Managing the key risks of farming; climate and commodity price variability

Kieran Ransom[1] and Rob Harris[2]
[1]formerly Department of Primary Industries, Bendigo, Vic 3550. www.dpi.vic.gov.au Email kieran.ransom@bigpond.co
[2] Department of Primary Industries, Hamilton, Vic 3300. www.dpi.vic.gov.au, Email rob.harris@dpi.vic.gov.au

Abstract
Broad-acre mixed crop and sheep farmers in north central Victoria are actively seeking practical management systems to cope with variable seasons and fluctuating prices. Some farmers have indicated that mixed farming systems of crops and sheep on lucerne pastures have proved to be resilient, and in some cases have generated consistent profits over the last 13 years, 1998-99 to 2010-11; a period that brought drought, wet summers and variable prices. An examination of the past will help plan for future climate challenges.

Detailed information from case study farms was used to test these claims. A computer model farm of 1000ha in North Central Victoria was subjected to three alternative management systems from 1997-98 to 2010-11 to test the farming systems financial and business resilience. Farming systems tested (and relative areas of the farm) included; (i) a mixed farming system of lucerne pastures (60%) and crops (40%); (ii) a mixed farming system of annual pastures (60%) and crops (40%); and (iii) an intensive cropping (80%) system with annual pastures (20%). The 'Lucerne pasture and crop'system was shown to be the most financially resilient and generated a cumulative cash flow (CCF) over the last 13 years of $864,000. The intensive crop system generated a CCF of $591,000 while the mixed annual pastures and crop system had a CCF of $281,000. Lucerne pastures reduce seasonal risk as low winter and spring rainfall may be followed by summer storms. Price risks are decreased by producing three commodities; meat, wool and grains.

Key Words
Crops, sheep, lucerne, cash flow, profit, drought

Introduction
This paper describes an analysis of three farming systems to test their financial and business resilience over a 13 year period of drought, good seasons and variable prices from 1998-99 to 2010-11. This understanding of the past will help farmers manage the climate challenges of an uncertain future as the past 13 years have similar characteristics to some climate model predictions to the year 2030.

Production risk is mainly a result of variability in rainfall both within and between years. Other weather risks include crop damage from waterlogging, frosts, hail and hot dry weather at critical times during grain production. Pests and diseases are generally considered lower risks. Price risk reflects the volatile commodity prices of grain, meat and wool. Some farmers have indicated that mixed farming systems of sheep on lucerne based pastures and crops have proved to be resilient, and in some cases generate consistent profits over the last 13 mostly low rainfall years.

Method
A computer model farm of 1000 hectares in the Tandarra district, about 50km north of Bendigo in north central Victoria was subjected to three alternative management systems for 13 years from 1997-98 to 2010-11. The long term average yearly rainfall was 415 mm. Soils are riverine plains type; predominantly red loams over clays. Case study farmers that used similar systems provided detailed information over this period. The farming systems tested were:
(i) 'Lucerne pasture and crop' system. A mixed farming system with 60% of the farm area under lucerne based pastures supporting a sheep enterprise, the remaining 40% under crop.
(ii) 'Annual pasture and crop' system. A mixed farming system with 60% of the farm area under annual pastures supporting a sheep enterprise, the remaining 40% under crops.
(iii) 'Intensive crop' system. A system of intensive cropping with 80% of the farm cropped; the remaining 20% under annual pastures supporting a sheep enterprise.

A summary of the alternative systems is shown in Table 1. Farm management was set at a high level with an equal skill base in each system. The pasture based sheep enterprises were modelled using local case study farm data and the GrassGro simulation program (Moore *et al.* 1997). The validated GrassGro simulations of pasture, sheep production and supplementary feeding were then fed into a financial model to generate gross

margins. Standardised costs were obtained from benchmarking information. Supplementary feed was costed at current market rates and fed in poor seasons, droughts and in some seasons to finish lambs. Crop yields were calculated from typical water use efficiencies (WUE), using kg/ha of grain per mm of growing season rain after an allowance for evaporation (Squires and Tow 1991). All costs and prices were adjusted annually to represent current conditions. Cropping costs of machinery, herbicides, fertiliser and cartage ranged from around $140/ha for some cereals and up to $320/ha for lupins and canola. Overhead costs including an owner-operator allowance were adjusted for inflation and increased from $88,000 to $100,000 over the 13 year period for both systems.

Table1. Farm details of the three systems tested. Each farm is 1000ha with the same environment, management skill base and cost structure.

	'Lucerne pasture and crop' system	'Annual pasture and crop' system	'Intensive crop' system
Pasture area	60% of farm area, lucerne based.	60% of farm area, annuals based.	20% of farm area, short annual pasture phase between crops.
Crop area	40% of farm area	40% of farm area	80% of farm area
Sheep flock structure	Self replacing merino flock, wethers sold as prime merino wether lambs. Surplus ewes to terminal sires for prime lambs.	Merino ewes joined to terminal sires for prime lambs. Replacement ewes purchased	Merino ewes joined to terminal sires for prime lambs. Replacement ewes purchased
Sheep flock size and stocking rate	Lucerne pasture stocking rate 8.8 DSE/ha, plus stubble and winter cereal grazing.	Annual pasture stocking rate 5.8 DSE/ha plus stubble and winter cereal grazing.	Annual pasture stocking rate 6.9 DSE/ha plus stubble and winter cereal grazing.
Crop sequence, type and typical yield WUE*	1. Wheat after lucerne pasture. WUE* 14kg/ha/mm. 2. Wheat after wheat. WUE normally 16 kg/ha/mm 3. Lupins under-sown to lucerne. WUE normally 8kg/ha/mm 4. Barley intercropped. WUE normally 14kg/ha/mm.	1. Wheat after canola. WUE normally 18kg/ha/mm. 2. Wheat after wheat. WUE normally 15kg/ha/mm 3. Barley after wheat. WUE normally 18 kg/ha/mm 4. Canola. WUE normally 8kg/ha/mm	1. Wheat after canola. WUE 18kg/ha/mm. 2. Wheat after wheat. WUE normally 15kg/ha/mm 3. Barley after wheat. WUE normally 18 kg/ha/mm 4. Canola. WUE normally 8kg/ha/mm

* WUE – water use efficiency, kg/ha/mm growing season rainfall
[#] DSE – dry sheep equivalent

Results and discussion

The sheep enterprise gross margins were positive each year for the 'Lucerne pasture and crop' system (Figure 1a). The large variable costs in 2002-03, 2006-07, 2007-08 and 2008-09 included supplementary feed costs of up to $350/t. In contrast sheep on 600 ha of pasture on the 'Annual pasture and crop' farm (Figure 1b) had an average gross margin of less than half that of the lucerne based system. The sheep gross margins on the 'Intensive crop' farm were small (Figure 1c) due to the small scale of the sheep enterprise. These results are consistent with previous case studies that found sheep on the lucerne based pastures have gross margins per hectare two to three times higher than sheep on annual pastures (Ransom et al 2007).

Crop gross margins (Figures 2 a, b & c) were negative for all systems in the severe drought years of 2002-03, 2006-07 and 2008-09; around zero for all systems in 1998-99 due to severe frosts, and around zero for all systems in 2004-05 and 2009-10 due to dry conditions. The intensive cropping system gross margins covered overhead costs in only four years; 2000-01, 2003-04 2007-08 and 2010-11.

The cumulative whole farm cash flows including overhead costs (Figures 3 a, b & c) indicated that the intensive cropping system had the highest cumulative cash flow (CCF) until 2001-02 when growing seasons rain and grain prices were relatively good. However during the 2002-03 drought, sheep on the 'Lucerne pasture and crop' farm had an operating profit of $111,000 as summer storms during the drought gave good lucerne growth for prime lamb finishing and lamb prices were favourable. A similar situation occurred in 2004-05, 2005-06 and 2007-08 when summer rains again provided good lucerne growth to finish prime lambs. Over the 13 year period of this study the cumulative cash flow of the 'Lucerne pasture and crop' farm was $864,000 compared to $591,000 for the 'Intensive crop' farm. The lucerne based farm had financial losses in two drought years while the intensive crop farm had losses in five years due to droughts and a severe frost.

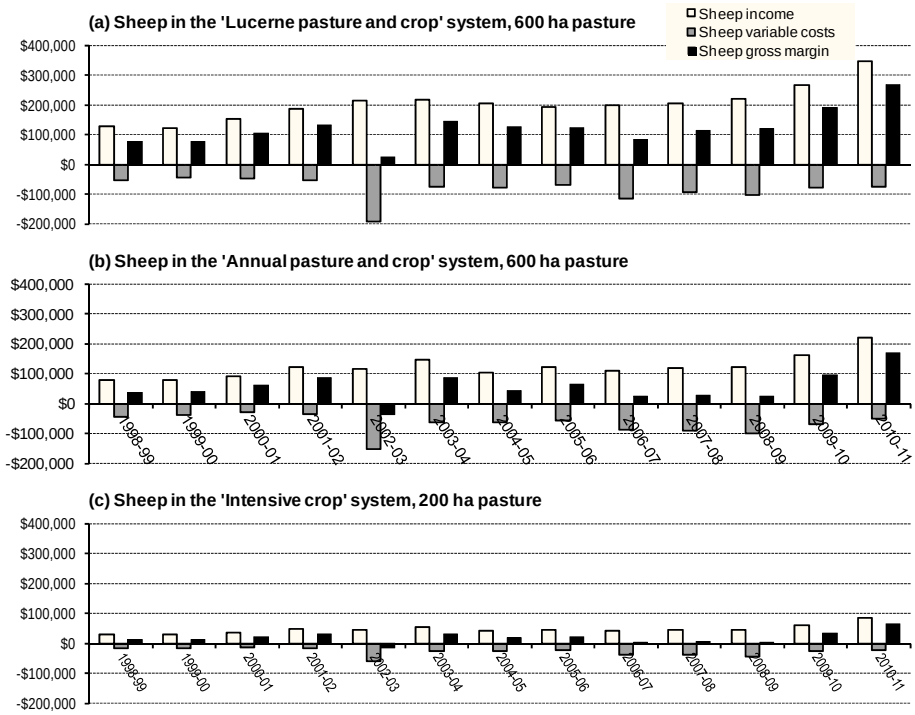

Figure 1 a b & c. Sheep income, variable costs and gross margins for the three farming systems.

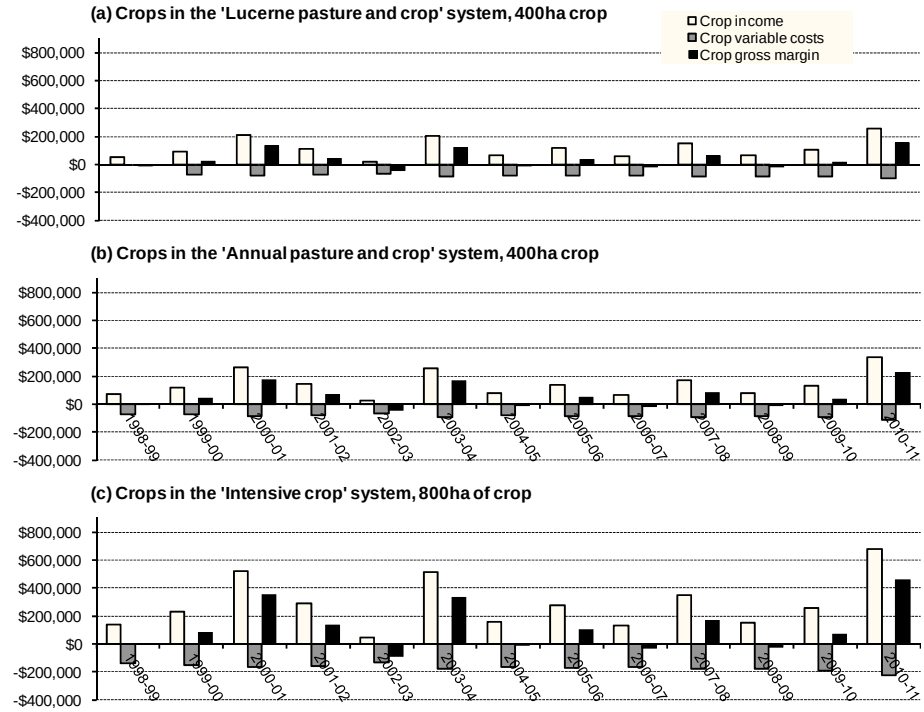

Figure 2 a b & c. Crop Sheep income, variable costs and gross margins for the three farming systems.

The CCF of the 'Annual pasture and crop' system was $281,000, less than half that of the 'Intensive crop' farm. It is sometimes claimed that the main role of sheep on a mixed farm is to prevent large financial losses in droughts. This is true on mixed farms when sheep merely regarded as 'stubble munchers and weed controllers', but this also limits the profit potential in good years. However the figures calculated in this study indicate some lucerne based sheep enterprises are highly profitable in their own right. They do not just prevent financial losses from cropping, but can generate positive cash flow during droughts, while neighbouring cropping farms are subject to financial stress. The annual pasture based sheep systems

generated smaller profits than the lucerne based system; a key feature is that they prevent large losses on cropping farms during droughts. Additional crop yield sensitivity analyses indicate that cereal crops required yields of 18 kg/ha/mm of effective rainfall to financially outperform the 'Lucerne pasture and crop' system as used on the case study farms. Crop yield benchmarking information indicates crop yields average around 15 kg/ha/mm on many well managed farms.

Sheep farming must adapt to survive future climate challenges of increasing variability, lower winter-spring rains and increased frequency of summer storms for northern Victoria while increasing its total factor productivity to match the productivity gains of the grains industry. The sheep industry innovations shown on these few case study farms indicate future directions to enable the sheep industry to prosper in the climate challenges of the future.

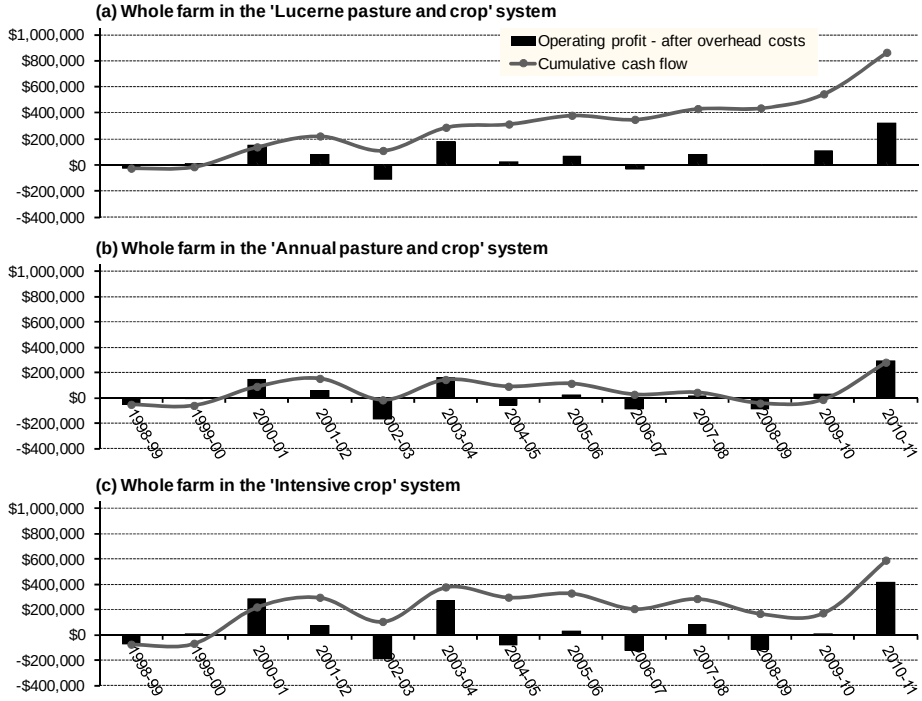

Figure 3. Operating profit and cumulative cash flows for the three farming systems.

Conclusion

Mixed lucerne pasture and crop farming systems can reduce price risk through the production of three commodities; meat, wool and grains. They also reduce the seasonal risk of reliance on winter-spring rains by profitably utilising summer rain storms. They are widely applicable over much of northern Victoria and the cropping areas of New South Wales where winter-spring rains are unreliable and climate models predict increasing variability, lower winter-spring rains and increased frequency of summer storms.

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