Risk Beyond Farmers' Control: Grain-Sheep Mixed Farming Systems under Rainfall and Commodity Price Variability

Rukman Wimalasuriya

Farm Management Economist
Department of Natural Resources & Environment, Box 3100, Bendigo, Vic. 3554
Email: rukman.wimal@nre.vic.gov.au

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ABSTRACT

Variability of rainfall and commodity prices are important off-farm factors influencing the profitability of dryland farming. Since neither of the above factors can be predicted, lessons from the past can be a preparation for the future. Analysing farm profit over ten years is suggested as a way to understand the risks inherent in farming. Financial sustainability of a farm business depends mainly on the net growth of farm equity over the years which can be achieved even with fluctuating farm profit.

"FarmProf" is a simple spreadsheet model developed in Excel, to analyse both annual farm profit and farm equity of a broadacre cropping farm or a mixed grain-livestock farm over a ten year period. If crop yield data are not available, FarmProf uses rainfall data to estimate crop yields. The model was used to analyse the profitability of a hypothetical mixed farm in North-central Victoria for the ten years from 1988-89 to 1997-98.

Annual farm profit varied from year to year between a loss of $20,000 and a profit of $195,000, with an average of $83,200 per annum. There were five high-profit years, three medium-profit years and two negative-profit years over the ten years. It was assumed that the rates and prices of farm inputs remained constant. Even with 2 years of net loss, farm equity doubled over the 10 years from $700,000 to $1,400,000. The contribution of rainfall and cereal price variability to the peaks and troughs in annual farm profit is discussed.

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INTRODUCTION

Risk in agriculture can be categorised into four types, namely, production, marketing, financial and environmental (White, 1992). There are several risks that can be minimised to some extent by either proper strategic planning (for eg., financial planning, natural resource protection, rotation planning) or making tactical adjustments (for eg., variety selection, spraying, adjusting fertiliser rates). Malcolm (1992) suggests that factors beyond the farm gate, and thus beyond the farmer's control, are probably more important determinants of survival and success than what farmers actually do. Variability of rainfall and commodity prices over the years become extremely important in this regard.

Annual Farm Profit and Equity

Farmers use their land to produce food, fibre and other materials with the primary purpose of making money. Therefore, the annual farm business profit (after tax) is important as their bottom line. Crop income is dependant on yields, quality and grain prices. Crop yields in dryland farming regions depend on the amount and distribution of rainfall, provided proper management and soil conditions prevail. Therefore, rainfall and price variability influence the profitability of dryland farming to a great extent.

Achieving a farm profit despite uncertain grain prices and rainfall, involves two aspects: minimising losses in below average years, and capitalising on average and above average years. Since neither future grain prices nor rainfall can be predicted, lessons from the past can be a preparation for the future. For this purpose, one needs to look at the profitability of farming over several years. A 10 year period is likely to capture most of the variability in rainfall and grain prices.

Financial sustainability of a farm business depends mainly on the net growth in Farm Equity over the years. One way to increase farm equity is by reducing farm debt. If a farmer pays-off farm debt from farm profit over several years and continue achieving a farm profit, his or her bank balance will grow. Irrespective of whether the farmer uses this surplus to purchase assets such as land and machinery, this positive bank balance becomes a farm asset (generally referred to as "liquid assets"). Any left-over profits after paying-off farm debt becomes farm assets, thereby increasing the value of total farm assets. An increase in the value of total farm assets would also increase farm equity, as shown below:

Farm equity = Value of total farm Assets - Total liabilities

An interesting question is the way in which ups and downs in farm profit over the years, affect farm equity.

Risk Management

Even though a farm might be run on best management lines, there will always be some low profit years due to low rainfall and/or low grain prices. These low profit years can neither be prevented nor accurately be predicted. On the other hand, there

will always be some average profit years as well as high profit years. In terms of risk management, should farmers be planning their cropping season targeting a high or average profit year, or a low profit year? The answer depends mainly on how often they generally experience these high, average and low profit years.

Before trying to manage risk, it is important to understand it. The risk of achieving a desired farm profit under uncertain rainfall and prices, could be understood by examining annual farm profits over several years. Rainfall and grain price data for the corresponding years can be used to determine the impact of their variation on farm profit.

VARIABILITY IN GRAIN PRICES AND RAINFALL

Historical prices from ABARE for 5 grain crops (wheat, barley, oats, lupins and canola) have been analysed for the seventeen year period from 1980-81 to 1996-97 (Wimalasuriya, 1997). Although the long-term trend in grain prices was similar for all crops, the year to year fluctuations were different, especially between cereals and other crops. Wheat and barley prices were closely related. A cereal price movement either up or down rarely continued beyond 2 years.

Kingwell (1997) analysed wheat and wool real prices from 1907. This study found that there are long periods of low or moderate prices and in these periods price changes between years are not dramatic.

Monthly rainfall data were obtained from the Bureau of Meteorology and analysed for 6 rainfall stations in the North-central cropping region (Elmore, Laanecoorie, Pyramid Hill, Raywood, Rochester and St. Arnaud). Deciles for the growing season rainfall (GSR) were calculated for different years and analysed to see the breakdown between high (> decile 7), average (between deciles 3 and 7) and low (< decile 3). Over the 10 year period from 1988 to 1997, three of the stations received low rainfalls only in 1 year and the rest in 2 years.

When all the blocks of 10 years starting from 1970 onwards were studied, all 6 rainfall stations had received mostly 1 or 2, sometimes 3, and very rarely 4 low rainfalls over all 10 year periods.

A more detailed account of the seasonal distribution and variability of rainfall is given in Cawood and McDonald (1996).

METHODOLOGY

A spreadsheet model named “FarmProf” was developed to calculate annual farm profit and equity for a ten year period. This model was used to analyse the profitability of a hypothetical farm in North-central Victoria. The objective of the analysis was to identify the number of average, above-average and below-average years of farm profit over a ten year period, and the contribution of different levels of

rainfall and grain prices to the fluctuating farm profit. The model was also used to examine how farm equity grows with fluctuating annual profit.

The FarmProf Model

The basis for this spreadsheet model is to examine annual farm profit over a period of 10 years. The model can be used for a cropping farm or a mixed crop/livestock farm. Incomplete data is a common problem encountered in performing a retrospective analysis. Therefore, the model was built with an option to use default data inputs.

Yields for 5 crops can be entered, or otherwise the water use efficiencies, evaporation losses and the growing season rainfall (GSR) so that the model would estimate crop yields. If the GSR is unknown, the annual rainfall can be entered. Data for grain prices, crop areas, crop variable costs, pasture costs and income, and livestock costs and income is entered by the user.

If grain prices for all 10 years are unknown, the model uses default port prices (ABARE, 1997). In this case, the user would enter the marketing costs and any quality premiums or bonuses received for each grain product. If any other data such as variable costs are not available, average figures from the Victorian Regional Gross Margin Books (Wimalasuriya, 1998) can be used for the calculation. All these data and the crop areas which are entered, are first used by the FarmProf model to calculate the total farm gross margin ($/annum).

The total overhead cost (permanent labour, rates, administration, depreciation and insurance) is entered for each year, or the default figure ($45,000) is used. An owner/operator allowance and the lease costs are entered. The model then calculates the annual farm business profit (before tax) for each of the 10 years. When the user enters either the amount of tax or an approximate percentage tax rate paid in each year, the model calculates the farm business profit (after tax) for each year.

Using the opening farm debt and the total value of farm assets for the 10 years which are entered, FarmProf calculates the farm equity for the 10 year period. Both the annual farm business profit (after tax) and the farm equity over the years are presented in graphs. Entering the types of commodity prices (using wheat price as the indicator) and rainfall (preferably the growing season rainfall) in terms of high, medium and low etc. under the 10 years of the graph on the spreadsheet, is useful to examine the impact of different combinations.

The Analysis using FarmProf

A hypothetical 900 ha mixed grain/sheep farm on red duplex soils of North-central Victoria, was analysed for the 10 year period from 1988-89 to 1997-98. Growing season rainfall for St. Arnaud and crop water use efficiencies from the TopCrop data (van Rees & Ridge, 1994) were used to estimate crop yields. Average marketing costs for the region were deducted from historical grain prices (ABARE, 1997) to arrive at farm-gate prices. Crop variable costs, pasture maintenance costs, and sheep costs and income were obtained from North-central Gross Margins 1998-99 (Wimalasuriya, 1998), and remained constant over the years.

Of the 900 ha arable land of the farm, 300 ha was pasture grazed by wool sheep, and the remaining 600 ha was equal portions of wheat, barley, lupins and canola. Annual total overhead costs were considered to be $45,000, owner/operator allowance was $30,000, lease costs were $6,000, and tax rate was 40% for all 10 years. The opening value of total farm assets was $800,000, and the opening farm debt $200,000. Any profits accrued after paying-off farm debt, was added on to the value of assets.

Rainfall deciles were used to categorise rainfall into different degrees (see below).

Rainfall decile	Category	Meaning
> 9	V.V.High	Extremely high
8-9	V.High	Very high
6-8	High	Slightly higher than average
4-6	Medium	Around average
2-4	Low	Slightly lower than average
1-2	V.Low	Very low
< 1	V.V.Low	Extremely low

Grain prices were categorised subjectively, depending on the averages and the ranges of wheat, barley, lupins and canola prices received during the period (see below).

Category	Meaning
V.High	Extremely high
High	Higher than average
Medium	Around average
Low	Lower than average
V.Low	Extremely low

RESULTS AND DISCUSSION

Annual farm profit varied from year to year between a loss of $20,000 (in 1994-95) and a profit of $195,000 (in 1995-96) with an average of $83,200 per annum (Figure 1). Even with 2 years of net loss, farm equity doubled over the 10 years from $700,000 to $1,400,000.

At the beginning of year 1 of this analysis (1988-89), the farm had no liquid assets, a total debt of $200,000 and a starting equity of $600,000. Because of the very high rainfall that resulted in higher crop yields and the high grain prices received in 1988-89, the farm business yielded a high profit of $113,782 (Appendix 1). When all this farm profit (after tax) was used to pay-off debt, the closing debt reduced to $86,218. This resulted in a farm equity of $713,782. Extremely high rainfall together with medium prices in 1989-90, resulted in a $131,763 profit which was higher than the previous year. When the remaining debt of $86,218 was settled out of this profit, there was still a surplus of $45,545 which became liquid assets. Farm equity increased from $713, 782 to $845,545.

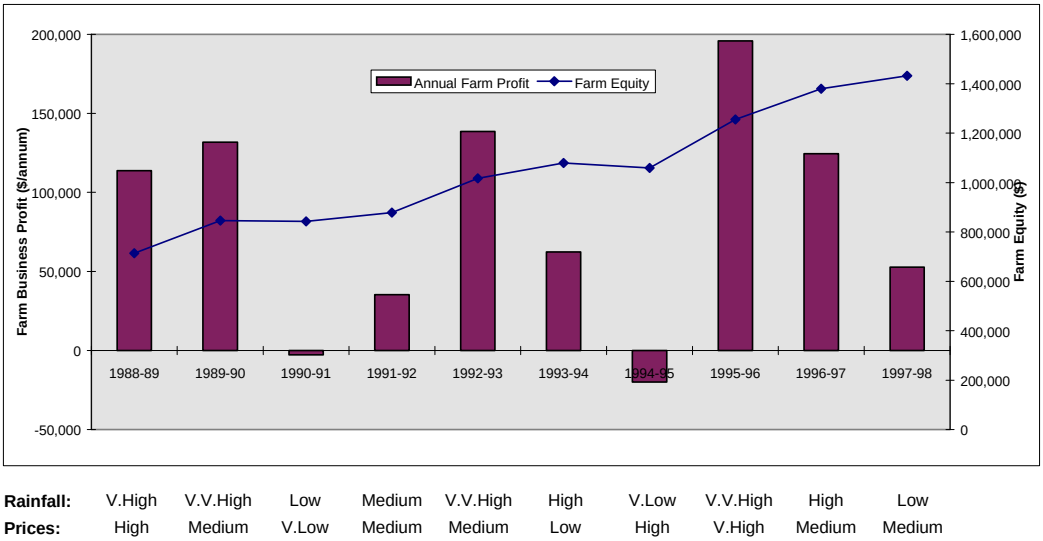

Figure 1: Estimated annual farm business profit and farm equity of the hypothetical farm over 10 years.

In contrast to the first two years, 1990-91 resulted in a net loss of $2,738. This was due to the low rainfall and very low prices received during this year. This loss was compensated by drawing cash out of liquid assets with resultant decreases in liquid assets and farm equity down to $42,807 and $842,807, respectively. It wasn't necessary to go into debt again because of the pool of liquid assets. Except in 1994-95, all the rest of the seven remaining years yielded positive farm profits, therefore both liquid assets and farm equity grew steadily. High grain prices in 1994-95 could not be exploited to maximise farm profit because of low crop yields due to the very low rainfall. The resulting net loss was $20,046 which was compensated by drawing from liquid assets. This reduced liquid assets from $279,096 to $259,050, thereby reducing farm equity from $1,079,096 to $1,059,050.

Sensitivity analyses show that the break-even rainfall (GSR) for lower than average grain prices was approximately 200 mm which is in the lower end of decile 2 (equivalent to around 300 mm annual rainfall). This was, provided rainfall was well distributed within the growing season. In the presence of extremely low grain prices, approximately 250 mm of GSR which is between deciles 3 and 4 (equivalent to around 390 mm annual rainfall) is required to break-even.

One could argue that the farm equity in this analysis doubled over the period because the first two years were high-profit years. Therefore, scenario analyses were performed by using the same combinations of rainfall and prices but changing the sequence within a 10 year period. Changing the sequence of rainfall and price combinations didn't change the net growth in farm equity significantly. When a ten year period commences with a year of net loss, two differences were noticed. Firstly, the net loss becomes higher than when the loss occurs after debt has been paid-off. For example, the net loss of $2,738 in the year 1990-91 of the above analysis increases up to $17,138 when the same combination of low rainfall and very low prices occurs in the first year when there are no liquid assets to draw from. This is merely due to the interest cost on the borrowings needed to compensate the loss. The

second difference was the longer time taken to pay-off the starting farm debt of $200,000.

Another scenario was analysed by replacing canola with oats. Canola is still not grown by lot of farmers, and it has been maintaining an attractive market price that doesn't fluctuate together with cereal prices. Substituting oats for canola decreased average annual farm profit by $10,000, while farm equity at the end of ten years was approximately $100,000 less. The other difference was that it was necessary to get into debt again in 1990-91 because there weren't sufficient liquid assets to draw from. The reason for this is the lower annual profits during the first two years resulted by lower market prices of oats compared to canola.

CONCLUSION

Irrespective of what you do on the farm, there would definitely be "good", "bad" and "average" years in terms of annual farm profit over the years. Over a 10 year period in the North-central Victorian cropping region, there would be 2, or sometimes 3 low or negative-profit years due to variable rainfall and grain prices. If one plans and manages the farming activities each year targeting these 2 or 3 low or negative-profit years, the farm would loose the opportunity to maximise annual profit and growth in equity over the rest of the 7 or 8 years out of a ten year period.

Decisions made by a farmer in the years of high prices, can greatly affect the future viability and prosperity of their business (Kingwell, 1997). The same situation applies to the years of favourable rainfall as well. Therefore, it is extremely important to look at a longer period such as 10 years to analyse and understand this risk, before trying to manage. This would help farmers to change their perception of risk management towards "positive thinking with care".

Presently, several techniques are becoming available both to predict future grain prices to some extent and also to market farm produce long before being harvested. These techniques are gradually resulting in some farmers' control over the variability of grain prices. If farmers adopt some of these techniques to overcome the risk of receiving extremely low prices, the main concern would be focussed around rainfall variability. However, rainfall for a future season can't be predicted accurately. If the rainfall is too low to produce a reasonable yield in a given season, there's nothing much that a farmer can do under a dryland farming situation. Therefore, apart from a limited range of tactical adjustments, the only way to manage the risk of achieving an extremely low rainfall is to understand the reality of its occurrence and to be prepared to face it.

Even with 2 or 3 low or negative-profit years over ten years in North-central Victoria, it is possible to achieve a net growth in farm equity, provided two conditions are fulfilled. Firstly, the farmer needs to plan the seasons targeting high-profit years and maintain the right on-farm management. It is also important to maintain the diversity of crops, especially by including non-cereal crops that attract high market prices, such as canola. Maximising farm profit in favourable years can be useful in two ways. Firstly, it would increase the annual profit in subsequent years by reducing the interest

costs, if the profits are used to pay-off debt. Any surplus left from the profits after paying-off debt can be used to compensate in poor years, without getting back into debt.

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Appendix 1: Farm business profit, farm equity and their components of the hypothetical farm over 10 years.

Parameter ($)	1988-89	1989-90	1990-91	1991-92	1992-93	3993-94	1994-95	1995-96	1996-97	1997-98
Value of farm assets	800,000	800,000	800,000	800,000	800,000	800,000	800,000	800,000	800,000	800,000
Opening debt	200,000	86,218	0	0	0	0	0	0	0	0
Farm profit (after tax)	**113,782**	**131,763**	**-2,738**	**35,396**	**138,607**	**62,286**	**-20,046**	**195,779**	**124,444**	**52,750**
Closing net finances	-86,218	45,545	-2,738	35,396	138,607	62,286	-20,046	195,779	124,444	52,750
Closing debt	86,218	0	0	0	0	0	0	0	0	0
Closing liquid assets	0	45,545	42,807	78,203	216,810	279,096	259,050	454,829	579,273	632,024
Farm equity	**713,782**	**845,545**	**842,807**	**878,203**	**1,016,810**	**1,079,096**	**1,059,050**	**1,254,829**	**1,379,273**	**1,432,024**