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Profitable Sheep Farming in South-west Victoria: Specialisation or Diversification Under Volatile Prices, Costs and Climate[1]

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Abstract

Changes in seasonal and market conditions and the cost-price squeeze have implications for the profit and risk of a farm business. Farming a range of activities is a common approach for reducing exposure to risk, whilst still making reasonable profits. Such diversification spreads yield and price risk across several activities. The effectiveness of diversification in reducing risk and maintaining satisfactory profit depends on the correlations between yields and prices of the various activities, complementarities between enterprises, and the ability of the farmer to manage the various systems. Alternatively, specialisation by producing one commodity well has the potential to generate higher profits than the diversified system, but also has higher exposure to price risk. A case study farm running prime lamb, Merino fine wool and cropping in south-west Victoria, was analysed to compare choices about diversification and specialisation in the farm system, and to examine the impact on profit and risk. The biophysical, economic, financial, wealth and risk dimensions of the business were simulated to examine how six different farm systems were likely to perform under volatile seasonal, price and cost conditions over a seven-year planning period.

The study focused on changes to the farm business that would increase profits from producing either one or a combination of different commodities - prime lamb, fine wool, beef and cereal crops - and evaluating the profit and the risk of making these changes. The six changes analysed were: (C1) increase soil fertility and develop all pastures to improve the base farm; (C2) all prime lamb; (C3) prime lamb and beef breeding cow and calf; (C4) prime lamb and cropping; (C5) lambing later and finishing all lambs in a feedlot; and (C6) lambing later and finishing all lambs on forage crops. Options that involved diversification of livestock enterprises, such as farming multiple sheep enterprises, or sheep

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and beef cattle, were sound approaches for managing risk, whilst achieving reasonable net profits and returns on capital ($254,000, 6.1 per cent and $275,000, 6.5 per cent, respectively). If higher profits are sought, then specialisation and focusing on a single enterprise, such as prime lamb, appeared the best option ($320,000, 7.2 per cent), but there was greater variation associated with the average profit over a run of years. For this analysis, farming a prime lamb enterprise based on pasture supply to finish the majority of lambs was generally more favourable than lambing later to maximise reproduction performance and finishing lambs in a feedlot ($294,000, 6.8 per cent) or forage crop system ($276,000, 6.5 per cent). Cereal cropping ($196,000, 5.2 per cent) was not a profitable option for this farm business when compared with prime lamb production. Finally, analysis of the factors contributing to variability of profit indicated that the price, particularly of lamb, was the substantial contributor to overall risk.

Key words: farm change, whole-farm analysis, economics, finance, wealth, risk

Introduction

Farming livestock in south-west Victoria, Australia, has long been profitable for some farmers. Livestock systems in the region are based on pasture grown and consumed on-farm, under a climate that predominantly has wet winters and dry summers, and annual average rainfall above 500 mm. The region is known for producing fine Merino wool, though relatively low wool prices and increasing profitability of lamb production has increased specialist prime lamb production in the past two decades. In recent years, a hotter and drier climate has enabled land that was once too wet in winter for cropping to be planted to cereal, oil seed and pulse crops. Over time annual farm profit across south-west Victorian farms has varied considerably, caused by volatile commodity prices and seasonal conditions (DEDJTR, 2014a; Tocker, 2016).

Holding a mixed portfolio of assets can reduce the total variability around average annual profit without excessively forgoing profits (Barry and Ellinger, 2012). Farming a portfolio of multiple activities (diversification) is commonly done to spread risks across the yields, prices and costs of the range of activities (Malcolm *et al.,* 2005; Shadbolt and Martin, 2005; Kimura *et al.,* 2010; Barry and Ellinger, 2012). The success of diversifying activities in reducing risk and maintaining profit depends on: the correlations between yields and prices; complementarities between enterprises; and the ability of the farmer to manage the various systems (Malcolm *et al.,* 2005). Alternatively, specialising by producing one commodity, and doing it at a high standard, has the potential to generate high profits, through greater efficiency of production and better quality and reliability of product (Malcolm *et al.,* 2005). However, specialised commodity producers are likely to face a greater need to manage price risk than more diversified producers (Ada *et al.,* 2006).

Extensive research and extension effort has been directed at improving the profits of livestock systems in south-west Victoria (Saul and Dark, 2003; Saul *et al.,* 2009; Morant, 2011; Saul *et al.,* 2011; Lewis *et al.,* 2012). The choices that managers of sheep and beef farming businesses make have been analysed using biophysical modelling methods to determine their influence on farm profit (MLA, 2004; Thompson, 2006; Warn *et al.,* 2006; Young *et al.,* 2006; Young *et al.,* 2010; Warn, 2011a; Warn, 2011b).

Structural adjustment of farming has occurred, and continues, across south-west Victoria. At the same time, changing climate (CSIRO and BOM, 2015), a growing world population and demand for food (Perrett, 2012; Prasad and Langridge, 2012), and the continuing cost-price squeeze (ABARES, 2016) mean there is good reason to investigate future options for change in farming systems in this region. Whole farm analysis encompasses the components of production, profit and efficiency, cash flow and debt servicing, additions to wealth, and business and financial risk (Malcolm, 2001; Malcolm *et al.,* 2005; Heard *et al.,* 2013). A whole-farm approach and analysis of the trade-off between profit and risk helps inform sound decisions about change (Heard *et al.,* 2013).

In this study, a case study mixed enterprise farm - prime lamb, Merino fine wool and cropping - in south-west Victoria was analysed to explore potential changes to maintain and improve profit over the next decade. It was hypothesised that specialisation in one enterprise would increase returns and exposure to risk, while diversification of enterprise mix would reduce exposure to risk, but also generate lower returns.

Method and Approach

The potential performance of the farm business over a medium term (seven years) was simulated without any change and compared with the simulated potential performance of the business with some plausible changes. The approach involved three key elements: a real case study farm; close involvement of an industry steering committee; and whole-farm modelling focussed on the technical, biophysical, human, economic, financial and risk aspects of the farm business (Malcolm *et al.,* 2012). This approach is based on previous economic research conducted for Victorian dairy and prime lamb farms (Malcolm *et al.,* 2012; Tocker *et al.,* 2013).

The steering committee was comprised of six local sheep farmers, two agricultural consultants, a sheep extension officer, a sheep scientist and agricultural economists. The steering committee provided direction about scenarios to analyse, assumptions to use in making changes to the farm system, and they assisted in interpreting results. This ensured that results were subject to rigorous questioning, with a range of well-grounded perspectives considered (Malcolm *et al.,* 2012).

Using case studies of real farm businesses as they currently operate and could operate provides information that facilitates improved understanding of such businesses and of the changes analysed (Armstrong *et al.,* 2005; Ho *et al.,* 2005; Malcolm *et al.,* 2012). The case study farm was chosen by the industry steering committee subject to the criterion that it was representative of a typical mixed sheep farm for the region.

Animal production within each farm system was simulated using GrassGro® (version 3.2.4), which enables the interacting processes of pasture growth and animal production in sheep and beef enterprises to be modelled using historical rainfall variability (Moore *et al.,* 1997; Freer *et al.,* 2012). GrassGro® has previously been used to analyse changes to farming systems (Clark *et al.,* 2000; Clark *et al.,* 2003; Robertson, 2006; Warn *et al.,* 2006; Graham and White, 2010; Warn, 2011a). Cereal crop production was modelled using Microsoft Excel, whereby a yield multiplier was linked to growing-season rainfall data (April to November) to give a range of possible crop yields (French and Shultz, 1984a, b). The operation of the base farm and each change was simulated over a 50-year period of weather data (1960 to 2009; SILO weather data) to derive a distribution of possible farm output.

The biophysical outputs were combined with price and cost information to produce annual whole-farm budgets in Microsoft Excel, based on farm management economic principles (Malcolm *et al.,* 2005). Whole-farm profit and loss, tax, cash flow, and balance sheets were constructed for the base farm and each change. Risk was incorporated using @Risk (version 6.1.1), an add-in software package to Microsoft Excel, which allows probability distributions to be defined for uncertain input variables (prices and costs) and Monte Carlo sampling of these distributions (Palisade, 2012).

For the purposes of the analysis, the farm was assumed to be purchased at the start of year one, run for the planning period of seven years and then sold. Based on advice from the steering committee, seven years was considered an acceptable period to analyse a reasonable range of risky outcomes.

Similarly, an annual 'cost-price squeeze' of 1 per cent (in real terms) was imposed on all costs. The different quantities of inputs used and outputs produced, coupled with different prices and costs modelled over many different combinations (4,000 iterations) of seven years of farming, were analysed to form distributions for various measures of performance for the base farm and each change.

Evaluating a change involves analysing how it may affect the various parts of the farm system - increases and decreases in production, benefits and costs - with the overall aim being to improve the performance of the farm as a whole. The analysis used a number of criteria to compare between options, as identified by Malcolm *et al.* (2005):

1. Production: For the new farming system, how do production inputs and outputs change?
2. Profit: How do annual operating profit (earnings before interest and tax (EBIT)) and annual net profit (earnings after interest and tax) change?
3. Efficiency: Will the change make the business more economically efficient, as measured by the modified internal rate of return (MIRR; return on capital) of the investment over the planning period?
4. Cash Flow and Finance: What is the likelihood of cash flow being able to cover debt servicing obligations?
5. Wealth: Does wealth or equity increase by the end of the planned period? This was measured by calculating cumulative (nominal) annual net cash flow after interest deductions from farming, and the difference between opening and closing asset values (adjusted for inflation of 2 per cent each year) and debt balances.
6. Risk: What is the variability (risk) associated with the different measures calculated above? This was assessed by calculating the standard deviation (SD) and coefficient of variation (CV) of the stream of annual net benefits. CV puts the SD associated with the mean in proportion to the mean and is useful when comparing between investments that involve different amounts of capital. Risk can also be divided into business risk and financial risk (Gabriel and Baker, 1980). Business risk is measured as the CV of net cash flow before interest for a typical one-year period. Financial risk is measured as fixed debt-servicing obligations as a proportion of net cash flow after interest, tax and principal for a typical one-year period, multiplied by business risk.

The Case Study Farm

The case study farm was located in south-west Victoria. The production system and enterprise structure as of 2011 was used as the base farm system data for this analysis. Prime lamb ewes and Merino fine wool ewes were farmed on 950 ha of mainly flat land, with an average rainfall of 730 mm. The business was run by the owner/operator, family and some casual labour. The property had good quality fencing, water system and service buildings.

The property consisted of one soil type (hard neutral brown; GrassGro® v.3.2.4) and three different pasture species and fertility levels. There were 400 ha of improved perennial ryegrass and subterranean clover pastures, with an average carrying capacity of approximately 9 ewes/ha, equating to 20 dry sheep equivalents per hectare (DSE/ha). In GrassGro® one DSE is defined as the energy intake required to maintain a standard sheep livestock unit (8.8 MJ/day of ME for a 50 kg wether). There were 370 ha of older perennial ryegrass and subterranean clover pastures, carrying approximately 6.5 ewes/ha (14 DSE/ha); and 60 ha of lucerne (18 DSE/ha). As part of the annual pasture renewal program, there were 60 ha of forage brassica crop for lamb finishing, and 30 ha of wheat and 30 ha of canola in a two-year forage and cereal crop rotation.

The farm was comprised of three sheep enterprises. The first was a self-replacing prime lamb enterprise flock of 2,500 Coopworth composite ewes, all mated to a maternal sire, and stocked at 6.9 ewes/ha (17.7 DSE/ha). The age of first joining was seven months old; lambs were born in mid-August and weaned in late November. Average lamb marking for mature ewes was 130 per cent and for ewe lambs (maidens) 70 per cent. The majority of lambs were sold direct to the abattoirs at 22 kilograms carcass weight (kg cwt), dressing out at 46 per cent, in most years by the end of April. Barley grain was fed out to the breeding ewes and weaners over the late summer period to maintain animal condition and help retain pasture cover.

The forage (brassica) crop used to grow lambs out over summer was sown in October and grazed from early January to mid-March. In south-west Victoria, depending on seasonal conditions, an average yield of 3.8 tonnes of dry matter per hectare (DM/ha) is available at first grazing (Jacobs *et al.,* 2006). The option of selecting a forage crop as a feed base option is not available in GrassGro®. Therefore, crop yield was linked with growing season rainfall (October to February; average 245 mm) using Microsoft Excel, with a production feeding rule in GrassGro® used to simulate animal consumption. The amount of forage crop consumed was then balanced by what was grown in that year, and any deficits were filled with additional supplementary feed.

The second sheep enterprise was a self-replacing Merino flock, comprising 1,500 Merino ewes, all mated to a Merino sire, stocked at 8.5 ewes/ha (17.0 DSE/ha), and cutting 21-micron wool. Lambs were born in mid-August and weaned in early December, and average lamb marking was 89 per cent. The majority of the young ewe lambs were held as replacements. Young wether lambs were shorn in mid-June and sold by mid-August.

The third sheep enterprise was a Merino flock, comprising 1,000 Merino ewes, all mated to a White Suffolk sire, giving a fine wool plus prime lamb operation, with replacement ewes sourced from the self-replacing Merino enterprise. Stocking rate was 9.9 ewes/ha (20.0 DSE/ha). Ewes were joined at 19 months old, lambs were born in mid-August and weaned in early December, and average lamb marking was 98 per cent. The majority of lambs were sold direct to the abattoirs, on average at 22 kg cwt, dressing out at 45 per cent, in most years by the end of May.

In extremely dry seasons, supplementary feed was used to maintain livestock numbers. This was instead of selling livestock and then rebuilding numbers. It was considered that supplementary feed was a suitable proxy for this management decision. Also, stocking rates of the current farm system and each change analysed were validated against farm performance in the area, expert opinion and biophysical model capabilities.

The farm also grew 30 ha of wheat and 30 ha of barley. Crop yields were modelled using the French and Shultz (1984a, b) method, where a multiplier was linked with growing season rainfall (April to November; average 570 mm). Average wheat yield was 4.5 t/ha and average barley yield was 4.0 t/ha. Yields were based on historical yield data for the region, expert opinion and past farm performance.

Key percentiles and distribution type for each of the probability distributions defined for input prices and costs are presented in Table 1. Distributions were developed using data from AWEX (2012), DEDJTR (2014b), NLRS-MLA (2012, 2014a, 2014b) and the expert opinion of the steering committee. Correlations were also calculated between relevant prices, shown in Appendix 1. No correlations were included between prices and seasonal conditions. The way the production model was linked to the economic model did not allow this relationship to be incorporated. (This weakness is an opportunity to redesign the model for future analysis.) However, analysis of correlations between rainfall and prices found them to be not always clear (DEDJTR, 2014a; Tocker, 2016). Consideration is needed on the timing of rainfall, prices and industry market conditions. Thus, useful future work could also be done on developing realistic correlations.

The value of assets, debt and equity for the base farm system are given in Table 2. Annual fixed debt-servicing obligations ($99,113) were based on an amortised 20-year loan at 7 per cent nominal interest. For the calculation of cumulative net cash flow, interest was charged on deficits at 7 per cent nominal and earned on surpluses at 4 per cent nominal. Details of the variable costs for each enterprise, fixed costs, livestock standard values and assumptions made for other key variables are given in Appendix 1. Further details of the farm characteristics modelled are available upon request.

Table 1. Distribution types and key values for specified prices and costs

Variable	Distribution type	Min	5%	95%	Max	Mean	Standard deviation	Source of @Risk distribution functions
Prime Lamb Enterprise Prices								
Lamb meat ($/kg cwt)	BetaGeneral	1.75	3.50	6.09	9.36	4.75	0.78	2004-2014 ESTLI
Skin ($/hd)	BetaGeneral	0.51	3.75	19.75	24.87	11.46	4.88	Expert opinion
Mutton ($/kg cwt)	ExtValue	0.30	1.08	4.22	5.30	2.41	0.94	2003-2012 1stX mutton
Replacement ewe ($/hd)	Lognorm	0	94	223	-	150	40	Expert opinion
Wool - 30μm ($/kg cfw)	BetaGeneral	3.12	3.30	5.42	6.04	4.25	0.78	2003-2012 Southern μm
Merino x Merino Enterprise Prices								
Lamb meat ($/kg cwt)	BetaGeneral	1.62	3.24	5.64	8.67	4.40	0.78	2004-2014 ESTLI
Skin ($/hd)	BetaGeneral	0.45	3.38	17.77	22.38	10.31	4.88	Expert opinion
Mutton ($/kg cwt)	ExtValue	0.32	1.12	4.56	5.50	2.61	1.03	2003-2012 Merino mutton
Replacement ewe ($/hd)	Lognorm	0	82	179	-	125	30	Expert opinion
Wool - 21μm ($/kg cfw)	BetaGeneral	6.17	6.65	11.00	14.42	8.50	1.59	2003-2012 Southern μm
Merino x White Suffolk Enterprise Prices								
Lamb meat ($/kg cwt)	BetaGeneral	1.74	3.46	6.03	9.27	4.70	0.78	2004-2014 ESTLI
Skin ($/hd)	BetaGeneral	0.48	3.56	18.76	23.63	10.88	4.88	Expert opinion
Mutton ($/kg cwt)	ExtValue	0.32	1.12	4.56	5.50	2.61	1.03	2003-2012 Merino mutton
Replacement ewe ($/hd)	Lognorm	0	82	179	-	125	30	Expert opinion
Wool - 21μm ($/kg cfw)	BetaGeneral	5.88	6.33	10.48	13.74	8.10	1.59	2003-2012 Southern μm
Beef Enterprise Prices								
Beef meat ($/kg lwt)	BetaGeneral	1.33	1.61	2.49	3.01	2.03	0.28	2000-2014 EYCI
Cull cow ($/kg lwt)	BetaGeneral	0.96	1.17	1.80	2.18	1.47	0.28	Expert opinion
Grain, Oil Seed and Pulse Enterprise Prices								
Wheat ($/t)	Lognorm	0	159	369	-	250	65	2000-2010 SWVic LFMP
Barley ($/t)	Lognorm	0	151	344	-	235	60	Expert opinion
Canola ($/t)	Lognorm	0	356	665	-	495	95	2000-2010 SWVic LFMP
Faba Beans ($/t)	Lognorm	0	274	438	-	350	50	Expert opinion
Lupins ($/t)	Lognorm	0	264	428	-	340	50	Expert opinion
Supplementary Feed Prices								
Oats ($/t)	Lognorm	0	111	364	-	215	80	2000-2010 SWVic LFMP
Barley ($/t)	Lognorm	0	169	364	-	255	60	Expert opinion
Lupins ($/t)	Lognorm	0	284	448	-	360	50	Expert opinion
Hay ($/t)	Lognorm	0	107	252	-	170	45	2000-2010 SWVic LFMP
Lucerne Hay ($/t)	Lognorm	0	165	359	-	250	60	Expert opinion
Silage ($/t)	Lognorm	0	45	90	-	65	14	2000-2010 SWVic LFMP
Syrup ($/t)	Lognorm	0	116	214	-	160	30	Expert opinion
Fertiliser (super) ($/t)	Lognorm	0	303	401	-	350	30	Expert opinion

Table 2. Value of assets, debt and equity for the base farm

			Purchase (open)	Salvage (close)
Assets	Owned land *(Land: $4,600/ha)*		$4,600,000	$4,600,000
	Livestock		$895,600	$895,600
	Plant and Equipment		$500,000	$150,000
	Fodder		$15,000	$15,000
	Total	*100%*	$6,010,600	$5,660,600
Debt		*17%*	$1,050,000	@ 7% interest, 20-year term ($99,113)
Equity		*83%*	$4,960,600	-

Six changes that were considered technically feasible and potentially acceptable were defined. The assumptions for each change are described below. For each change, it was assumed any investment required would be funded by borrowed capital in the form of an amortised 10-year loan at 7 per cent nominal interest. The steering committee considered this a plausible approach, given the numerous mechanisms available for funding different types of capital requirements.

Change 1 - Base farm improved (C1)

It was judged by the steering committee that the performance of the base farm could be increased by improving soil fertility and pasture species on the undeveloped land, and further increasing soil fertility on the developed land. Results from the Hamilton long-term phosphate experiment indicate that an Olsen P for pasture production of around 15 mg/kg can produce 12.5 t DM/ha annually (Cayley *et al.,* 1998; Saul and Dark, 2003), and that a capital application of 10 kg of P per hectare in excess of maintenance is required to increase Olsen P by 1 unit (Saul and Dark, 2003). This, along with more tightly-managed grazing, would enable an increase in the number of stock carried, while maintaining adequate pasture cover levels. A stocking rate of 22.5 DSE/ha, coupled with a slight increase in supplementary feed levels, was considered achievable.

Increasing soil fertility on the existing developed pastures (400 ha) and lucerne (60 ha) involved a capital application of superphosphate fertiliser and lifting the average soil Olsen P by 1 unit from 15 to 16 mg/kg. Increasing soil fertility on the undeveloped pastures (370 ha) and forage crop (60 ha) involved a capital application of fertiliser to increase the average soil Olsen P from 9 to 13 mg/kg. An increase in Olsen P by an additional 2 units was also included when extra fertiliser was applied to develop the land and sow new pastures. On the existing 60 ha of cereal crop, fertility was lifted from 11 to 13 mg/kg Olsen P units, and similarly an increase in Olsen P of another 2 units was obtained when extra fertiliser was applied during the sowing of new pastures. Increasing fertility therefore required 262 tonnes of superphosphate fertiliser in total, at a cost of $91,490 to be applied in year one. In addition to this, 300 of 370 ha of undeveloped land needed to be cleared of rocks in year one, costing on average $250/ha. Finally, the cost of sowing 370 ha of new pasture was $148,000 comprising the costs of seed and fertiliser ($250/ha) and fuel and vehicles ($150/ha). In total, $314,490 was required to increase pasture supply. These changes would lead to 680 ha of improved pasture and 150 ha of lucerne, as well as 60 ha of annual forage crop and 60 ha of cereal crop as part of the annual pasture renewal program. Livestock purchases of 600 Coopworth composite and 600 Merino ewes would be needed to increase the stocking rate to 22.4 DSE/ha. A total of 3,100 prime lamb ewes, 1,800 Merino ewes and 1,300 Merino ewes crossed to a White Suffolk sire would be farmed. Total investment for all changes in this scenario was $515,140.

The lambing date was brought forward for each sheep enterprise to better match the stocking rate with pasture supply, i.e. late July for prime lamb ewes, mid-August for Merino ewes, and late July for the Merino ewes to White Suffolk sire. It was assumed these changes would be implemented and a steady state would be achieved in year one. In practice, it may take several years to improve the farm and implement each change; however, the complexity and number of scenarios analysed meant that such an approach would have been unwieldy to model.

Variable costs such as animal health, shearing, freight, selling costs, supplementary feed and maintenance fertiliser application all increased in direct proportion to stocking rate. There was also an increase in total fuel and vehicle running costs, general repairs and maintenance, pasture and lime maintenance, labour costs and debt-servicing obligations (Table 3). Annual fixed debt-servicing obligations (interest and principal; old and new debt) were $172,457.

Change 2 - Farming all prime lamb (C2)

The second change analysed involved farming all prime lamb. This required: increasing soil fertility and improving pastures, leading to 740 ha of improved pasture, 150 ha of lucerne and 60 ha of annual forage crop; running 6,100 prime lamb ewes lambing in late July, stocked at 22.8 DSE/ha. In total, $332,490 was required to increase pasture supply (rock clearing, fertiliser and new pasture). Changing to prime lamb involved selling the Merino ewes (2,500 hd) and purchasing more Coopworth ewes (3,600 hd), with an extra $172,100 required to fund stock purchases. Total investment to make these changes was $504,590.

The increase in the scale of the enterprise meant a greater supply of prime lambs was available for sale and enabled a price premium to be received. Average lamb price was increased by 15 cents/kg cwt to $4.90/kg cwt compared to the base farm. All lambs were sold by the end of March. The increases in farm variable and fixed costs and annual debt-servicing obligation are in given in Table 3.

Change 3 - Prime lamb and beef breeding cow and calf enterprise (C3)

The third change investigated an enterprise mix of 70 per cent sheep and 30 per cent cattle. This involved developing the farm so there was 815 ha of improved pasture, 100 ha of lucerne and 35 ha of annual forage crop, and farming 4,300 prime lamb ewes and 285 spring calving beef cows. To maintain the 60 ha of new pasture sown each year, 25 ha was direct drilled. Due to grazing patterns and assuming supplementary feed would be used, the sheep enterprise was set at a slightly higher stocking rate (23.2 DSE/ha) than the cattle enterprise (20.7 DSE/ha), with an overall farm average of 22.4 DSE/ha. Animal health benefits included one less drench for ewes and lambs and no additional labour requirements.

Investment costs included $30,000 for upgrading the cattle yards, $10,000 on fencing and $10,000 on upgrading the water system. An additional $185,286 was required to fund livestock purchases and $339,990 was spent on pasture improvement. The total investment cost was $575,276.

For the prime lamb enterprise, lambing date was brought forward to late July. The Angus self-replacing beef cow operation was stocked at 1.5 cows/ha, calving in mid-September. Non-replacement 8 month-old heifers were sold at the end of May. Steers were sold when they reached 450 kilograms liveweight (kg lwt) at about 15 months old, between mid-December and mid-February. Purchased silage was used to keep body condition on cows and weaners when seasonal conditions required. There was an increase in some farm variable and fixed costs (Table 3).

Change 4 - Prime lamb and cropping (C4)

The fourth change involved planting half of the farm (455 ha) to cereal, oil seed and pulse crops each year and running a grazing prime lamb system (3,000 ewes) on the other half. Average stocking rate was 22.6 DSE/ha, over a seven-year crop, five-year pasture, rotation. Of the 950 ha farm, 170 ha was unable to be cropped due to low-lying areas, rocky outcrops and laneways, leaving 780 ha available. This was split into 65 ha paddocks and overlaid with a 12-year rotation program. The rotation for a 65 ha block was: 1. canola (average yield 2.4 t/ha); 2. wheat (4.9); 3. barley (4.2); 4. half, faba beans (3.5), half, lupins (3.0); 5. canola (2.2); 6. wheat (4.5); 7. half, faba beans (3.1), half, lupins (2.6); 8 to 12. pasture. On average, only four months of grazing was available in the year the pasture was established and soil fertility levels were improved. Across the farm in any one year, there would be: 130 ha of canola, 130 ha of wheat, 65 ha of barley, 65 ha of faba beans, 65 ha of lupins, 452 ha of pasture, and 43 ha of fallow (sprayed-out pastures/waiting for new pastures to be established). A five-year pasture rotation was assumed to give the soil a break from cropping. Growing canola followed by wheat allows for optimal pest and disease management; and faba beans and lupins in the rotation is a good break crop, with the stubbles providing valuable feed for fattening lambs. Crop yields were modelled using the same method as that for the base farm, with a multiplier linked to growing season rainfall. Waterlogging is an issue in parts of south-west Victoria during extremely wet winters. Planting crops on raised beds is a practice used in the region to help mitigate crop loss and enable reasonable yields to still be achieved. Considering the contour and low-lying areas on the case study farm, planting on raised beds was incorporated into the cropping regime.

Prior to cropping, $75,000 was spent on clearing rock from the undeveloped area and $91,490 was spent on capital fertiliser to increase soil fertility across the farm. The cost of installing and maintaining raised crop beds over the seven-year period was $174,423. Each year, 65 ha of pasture land was converted into raised beds and 65 ha of existing raised beds were maintained, at a total cost of $24,918/year. An additional $370,000 was invested in extra machinery.

Over the summer period, crop stubbles were grazed. Estimating the value of stubble feed and how much is available each year can be difficult. There are three components to stubble feed: the grain spilled at harvest and left on the ground, the straw, and the green weeds that grow and/or the shooting of grain after summer rains. For this analysis the value of stubble was estimated based on how much grain was left on the ground, as this is the most valuable component of stubble feed. The stubble available each year was estimated and held constant. Production feeding rules in GrassGro® were used to simulate animal consumption.

Lambing date was brought forward to late July. Changes in farm variable and fixed costs are given in Table 3. After selling the Merino ewes and buying more prime lamb ewes, $367,150 worth of capital was released. This was invested into land development and machinery, which had a total cost of $536,490, meaning an extra $169,340 was required to fund this development option.

Change 5 - Prime lamb, lambing later and finishing lambs in a feedlot (C5)

This change examined farming all prime lamb, lambing in early September and finishing all lambs in a feedlot. This was to facilitate a higher lamb marking rate from improved (warmer) seasonal conditions and having more pasture available at lambing, and then finishing those lambs over summer and autumn in a feedlot system, when good-quality pasture supply is low.

Average lamb marking for mature ewes was 140 per cent and for ewe lambs 65 per cent. Lambs were put into the feedlot from the 1st of January or at a weight of 35 kg lwt, and were sold once they reached 50 kg lwt. To help lighter lambs reach the 35 kg lwt target, 40 ha of forage crop was planted each year. This meant there was 910 ha of pasture available for ewes and young lambs, enabling 7,000 ewes to be farmed (22.9 DSE/ha).

Lambs in the feedlot were fed a high-quality barley, lupin and lucerne hay diet with an average daily intake of 1.47 kg DM/hd/day with an assumed growth rate of 320 g/hd/day. On average the lambs were in the feedlot for 47 days.

As with the other options, $338,490 was spent to increase pasture supply. After the sale of the Merino flock, an additional $332,550 was required to fund prime lamb ewe purchases. An additional $133,600 was also required in infrastructure with regards to setting up the feedlot and building grain storage facilities, and an additional $180,000 for a feed wagon and loader. Total investment to make these changes was $984,640. There were changes in farm variable and fixed costs (Table 3) and, for animal health, an extra 6-in-1 vaccination for lambs in the feedlot. The increase in the scale of the prime lamb enterprise meant a price premium of 30 cents could be assumed.

Change 6 - Prime lamb, lambing later and finishing lambs on forage crops (C6)

The final change was based on C5 but, instead of finishing lambs in a feedlot, a forage (brassica) crop was used. Lambs were put onto the forage crop at the beginning of January and remained there for three months, with lambs removed for sale as they reached either 47 kg lwt (ewe lambs) or 48 kg lwt (wether lambs). To finish the volume of lambs (7,800 head), approximately 160 ha of forage crop was grown annually, with some supplementary feed (oats and barley); equating to approximately 38 lambs/ha. The remaining 790 ha of developed pasture carried 6,100 ewes (22.4 DSE/ha).

As with the other options, pasture development was required, $302,490 in total. Changing to prime lamb required an additional $168,800 to fund stock purchases (Table 3).

Further details of the farm and enterprise biophysical characteristics modelled for each change are available upon request.

Table 3. Additional costs, investment required and debt for each change (in real dollars)

	Change 1		**Change 2**		**Change 3**		**Change 4**		**Change 5**		**Change 6**	
	Base Farm Improved		Prime Lamb		Prime Lamb and Beef Breeding		Prime Lamb and Cropping		Prime Lamb and Feedlot		Prime Lamb and Forage Crop System	
Prices												
Lamb price ($/kg cwt)	$4.75		$4.90		$4.80		$4.75		$5.05		$4.95	
Variable Costs												
Fuel & vehicle	$2,000		$1,500		-$3,500		-$2,750		$0		$11,500	
Repairs & maint.	$3,000		$2,000		$1,000		-$3,000		$2,000		$2,000	
Pasture maint.	$1,000		$1,000		$3,500		$1,250		$3,000		$26,000	
Lime	$10,000		$10,000		$10,000		$10,000		$10,000		$10,000	
Fodder crop	$0		$0		-$4,000		-$9,600		-$3,200		$16,000	
Fixed Costs												
Labour	$10,000		$5,000		$0		$5,000		$25,000		$5,000	
Depreciation	$0		$0		$0		$50,080		$21,080		$0	
Assets	Purchase	Salvage	Purchase	Salvage	Purchase	Salvage	Purchase	Salvage	Purchase	Salvage	Purchase	Salvage
Livestock	$200,650	$200,650	$172,100	$172,100	$185,286	$185,286	-$367,150	-$367,150	$332,550	$332,550	$168,800	$168,800
Plant and equip.	$0	$0	$0	$0	$0	$0	$370,000	$188,700	$180,000	$79,200	$0	$0
Past. dev. & fert.	$314,490	$314,490	$332,490	$332,490	$339,990	$339,990	$166,490	$166,490	$338,490	$338,490	$302,490	$302,490
Infrastructure	$0	$0	$0	$0	$50,000	$50,000	$0	$0	$133,600	$86,840	$0	$0
Total	$515,140	$515,140	$504,590	$504,590	$575,276	$575,276	$169,340	-$11,960	$984,640	$837,080	$471,290	$471,290
Debt												
Opening debt	$515,140		$504,590		$575,276		$169,340		$984,640		$471,290	
Annual fixed debt-servicing obligations	$73,344		$71,842		$81,906		$24,110		$140,190		$67,101	

Results

Mean production values for each option are presented in Table 4. A profit and loss statement for each option, reporting the mean values, is presented in Table 5. The values reported are for a steady state year, chosen as year four from a seven-year planning period. Further details about production values, income, variable and overhead costs are given in Appendix 2.

Each change generated a higher annual mean operating profit in a steady state year than the base farm system ($278,000). The change to farming all prime lamb (C2) gave the highest operating profit ($496,000), closely followed by prime lamb and feedlot (C5; $490,000). The next most profitable change was prime lamb and beef (C3; $445,000), closely followed by prime lamb and forage crop (C6; $441,000), then improving the base farm (C1; $418,000). Prime lamb and cropping (C4) was the least profitable change ($332,000), but still better than the base farm.

The prime lamb and feedlot change (C5) generated the highest gross income but also had the highest costs. Farming all prime lamb (C2), prime lamb and forage crop (C6) and base farm improved (C1) each had similar levels of total gross income and total costs. Prime lamb and beef (C3) and prime lamb and cropping (C4) also had similar levels of total gross income, but different costs.

Table 4. Mean production parameters for each change based on GrassGro® modelling over 50 years of weather data (1960 to 2009) for the Penshurst area

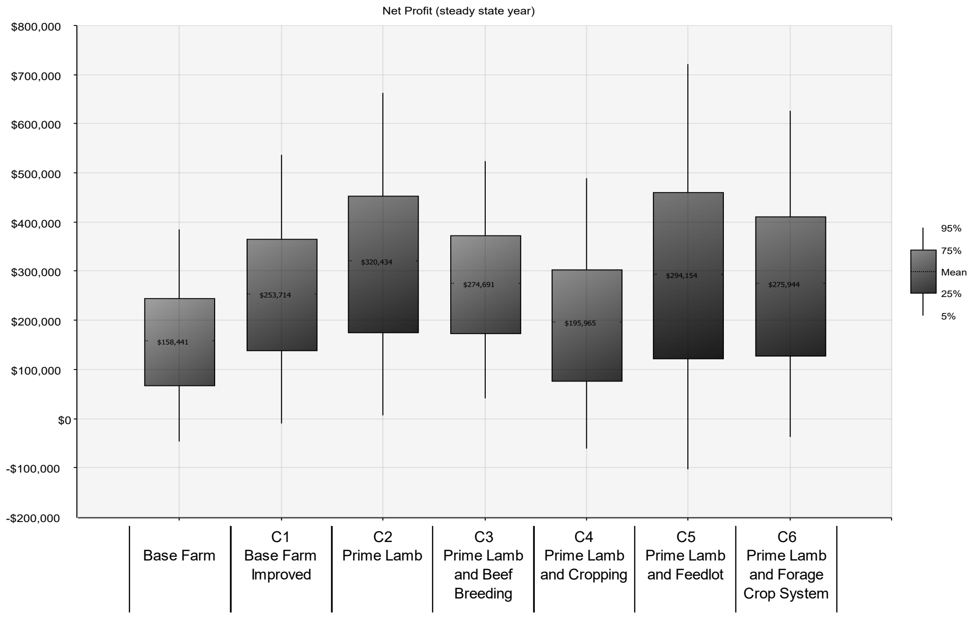
	Status Quo	Change 1	Change 2	Change 3	Change 4	Change 5	Change 6
	Base Farm	Base Farm Improved	Prime Lamb	Prime Lamb and Beef Breeding	Prime Lamb and Cropping	Prime Lamb and Feedlot	Prime Lamb and Forage Crop System
	Mean	*Mean*	*Mean*	*Mean*	*Mean*	*Mean*	*Mean*
Prime Lamb - Land area (ha)	494	491	950	660	435	950	950
Pasture grown (kg DM/ha)	10,672	11,916	11,899	12,025	12,633	12,526	12,705
Average stocking rate (DSE/ha)	17.7	22.1	22.8	23.2	22.6	22.9	22.4
Supp. feed (t) - barley	25	33	63	40	13	94	89
- oats	8	3	16	8		8	53
Supp. feed (t) - feedlot - barley						479	
- lupins						60	
- lucerne						136	
Av. no. mature & 1-2 y.o. females	2,759	3,405	6,689	4,750	3,306	7,513	6,511
Total no. of lambs sold	3,084	3,968	7,759	5,522	3,872	9,254	8,047
Merino x Merino - Land area (ha)	230	225					
Average stocking rate (DSE/ha)	17.0	21.5					
Supp. feed (t) - barley	13	18					
Av. no. mature & 1-2 y.o. females	1,641	2,010					
Wool production - kg cfw	10,511	13,162					
Merino x White Suffolk - area (ha)	166	174					
Average stocking rate (DSE/ha)	20.0	24.2					
Supp. feed (t) - barley	12	10					
- oats	11	10					
Av. no. mature & 1-2 y.o. females	1,165	1,429					
Wool production - kg cfw/ha	8,333	11,519					
Beef Breeding - Land area (ha)				290			
Pasture grown (kg DM/ha)				12,539			
Average stocking rate (DSE/ha)				20.7			
Supp. feed (t; silage)				52			
Av. no. mature & 1-2 y.o. females				414			
Total No. of steers and heifers sold				242			
Wheat - yield (t)	135	135			611		
Barley - yield (t)	120	120			273		
Canola - yield (t)					300		
Faba Beans - yield (t)					215		
Lupins - yield (t)					182		

Table 5. Mean for gross income, variable costs, overhead costs, operating profit and net profit for the base farm and each change in a steady state year (year 4), as modelled using GrassGro® production data

	Steady State Year						
	Status Quo	Change 1	Change 2	Change 3	Change 4	Change 5	Change 6
	Base Farm	Base Farm Improved	Prime Lamb	Prime Lamb and Beef Breeding	Prime Lamb and Cropping	Prime Lamb and Feedlot	Prime Lamb and Forage Crop System
	Mean	*Mean*	*Mean*	*Mean*	*Mean*	*Mean*	*Mean*
Gross Income	$871,010	$1,096,322	$1,154,560	$1,030,208	$1,056,439	$1,433,876	$1,179,933
Variable Costs	$350,082	$425,676	$411,192	$342,141	$425,075	$653,404	$490,709
Gross Margin	**$520,928**	**$670,646**	**$743,368**	**$688,067**	**$631,364**	**$780,471**	**$689,224**
Overhead Costs	$108,697	$119,000	$113,848	$108,697	$165,446	$156,173	$113,848
Owner/Operator Allowance	$133,939	$133,939	$133,939	$133,939	$133,939	$133,939	$133,939
Operating Profit (EBIT)	**$278,292**	**$417,707**	**$495,581**	**$445,431**	**$331,979**	**$490,359**	**$441,436**
Interest & Lease Costs:	$67,736	$95,405	$94,839	$98,635	$76,832	$120,623	$93,050
Net Farm Income	$210,556	$322,302	$400,743	$346,796	$255,147	$369,736	$348,386
Tax Payable	$52,115	$68,588	$80,309	$72,104	$59,182	$75,852	$72,442
Net Profit / Change in Equity	**$158,441**	**$253,714**	**$320,434**	**$274,691**	**$195,965**	**$294,154**	**$275,944**

After deducting interest costs and tax to give net profit, the ranking of options remained similar (Table 5). The higher capital investment required for the prime lamb and feedlot change (C5) meant a larger reduction in annual mean net profit ($294,000); compared with fewer ewes being farmed, lambing being earlier and lambs finished on pasture and forage crop (C2; $320,000). Lambing later and finishing lambs on forage crops (C6) and prime lamb and beef (C3) were the next most profitable changes, followed by improving the base farm (C1) and farming prime lamb and cropping (C4). The base farm had the lowest mean net profit. Of all of the options, prime lamb and feedlot (C5) had the greatest variability in possible net profit results (Figure 1). Farming all prime lamb (C2) and prime lamb and forage crop (C6) had the next greatest variability in profit. Prime lamb and beef (C3) had the least.

Figure 1. Box and whisker plot showing net profit and the variability of profit for each option in a steady state year



To assess the efficiency of the extra capital invested into each of the six changes, return on marginal capital invested (marginal MIRR; in real terms) was calculated (Table 6). No capital gains were included. Increasing stocking rate and farming all prime lamb (C2) generated the highest mean return on marginal capital at 33 per cent, but also had a high level of variability as based on SD. The prime lamb forage crop finishing system (C6) generated the next best return on marginal capital with 26 per cent, for slightly less variability. The prime lamb and feedlot system (C5) had the least variability (SD), but also a lower mean return on marginal capital of 19 per cent, for the greatest amount invested. Prime lamb and cropping (C4) had the least invested and had the lowest return on marginal capital (17 per cent), but with a high level of variability (SD).

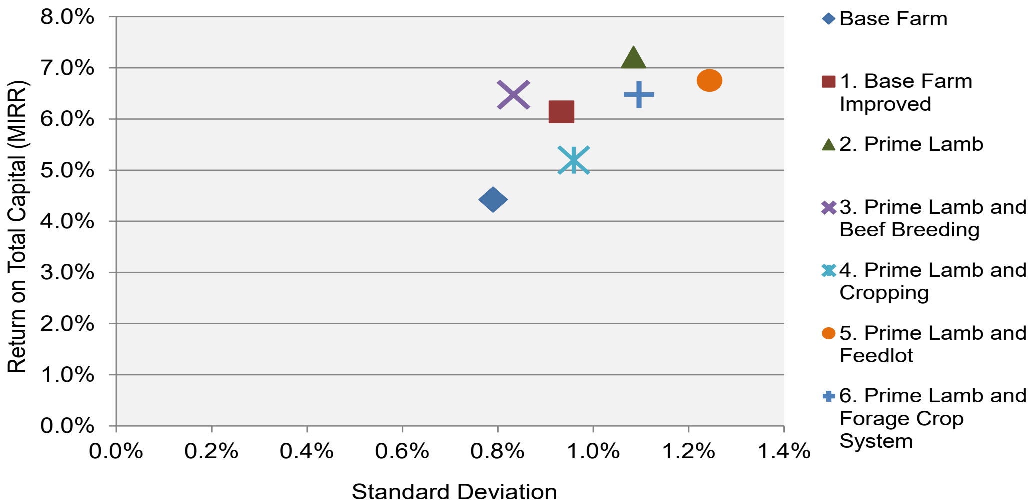
Table 6. Mean real marginal modified internal rate of return (marginal MIRR) on extra capital invested; Mean real modified internal rate of return (MIRR) on total capital invested and associated statistical measures (SD; CV) for each option

Option	Marginal MIRR on extra capital invested			MIRR on total capital invested		
	Mean	*Standard Deviation*	*Coefficient of Variation*	*Mean*	*Standard Deviation*	*Coefficient of Variation*
Base Farm	-	-	-	4.4%	0.8%	18%
1. Base Farm Improved	21.6%	16.8%	78%	6.1%	0.9%	15%
2. Prime Lamb	33.5%	24.4%	73%	7.2%	1.1%	15%
3. Prime Lamb and Beef Breeding	23.6%	14.3%	60%	6.5%	0.8%	13%
4. Prime Lamb and Cropping	16.5%	24.2%	146%	5.2%	1.0%	18%
5. Prime Lamb and Feedlot	18.6%	11.0%	59%	6.8%	1.2%	18%
6. Prime Lamb and Forage Crop System	25.8%	20.3%	79%	6.5%	1.1%	17%

Risk is defined as the variability of annual performance around the annual average performance. Comparing variability based on the coefficient of variation (CV) showed that farming all prime lamb (C2) was the best choice, with a moderate level of risk (CV) relative to return on marginal capital (Table 6). The prime lamb and forage crop system (C6) generated the next best return on marginal capital for similar risk, while prime lamb and beef breeding (C3), with a slightly lower return, had the lowest level of risk when compared to the other changes. Prime lamb and cropping (C4) had the largest CV (highest risk) and lowest return for the extra capital invested.

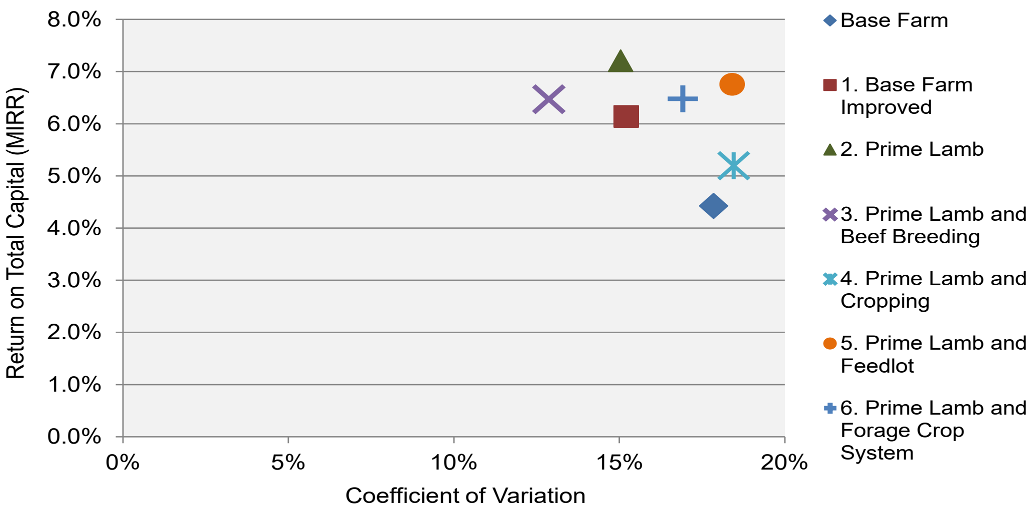
All changes showed promise of producing higher returns on total capital than the base farm system (Table 6; Figure 2). Increasing stocking rate and farming all prime lamb (C2) gave the highest mean return on total capital for a moderate level of variability (SD) when compared to the other options. Prime lamb and cropping (C4) gave the lowest return on total capital of all six changes.

Figure 2. Return on total capital invested (MIRR; real) versus standard deviation in return for each option



Without considering the significantly different amounts of capital involved, and just focussing on SD relative to return on capital (CV), the base farm had high risk relative to return (Figure 3). Farming all prime lamb (C2) promises a higher return on total capital for less risk than the base farm. Alternatively, prime lamb and beef breeding (C3) offered the best return on total capital for the least risk.

Figure 3. Return on total capital invested (MIRR; real) versus coefficient of variation in return for each option

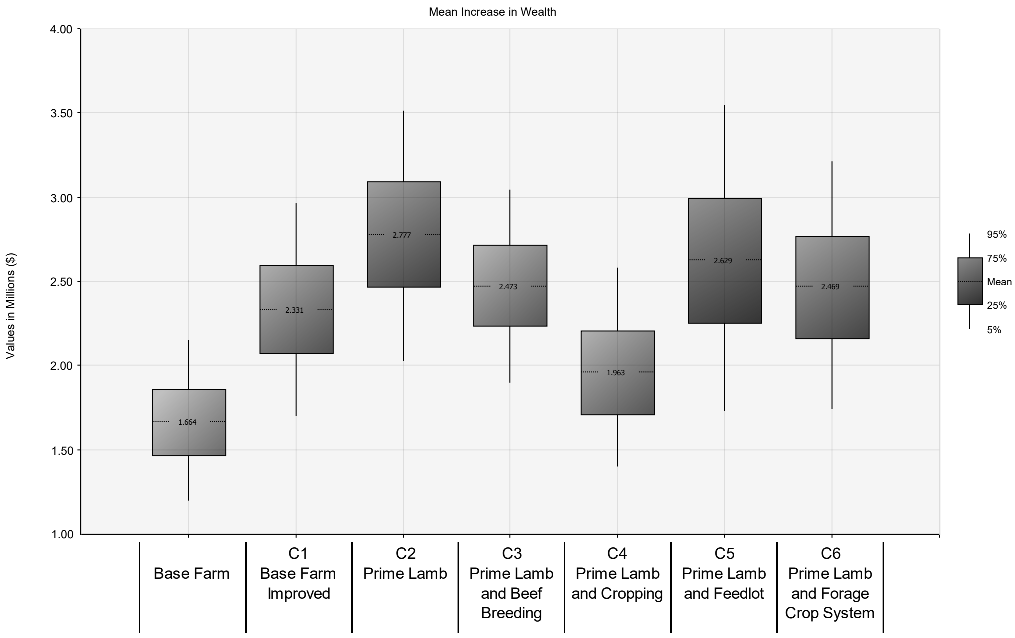


Farming all prime lamb (C2) generated the highest addition to end wealth ($3.654 million; nominal), while the base farm generated the least (Table 7). As found with the economic analysis, as the potential for additional wealth increases, so too does variability (Figure 4). Farming prime lamb and beef breeding (C3) had the least variability for moderate additions to wealth, while the prime lamb and feedlot option (C5) had the greatest level of risk for higher additions to wealth.

Table 7. Total increase in wealth (mean) and marginal increase in wealth (mean) for each option at the end of year seven (future value), made up of cumulative nominal net cash flows after interest from farming and 2% per annum inflation of assets values

Option	Cumulative net cash flow (after int. & principal) from 7 yrs. farming *(nominal)*	Amount of principal paid off over 7 yrs.	Adjustment of assets by 2% p.a. inflation *(nominal)*	Increase in wealth after 7 yrs. *(nominal)*	Difference in wealth b/w change and base farm *(nominal)*
Base Farm	$1,604,000	$222,000	$364,000	$2,190,000	
1. Base Farm Improved	$2,093,000	$544,000	$429,000	$3,067,000	$877,000
2. Prime Lamb	$2,689,000	$538,000	$428,000	$3,654,000	$1,465,000
3. Prime Lamb and Beef Breeding	$2,236,000	$582,000	$437,000	$3,255,000	$1,065,000
4. Prime Lamb and Cropping	$2,259,000	$328,000	-$4,000	$2,583,000	$393,000
5. Prime Lamb and Feedlot	$2,299,000	$838,000	$322,000	$3,460,000	$1,270,000
6. Prime Lamb and Forage Crop System	$2,308,000	$517,000	$424,000	$3,249,000	$1,059,000

Figure 4. Mean total increase in wealth for each option, in present value terms



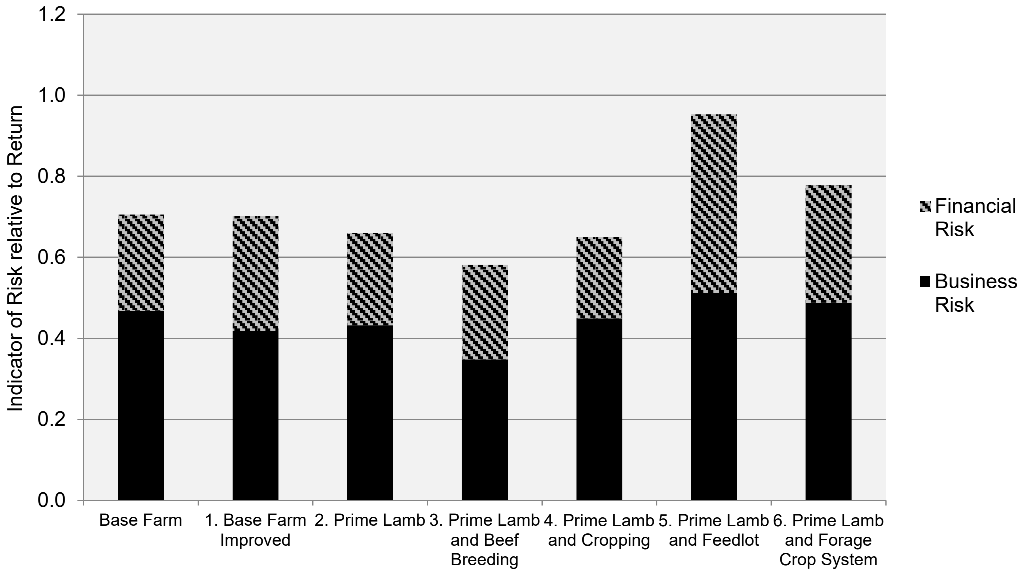
Comparing profit, economic efficiency and wealth is important, but examining the ability to meet debt-servicing obligations (finance) is also necessary. Analysis showed that if the farmer took out an amortised 20-year loan at 7 per cent interest on existing debt for the base farm, farm annual net cash flow in the steady state is able to cover debt-servicing requirements in 92 per cent of years (Table 8). For each new change, the existing debt coupled with new debt consisting of an amortised 10-year loan at 7 per cent interest meant that debt-servicing requirements could be met in 90 to 96 per cent of years for all changes except C5, which was 84 per cent of years. If the interest rate was 15 per cent per annum, the mean annual net cash flows generated from the base farm and C1, C2, C3, C4 and C6 would be greater than principal and interest repayments required in 79 to 87 per cent of years and, for C5, in 71 per cent of years.

Table 8. The probability of annual net cash flow (ANCF) being greater than annual principal and interest repayments, for an amortization loan at a 7% interest rate and 15% interest rate, in the steady state year for each option

Option	Fixed annual debt servicing obligations at 7% interest	Probability of ANCF being greater than debt servicing obligations (7%)	Fixed annual debt servicing obligations at 15% interest	Probability of ANCF being greater than debt servicing obligations (15%)
Base Farm	$99,000	92%	$168,000	83%
1. Base Farm Improved	$172,000	92%	$270,000	81%
2. Prime Lamb	$171,000	94%	$268,000	86%
3. Prime Lamb and Beef Breeding	$181,000	96%	$282,000	87%
4. Prime Lamb and Cropping	$123,000	92%	$201,000	83%
5. Prime Lamb and Feedlot	$239,000	84%	$364,000	71%
6. Prime Lamb and Forage Crop System	$166,000	90%	$262,000	79%

The final comparison is to compare the business, financial and total risk of each option. Prime lamb and beef (C3) had the lowest level of business risk and total risk (Figure 5). While cash flow was higher for farming all prime lamb (C2), variability relative to the mean was slightly more compared to the prime lamb and beef system, and so business risk was higher. Higher borrowings create higher financial risk, as demonstrated by the prime lamb and feedlot system (C5), which had the greatest borrowing and therefore the highest financial risk.

Figure 5. Sources of variability of annual net cash flows in a steady state year for each option



Discussion

The base farm was earning a competitive rate of return on capital of 4.4 per cent and performing above average compared with the mean of 2.9 per cent for a benchmark sample of prime lamb and Merino ewe enterprises in south-west Victoria (DEDJTR, 2014c). However, opportunities existed to improve performance further and a number of options that involved diversification or specialisation were examined.

For the case study farm, it was considered that improvements in soil fertility and pasture species could increase annual pasture production to approximately 12.5 t DM/ha and increase stocking rate to 22.5 DSE/ha. Such stocking rates have been shown to be possible under good pasture and livestock management, where an annual average pasture production of 11.5 t DM/ha (based on new and older pastures species) was achieved at an Olsen P of 12 mg/kg (Saul and Dark, 2003), and subsequently higher stocking rates could be carried (Saul and Kearney, 2002).

While improving production and profitability of a farm business is important for many farmers, the variability around profit is also of concern. Historical farm data for south-west Victoria shows there has been considerable variation in farm profit over time (DEDJTR, 2014a; Tocker, 2016). The principle where higher profits can be achieved by taking higher risks means that when analysing and deciding on different choices, there is a trade-off between risk and profit; for example, in what enterprises to run, and whether to diversify and reduce risk, but potentially receive a lower profit, or specialise and receive a higher profit, but at higher risk. Whether a farm runs multiple enterprises, or only one enterprise, depends on the farmer's preferences and the available resources. A farmer may have a preference for specialising in a particular enterprise or the land and environment may be only suited to a particular enterprise. Conversely, a farmer may enjoy running multiple enterprises, and the resources enable them to do so. Diversification of activity mix or having a portfolio of investments is a common approach to managing risk, by hedging profits and risk without excessively forgoing profits (Parry *et al.,* 2000). Similarly, specialising and doing one activity very well can increase exposure to risk, but profits can also be high.

Assessing the variability of annual performance gives an indication of the risk associated with the choice. While a development option may provide a high average profit, a wide range of outcomes around the average may mean that an alternate choice with a lower average and smaller range in profit is preferred. The most appropriate choice will depend on the risk preference of the decision maker, and incorporating profit and risk into an analysis enables a more informed decision to be made (Antle, 1983; Robertson *et al.,* 2012).

For the case study farm, the worst choice of the options analysed, based on profit, efficiency, cash flow and wealth creation, was to continue with business as usual (base farm). The analysis showed that farming all prime lamb (C2) generated the highest results for performance. Prime lamb and cropping (C4) generated the lowest results of the six changes. For each change, there was an increase in the SD around the various performance measures, compared to the base farm. However, when SD was put in relation to the mean (CV), the variability (risk) around the different measures was less for some of the changes compared to the base farm.

Improving the base farm (C1) generated reasonable returns on total capital for a moderate amount of variability in relation to average return (CV) compared to the base farm and other changes. Diversifying and farming a prime lamb and beef breeding operation (C3) had the least risk (CV) for a reasonable return on capital, while specialising and farming all prime lamb (C2) generated the highest return on capital for moderate risk, compared to all options. The results support the original hypothesis that diversification, i.e. farming sheep and beef breeding (C3), or multiple sheep enterprises (C2), are good approaches for managing risk, through income generated from different sources, while offering reasonable profits. If higher profits are sought then operating a single enterprise (all prime lamb; C2) is best, albeit with greater risk.

For the different lamb finishing systems, farming based on pasture supply to finish the majority of lambs (C2) was a slightly more profitable and less risky option than farming to optimise reproduction and finishing lambs in a feedlot (C5) or forage crop system (C6). As reported in other studies (Thompson, 2006; Warn *et al.,* 2006; Young *et al.,* 2006; Young *et al.,* 2010), lambing later makes possible slightly higher stocking rates, as lambing takes place when there is more feed available, and there is generally higher lamb survival from better weather conditions. But lambing later means supplementary feed costs are incurred to finish lambs later in the season when there is less green feed available. Lambing earlier requires additional supplementary feeding of ewes prior to lambing and slightly fewer lambs on the ground due to colder weather conditions, but a greater majority of those lambs are able to be finished on pasture and sold earlier. While these management approaches depend on the location and resources of the farming system, lambing later was not as profitable as lambing earlier for this case study farm; however, there was not a large difference between the average results.

Of the different lamb finishing systems, pasture (C2), feedlot (C5) and forage crop (C6), the feedlot change had the highest variability (SD and CV) around the mean return on total capital of all systems. This result does not mean, however, that feed-lotting lambs is an excessively risky option. One of the main reasons for the higher (total) variability is the increase in the number of ewes farmed. Given that lambs enter the feedlot at 35 kg lwt, pasture which was once used to finish lambs can be used to run extra ewes. Farming extra ewes means additional lambs on the ground and therefore greater fluctuations in the number of lambs sold between seasons. This also means more variable demand for supplementary feed and exposure to supplementary feed prices.

Each lamb finishing system also entails its own unique set of risks. The viability of a feedlot system depends on the cost of grain. The forage crop system relies on growing sufficient forage crop to finish lambs. Lambing earlier requires reasonable winter weather conditions to ensure lamb survival at lambing. To make a fair comparison of the variability between the different options, analysis would need to be conducted based on the same number of lambs finished. For the present study, the analysis was based on maximising profit for a set farming area (950 ha). As well as the profit and associated variability generated by each lamb finishing system, there is also an element of what the farmer enjoys doing and their attitude to risk - do they have the skills and enthusiasm for regularly trading grain, or planting forage crops, or lambing ewes in the middle of winter?

Cropping was not a profitable option when compared to options more suited to the farm resources and environment, such as prime lamb. Planting crop on raised beds to limit waterlogging enabled high crop yields to be achieved, but the cost to develop and maintain the raised beds affected profitability. For higher profits to be achieved, crop yields would need to be higher than currently achievable to compete with the high production and profits achieved from farming prime lamb on this case study farm.

Analysis of the factors that contribute to variability in profit for a prime lamb enterprise, indicated that lamb price was a substantial contributor to enterprise risk (data not shown). Mutton, skin, wool and supplementary feed prices also had some influence. Overall, there did not appear to be a consistent trend between climatic conditions, production and profit. These findings are similar to the trends of the south-west Victoria benchmark data (DEDJTR, 2014a; Tocker, 2016), where price was strongly correlated with whole farm and enterprise profitability, and climate had a weaker relationship. These findings are also supported by Martin (1996) and Wolf *et al.* (2009) where price was considered the main factor in the variation of profit, but different to the findings of Browne *et al.* (2013) who found that rainfall variability had more effect on profit than prices.

In this research into different options of change for a case study farm, and while costs associated with added risk have been counted in the analysis, there are still issues to do with the increasing management complexity and the degree to which producers can successfully apply the management strategies required to increase production. There is still risk that higher stocking rates and lambing percentages may not be consistently achieved. Likewise, farming multiple sheep enterprises or sheep and cattle or cropping is a well-established practice, but there is risk and uncertainty around managing the performance of each enterprise at the required high standard. On an individual basis, farmers would need to assess how confident they are about achieving such production targets and farming multiple enterprises when weighing up the different choices.

The financial analysis illustrates the risk associated with each of the changes, and that financing matters (Malcolm, 2011). Considering price and yield risk and overlaying the financial implications of each of the changes for the business further informs the decision-maker about each of the choices. Even though a change may look attractive in terms of profit or return on capital, and risk (before financing considerations), financial matters will be decisive. The capital required has to be able to be borrowed, and borrower and lender need to be confident the loan can be serviced under most of the range of circumstances that are likely to apply. If any of these changes were taken up, some thought would be needed by the investor about what steps are needed in the event of rising interest rates and periodic deficiencies of annual net cash flows.

There is always refinement that can be made to any farm business to improve profitability, but the success of a change is always subject to increased management complexity, the degree to which farmers can achieve the changes in practice, and meeting financial obligations.

Conclusion

Diversification of livestock enterprises, such as farming multiple sheep enterprises, or sheep and beef cattle, are sound approaches for managing risk, whilst achieving reasonable profits. If higher profits are sought, and the associated higher risk is acceptable, then specialisation and focussing on a single enterprise appears the best option, such as specializing in prime lamb production. For this analysis, farming a prime lamb enterprise based on pasture supply to finish the majority of lambs was generally more favourable than farming to maximise reproduction performance. Cropping was not a viable option for this case study farm when competing with prime lamb.

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Appendix 1 Supplementary material - assumptions

Table 1.1 Price correlations for base farm (SQ) and base farm improved (C1)

Price correlations	PL Lamb Meat Price	PL Skin Price	PL Mutton Price	PL Repl. Ewe Price	PL Wool Price	MM Lamb Meat Price	MM Skin Price	MM Mutton Price	MM Repl. Ewe Price	MM Wool Price	MWs Lamb Meat Price	MWs Skin Price	MWs Mutton Price	MWs Repl. Ewe Price	MWs Wool Price	CC Wheat	CC Barley	Supp. Feed Oats	Supp. Feed Barley	Supp. Feed Hay
PL Lamb Meat Price	1																			
PL Skin Price	0	1																		
PL Mutton Price	0.78	0	1																	
PL Replacement Ewe Price	0.76	0	0.83	1																
PL Wool Price	0.39	0	0.47	0.53	1															
MM Lamb Meat Price	0.97	0	0.71	0.72	0.29	1														
MM Skin Price	0	1	0	0	0	0	1													
MM Mutton Price	0.71	0	0.79	0.79	0.31	0.77	0	1												
MM Replacement Ewe Price	0.72	0	0.78	0.76	0.33	0.76	0	0.88	1											
MM Wool Price	0.28	0	0.31	0.34	0.57	0.37	0	0.51	0.54	1										
MWs Lamb Meat Price	0.97	0	0.71	0.72	0.28	0.96	0	0.72	0.72	0.29	1									
MWs Skin Price	0	1	0	0	0	0	1	0	0	0	0	1								
MWs Mutton Price	0.71	0	0.79	0.79	0.31	0.72	0	0.86	0.84	0.43	0.77	0	1							
MWs Replacement Ewe Price	0.72	0	0.79	0.76	0.34	0.72	0	0.84	0.81	0.47	0.76	0	0.87	1						
MWs Wool Price	0.28	0	0.31	0.33	0.57	0.29	0	0.39	0.43	0.82	0.37	0	0.51	0.54	1					
CC Wheat	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1				
CC Barley	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1			
Supp. Feed - Oats	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.85	0.85	1		
Supp. Feed - Barley	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0.85	1	
Supp. Feed - Hay	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.80	0.80	0.80	0.80	1

Table 1.2 Price correlations for prime lamb (C2), prime lamb and beef breeding cow and calf (C3), and prime lamb and forage crop finishing system (C6)

Price correlations	PL Lamb Meat Price	PL Skin Price	PL Mutton Price	PL Repl. Ewe Price	PL Wool Price	BC Beef meat price	BC Cull cow price	Supp. Feed Oats	Supp. Feed Barley	Supp. Feed Hay	Supp. Feed Silage
PL Lamb Meat Price	1										
PL Skin Price	0	1									
PL Mutton Price	0.80	0	1								
PL Replacement Ewe Price	0.80	0	0.80	1							
PL Wool Price	0.35	0	0.50	0.60	1						
BC Beef meat price	0	0	0	0	0	1					
BC Cull cow price	0	0	0	0	0	0.80	1				
Supp. Feed - Oats	0	0	0	0	0	0	0	1			
Supp. Feed - Barley	0	0	0	0	0	0	0	0.85	1		
Supp. Feed - Hay	0	0	0	0	0	0	0	0.80	0.80	1	
Supp. Feed - Silage	0	0	0	0	0	0	0	0.30	0.30	0.50	1

Table 1.3 Price correlations for prime lamb and cropping (C4)

Price correlations	PL Lamb Meat Price	PL Skin Price	PL Mutton Price	PL Repl. Ewe Price	PL Wool Price	CC Wheat	CC Barley	CC Canola	CC Faba Beans	CC Lupins	Supp. Feed Oats	Supp. Feed Barley	Supp. Feed Hay
PL Lamb Meat Price	1												
PL Skin Price	0	1											
PL Mutton Price	0.80	0	1										
PL Replacement Ewe Price	0.80	0	0.80	1									
PL Wool Price	0.35	0	0.50	0.60	1								
CC Wheat	0	0	0	0	0	1							
CC Barley	0	0	0	0	0	0.99	1						
CC Canola	0	0	0	0	0	0.85	0.85	1					
CC Faba Beans	0	0	0	0	0	0.60	0.60	0.65	1				
CC Lupins	0	0	0	0	0	0.60	0.60	0.65	0.75	1			
Supp. Feed - Oats	0	0	0	0	0	0.80	0.80	0.70	0.60	0.60	1		
Supp. Feed - Barley	0	0	0	0	0	0.99	1	0.85	0.60	0.60	0.85	1	
Supp. Feed - Hay	0	0	0	0	0	0.71	0.80	0.60	0.50	0.50	0.80	0.80	1

Table 1.4 Price correlations for prime lamb and feedlot finishing (C5)

Price correlations	PL Lamb Meat Price	PL Skin Price	PL Mutton Price	PL Repl. Ewe Price	PL Wool Price	Supp. Feed Oats	Supp. Feed Barley	Supp. Feed Hay	FL Supp. Fd. Barley	FL Supp. Fd. Lupins	FL Supp. Fd. Lucerne Hay	FL Supp. Fd. Syrip
PL Lamb Meat Price	1											
PL Skin Price	0	1										
PL Mutton Price	0.80	0	1									
PL Replacement Ewe Price	0.80	0	0.80	1								
PL Wool Price	0.35	0	0.50	0.60	1							
Supp. Feed - Oats	0	0	0	0	0	1						
Supp. Feed - Barley	0	0	0	0	0	0.65	1					
Supp. Feed - Hay	0	0	0	0	0	0.65	0.91	1				
FL - Supp. Feed - Barley	0	0	0	0	0	0.14	0.84	0.73	1			
FL - Supp. Feed - Lupins	0	0	0	0	0	0.04	0.56	0.47	0.62	1		
FL - Supp. Feed - Lucerne Hay	0	0	0	0	0	0.12	0.71	0.83	0.85	0.52	1	
FL - Supp. Feed - Syrip	0	0	0	0	0	0	0	0	0	0	0	1

Table 1.5 Sheep enterprise variable costs

Animal health	ewes ($/head)	lambs ($/head)
Prime Lamb (PL)	$6.05	$3.67
Merino and Merino x White Suffolk	$5.90	$4.02

Labour - Shearing	$/head	No. x PL	No. x Merino	**Labour - Crutching**	$/head	No. x PL	No. x Merino
ewes	$6.00	1	1	ewes	$1.10	2	2
lambs	$5.00	0.5	0.7	lambs	$1.10	1.5	1.7
rams	$8.50	1	1	rams	$2.00	2	2

Wool costs / Shearing supplies
Wool tax 2% of wool income — Commissions, etc. $40.00 /bale — Wool packs $11.00 /bale (av. 200kg)

Livestock selling costs
Livestock cartage $2.00 /hd — Commissions 4.50% — Levies 1.90%

Other costs (general) $1.00 /hd

- Costs based on expert opinion.

Table 1.6 Beef breeding cow enterprise variable costs

Animal health	$9.50 /hd	**Freight & cartage**	$6.70 /hd	**Selling**	$8.10 /hd	**Other**	$4.00 /hd

- Costs based on historical datasets (DEDJTR 2014b) and expert opinion.

Table 1.7 Crop enterprise variable costs

		Wheat	**Barley**	**Canola**	**Faba Beans**	**Lupins**
Seed	/ha	$42	$42	$50	$62	$47
Chemicals	/ha	$96	$86	$70	$180	$60
Fertiliser	/ha	$152	$142	$138	$52	$52
Contract harvesting	/ha	$58	$58	$88	$85	$85
Repairs & maintenance	/ha	$16	$16	$16	$16.5	$10.5
Fuel	/ha	$26.5	$26.5	$26	$27.5	$17.5
Insurance	/ha	$10	$10	$10	$10	$10
Sundries	/ha	$15	$12	$15	$10	$10
Freight / cartage	/t	$15	$15	$15	$15	$15

- Costs based on historical datasets (DEDJTR 2014b) and expert opinion.

Table 1.8 Other whole farm variable costs

Fuel and vehicle ^		$19,000
Repairs & maintenance		$19,000
Pasture costs	Annual pasture renewal - seed & fert. (60 ha @ $250/ha)	$15,000
	Weed, pest control and other	$4,000
Annual maintenance fertiliser	Application rate 0.0008 t P/DSE; 8.8% P per tonne of super.	
Forage crop costs	Seed & fert. (60 ha @ $160/ha)	$9,600

- Costs based on historical datasets (DEDJTR 2014b), actual farm data and expert opinion.
^ Includes annual pasture renewal and forage crop fuel and vehicle costs of approx. $50/ha.

Table 1.9 Fixed costs

Labour		$10,000
Depreciation		$50,000
Rates		$14,000
Administration		$4,500
Other *(Electricity, Insurance, etc)*		$27,000
Operator's allowance	Owner/Operator	$80,000
	Family	$50,000

- Costs based on actual farm data and expert opinion.

Table 1.10 Livestock standard values

Prime Lamb Ewe standard value	$150	/hd
Merino Ewe standard value	$125	/hd
Prime Lamb Ram purchase value	$1,000	/hd
Merino Ram purchase value	$900	/hd
Cow standard value	$840	/hd
Heifer standard value	$730	/hd
Weaner Heifer standard value	$400	/hd
Weaner Steer standard value	$450	/hd
Steer standard value	$690	/hd
Bull purchase value	$1,500	/hd

- Prices based on actual farm data and expert opinion.

Table 1.11 Other variables

Effective annual average tax rate assumed on tax income	15%		
Interest earned on annual net cash flow surpluses	4% *(nominal)*	Interest charged on deficits	7% *(nominal)*
Inflation on income and costs	2%		
Cost price squeeze	1%		

Appendix 2 Supplementary material - results

Table 2.1 Mean and standard deviation values of specified production parameters for each change based on GrassGro® modelling over 50 years of weather data (1960 to 2009) for the Penshurst area

	Status Quo		**Change 1**		**Change 2**		**Change 3**		**Change 4**		**Change 5**		**Change 6**	
	Base Farm		Base Farm Improved		Prime Lamb		Prime Lamb and Beef Breeding		Prime Lamb and Cropping		Prime Lamb and Feedlot		Prime Lamb and Forage Crop System	
	Mean	*Standard deviation*	**Mean**	*Standard deviation*	**Mean**	*Standard deviation*	**Mean**	*Standard deviation*	**Mean**	*Standard deviation*	**Mean**	*Standard deviation*	**Mean**	*Standard deviation*
Prime Lamb - Land area (ha)	494		491		950		660		435		950		950	
Pasture grown (kg DM/ha)	10,672	*1,641*	11,916	*1,816*	11,899	*1,740*	12,025	*1,818*	12,633	*1,845*	12,526	*1,858*	12,705	*1,879*
Animal intake (kg DM/ha)	4,963	*133*	6,379	*218*	6,492	*258*	6,602	*233*	6,333	*207*	6,515	*214*	6,465	*200*
Utilisation	47%	*7%*	55%	*7%*	56%	*7%*	56%	*8%*	51%	*7%*	53%	*7%*	52%	*7%*
Average stocking rate (DSE/ha)	17.7	*0.5*	22.1	*0.6*	22.8	*0.6*	23.2	*0.7*	22.6	*0.7*	22.9	*0.6*	22.4	*0.6*
- developed pasture av. stocking rate	19.6	*0.6*	22.5	*0.6*	22.8	*0.6*	23.5	*0.7*	21.8	*0.6*	22.6	*0.6*	22.4	*0.6*
- lucerne av. stocking rate	18.2	*1.1*	18.9	1.2	18.5	1.6	18.5	1.6						
Supp. feed (t; barley) - ewes	17	*21*	27	*50*	51	*102*	29	*67*	11	*26*	88	*109*	68	*81*
- lambs	2	*8*	3	*10*	1	*5*	3	*11*	2	*8*	5	*13*	0	*0*
Supp. feed (t; oats) - lbs. on fodder crop	8	*3*	3	*2*	16	*6*	8	*4*			8	*2*	53	*8*
- barley (*if low yield*)	6	*12*	3	*10*	11	*32*	8	*19*			1	*6*	21	*49*
Supp. feed (t; barley) - lambs on feedlot											479	36		
- lupins											60	5		
- lucerne hay											136	10		
Av. no. mature & 1-2 y.o. females	2,759	*13*	3,405	*15*	6,689	*30*	4,750	*15*	3,306	*13*	7,513	*26*	6,511	*25*
Lamb marking % (lambs per ewe)	117%	*7%*	122%	*8%*	121%	*7%*	122%	*8%*	122%	*7%*	125%	*8%*	126%	*8%*
Total no. of lambs sold	3,084	*224*	3,968	*296*	7,759	*574*	5,522	*461*	3,872	*292*	9,254	*677*	8,047	*616*
Lamb production - kg cwt	67,997	*4,933*	87,446	*6,487*	171,047	*12,561*	121,684	*10,148*	85,259	*6,420*	216,224	*15,712*	176,652	*13,470*
- kg cwt/ha	138	*10*	178	*13*	180	*13*	184	*15*	196	*15*	228	*17*	186	*14*
Wool production - kg cfw/ha	28.6	*0.9*	37.8	*1.5*	39.4	*1.8*	39.0	*1.5*	37.6	*1.5*	40.2	*1.4*	41.8	*1.5*
Merino x Merino - Land area (ha)	230		225											
Average stocking rate (DSE/ha)	17.0	*0.6*	21.5	*0.8*										
Supp. feed (t; barley) - ewes	9	*10*	14	*19*										
- lambs	4	*7*	4	*9*										
Av. no. mature & 1-2 y.o. females	1,641	*13*	2,010	*10*										
Lamb marking % (lambs per ewe)	89%	*6%*	89%	*7%*										
Lamb production - kg cwt/ha	92	*6*	117	*9*										
Wool production - kg cfw/ha	45.7	*1.4*	58.5	*2.0*										
Merino x White Suffolk - Land area (ha)	166		174											
Average stocking rate (DSE/ha)	20.0	*0.6*	24.2	*0.8*										
Supp. feed (t; barley) - ewes	6	*6*	8	*16*										
- lambs	3	*4*	1	*3*										
Supp. feed (t; oats) - lbs. on fodder crop	11	*1*	10	*1*										
- barley (*if low yield*)	3	*7*	1	*5*										
Av. no. mature & 1-2 y.o. females	1,165	*9*	1,429	*11*										
Lamb marking % (lambs per ewe)	98%	*8%*	100%	*9%*										
Lamb production - kg cwt/ha	136	*12*	163	*14*										
Wool production - kg cfw/ha	50.2	*1.2*	66.2	*2.6*										
Beef Breeding - Land area (ha)							290							
Pasture grown (kg DM/ha)							12,539	*1,849*						
Animal intake (kg DM/ha)							6,074	*258*						
Utilisation							49%	*6%*						
Average stocking rate (DSE/ha)							20.7	*0.9*						
Supp. feed (t; silage) - cows							20	*61*						
- young stock							32	*47*						
Av. no. mature & 1-2 y.o. females							414	*2*						
Calf marking % (calves per cow)							92%	*2%*						
Total No. of steers and heifers sold							242	*8*						
Beef Production - kg lwt							61,252	*2,769*						
Beef Production - kg lwt/ha							211	*10*						
Wheat - area (ha)	30		30						130					
yield (t/ha)	4.5	*1.1*	4.5	*1.1*					4.7	*1.1*				
Barley - area (ha)	30		30						65					
yield (t/ha)	4.0	*1.0*	4.0	*1.0*					4.2	*1.0*				
Canola - area (ha)									130					
yield (t/ha)									2.3	*0.6*				
Faba Beans - area (ha)									65					
yield (t/ha)									3.3	*0.8*				
Lupins - area (ha)									65					
yield (t/ha)									2.8	*0.7*				

Table 2.2 Mean and standard deviation values for income, variable costs, overhead costs, operating profit, net farm income and net profit for the base farm and each change in a steady state year (year 4), as modelled on GrassGro® production data

		Steady State Year (Mean & Standard Deviation)													
		Status Quo Base Farm		**Change 1** Base Farm Improved		**Change 2** Prime Lamb		**Change 3** Prime Lamb and Beef Breeding		**Change 4** Prime Lamb and Cropping		**Change 5** Prime Lamb and Feedlot		**Change 6** Prime Lamb and Forage Crop System	
		Mean	Standard deviation	**Mean**	Standard deviation	**Mean**	Standard deviation	**Mean**	Standard deviation	**Mean**	Standard deviation	**Mean**	Standard deviation	**Mean**	Standard deviation
Gross Income															
- Prime Lamb	Lamb sales	$358,817	$62,009	$462,435	$80,050	$929,144	$160,008	$649,334	$114,007	$449,779	$77,996	$1,193,807	$206,026	$966,372	$166,925
	Cull ewe sales	$45,009	$15,940	$55,867	$19,748	$108,599	$38,313	$78,031	$27,496	$53,417	$18,849	$121,709	$42,626	$105,254	$36,874
	Wool sales	$56,551	$8,797	$75,251	$11,889	$148,662	$23,796	$103,029	$16,138	$69,421	$11,099	$154,896	$24,383	$139,974	$22,061
	less: Repl. ewe/ram purch.	$13,322	$20	$16,352	$30	$32,129	$26	$22,787	$26	$15,979	$28	$36,720	$35	$31,832	$35
	Inventory change	$15	$2,115	$84	$2,322	$285	$3,470	$30	$2,482	$77	$2,153	$183	$3,617	$166	$3,411
		$447,071	$77,539	$577,285	$100,034	$1,154,560	$199,922	$807,638	$141,520	$556,715	$96,928	$1,433,876	$247,270	$1,179,933	$203,927
- Merino	Lamb sales	$96,705	$16,570	$120,248	$21,156	-	-	-	-	-	-	-	-	-	-
	Cull ewe & wether sales	$21,371	$7,614	$25,673	$9,087	-	-	-	-	-	-	-	-	-	-
	Wool sales	$89,283	$14,337	$111,781	$18,158	-	-	-	-	-	-	-	-	-	-
	less: Repl. ewe/ram purch.	$5,792	$70	$7,074	$57	-	-	-	-	-	-	-	-	-	-
	Inventory change	$31	$1,860	$59	$1,725	-	-	-	-	-	-	-	-	-	-
		$201,597	$31,283	$250,688	$39,602	-	-	-	-	-	-	-	-	-	-
- Merino x	Lamb sales	$114,328	$20,454	$144,515	$25,943	-	-	-	-	-	-	-	-	-	-
White Suffolk	Cull ewe s.	$14,739	$5,223	$18,435	$6,617	-	-	-	-	-	-	-	-	-	-
	Wool sales	$53,971	$8,586	$71,697	$11,605	-	-	-	-	-	-	-	-	-	-
	less: Repl. ewe/ram purch.	$22,868	$2,979	$28,373	$3,715	-	-	-	-	-	-	-	-	-	-
	Inventory change	-$38	$1,322	$63	$1,316	-	-	-	-	-	-	-	-	-	-
		$160,132	$26,179	$206,338	$33,985	-	-	-	-	-	-	-	-	-	-
- Beef	Steer sales	-	-	-	-	-	-	$139,153	$18,860	-	-	-	-	-	-
Breeding	Heifer sales	-	-	-	-	-	-	$34,823	$5,952	-	-	-	-	-	-
	Cull cow sales	-	-	-	-	-	-	$51,437	$8,202	-	-	-	-	-	-
	less: Repl. cow/bull purch.	-	-	-	-	-	-	$2,921	$17	-	-	-	-	-	-
	Inventory change	-	-	-	-	-	-	$0	$2,682	-	-	-	-	-	-
		-	-	-	-	-	-	$222,569	$30,120	-	-	-	-	-	-
- Cropping	Wheat s.	$33,648	$12,354	$33,535	$11,914	-	-	-	-	$151,492	$53,082	-	-	-	-
	Barley sales	$28,562	$10,371	$28,477	$9,999	-	-	-	-	$64,355	$22,922	-	-	-	-
	Canola sales	-	-	-	-	-	-	-	-	$147,826	$44,591	-	-	-	-
	Faba Bean sales	-	-	-	-	-	-	-	-	$73,985	$19,936	-	-	-	-
	Lupin sales	-	-	-	-	-	-	-	-	$62,066	$17,060	-	-	-	-
		$62,210	$22,200	$62,011	$21,393	-	-	-	-	$499,724	$146,015	-	-	-	-
Other farm income		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total Gross Income		$871,010	$127,979	$1,096,322	$163,936	$1,154,560	$199,922	$1,030,208	$145,440	$1,056,439	$168,912	$1,433,876	$247,270	$1,179,933	$203,927
Variable Costs															
- Prime Lamb	Animal hth.	$26,149	$1,024	$33,036	$1,368	$64,674	$2,633	$40,393	$1,847	$32,114	$1,348	$82,501	$3,369	$65,083	$2,849
	Shearing labour	$38,199	$1,496	$48,260	$1,999	$94,478	$3,846	$67,215	$3,074	$46,913	$1,970	$109,885	$4,488	$95,075	$4,162
	Shearing supplies	$4,820	$189	$6,090	$252	$11,922	$485	$8,481	$388	$5,920	$249	$13,866	$566	$11,997	$525
	Supp. feed	$5,247	$7,115	$8,725	$15,762	$15,581	$30,776	$9,176	$21,246	$3,734	$8,967	$26,124	$33,551	$19,081	$23,966
	Fodder crop	$4,451	-	$3,297	-	$9,891	-	$5,770	-	-	-	$6,594	-	$26,376	-
	Supp. feed on Fodder crop	$5,954	$4,692	$3,188	$4,353	$11,835	$12,649	$6,730	$8,038	-	-	$4,255	$2,536	$27,878	$18,937
	Supp. feed on Feedlot	-	-	-	-	-	-	-	-	-	-	$196,854	$41,620	-	-
	Freight and cartage	$7,230	$283	$9,134	$378	$17,882	$728	$12,722	$582	$8,879	$373	$20,798	$849	$17,995	$788
	Selling costs	$10,303	$403	$13,017	$539	$25,482	$1,037	$18,129	$829	$12,653	$531	$29,638	$1,210	$25,643	$1,123
	Other	$6,025	$236	$7,612	$315	$14,902	$607	$10,602	$485	$7,400	$311	$17,332	$708	$14,996	$656
- Merino	Animal hth.	$12,355	$330	$15,142	$457	-	-	-	-	-	-	-	-	-	-
	Shearing labour	$20,734	$554	$25,412	$768	-	-	-	-	-	-	-	-	-	-
	Shearing supplies	$4,616	$123	$5,658	$171	-	-	-	-	-	-	-	-	-	-
	Supp. feed	$3,531	$4,633	$5,066	$7,676	-	-	-	-	-	-	-	-	-	-
	Freight and cartage	$2,482	$66	$3,042	$92	-	-	-	-	-	-	-	-	-	-
	Selling costs	$3,629	$97	$4,448	$134	-	-	-	-	-	-	-	-	-	-
	Other	$2,668	$71	$3,270	$99	-	-	-	-	-	-	-	-	-	-
- Merino x	Animal hth.	$9,011	$358	$11,173	$465	-	-	-	-	-	-	-	-	-	-
White Suffolk	Shearing lb.	$14,951	$593	$18,537	$772	-	-	-	-	-	-	-	-	-	-
	Shearing supplies	$3,252	$129	$4,032	$168	-	-	-	-	-	-	-	-	-	-
	Supp. feed	$2,476	$2,553	$2,729	$4,917	-	-	-	-	-	-	-	-	-	-
	Fodder crop	$5,440	-	$6,594	-	-	-	-	-	-	-	-	-	-	-
	Supp. feed on Fodder crop	$4,809	$2,805	$4,293	$2,338	-	-	-	-	-	-	-	-	-	-
	Freight and cartage	$2,484	$99	$3,080	$128	-	-	-	-	-	-	-	-	-	-
	Selling costs	$3,410	$135	$4,228	$176	-	-	-	-	-	-	-	-	-	-
	Other	$2,258	$90	$2,800	$117	-	-	-	-	-	-	-	-	-	-
- Beef	Animal hth.	-	-	-	-	-	-	$6,425	$78	-	-	-	-	-	-
Breeding	Supp. feed	-	-	-	-	-	-	$3,838	$7,509	-	-	-	-	-	-
	Freight and cartage	-	-	-	-	-	-	$4,532	$55	-	-	-	-	-	-
	Selling costs	-	-	-	-	-	-	$5,479	$66	-	-	-	-	-	-
	Other	-	-	-	-	-	-	$2,705	$33	-	-	-	-	-	-
- Additional	Fert. (sup.)	$55,945	$5,065	$69,674	$6,338	$70,878	$6,403	$69,883	$6,302	$32,287	$2,953	$71,376	$6,416	$76,858	$7,004
Livestock	Fuel & Veh.	$19,576	-	$21,636	-	$21,121	-	$15,970	-	$16,742	-	$19,576	-	$31,424	-
Costs:	Rep. & Mnt.	$19,576	-	$22,667	-	$21,636	-	$20,606	-	$16,485	-	$21,636	-	$21,636	-
	Pasture maint. / dev.	$19,576	-	$30,909	-	$30,909	-	$33,485	-	$31,167	-	$32,970	-	$56,667	-
- Cropping	Seed	$2,596	-	$2,596	-	-	-	-	-	$22,435	-	-	-	-	-
	Chemicals	$5,625	-	$5,625	-	-	-	-	-	$44,066	-	-	-	-	-
	Contract services	$3,585	-	$3,585	-	-	-	-	-	$34,824	-	-	-	-	-
	Fertiliser	$9,087	-	$9,087	-	-	-	-	-	$55,317	-	-	-	-	-
	Rep. & Mnt.	$989	-	$989	-	-	-	-	-	$7,166	-	-	-	-	-
	Fuel	$1,638	-	$1,638	-	-	-	-	-	$11,820	-	-	-	-	-
	Insurance	$618	-	$618	-	-	-	-	-	$4,688	-	-	-	-	-
	Sundries	$835	-	$835	-	-	-	-	-	$6,161	-	-	-	-	-
	Freight / cartage	$3,950	$901	$3,953	$910	-	-	-	-	$24,305	$5,340	-	-	-	-
Total Variable Costs		$350,082	$20,832	$425,676	$31,800	$411,192	$40,785	$342,141	$32,013	$425,075	$8,526	$653,404	$60,445	$490,709	$38,421
Total - Prime Lamb var. costs		$172,027	$12,083	$212,291	$19,288	$411,192	$40,785	$276,442	$27,284	$214,293	$10,436	$653,404	$60,445	$490,709	$38,421
Total - Merino var. costs		$79,650	$4,826	$98,666	$7,470	-	-	-	-	-	-	-	-	-	-
Total - Merino x WS var. costs		$69,480	$5,243	$85,792	$7,036	-	-	-	-	-	-	-	-	-	-
Total - Beef Breeding var. costs		-	-	-	-	-	-	$65,699	$7,488	-	-	-	-	-	-
Total - Cropping var. costs		$28,925	$901	$28,928	$910	-	-	-	-	$210,782	$5,340	-	-	-	-

Gross Margin	- total	$520,928	$129,191	$670,646	$167,575	$743,368	$202,181	$688,067	$148,951	$631,364	$168,502	$780,471	$247,747	$689,224	$203,925
	- per ha	$548	$136	$706	$176	$782	$213	$724	$157	$665	$177	$822	$261	$725	$215
- Prime Lamb	- total	$275,044	$77,075	$364,994	$100,535	$743,368	$202,181	$531,196	$142,508	$342,422	$95,674	$780,471	$247,747	$689,224	$203,925
	- per DSE	$31	$9	$34	$9	$34	$9	$35	$9	$35	$9	$36	$11	$29	$8
	- per ha	$557	$156	$743	$205	$782	$213	$805	$216	$787	$220	$822	$261	$725	$215
- Merino	- total	$121,947	$31,933	$152,022	$41,300	-	-	-	-	-	-	-	-	-	-
	- per DSE	$31	$8	$31	$8	-	-	-	-	-	-	-	-	-	-
	- per ha	$530	$139	$676	$184	-	-	-	-	-	-	-	-	-	-
- Merino x White Suffolk	- total	$90,652	$25,974	$120,546	$33,781	-	-	-	-	-	-	-	-	-	-
	- per DSE	$27	$8	$29	$8	-	-	-	-	-	-	-	-	-	-
	- per ha	$546	$156	$693	$194	-	-	-	-	-	-	-	-	-	-
- Beef Breeding	- total	-	-	-	-	-	-	$156,871	$32,256	-	-	-	-	-	-
	- per DSE	-	-	-	-	-	-	$26	$5	-	-	-	-	-	-
	- per ha	-	-	-	-	-	-	$541	$111	-	-	-	-	-	-
- Cropping	- total	$33,285	$21,615	$33,084	$20,822	-	-	-	-	$288,942	$142,085	-	-	-	-
	- per ha	$555	$360	$551	$347	-	-	-	-	$635	$312	-	-	-	-
Overhead Costs:															
	Labour	$10,303	-	$20,606	-	$15,455	-	$10,303	-	$15,455	-	$36,061	-	$15,455	-
	Depreciation	$51,515	-	$51,515	-	$51,515	-	$51,515	-	$103,113	-	$73,234	-	$51,515	-
	Rates	$14,424	-	$14,424	-	$14,424	-	$14,424	-	$14,424	-	$14,424	-	$14,424	-
	Administration	$4,636	-	$4,636	-	$4,636	-	$4,636	-	$4,636	-	$4,636	-	$4,636	-
	Other	$27,818	-	$27,818	-	$27,818	-	$27,818	-	$27,818	-	$27,818	-	$27,818	-
Total Overhead Costs		$108,697	-	$119,000	-	$113,848	-	$108,697	-	$165,446	-	$156,173	-	$113,848	-
Owner/Operator Allowance		$133,939	-	$133,939	-	$133,939	-	$133,939	-	$133,939	-	$133,939	-	$133,939	-
Operating Profit (EBIT)		$278,292	$129,191	$417,707	$167,575	$495,581	$202,181	$445,431	$148,951	$331,979	$168,502	$490,359	$247,747	$441,436	$203,925
Interest & Lease Costs:															
	Current loan interest cost	$67,736	-	$67,736	-	$67,736	-	$67,736	-	$67,736	-	$67,736	-	$67,736	-
	New loan interest cost	$0	-	$27,669	-	$27,103	-	$30,899	-	$9,096	-	$52,887	-	$25,314	-
Total Interest & Lease Costs:		$67,736	-	$95,405	-	$94,839	-	$98,635	-	$76,832	-	$120,623	-	$93,050	-
Net Farm Income		$210,556	$129,191	$322,302	$167,575	$400,743	$202,181	$346,796	$148,951	$255,147	$168,502	$369,736	$247,747	$348,386	$203,925
Tax Payable		$52,115	$19,460	$68,588	$24,992	$80,309	$30,119	$72,104	$22,744	$59,182	$25,363	$75,852	$37,436	$72,442	$30,289
Net Profit / Change in Equity		$158,441	$129,940	$253,714	$167,120	$320,434	$201,905	$274,691	$147,903	$195,965	$168,900	$294,154	$249,878	$275,944	$205,054