Comparing the profitability of sheep, beef, dairy and grain farms in southwest Victoria under different rainfall scenarios

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Contributed paper prepared for presentation at the 56th AARES annual conference, Fremantle, Western Australia, February7-10, 2012

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Working Paper

Abstract

Dryland farming is commonplace in Australia so the profitability of dryland farms often depends on the amount and timing of rainfall. With drier weather conditions featuring in climate change projections for southern Australia, it is important to understand the relationships between rainfall, commodity prices and farm profitability. Using correlated farm commodity and input prices from the past nine years, farm profitability was calculated for a range of farm types in southwest Victoria under low, average and high rainfall scenarios. Fourteen representative farms were examined that included production of Merino fine wool, prime lamb, beef cattle, milk, wheat and canola. This paper compares and contrasts the spread of profitability of these farms against the backdrop of price variability and rainfall scenarios. Inferences about the resilience to climate and price volatility of the different farm types are made. The type of metric used to describe profitability is shown to importantly affect the nature of inferences to be drawn through the comparison of farms.

Keywords

dryland farming, farm enterprises, climate change, price variability

1. Introduction

Dryland farming is commonplace in Australia so the profitability of dryland farms often depends on the amount and timing of rainfall (Pearson et al., 2011). Recurrent droughts and floods are natural features of Australia's climate so farmers need to manage for these conditions.

Dryland farmers face many uncertainties, the two greatest being yield and commodity price risks (Kingwell, 2000). Changes in rainfall and climate impact on soil moisture, pasture and crop growth, and subsequently affect crop yields and livestock production dependent on pasture growth. Price risk is the price variability farmers face in selling their produce and purchasing inputs. Prices fluctuate as a result of both local and international influences (Kingwell, 2000). Understanding the effect of changes in rainfall and prices on enterprise and farm profitability enables farmers to better manage these risks.

With drier weather conditions featuring in climate change projections for southern Australia, understanding the relationships between rainfall, commodity prices and farm profitability is increasingly important. Climate change projections for Australia, under a high emissions scenario (A1FI), are that warming will occur and annual precipitation will decrease, especially during autumn (CSIRO and Australian Bureau of Meteorology, 2007). Relative to a 1990 baseline (averaged across 1980-1999), rainfall in southwest Victoria is estimated to decrease by 2-5% by 2030, 5-10% by 2050 and 10-20% by 2070. Temperatures in southwest Victoria are estimated to increase by 1-1.5°C by 2030 and 1.5-2.0°C by 2050 (CSIRO and Australian Bureau of Meteorology, 2007). These projections, particularly for decreased rainfall, mean that farmers will need to prepare and manage their systems and farm finances to allow for these environmental challenges.

Southwest Victoria is a high rainfall zone with a relatively reliable rainfall and subsequently a relatively reliable growing season compared to many other areas in Australia (Cullen et al., 2009). Southwest Victoria suits a number of land uses including sheep, beef, grains and dairy farming. Most often farms are mixed enterprises, with farm managers choosing the mixture based on relative expected returns of enterprises, their management expertise, or environmental conditions such as soil type and expected rainfall. The wide range of enterprises within the region provides a rich data set on different types of farming.

Accordingly, this paper compares and contrasts the profitability of 14 different types of farm production; sheep, beef, dairy and grain in southwest Victoria, against the backdrop of price variability and rainfall scenarios. Inferences about the resilience to climate and price volatility of the different farm types are made. We hypothesise that under selected rainfall and price scenarios and using various metrics ($/ha, $/farm, $/ha/100mm growing season rainfall), there will be particular farms that are the most profitable, and that consistently outperform other farms.

2. Methods

2.1. Representative Farms

Fourteen representative farms were examined that included the production of Merino fine wool, prime lamb, beef cattle, milk, wheat and canola. The farms were based on Browne et al. (2011) and their main attributes are shown in Table 1. Dairy farms were in Terang (38°16'S, 142°53E) while the beef, sheep and grain farms were in Hamilton (37°16'S, 142°03'E). Livestock farms were modelled using the mechanistic biophysical models GrassGro (Moore et al., 1997) and DairyMod (Johnson et al., 2008), which have been validated elsewhere (Clark et al., 2000; Cohen et al., 2003; Cullen et al., 2008). The models were run for financial years from 1966 to 2001, with the first five years of data excluded to allow model parameters to settle.

Table 1: Main attributes of the livestock farms simulated in this study and produce generating under average rainfall conditions.

Farm type		Farm Size (ha)[1]	Stocking rate (animals/ha)	Stocking rate (DSE/ha)	Lambing / calving date	Lambing / calving rates[2]	Sale age – female stock	Sale age – male stock	Product (kg/hd)	Type of product	Hay fed (kg /hd/yr)	Barley fed (kg /hd/yr)
Wool	Avg	1200	8.6 ewes/ha	17.3 [3]	Aug 21	0.814	20 mo	10.5 mo	4.2	Clean fleece	-	7
	Top	900	9.8 ewes/ha	20.2 [3]	Sep 6	0.859	18 mo	10 mo	4.4	Clean fleece	-	4
Prime lamb	Avg	500	8.3 ewes/ha	19.8 [3]	Jul 21	1.107	21-25 wks	21-25 wks	19.3	CW lamb	-	11
	Top	700	10.3 ewes/ha	24.4 [3]	Jul 28	1.137	20-24 wks	20-24 wks	18.7	CW lamb	-	6
Cow-calf	Avg	350	1.4 cows/ha [4]	17.3	Apr 4	0.748	23 mo	9 mo	293.8	LW beef	156	2
	Top	500	1.7 cows/ha [4]	22.0	Apr 4	0.763	23 mo	9 mo	309.8	LW beef	88	1
Steers	Avg	350	2.4 steers/ha [5]	19.7	-	-	-	18-20 mo	454.4	LW beef	116	85
	Top	500	2.8 steers/ha [5]	22.4	-	-	-	18-20 mo	471.1	LW beef	4	57
Dairy (pasture)	Avg	300	1.7 cows/ha [6]	49.2	Apr 1, Sep 1	0.97	2 wks	2 wks	465.2	MFP	761	605
	Top	270	2.0 cows/ha [7]	58.0	Apr 1, Sep 1	0.97	2 wks	2 wks	457.7	MFP	844	650
Dairy (pasture/ supplement)	Avg	300	1.7 cows/ha [6]	49.2	Apr 1, Sep 1	0.97	2 wks	2 wks	517.3	MFP	469	1083
	Top	270	2.0 cows/ha [7]	58.0	Apr 1, Sep 1	0.97	2 wks	2 wks	503.7	MFP	511	1157

Avg, average farm type, CW, carcase weight; LW, liveweight; MFP, milk fat plus protein; mo, months; Top, a leading farm in the top 20% of farms in the region ranked by gross margin/ha/100 mm rainfall; wks, weeks.

[1] English (2007); Quinn and English (2007); English et al. (2008); Tocker and Quinn (2008); Tocker et al. (2008); Berrisford and Tocker (2009); Gilmour et al. (2009); Tocker et al. (2009); Gilmour et al. (2010); Tocker and Berrisford (2010); Tocker et al. (2010)
[2] Lambing / calving rate is the average number of live lambs or live calves born per breeding ewe or breeding cow
[3] Tocker et al. (2009)
[4] Graham et al. (1992)
[5] Bird et al. (1989)
[6] Dairy Australia (2009)
[7] WestVic Dairy (2010)

Two types of livestock farms were described: an average farm and a 'top' farm, the latter based on their operating profit/ha (excluding interest and lease costs) in the Farm Monitor benchmarking studies, with leading farms representing the top 20% of farms. The major differences between these farm systems were the stocking rates and pasture species. Average beef and sheep farms' pastures consisted of annual grass and had a fixed legume content of 25%, whilst top farms had perennial ryegrass and legumes fixed at 30%. Pastures on dairy farms were perennial ryegrass and white clover, with top farms using a species of perennial ryegrass that could produce more in winter, being more resistant to cold temperatures. During dry years, the stocking rate of sheep and beef farms was reduced by 15% to simulate destocking and to reduce supplementary feed costs.

Although most farms in southwest Victoria with the exception of dairy farms are mixed farms, in this study only single-enterprise farms were simulated, as this allowed the different types of production to be compared. The size of farms reflected the relative size of single enterprise farms in the region with wool farms being the largest, followed by prime lamb, beef, wheat, dairy and canola (see Table 1). Although single-enterprise grain farms are rare in southwest Victoria, their farm sizes were estimated from the 1998-2009 average enterprise sizes for wheat and canola from the Holmes Sackett benchmarking reports (McEachern et al., 2010), with wheat being 550 hectares and canola 250 hectares.

The yields of the grain farms were from the Southwest Farm Monitor benchmarking reports from 2002-2011 (Tocker et al., 2008; Tocker et al., 2009; Tocker and Berrisford, 2010; Tocker et al., 2010; Tocker and Berrisford, 2011) with yields for dry and wet years based on years below the 25^{th} percentile or above the 75^{th} percentile of growing season rainfall, respectively.

2.2. Rainfall variability

Weather for the modelled farms was generated using SILO patched-point data sets from the Queensland Department of Environment and Resources Management (http://www.longpaddock.qld.gov.au/silo/). Climate files for Hamilton Research Station and Terang were downloaded and used in the GrassGro and DairyMod models. A typical year was represented by the modelled long-term average results from 1971-2001.

Rainfall in southwest Victoria is very reliable in September and is therefore unsuitable for differentiating between dry and wet years. Instead, 'late spring' from October to December, was used. Dry years were represented by years that had annual and late spring rainfall below the 25^{th} percentile. Two dry years matched the criterion for both Hamilton and Terang, being 1981-82 and 1997-98. The model outputs of these two years were averaged and used to represent a poor season. Wet years were represented in a similar way by choosing model outputs from years above the 75th percentile of annual and late spring rainfall. There were four suitable wet years and the two chosen, 1985-86 and 1986-87, had the highest late spring rainfall (Table 2).

Table 2: Rainfall scenarios for Hamilton (sheep, beef and grain farms) and Terang (dairy farms)

	Rainfall Scenario	Hamilton (Sheep/Beef)	Hamilton (Grains)	Terang (Dairy)
Annual rainfall (mm/year)	Average	684	633	786
	Dry year	591	562	646
	Wet year	814	756	956
Growing season (Apr-Dec) rainfall (mm)	Average	589	531	674
	Dry year	478	388	532
	Wet year	716	619	817
Late spring (Oct-Dec) rainfall (mm)	Dry year	<108	<103	<128
	Wet year	>188	>192	>220

2.3. Price data for farm commodities and expenses

Price information was gathered across nine years from July 2002 to June 2011 for the main commodity on each farm, which was selected as the commodity that produced the highest income (Table 3). Hence, for illustration, when a wool enterprise is described in subsequent sections of this paper, it is assumed that 18.5 micron wool is produced, as that is the wool type that over the study period, for the farms surveyed, produced the greatest income.

Table 3: Prices for the main commodities sold by farms, as well as fertiliser and supplementary feed costs

Farm	Main commodity or expense	Low price (25th percentile)	Median price (50th percentile)	High price (75th percentile)
Wool	18.5µm wool ($/kg CFW) [1]	10.92	12.30	13.88
Prime lamb	Trade lamb ($/kg CW) [2]	3.60	3.91	4.25
Cow-calf	9 months steers ($/kg LW) [2]	1.70	1.83	1.98
Steer	18-20 month steers ($/kg LW) [2]	1.64	1.74	1.85
Dairy	Milk fat plus protein ($/kg MFP) [3]	4.90	5.45	6.09
Wheat	Wheat ($/t) [4]	243	288	337
Canola	Canola ($/t) [4]	481	551	623
	Feed Barley ($/t) [5]	221	259	306
	Hay ($/t) [5]	164	195	231
	Urea ($/t) [6]	497	573	669
	DAP ($/t) [6]	678	824	986

CFW, clean fleece wool; CW, carcase weight; LW, liveweight

[1] AWEX (2011)
[2] MLA (MLA, 2011)
[3] Xcheque Pty Ltd (Xcheque Pty Ltd, 2011c)
[4] Tocker et al. (2008; 2009; 2010); Tocker and Berrisford (2010; 2011)
[5] Xcheque Pty Ltd (2011a)
[6] Xcheque Pty Ltd (2011b)

The prices for the most volatile expenses (feed barley, hay and fertilisers) were also gathered from 2002 to 2011. Beef, sheep meat, wheat and canola prices were derived from market sale data in southwest Victoria, and wool, milk fat plus protein, supplementary feed and fertiliser prices were from a national data set. Only data from the relevant month of sale was used for the main commodities. All financial data were converted to 2010-2011 values using inflation rates from Australian Commodity Statistics (ABARE, 2010).

Low, average and high prices were represented by the 25th, 50th and 75th percentile prices across the nine years of price distributions. The Palisade @Risk® software program (Palisade Corporation, Newfield, NY, USA) was used to calculate these values. @Risk uses Monte Carlo simulations to estimate the probability distribution of a data set.

All other variable farm expenses that did not change substantially from year to year were averaged across five years of data from the Farm Monitor reports, from July 2005 to Jun 2011 (English, 2007; English et al., 2008; Tocker et al., 2008; Gilmour et al., 2009; Tocker et al., 2009; Gilmour et al., 2010; Tocker and Berrisford, 2010; Tocker et al., 2010; Gilmour et al., 2011; Tocker and Berrisford, 2011). Variable costs common to all livestock farms were supplementary feed costs, pasture maintenance, animal health and livestock selling costs. Beef, sheep and grain farms also had variable costs for repairs, maintenance, contract services and casual labour, and sheep farms had shearing supplies and wool selling costs. Additional dairy variable costs were for fertiliser, calf rearing, shed power, dairy supplies, fuel and oil. Other variable costs for grain farms were seed, chemicals, soil conditioners, freight, fuel and insurance.

Fixed costs were calculated from five years of data from the Farm Monitor reports (English, 2007; English et al., 2008; Tocker et al., 2008; Gilmour et al., 2009; Tocker et al., 2009; Gilmour et al., 2010; Tocker and Berrisford, 2010; Tocker et al., 2010; Gilmour et al., 2011; Tocker and Berrisford, 2011). Fixed costs common to all farms were rates, rents, registration, insurance, administration, paid labour, repairs and maintenance and depreciation. Sheep, beef and grain farms had additional costs of landcare, fuel and vehicle expenses. Grain farms also had electricity and gas, lime and gypsum, materials, repairs and maintenance and paid labour costs.

Farm operating profit was calculated as income less variable and fixed costs, including owner/operator allowance. Interest repayments on loans were not included.

2.4. Correlated prices and farm profit calculations

The price scenarios used on each farm aimed to equitably compare the profitability of the farms. To create realistic pricing scenarios, @Risk was used to correlate the price data across all classes of beef and sheep meat, different wool microns, skin prices, milk fat plus protein, grains, supplementary feed, fertilisers and rainfalls (annual, late spring and growing season rainfall for Hamilton and Terang). A series of 2000 price observations were calculated from the fitted distributions, where the correlations between all variables influenced the draws of observations. The distributions included truncations at upper and lower levels where the truncation points were 10% above (below) the observed highest (lowest) values in the nine year data series.

The 2000 price observations were categorised according to low, average or high rainfall (both annual and late spring) for Hamilton and Terang to restrict the available prices to those that would occur with a specific amount of rainfall. The price of the main commodity at low, average and high prices (25th, 50th and 75th percentiles) was used to determine which of the 2000 price sets should be used, the process being repeated for each farm type.

The profitability of each farm was calculated using the biophysical outputs for a dry, average or wet year and the corresponding price set for rainfall and price. Three profitability metrics were used: $/farm, $/ha and $/ha/100mm growing season rainfall. The outputs were validated against the Farm Monitor benchmarking reports for southwest Victoria.

2.5. Farm rankings and coefficients of variation

The effect of rainfall was examined using the average rainfall scenario in conjunction with low, medium and high prices, and calculating the coefficient of variation for the operating profit. The effect of price was considered by using median prices across dry, average and wet years, and calculating the coefficient of variation for operating profit.

The relative profitability of the farms was examined using Pearson's rank correlations. Each of the farms was ranked against one another to determine their operating profit under the nine scenarios (three price scenarios by three rainfall scenarios). The rankings for each farm were then averaged and the coefficient of variation of ranks was calculated. Pearson's rank correlation was completed for three metrics: $/farm, $/ha and $/ha/100mm growing season rainfall.

Profitability was also examined according to the likelihood of each rainfall and price scenario occurring. We estimated that dry and wet years would occur 25% of the time and average rainfall the remaining 50% of the time. Similarly, low and high prices were likely to each occur 25% of the time and median prices 50%. When price and rainfall scenarios were combined, median price and rainfall would occur 25%, average rainfall with low or high prices 12.5% each, median prices with low or high rainfall 12.5% each and the remaining scenarios 6.25%. The weighted average across the nine scenarios was then calculated for each farm, using the three metrics $/farm, $/ha and $/ha/100mm growing season rainfall.

3. Results and Discussion

The key results were that rainfall had a greater impact on farm profitability than commodity prices, except for the wheat farm, where the price had more influence. The results showed that of the representative farms studied, the top prime lamb farm, followed by the top wool farm, were ranked as the most profitable farms using the metric of operating profit per farm. This is not surprising given the greater land area of these farms. By contrast, when operating profit was calculated per hectare, then dairy farms were the most highly ranked.

All farms except for the wheat farm were more affected by variations in rainfall than commodity prices (Table 4). While higher rainfall consistently improved the profitability of farms, an increase in the main commodity price did not always produce higher profits, due to the influence of correlated prices from other farm produce sales and inputs.

Table 4: The variation in farm operating profit and variable costs from changes in rainfall or prices.

Operating Profit (rainfall variation)	COV	Operating Profit (price variation)	COV	Variable costs (rainfall variation)	COV	Variable costs (price variation)	COV
Cow-calf Top	1.07	Cow-calf Top	0.55	Cow-calf Avg	0.21	Dairy P/S Avg	0.06
Steer Avg	0.87	Canola	0.43	Dairy P/S Avg	0.20	Dairy P/S Top	0.06
Cow-calf Avg	0.79	Wheat	0.35	Canola	0.20	Canola	0.05
Wool Avg	0.76	Cow-calf Avg	0.32	Dairy P/S Top	0.20	Dairy P Avg	0.05
Dairy P/S Avg	0.71	Dairy P/S Avg	0.27	Dairy P Avg	0.19	Dairy P Top	0.05
Canola	0.71	Dairy P Avg	0.27	Dairy P Top	0.19	Steer Avg	0.04
Wool Top	0.68	Steer Avg	0.25	Cow-calf Top	0.11	Steer Top	0.04
Dairy P Avg	0.67	Prime lamb Avg	0.24	Wool Avg	0.08	Wheat	0.03
Dairy P/S Top	0.62	Wool Avg	0.23	Prime lamb Top	0.08	Cow-calf Avg	0.02
Dairy P Top	0.59	Dairy P/S Top	0.23	Wool Top	0.07	Cow-calf Top	0.01
Steer Top	0.30	Dairy P Top	0.23	Steer Top	0.07	Wool Avg	0.01
Wheat	0.29	Prime lamb Top	0.19	Steer Avg	0.06	Prime lamb Avg	0.01
Prime lamb Avg	0.26	Wool Top	0.16	Prime lamb Avg	0.06	Prime lamb Top	0.01
Prime lamb Top	0.25	Steer Top	0.14	Wheat	0.03	Wool Top	0.00

COV, coefficient of variation; P, pasture; P/S, pasture/supplement

3.1. Comparison of farm performance

The most profitable farms from Pearson's rank correlations had more variation in profit when using any metric (Table 5). Therefore, although the top-ranked farms across all rainfall and price scenarios were the most profitable, they did not consistently hold that same ranking under each particular rainfall and price scenario. Conversely, the cow-calf, canola and average steer farms were ranked with the lowest operating profit across all metrics yet had the least variation in rank, so these farms consistently had the least profit compared to the other farms and displayed less variability in profit.

The results showed that for the representative farms studied, the top prime lamb and wool farms were ranked as the first and second most profitable farms ($/farm) across the nine rainfall and price scenarios. These farms were therefore in the best position to manage fluctuating commodity prices and changes in rainfall. The third and fourth most profitable farms calculated as $/farm were the two top dairy farms. The wool farm was the highest ranking average type of farm, with its 1,200 hectares size contributing to its relatively high profitability ranking.

Table 5: Ranked farms in order of highest operating profit ($/farm, $/ha and $/ha/100mm growing season rainfall) and the variation in rankings.

Rank	Operating Profit ($/farm)	COV of rank	Operating Profit ($/ha)	COV of rank	Operating Profit ($/ha/100mm GS rainfall)	COV of rank
1	Prime lamb Top	0.6	Dairy P/S Top	1.2	Dairy P/S Top	1.2
2	Wool Top	0.7	Dairy P Top	0.4	Dairy P Top	0.6
3	Dairy P/S Top	0.8	Prime lamb Top	0.3	Prime lamb Top	0.4
4	Dairy P Top	0.4	Dairy P Avg	0.6	Dairy P Avg	0.6
5	Wool Avg	0.4	Dairy P/S Avg	0.7	Dairy P/S Avg	0.7
6	Steer Top	0.3	Steer Top	0.4	Wheat	0.5
7	Wheat	0.5	Wool Top	0.2	Steer Top	0.4
8	Dairy P Avg	0.2	Wheat	0.4	Wool Top	0.3
9	Dairy P/S Avg	0.4	Prime lamb Avg	0.2	Prime lamb Avg	0.2
10	Prime lamb Avg	0.2	Wool Avg	0.1	Wool Avg	0.2
11	Cow-calf Top	0.1	Steer Avg	0.1	Canola	0.2
12	Steer Avg	0.1	Canola	0.1	Steer Avg	0.2
13	Canola	0.1	Cow-calf Top	0.1	Cow-calf Top	0.1
14	Cow-calf Avg	0.0	Cow-calf Avg	0.0	Cow-calf Avg	0.0

COV, coefficient of variation; GS, growing season; P, pasture; P/S, pasture/supplement

While $/farm is a common metric to compare the farm's overall profitability, $/ha is another useful measure when considering some land use changes. The dairy farms, for example, were the most profitable when calculated per hectare, but using this metric and also $/ha/100mm growing season rainfall, the dairy farms had the most variation in their profit rankings.

When operating profit was weighted according to the likelihood of each price or rainfall scenario occurring, the top wool farm was more profitable in $/farm than the top prime lamb farm (Table 6). The influence of farm size on operating profit was clear when using the $/farm metric, where both farms perform slightly better using a weighted average than when Pearson's rank was employed.

Table 6: Farms in order of highest profitability ($/farm, $/ha) with a weighted operating profit according to the likelihood of rainfall and price scenarios occurring.

Farm	Operating Profit ($/farm)	Farm	Operating Profit ($/ha)
Wool Top	345,594	Dairy P/S Top	1,080
Prime lamb Top	327,111	Dairy P Top	1,056
Dairy P/S Top	291,507	Dairy P Avg	767
Wool Avg	285,755	Dairy P/S Avg	760
Dairy P Top	285,269	Prime lamb Top	467
Dairy P Avg	230,207	Wheat	420
Dairy P/S Avg	227,943	Steer Top	406
Steer Top	202,877	Wool Top	384
Wheat	184,792	Prime lamb Avg	282
Prime lamb Avg	140,811	Wool Avg	238
Cow-calf Top	87,635	Steer Avg	211
Steer Avg	74,035	Canola	211
Canola	52,796	Cow-calf Top	175
Cow-calf Avg	26,539	Cow-calf Avg	76

P, pasture; P/S, pasture/supplement

As expected, the top farms consistently produced higher profits than average farms of the same type when compared either by rank or weighted average. Pasture species had an effect on the difference in profitability between average and top stocking rates, particularly in the growth rates of animals and the amount of supplementary feed required. Bathgate et al. (2009), found that when new pastures were introduced on all appropriate soil types on mixed farms, farm profit increased by 26% ($28/ha); a result consistent with our findings for both sheep and beef farms. As with our farms, Bathgate et al. (2009) ascertained that improved pasture usually leads to increased profitability as a result of increased stocking rates and that farm systems respond to even small changes in dry matter digestibility.

3.2. Managing farms with reduced rainfall

Climate change is expected to reduce the number of wet years and increase the number of dry years that occur. There will be fewer plentiful years to buffer the reduced income that farmers receive during dry years.

Despite the high operating profit of dairy farms ($/ha), compared to other farms (Table 6), dairy farmers may want to diversify to minimise risk under lower expected rainfall conditions from climate change. Dairy farm profits were dramatically reduced under low rainfall scenarios (Figure 1) and under low rainfall conditions, wheat farms ranked as the most profitable ($/ha/100mm growing season rainfall), followed by the top prime lamb farm. The dairy profit rankings showed that all farms except canola were negatively correlated with the dairy farm rankings of profitability for $/ha, $/farm or $/ha/100mm growing season rainfall. Prime lamb and steer farms in particular were significantly negatively correlated (<1%) with dairy operating profit rankings, and the remaining farms were negatively correlated but with a weaker relationship. One option to consider is prime lamb, given the high prices over the last decade (Tocker and Berrisford, 2011). The operating profit of dairy farms was negatively correlated with both beef and sheep farms and could buffer dairy farms against loss when the price of milk fat plus protein is low. The low rainfall scenario for dairy farms (646mm/year) was slightly less than the average rainfall scenario of sheep farms in Hamilton (684mm/year) and prime lamb farms in particular performed well compared to dairy farms at this level of rainfall (Figure 1) and when the price of milk fat plus protein was low or average. However, a complete analysis is required to see whether prime lamb is still as profitable compared to dairy using only small areas of land, and how having sheep would affect the overall profitability when milk fat plus protein prices are high. The additional skills required to incorporate another enterprise would also be a barrier to many dairy farmers.

3.3. Individual farm analyses

The results for individual farm performance, calculated as operating profit per farm and operating profit per hectare, are shown in Figures 1 and 2.

3.3.1. Sheep

Sheep farms performed well compared with other farms when compared using operating profit at the farm level ($/farm). This was partially due to the larger sizes of sheep farms and also because they had dual income streams from sheep meat and wool, which provided a safeguard when the price of the main commodity diminished. Prime lamb farms usually performed better than wool farms ($/ha), especially since the price of lamb over the last decade was relatively high. Wool and prime lamb farms derived 63-65% and 24-26% of their income from wool, respectively, and the remaining income from sheep meat. There was a weak negative correlation between wool and meat prices, so a low wool price often corresponded with high meat prices. This was the reason that the profitability of wool farms did not always rise as the wool price increased. However this weak negative correlation helped reduce the risks associated with low prices of either meat or wool.

Sheep and beef farms may have been disadvantaged by using supplementary feed prices from the dairy industry. These prices were chosen to keep supplementary feed prices consistent across farms and because this was the most complete data set available. Dairy farms' greater use of feed, their ability to use feed contracts throughout the year and purchasing of forward contracts may enable dairy farmers to obtain discounts on grain. Despite these discounts, the higher feed quality requirements of dairy farms also result in higher feed prices than on sheep or beef farms.

Figure 1: Operating profit per farm for wool, prime lamb, cow-calf, steer, dairy, wheat and canola farms under low, average and high rainfall scenarios, as well as low, median and high correlated prices.

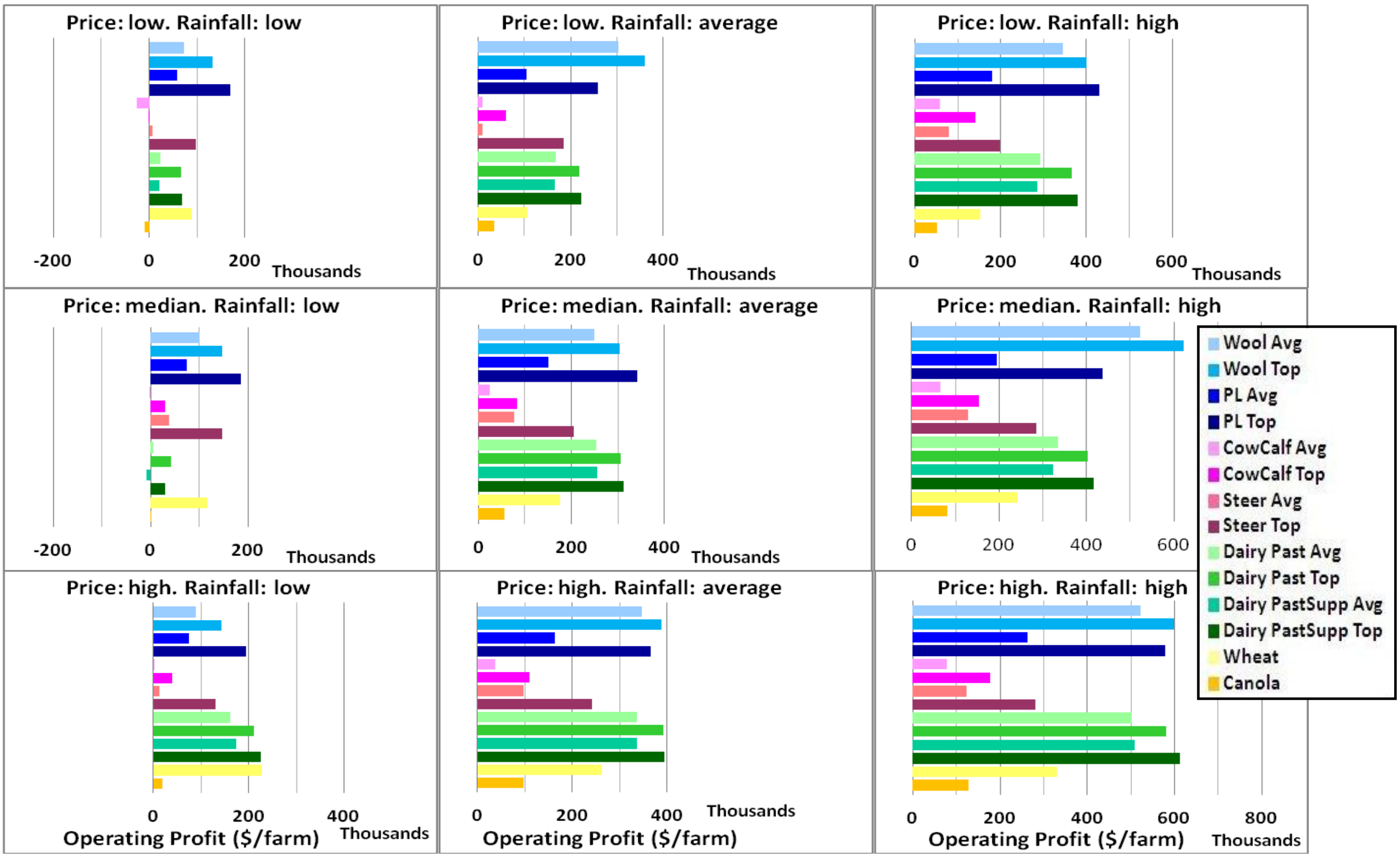
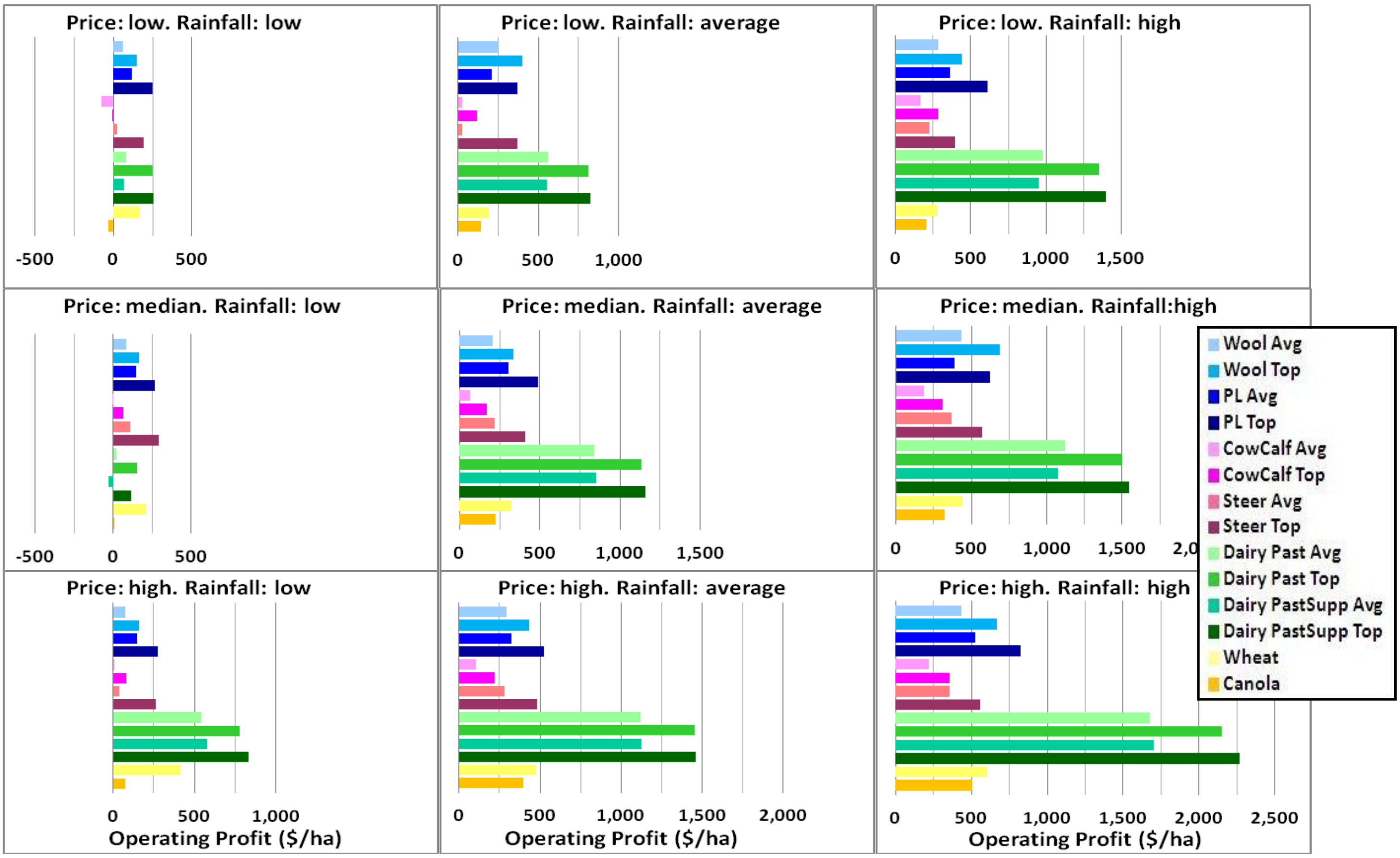


Figure 2: Operating profit per hectare for wool, prime lamb, cow-calf, steer, dairy, wheat and canola farms under low, average and high rainfall scenarios, as well as low, median and high correlated prices.



3.3.2. Beef

Beef farms generally did not return as great a profit as other farms, with the exception of the top steer farm. The beef farms were smaller than the sheep farms and the scale contributed to their poor results.

The cow-calf farms calved in autumn and therefore their supplementary feed requirements were greater than for spring calving. This may have caused the cow-calf farms to be less resilient during dry years than the steer farms or other types of cow-calf farms, such as farms with spring calving.

Steer farms were less affected by the sale price of steer than by the difference between the purchase and sale prices. This is seen under low and high rainfall conditions, where, under the median price scenario, steer farms were more profitable than when prices were high. The median purchase price of steers was 2-7c/kg liveweight higher than the sale price. However the purchase price of steers rose to 13-16c/kg liveweight above the sold price when the steer price was high, significantly reducing the profit of the farms. When rainfall was high, the extra available feed helped with weight gain and also reduced supplementary feed costs, however, it was not enough in itself to compensate for a larger difference between purchase and sale liveweight prices.

3.3.3. Dairy

The profitability of the two types of dairy farms were fairly similar, although the farms with higher supplementary feed were usually slightly higher than the farms where cows were mainly fed pasture. The farms with higher supplementary feeding had a higher income than the other dairy farms, but this income was largely negated by the extra supplementary feed costs.

Under low rainfall conditions, dairy farms were more profitable when milk fat plus protein was at a low price, rather than median price. This was driven mainly by an increase in the price of feed barley from $258 to $358/t and was the only scenarios where the average dairy pasture farm had a higher profit than the average farm with more supplementary feeding.

3.3.4. Grain

Southwest Victoria receives higher and more reliable rainfall than other areas of the state, making it easier to grow wheat but for the same reason wheat is usually feed quality. The wheat farm was the only farm influenced more by price than rainfall. The likely reason being that rainfall was already sufficient for the crop to grow. While additional rain improved yield and therefore profits, it did not make as much difference as an increase in wheat price.

A potential drawback in the methodology was that modelling the grain farms was beyond the scope of the project. The yields may have been more accurately matched with the climate data through modelling.

4. Conclusion

This research compared the profitability of wool, cow-calf, steer, dairy, wheat and canola single enterprise farms in southwest Victoria. The top wool and prime lamb farms were the most profitable farms under a weighted average of the various price and rainfall scenarios, followed by dairy and wool farms, in terms of the magnitude of total farm profits. These results were unexpected, as dairy farms were assumed to be the most profitable given their intensity of land use and the higher rainfall they received. However, the four dairy farms were the most profitable on a $/ha basis, earning considerably more than the other farms.

Top farms were more profitable than average farms as a result of their higher stocking rates and improved pastures. The most profitable farms, however, tended to also have greater variability in returns across the range of rainfall and price scenarios. This finding is consistent with the common adage in investment of high return but high risk.

Under low rainfall scenarios, the farms ranked with the highest profitability ($/farm) were the top prime lamb farm, followed by wheat, the top wool farm and then the top steer farm. When the profitability was calculated according to rainfall received ($/farm/100mm growing season rainfall), the wheat farm then top prime lamb farms were the most profitable. With reduced rainfall expected in the future as a result of climate change, farmers will need to consider carefully the amount of land dedicated on mixed farms to sheep, beef and grain enterprises. Dairy farmers may need to diversify to better manage the risk of low rainfall.

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