weighted average gross margin per DSE was $57.70 (S McEachern pers. comm.).

The marginal value of grazing on each monitor paddock was determined by a twofold process. The first step was to allocate a DSE value to any grazing other than lamb finishing and from that figure subtract the average rating of 8 DSE. For some paddocks the extra grazing was more than 8 DSE and in that case the extra grazing was simply valued at the benchmark average of $57.70/DSE and added to the gross margin produced by the lamb finishing component. Where the additional grazing was less than 8 DSE then the difference was again valued on the same basis but subtracted from the value produced by the lamb finishing component.

The value of lamb finishing was determined on the basis of the actual weight gained in the monitor paddock. Live weight gained per ha was multiplied by an assumed 45% dressing percentage and was valued at the 3yr median lamb price of 604 c/kg. Variable costs included 2 drenches and one fly treatment per 15kg of individual live weight gain and calculated to be 13 c/kg of live weight gain. Any supplements were recorded and costed as fed. Transaction costs were allocated as 5% of the value gained and freight costs allocated as 5c/kg of live weight gained which was based on the typical cost to freight animals 200km to market.

Additional maintenance fertiliser was also assumed to be required where the total DSE per ha including lamb finishing exceeded the benchmark average of 8 DSE and was determined on the basis of 1kg of P required per extra DSE and valued at $5/kg of P spread ($450/tonne of SSP). The actual cost of establishment was amortised over the expected lifespan of the pasture at an interest rate of 7% pa. For annual crops the full cost of establishment was allocated to the year of measurement.

Finally, the total costs per ha were subtracted from net value of lamb live weight gain less/plus the value of extra grazing gained/forgone to generate a marginal economic gain which is the nominal increase in profit from the combination of pasture/crop establishment and allocation to lamb finishing.

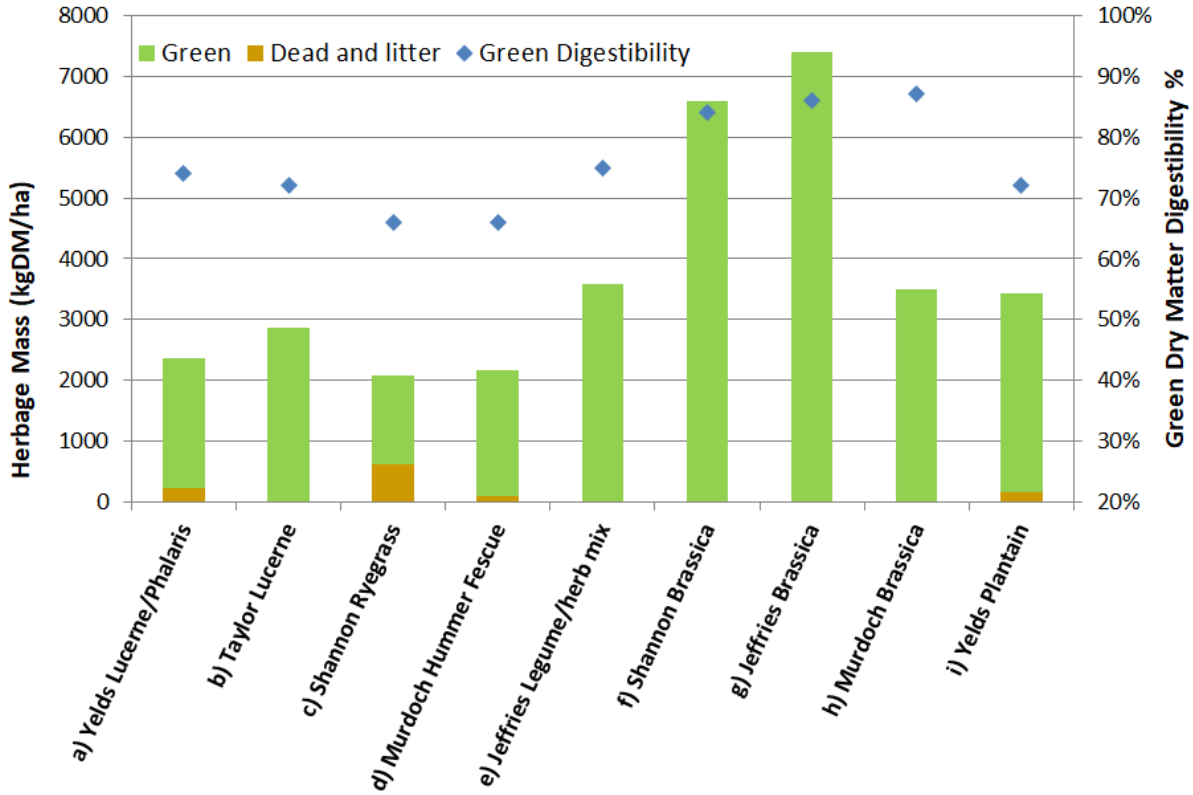
4 Results

4.1 Objectives 1,2 and 3

4.1.1 Herbage growth, biomass and feed quality.

Figure 2.1.1 shows the measured herbage mass and green herbage digestibility for each of the monitored paddocks in the summer of 2017-18. Brassica paddocks with excellent weed control at Cathcart and Delegate River exceeded 6 and 7 tonnes of dry matter per ha at the commencement of the first grazing. This was more than twice the dry matter accumulated in the legume-based pastures and three times that in the mixed grass pastures which had been used for considerable grazing value over the lambing period. Feed quality testing also showed that these brassica crops had the highest dry matter digestibility although it should be noted that the Murdoch and Jeffries brassicas had crude protein levels were suboptimal for these levels of digestibility (11.8% and 7.3% CP) which may have served to limit lamb growth rates.

Figure 2.1.1 Herbage mass and digestibility at the time of the first lamb grazing 2017-18



These herbage availabilities are the direct result of the herbage growth in the preceding period less any pasture utilised by other grazing. Table one defines the length of the preceding period and the calculated growth rate required to achieve the herbage mass measured at the end date of the period. Where the pasture type had prior modelling this growth rate is compared with the potential range of performance across a range of years. The pasture at **site a)** was closest in composition to the original modelling work and achieved a growth rate of 28 kg DM/ha/day over the 93 days to the 16th of November placing its performance just above the median for the modelled pasture for the same period of the year.

Table 2.1.1 2017-18 herbage growth calculated from biomass measurements and stock numbers compared with the original modelling where applicable.

		Measured Period			*Modelled Percentiles		
Site	**Co-operator -Pasture**	**Start**	**End**	**Growth Rate**	**10th**	**median**	**90th**
a	Yelds - Phalaris Lucerne	15 Aug	16 Nov	28	9	24	38
b	Taylor - Lucerne	3 Oct	30 Nov	32	9	19	31
		3 Jan	14 Feb	24	6	19	41
c	Shannon - Rye/ Clover	15 Aug	20 Dec	11	21	36	48
d	Murdoch - Hummer Fes	15 Aug	8 Dec	30	n/a	n/a	n/a
e	Jeffries - Legume/herbs	1 Sep	10 Nov	40	n/a	n/a	n/a
					20th	median	80th
f	Shannon - Brassica	5 Oct	20 Dec	86	43	55	74
g	Jeffries - Brassica	10 Oct	10 Jan	80	43	55	74
h	Murdoch - Brassica	5 Oct	20 Dec	46	43	55	74
i	Yelds - Plantain	7 Oct	16 Nov	57	n/a	n/a	n/a

*From systems modelled in the "Exploring Lamb Finishing Systems on the Monaro" report and private modelling of the Lowanna System.

The Lucerne at **site b)** was the only ostensibly pure stand monitored and over the two periods measured the observed growth rate was within the expected range with the spring growth being around the 90th percentile of the modelled growth while the summer growth period was just over the median growth rate expected from the modelling.

Plate 2.1.1 Lucerne available at site b at the first lamb grazing each year.

30 Nov 2017

26 Nov 2018

High performance grass pastures were represented at **sites c) and d)** and while these pasture types were not part of the original modelling subsequent modelling for Michael Shannon gave a benchmark for what might be expected from the Bealy Ryegrass at site c). Interestingly the calculated growth rate for this site was very low at 11kgDM/ha/d when the median expected from the modelling was 36kgDM/ha/d over the same period of the year. Only total DSE grazing days were provided for this site and it is suspected that a cohort of grazing animals may have been missed in

the record or that the DSE calculations were made on a different basis. At **site d)** the growth rates observed were calculated to be 30kgDM/ha/d and given this site is dryer than **site c)** this would be expected to be around or slightly above the long-term median for this pasture at this location.

The Brassicas at **site f) and g)** performed at the highest level that might have been expected from the modelled data however in the case of the Delegate River site it would be expected that temperatures would have been considerably higher that at the Bungarby site modelled and hence would reasonably be expected to produce more biomass. It should be noted though that the soil moisture available in the early period of crop growth was very limiting and the majority of growth occurred later in the pre-grazing period. Interim biomass observations suggest that the growth at **site f)** was over 160kgDM/ha per day between the 13th of November and the 20th of December in order to accumulate the measured 6.6 tonnes of dry matter observed. At **site g)** a similar observation was made with early summer growth in excess of 110kgDM/ha/d. Performance of the brassica at **site h)** was the poorest of the three brassicas however the paddock had come out of pasture with a heavy load of Poa tussock making seed bed preparation difficult and also had a considerable weed challenge from spear thistle which robbed the crop of water and nutrients without contributing to the grazable biomass.

Not modelled in the original work were pastures with a dominance of white clover along with herbaceous species such as plantain and chicory. At **site e)** the growth over the measured period was calculated as being 40kg/ha/day in 2017 and produced large quantities of herbage mass of high digestibility. At **site i)** paddock preparation was not as good and there was a considerable weed burden with relatively low amounts of clover but at the time of grazing in 2017 there was a good population of plantain. Based on an estimate of dry matter on the 7th of October the average growth rate until grazing commenced on the 16th of November was 57kgDM/ha/d.

Plate 2.1.2 Herbage available at **site e)** at the first lamb grazing each year.

11th October 2017

31st October 2018

Observed biomass at the commencement of grazing in the 2018-19 season is shown in figure 2.1.2. The winter and spring of 2018 were much drier than 2017 and this shows in the amount of herbage accumulated especially on pastures which have general utility and were used to graze lambing ewes

before lock up and had very low soil moisture levels in the second half of spring. Green herbage on these more general purpose pastures at **sites a), b) and d)** had low levels of biomass accumulation compared with 2017 despite similar grazing patterns suggesting that pasture growth rates were less than half of the previous year placing the seasonal growth below the bottom quartile of the modelled data. At **site e)** spring rainfall was better than at other sites and hence pasture growth rates were higher enabling the accumulation of around 7 tonnes of DM at the time of first grazing. This was not directly comparable with the first year as the monitor paddock, while adjacent to the original, was not the same composition having a much greater contribution of Chicory to the measured biomass.

The brassica at **site g)** didn't accumulate quite as much biomass as the previous year however this was only to be expected as grazing commenced a full month earlier and average herbage growth rates from sowing to grazing was still almost 70kgDM/ha/d and within the expected range. At **site h)** a different paddock was sown to the previous year with much better preparation and less weeds which resulted in much greater accumulation of biomass prior to grazing (6.5 tonnes DM/ha) which averaged over the period from sowing represents a growth rate of 88kgDM/ha/d.

The herb and clover mixes at **sites i) and j)** were both used opportunistically for spring grazing with breeding animals so suffered the same poor accumulation of biomass as the grass and Lucerne sites. With the use of feed supplements in 2018 **site i)** had carried 18 DSE for the year in addition to the number of lambs grazed for the trial. It is likely that this was beyond the limits of a plantain/clover pasture in its first year after establishment as the amount of the target species remaining in 2018-19 was very low and the pasture performance suffered as a result. The relatively low biomass accumulation in the paddocks that had been used for grazing over early spring compared with the specialist pasture at **site e)** and the brassica crops which had full rest prior to grazing with lambs illustrates the value of exerting discipline in reserving dedicated areas for lamb finishing

Figure 2.1.2 Herbage mass and digestibility at the time of the first lamb grazing 2018-19

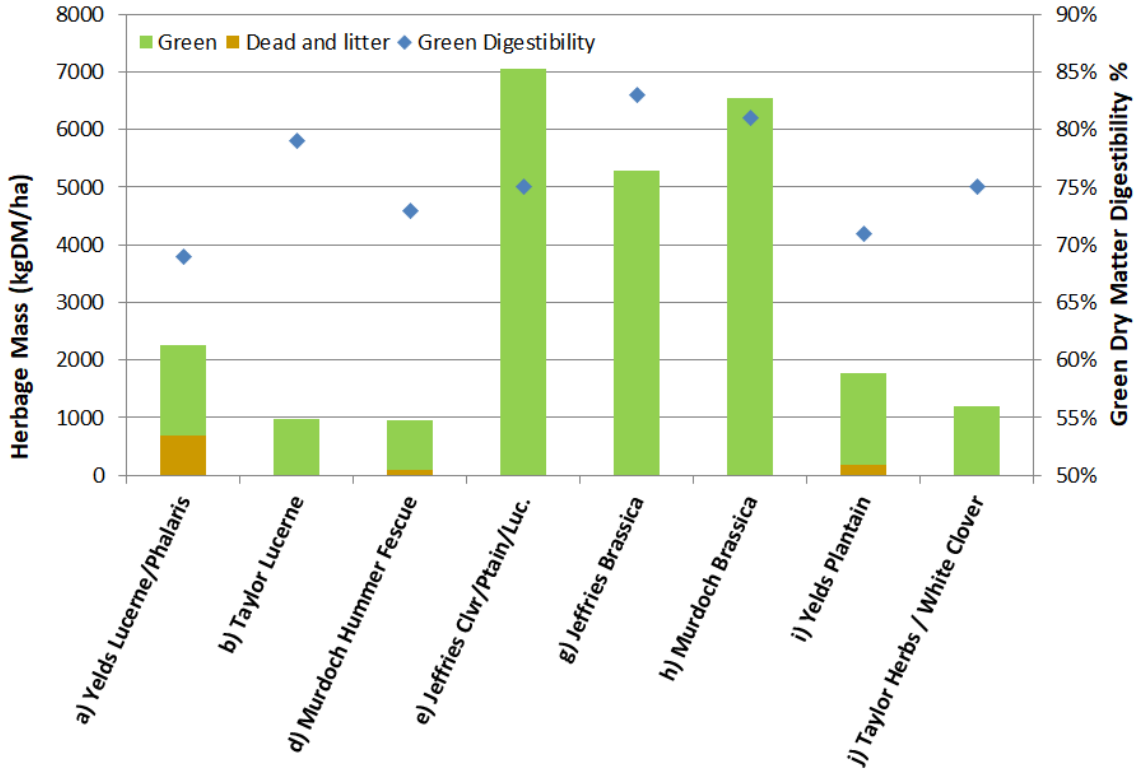


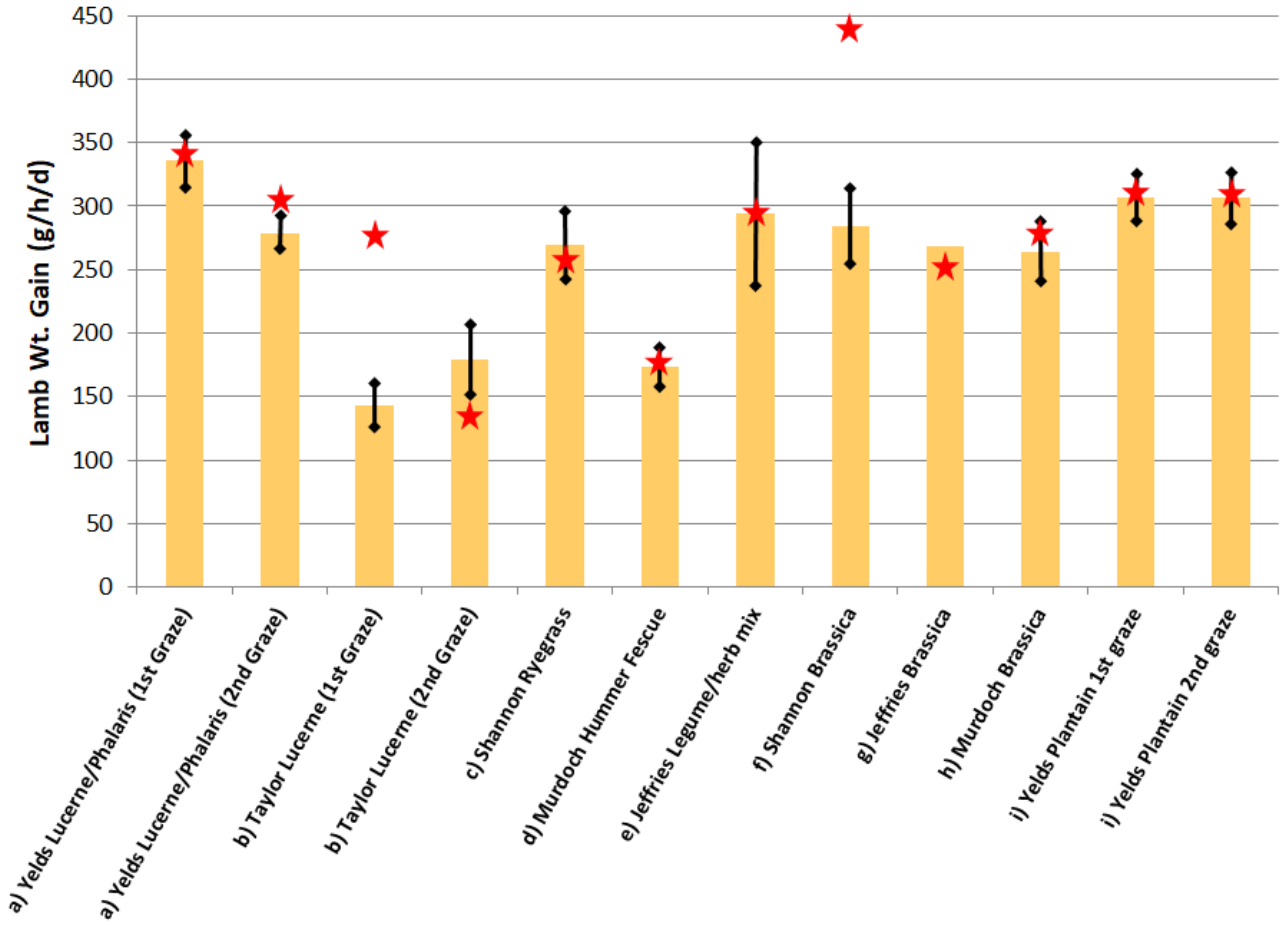
Plate 2.1.3 Herbage available at **site *h*** at the first lamb grazing each year.

20th December 2017 | 10th December 2018

4.1.2 Animal Performance

Measured lamb weight gains ranged from around 150g/h/d to almost 350g/h/d over the 2017-18 trial period. In most cases the measured gain was aligned with the expected gain using the GrazFeed™ decision support tool. As GrazFeed™ represents the animal component of GrassGro® this alignment served as validation of the original modelling in terms of expected weight gains. There were two instances where the modelled data did not align well with measurements. On **site b)** animals did not achieve the expected weight gains in the first grazing period but in this instance the lambs had only been weaned the day prior to being placed in the Lucerne so voluntary intake would undoubtedly have been lower than expected due to both the stress of weaning and he change in diet from grass based pastures. On **site f)** the brassica had very low dry matter content and extremely very high protein levels. GrazFeed™ predictions were for over 400g/h/d but the model does not account for suppression of dry matter intake due to the inability of the animals to excrete the excess water. This along with low gut residence times due to low fibre content can reasonably explain the over estimation of animal performance by the model. This does not impact the validity of the original modelling since the performance of the animals was derived from previous trial data rather than GrazFeed™ or GrassGro®. Despite this anomaly the modelled growth rates on the remaining two brassica crops aligned well with the observed data as these crops had significantly higher dry matter percentages and much lower crude protein levels.

Figure 2.1.3 Weight gains for each lamb grazing period in 2017-18.



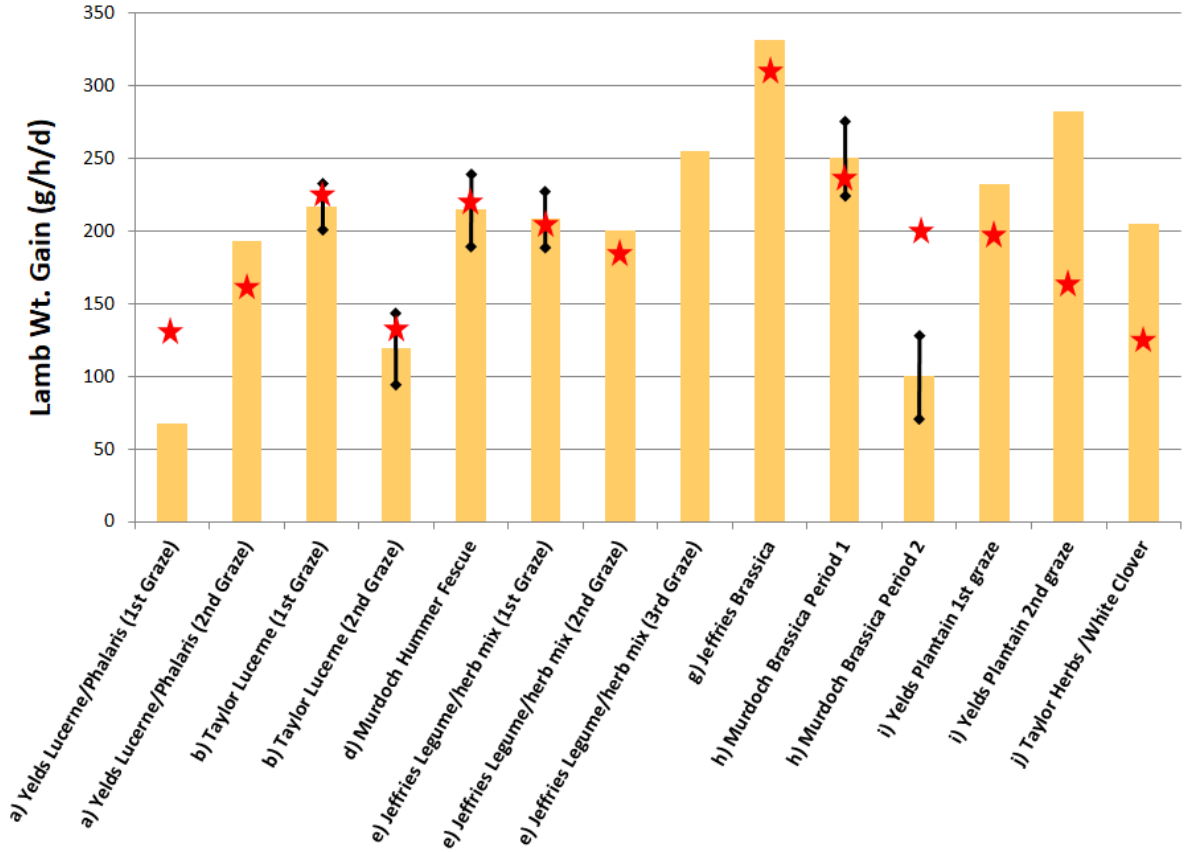
Bars indicate the 95% confidence interval for the average weight gain and red stars indicate the predicted weight gain from GrazFeed™ ™ using the appropriate breed characteristics for each site and the measured herbage characteristics for mass and quality for each grazing period.

In the 2018-19 trial period the poor seasonal conditions caused graze times to be shorter especially on pasture paddocks that had been grazed earlier in the spring and had not been able to recover sufficient herbage mass. Graze times were as short as 10 days on some sites and this has undoubtedly affected the reliability of weight gain data when calculated over such short timeframes.

Weight gains ranged from around 70g/h/d on late spring grass dominant pasture at **site a)** up to more than 300g/h/d on brassica crop at **site g)**. Not all co-operators provided individual animal data so not all weight gains show a 95% confidence interval however where this has been provided the predicted animal performance from GrazFeed™ is generally well aligned with the measured performance.

The measured weight gains did not reach expected levels for the first grazing period at **site a)** and this may have been due to the addition of a large number of extra lambs to the mob impacting both the availability of pasture throughout the grazing period and also causing some bullying at the self-feeders being used at the time. Similarly, the performance of the lambs in the second grazing period at **site h)** was also lower than expected and remains unexplained although since the model assumes all animals are perfectly healthy it could potentially be due to subclinical effects of worms.

Figure 2.1.4 Weight gains for each lamb grazing period in 2018-19.



Bars indicate the 95% confidence interval for the average weight gain and red stars indicate the predicted weight gain from GrazFeed™ ™ using the appropriate breed characteristics for each site and the measured herbage characteristics for mass and quality for each grazing period.

Plate 2.1.4 Lambs grazing *Leafmore* Brassica at site ***h*** Mila 3rd January 2019.

Plate 2.1.5 Biomass pre and post the second 2018-19 grazing along the sampling transect at site ***e***

10th January 2019 30th Jan 2019

4.1.3 Economic output from lamb finishing pastures and crops

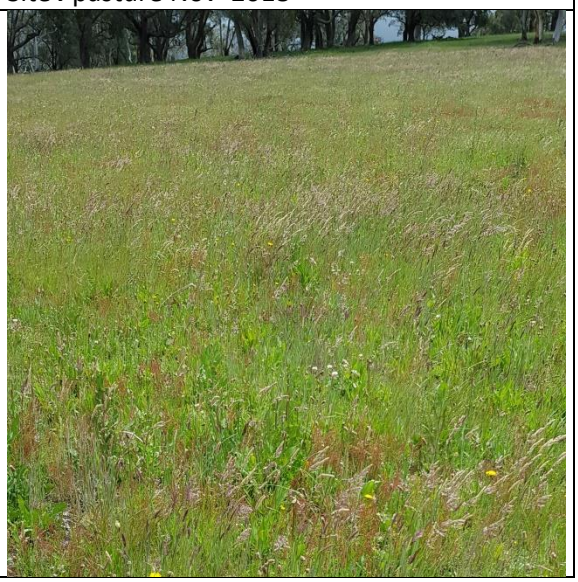
While there is considerable variation in the profit margin from the various crop and pasture systems tested it is important to note that they cannot be directly compared to each other rather they should be interpreted as the relative gain in profit margin applicable to that pasture or crop system at that location in that year.

For the 2017-18 year the net profit from the establishment and utilisation of pasture /crops for lamb finishing ranged from $123/ha to an incredible $2394/ha. In general, pasture systems that were able to achieve a net gain in base carrying capacity performed well for example the pasture at **site a)** saw a net gain in value of production of $729/ha but nearly 40% of this gain came from additional background grazing over and above the assumed 8 DSE/ha baseline. The highest net profit figure came from **site *i*** on a pasture dominated by plantain however a key characteristic of this system was the intensive use of supplements in order to increase the utilisation rate of the pasture grown without compromising growth rates. In this way both a high gain of lamb live weight as well

as a more than doubling of background stocking rate was achieved but at the cost of more than $350/ha being spent on supplements. The legume-based pasture system at **site e)** had the highest rate of forgone background grazing but this enabled much higher rates of utilisation by growing lambs and yielded the second highest net profit. By contrast the Hummer fescue pasture at **site d)** had one of the lowest yields of lamb live weight but compensated through higher stocking rates of other stock classes throughout the year giving an additional 10DSE's of other grazing throughout the year helping it to reach a net profit of $845/ha. Net other grazing contributed more than 50% of the extra income in this system which in many ways is not surprising since this pasture type is not especially adapted to high quality growth over summer relative to other times of the year.

In the 2018-19 period seasonal conditions were considerably poorer during the late winter and spring period which compromised the recovery of the more general-purpose pastures at **site a) and d)** particularly since late spring growth was insufficient to generate sufficient regrowth for lamb finishing in early summer. At **site *a*)** large increases in stock density and supplementary feeding as the animals entered the monitor paddock had a dramatic impact on the measured performance of the monitor group. Poor lamb growth rates in the first grazing period compromised the overall result with a net loss of $193/ha however lamb weights were monitored throughout the whole rotation around the three like paddocks and although pasture biomass and quality was not measured it was still possible to determine the economic output of the whole system rather than the single monitor paddock and the results are shown in **Table 2.1.3** in the column marked (*a*). Taken across the whole area of like pasture the net profit was $136/ha. **Site *e*** showed the highest net profit in 2018-19 and is notable in that it was the only site where the pasture was dedicated to the finishing of lambs with no other grazing the entire year. A total live weight gain of more than 1200kg/ha was achieved across three grazing periods with only one period utilising feed supplements to achieve the result. Despite foregoing the entire value of the background grazing, site e still achieved a net profit of more than $2000/ha. It must be noted that seasonal conditions at this site were better than the other sites but rainfall was still below average for the summer. **Site *i*** was the most changed from the previous year with the net profit falling to just $85/ha after the heady highs of the previous year. With the addition of significant supplementary feeding **site *i*** carried more than 30 DSE in 2017-18 after being sown in the Autumn of 2017 and this was clearly not sustainable as the proportion of sown species had diminished greatly in 2018-19.

Plate 2.1.1 View of typical herbage at site ***i*** in each year of the demonstration.

Site ***i*** pasture in Nov 2017	Site ***i*** pasture Nov 2018
	

Only 2 sites had forage brassicas in the 2018-19 season brassicas were sown into the same paddock at site ***g*** and a nearby paddock at site ***h***. The utilisation strategy at these sites were quite different with the paddock at site g being reserved solely for lamb finishing whereas at **site h** considerable other grazing occurred including breeding ewes and cows as well growing steers and a further cohort of lambs which were not weighed. Site g achieved a net profit of $1052/ha while site h achieved $572/ha however the net other grazing at **site h** was valued at the benchmark average of $55.70/DSE and since a significant proportion was in the form of growing stock this is likely to be an underestimate.

4.1.4 Breeder numbers forgone to finish stock (area required for finishing)

The original modelling work looked at three finishing options for retaining lambs through to heavier weights. The first was to simply retain them on the traditional perennial grass-based pasture. The second was to establish Lucerne pastures as a specialist finishing resource and the third was to grow a specialist finishing crop in the form of forage brassicas each had different outcomes in regard to the carrying capacity forgone by the breeding component of the enterprise.

Finishing on traditional improved pastures.

The modelling of this option suggested that in most years lambs could be retained into the autumn in existing systems without greatly impacting the breeder numbers being carried. Sites ***a***, ***c*** and ***d*** most closely matched this strategy where lambs were finished on grass-based pastures without excluding other grazing throughout the year. In each case in 2017-18 significant lamb live weight gain was achieved while increasing the total DSE rating of the background grazing. Even in a much poorer season through 2018-19 sites ***a*** was able to achieve even greater kg of live weight gain albeit with a 40% reduction on the 8 DSE background carrying capacity whereas at site ***d,*** while only 99kg/ha of lamb live weight gain was achieved, other grazing was maintained above the 8 DSE assumed baseline. This is again in line with the original modelling which found that in the worst 10%

of years lambs were sold at the earliest possible sale date (1st Feb) at weights only 5kg heavier than the average sale weight of the base enterprise which sold store lambs at the start of summer.

Finishing on pure Lucerne

Only site ***b*** gave an example of finishing lambs on pure Lucerne but unlike the system modelled the paddock was used for significant levels of other grazing rather than being reserved purely for lamb finishing. In the 2017-18 season 209kg/ha of lamb live weight gain was achieved while giving up only 1.3 DSE (16%) of background grazing capacity. By comparison the modelling results showed that when solely used for lamb finishing the Lucerne was able to finish 20 lambs/ha with an average live weight gain of 17kg/hd ie 340kg of lamb live weight gain per ha. These results would suggest that given the grazing pattern practised on the host farm a 60% more area of Lucerne would be required to achieve the same finished lamb weights as in the model however compared with the modelling this only reduces the baseline carrying capacity by around 5% compared with 17% in the modelling. Overall this is reflected in the relative profitability where the average net profit from the addition of Lucerne at site b is $425/ha whereas the impact of Lucerne on farm net profit in the modelling work averaged $270/ha.

Finishing on Brassica Crop

In the original modelling brassica crops were assumed to be grown exclusively for the finishing of lambs however, similar to the Lucerne example above, the three brassica sites monitored in 2017-18 all provided significant grazing over and above the finishing of lambs. Across the three sites (***f***, ***g*** and ***h***) lamb live weight gained ranged from 274 to 477 kg/ha while at the same time maintaining 50 – 60% of the background stocking rate. By comparison the modelling suggested that with 80% utilisation of the crop and 100% allocation to lamb grazing the total lamb live weight gain expected would approach 950kg/ha.

In the 2018-19 season the brassica crop at **site g** was predominantly allocated to grazing by the measured lamb cohort and this approach achieved a lamb live weight gain of around 870kg/ha with an additional 1DSE in background grazing which is a very similar performance level to the modelled data. The crop at site ***h*** achieved 305kg/ha of lamb live weight gain but also carried background grazing 2.5 DSE higher than the 8 DSE baseline. Overall while the real world grazing strategies did not allocate the entire crop to lamb finishing once the other grazing is accounted for, crop performances are in the order of that indicated by the modelling and the area of crop required to finish lambs shown in the original report should be a reasonable indicator.

Table 2.1.2 Cost / Benefit analysis for the monitored sites in the 2017-18 financial year.

	Monitoring Site									
Production Gains	***a***	***b***	***c***	***d***	***e***	***f***	***g***	***h***	***i***	***Base Store System (modelled)***
Live Wt. Gain / ha	169	209	144	184	621	379	294	477	1010	93
Dressed Wt. / ha	76	94	65	83	279	171	132	214	455	
Lamb Value Gained /ha	460	568	391	501	1688	1032	799	1296	2745	
Net other grazing* (DSE/ha)	4.8	-1.3	2.3	10	-4.7	-2.5	-2.3	-4.2	10	5.1
Value of net other grazing ($/ha)	267	-70	128	557	-262	-139	-128	-234	557	
Net Gain ($/ha)	**727**	**498**	**519**	**1058**	**1426**	**893**	**671**	**1062**	**3302**	**407**
Additional Costs ($/ha)										
Amortised estab't cost (inc. Lime)	71	57	142	103	240	484	455	550	223	42
Cost of additional maint. fertiliser	39	20	26	69					150	inc above(42)
Supplements used	61	0	0	0	145				365	41
Marginal commission on sales	23	28	20	25	84	52	40	65	137	22
Marginal freight	8	11	7	9	31	19	15	24	50	inc above (22)
Marginal husbandry costs	22	27	19	24	81	49	38	62	131	28
Total Costs ($/ha)	**224**	**143**	**213**	**230**	**579**	**569**	**548**	**701**	**907**	**247**
Net Profit ($/ha)	**503**	**355**	**305**	**828**	**845**	**324**	**123**	**361**	**2394**	**161**

*the baseline stocking rate of 8 DSE/ha is subtracted from the DSE carried in the paddock excluding those from lamb finishing to determine the net change in baseline grazing capacity.

Table 2.1.3 Cost / Benefit analysis for the monitored sites in the 2018-19 financial year.

	Monitoring Site								
Production Gains	**a**	**(a)**	**b**	**d**	**e**	**g**	**h**	**i**	**j**
Live Wt. Gain / ha	195	274	253	99	1242	871	305	381	105
Dressed Wt. / ha	88	123	114	45	559	392	137	171	47
Lamb Value Gained /ha	530	744	689	268	3376	2367	829	1036	285
Other net grazing* (DSE/ha)	-3.3	-3.3	-0.7	1.7	-8	-7	2.5	-2.9	-0.3
Value of other grazing ($/ha)	-184	-184	-38	95	446	-390	139	-159	-17
Net Gain ($/ha)	**346**	**560**	**651**	**363**	**2930**	**1977**	**968**	**877**	**268**
Additional Costs ($/ha)									
Amortised estab't cost (inc. Lime)	61	61	46	103	240	650	300	223	71
Cost of additional maint. fertiliser	27	20	30	20				42	16
Supplements used	380	246			158			406	
Marginal commission on sales	26.5	37	34	13	169	118	41	52	14
Marginal freight	10	14	13	5	62	43	15	19	5
Marginal husbandry costs	25	36	33	13	161	113	40	50	14
Total Costs	**539**	**424**	**156**	**154**	**791**	**925**	**396**	**792**	**119**
Net Profit ($/ha)	**-193**	**136**	**495**	**209**	**2139**	**1052**	**572**	**85**	**148**

*the baseline stocking rate of 8 DSE/ha is subtracted from the DSE carried in the paddock excluding those from lamb finishing to determine the net change in baseline grazing capacity.

5 Discussion

5.1 Explanation of results

5.1.1 Interpretation

Overall, despite it being impossible to fully replicate the simple farm systems represented in the modelling the data collected in this project gives a reasonable validation of the core aspects of the modelling report. With a few exceptions the modelled growth rates of the crops and pastures was indicative of the actual growth achieved over the two years of monitoring. Using GrazFeed™ to validate the animal model component showed that the lamb growth rates achieved in the paddock were very similar to the predicted growth rates produced by the GrazFeed™ model.

Notwithstanding the confounding effects of the more complex real-world grazing systems, overall land productivity measures were within the expected range indicated in the modelling report.

Importantly only at one site in one year of the demonstration was the net profit lower than would have otherwise been expected in the absence of a lamb finishing component. Otherwise all the pasture and crop systems tested gave an additional net return and would have improved the profit of the farm enterprise despite the relatively poor seasonal conditions in 2018-19. Due to the Lucerne modelling not allocating any extra grazing value beyond its use for lamb finishing, it is likely that the modelling results may have underestimated the additional value Lucerne brings to the farms value. Brassica crops were highly profitable as expected even with crop establishment costs approaching double the costs used in the modelling report. Overall this should give MFS producers confidence in the original modelling results and should give great confidence in the reliability of increased profit flowing from lamb finishing regardless of the pasture/crop system chosen.

Where significant supplementary feeding was undertaken good lamb growth rates were maintained while at the same time achieving very high rates of utilisation of pasture and potentially reducing the total area of finishing forage required to achieve marketable weights. The interaction of supplements with finishing forage is an area of ongoing interest to the MFS group and will be the subject of further study in the summer of 2019-20 weather conditions permitting. Of additional interest in this space will be the impact of these high utilisation systems on the longevity of lamb finishing pastures.

While highly profitable systems were apparent both with and without additional grazing over and above the lamb finishing it was certainly apparent that the highest levels of lamb production per ha was achievable on systems where the crop or pasture was solely used for grazing by lambs. Site ***e*** at Delegate River achieved the highest two-year average net profit while essentially providing grazing solely for lamb finishing. It would have been good to be able to see the impact of this very focussed grazing strategy at other locations and in other pasture systems.

Project Objectives - checklist

By June 2019, in the Monaro region of Southern NSW:

1. Six (6) producer demonstration sites will validate / ground truth the modelling projections demonstrating the relative profitability of the following six (6) finishing pasture systems in sheep meat enterprises;
   a) Improved grass pasture (phalaris or fescue based)
   Improved pasture based on Hummer Fescue was studied at site d and the validations summarised in the results shown above
   b) Improved grass pasture (sub clover or Lucerne based)
   An improved pasture with Cocksfoot, Phalaris and Lucerne was studied at Site ***a*** and the validations summarised in the results shown above
   Also a pasture dominated by White Clover with additional Chicory and Lucerne was studied at Site ***e*** and the validations summarised in the results shown above
   c) Lucerne
   A pure Lucerne sward was studied at site ***b*** and the validations summarised in the results shown above
   d) Brassica (rape)
   A brassica forage crop was studied at site ***f*** in 2017 and the validations summarised in the results shown above
   e) Brassica (rape)
   Brassica forage crops were studied at sites ***g*** and ***h*** in 2017 and the validations summarised in the results shown above
   f) Plantain
   A plantain-based pasture was studied at site***i*** in both years and at site ***j*** in 2018-19 and the validations summarised in the results shown above
   g) Control / baseline (permanent pasture) – already documented in Grassgro® modelling paper

2. Validate on-farm the following metrics for each of the six (6) demonstration systems;

   (g) Dry Matter Production (kg DM/ha/year)
   Herbage mass was measured, and herbage growth rates derived over defined periods in the lead up to lamb grazing.
   (h) Feed quality (DMD, ME etc)
   Feed quality was measured at the time of commencement of first grazing.
   (i) Lamb live-weight gains (g/hd/day)
   Lamb live weights were measured, and lamb growth rates derived.
   (j) Condition scores
   Lambs were not condition scored. Grazing periods were too short to reliably collect information on the impact of specific grazing periods on condition of animals.
   (k) Percentage (%) of farm area (ha) required for finishing lambs to target weights
   Actual recorded weight gains and grazing in addition to lambs was used to assess what proportion of land resources would be needed to finish lambs and to validate the relevant components of the modelled data.
   (l) Soil fertility (phosphorus, sulphur, PBI, K, Ca, Na, Mg, Al, CEC, EC, pH)

Recent soil tests results were provided by co-operators where available and soil tests taken where this was not available.

3. Conduct a cost benefit analysis to determine the overall profitability of each system in context of whole farm profit compared to the traditional base selling system (turn-off store lambs).

Cost benefit analysis completed and shown in the results above.

4. Demonstrate the value of EID sheep tags to monitor performance of one of the lamb treatment groups.

EID sheep tags were used to identify a subset of each of the monitor mobs of lambs. For each system measured, 50 lambs were tagged with EID and followed throughout. Although it is hard to quantify in economic terms, the value of using these tags to monitor livestock performance was certainly clearly demonstrated. Prior to the PDS, only one (1) of the five (5) core producers used an EID system in his lamb finishing enterprise. Following the PDS, the remaining four (4) core producers have indicated they will implement an EID system to better track animal performance and be able to make more pro-active rather than reactive decisions about supplementation and timing of grazing rotations.

5. Document six years of comparative analysis data for prime lamb enterprises for 15 core farm businesses including the following key performance indicators;

(i) income ($/DSE) and income/HA
(j) enterprise expenses ($/DSE) and per HA
(k) gross margin ($/DSE) and per HA
(l) net profit ($/DSE)
(m) net profit ($/Ha/100mm) and per HA
(n) Lamb Cost of Production ($/Kg Dwt Produced)
(o) Lamb Production (Kg DWt/Ha)
(p) Lamb Production (Kg Dwt/Ha/100mm rain)

Six years of comparative analysis data for prime lamb enterprises has been documented (see Appendix for a copy of the data) from 2013/14 to the 2018/19 financial year for the members of the MFS benchmarking group that have a prime lamb enterprise in their mix. This number has fluctuated from 3 – 8 farm businesses and has included the key performance indicators as listed above. Surprisingly the net profit ($/ha/yr) for prime lamb enterprises for members of this benchmarking group showed lower overall profit margins when compared with the core PDS group highlighting the significant effect of management, location, seasons etc on the overall result. I believe the data collected from the PDS would be possibly more robust considering it is all real actual, on-ground, animal / pasture measurements.

Benchmarking Group – Average Net Profit ($/ha/yr)

2013 – 14 - $116/ha (Range $28 - $498)
2014 – 15 - $269/ha (Range $169 - $456)
2015 – 16 - $93/ha (Range $15 - $180)
2016 – 17 - $166/ha (Range $64 - $312)
2017 – 18 - $187/ha (Range $21 - $383)

2018 – 19 - $231/ha (Range $91 - $419)

6. Deliver a series of educational, training and information activities to showcase the six case-study sites to 65 core farm businesses incorporating 200 observer producers to increase confidence, awareness and capacity to adopt and integrate lamb finishing systems into their farm enterprise.

   Throughout the two years of data capture for this PDS project, educational and information activities were delivered approximately twice a year to update members on the information and provide a platform for discussion of results, interpretation and producer exchange and interaction. The following communication / education activities were delivered;

   - → **6th April 2018** - Lamb Finishing Presentation – Year 1 Results – 45 attendees
   - → **6th Sept 2018** – Lamb Finishing Presentation – Economic Analysis – 50 attendees
   - → **11th Sept 2019** - Lamb Finishing Presentation – Final Results – 60 attendees

   Communication activities around these field days included regular newsletter articles, a website page, local newspaper articles, radio interviews and case studies.

   Results from our post project observer survey indicated 90% of respondent's indicated that this project has increased their confidence, knowledge and skills in finishing lambs and 85% plan to implement changes as a result of the data presented. These changes include adding supplementation to the system as well as allocating a greater area to the finishing enterprise and recording more pasture and livestock performance data.

7. A target of 15 farm businesses will have adopted some component of lamb finishing systems into their management by the end of the project ie October 2019.

   This objective is always hard to measure definitively as the majority of MFS members that were able to finish lambs, were already doing so prior to this project, dependant on the season and market prices. Also, the fact that no pre-project OBSERVER survey was done, hampered the ability to record any change. I think we can confidently say that at least 15 farm businesses will have "improved" their finishing enterprise as a result of this PDS work and in many cases expanded the enterprise.

6 Conclusions/recommendations

6.1 Final conclusions

6.1.1 Key messages

Average net profits per hectare for the nine systems measured over the two years for the various systems ranged from $305/ha to $1492/ha demonstrating a strong argument to adopt a finishing program versus selling store lambs at a total enterprise gross margin of $161/ha.

When you extrapolate this into whole farm income terms, if livestock producers achieved even the lower average annual net profit of $305 / ha on an average farm size of 2500ha with 20% of this area allocated to a prime lamb enterprise, an annual income increase per farm of $72,000 would be possible ABOVE the traditional store lamb system.

The extreme variation in overall net profit from Year 1 and Year 2 for all the systems measured reinforced the message that season and lamb price as well as input costs can significantly impact overall profit, however increases in business profitability versus the store system were still evident over the two years.

Feedback from both core and observers was positive with all core producers making changes to their lamb finishing enterprise as a result of the PDS data. The changes indicated were expected to translate to an estimated 5-10% improvement to overall gross margins for one producer and potentially increase net profit by 25% ie. an increase from $400/ha to $500/ha for a second producer as an example.

Results from this demonstration have reliably confirmed the modelled data from the original report and should give producers on the Monaro the confidence to pursue lamb finishing on more specialised crops and pastures in the knowledge that the approach will increase farm profitability. In many cases the allocation of land to specialised lamb finishing can double or even treble the profitability of that part of the landscape and any minor reduction the carrying capacity for breeding stock is more than compensated. In many cases these highly productive finishing pastures can achieve the objective of finishing lambs while still providing a feed resource at other times of the year for breeding stock.

The use of supplements and the principle of substitution appears to enable increased utilisation of herbage while at the same time maintaining per head performance and meeting market targets. More work is warranted to explore this opportunity and to demonstrate its value as a tactical finishing strategy.

Using the data from this PDS, Monaro Farming Systems was able to successfully apply for further PDS funding to explore the benefits of supplementation in finishing lambs. This data will help

quantify the economic benefits of using supplementation and sensitivity of the system to grain and livestock pricing.

7 Bibliography

7.1 References

PROGRAZE manual (2006) PROGRAZE – profitable, sustainable grazing. Eighth edition. (Ed. P. Graham). NSW Department of Primary Industries and Meat & Livestock Australia.

8 Appendix

8.1 Trial Data - Attachments

8.1.1 Location of all trial meta data, project material and outputs

All project attachments have been ordered in a **drop box file** which will be shared with MLA. This was due to the number of attachments and file sizes which made emailing electronic copies quite an onerous process. MLA can then download the relevant material from the drop box folders.

The Dropbox folders and content are ordered as follows;

MLA.PDS.1701_Monaro Farming Systems

Communications

↓

- Case Studies
- Newsletters
- Whole of Project - MER
- Media (radio interview, newsletter article)

Comparative Analysis MFS Benchmarking Group

↓

- Prime Lamb Comparisons 18-19
- Prime Lamb Comparisons 17-18
- Prime Lamb Comparisons 16-17
- Prime Lamb Comparisons 2014 - 2016

Financial Reconciliation

Results Presentations

↓

- First year economic summary – Sept 2018
- 1st Year lamb finishing summary – April 2018
- Lamb finishing final results – Summary

- Second year economic summary

Site Data

↓

- Feed quality
- Liveweight data
- Photos
- Soil tests
- Year 1
- Year 2

Survey Data

- Post skill surveys
  - → Core group
  - → Observers
- Pre skill survey - Core