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The relative profitability of dairy, sheep, beef and grain farm enterprises in southeast Australia under selected rainfall and price scenarios

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ABSTRACT

Dryland farming and its profitability is directly affected by the amount and timing of rainfall that influence and consequently impacts on pasture and crop yields. Yet rainfall is not the sole determinant of farm enterprise profitability; prices of farm inputs and commodities produced also affect farm profits. This study draws on farm commodity prices and input prices from the past 9 years to form correlated price and cost datasets that are then used in examining the profitability of a range of farm enterprises in south eastern Australia under low, average and high rainfall scenarios. Fourteen representative farm enterprises were examined that included the production of Merino fine wool, prime lamb, beef cattle, milk, wheat and canola. The spread of profitability of these farm enterprises against the backdrop of price variability and rainfall scenarios was compared. The results show that profitability of the enterprises studied is currently affected more by changes in rainfall than by commodity prices and that dairy enterprises are the most profitable on a $/ha basis but that the profitability of wheat, steer and prime lamb enterprises are least affected by low rainfall scenarios. The self-replacing cow–calf beef systems, canola and dairy enterprises are the most vulnerable to reduced rainfall and may benefit by reducing profit risk through changes such as expanding the enterprise or diversifying across other types of enterprises. Farm diversification involving combinations of enterprises with negatively correlated profits will enable the variance in farm profits to be reduced. Such actions could form part of farms' adaptation strategies to climate and price variability.

1. Introduction

Dryland farming and its profitability is directly affected by the amount and timing of rainfall (Nnaji, 2001; Sadras, 2002). This is especially true in Australia where dryland farming is commonplace and variation in rainfall across regions and years is marked (Alexander et al., 2007; Hennessy et al., 1999; Pearson et al., 2011). Changes in rainfall impact on soil moisture, pasture and crop growth, and thereby affect crop yields and livestock production. The variability in rainfall leads to variability in pasture and crop yields (Asseng et al., 2012; Petersen and Fraser, 2001) and this yield variability is particularly pronounced in Australia (Kingwell, 2012).

But rainfall and yields are not the only key factors affecting the profitability of dryland farms. Prices of farm inputs and commodities produced also play important roles. These prices fluctuate as a result of both local and international influences (FAO, 2011), and in many countries over the last decade these prices, and crop prices in particular, have fluctuated greatly (Kingwell, 2012).

Understanding the effect of changes in rainfall and prices on enterprise and farm profitability can enable farmers and their advisers to better manage these risks. With drier weather conditions and greater climate variability featuring in climate change projections for many places around the world, understanding the relationships between rainfall, commodity prices and enterprise profitability is increasingly important. Climate change projections for southern Australia point towards greater warming and a decline in annual rainfall, especially during autumn (CSIRO and Australian Bureau of Meteorology, 2007). These projections, that often include enhanced climate variability, mean that farmers may need to prepare and manage their systems and farm finances to accommodate additional environmental challenges. Understanding how different farm enterprises currently fare under existing environmental variability is the precursor to such studies. This paper provides such an initial appraisal of farm enterprise profitability under

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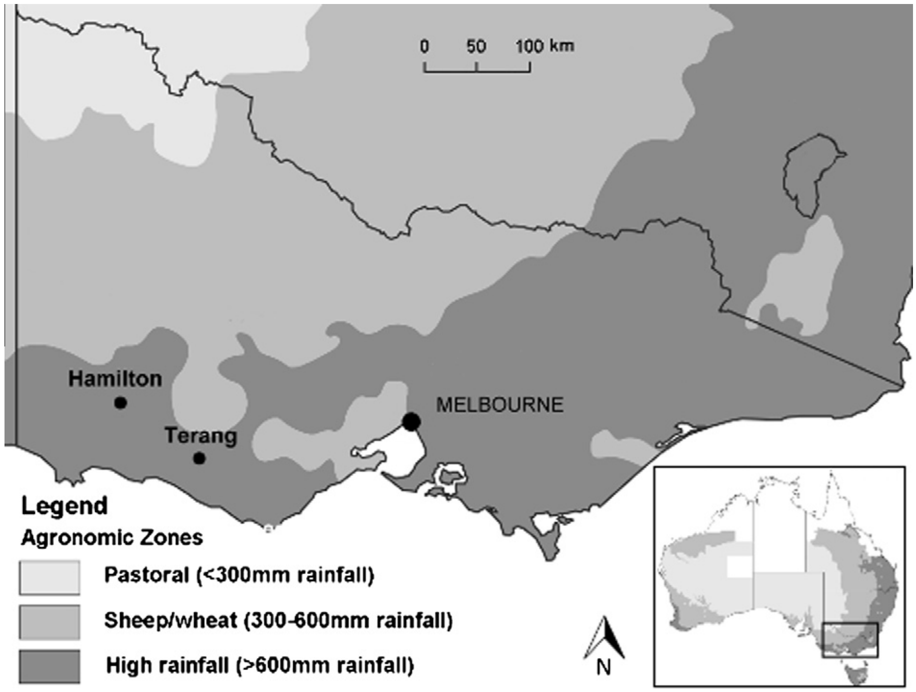

Fig. 1. Map of study region with Hamilton and Terang in the high rainfall zone of south eastern Australia.

current climate and price conditions. This paper explores how rainfall and price variability affects different farm enterprises in a dryland agricultural region of southern Australia.

The study region (Fig. 1) in southern Australia currently includes a number of land uses including sheep, beef, dairy and grain farming. Aside from dairy farms, most farms are mixed enterprises, with farm managers tending to choose 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 enterprise types within the region provides a rich data set for comparing these enterprises.

The objectives of this paper are to (1) compare and contrast the profitability of 14 different types of enterprises based on sheep, beef, dairy and grain production in the study region (2) examine how enterprise operating profit changes with low, median and high commodity prices as well as low, average and high rainfall scenarios and (3) compare the performance of average and top enterprises based on operating profit. Inferences about the resilience to rainfall and price volatility of the different enterprises are made. We hypothese that under selected rainfall and price scenarios, and using the metric of operating profit per hectare, there will be particular enterprises that are less vulnerable to rainfall and price volatility and that farms with higher productivity and profitability will have greater variation due to price and climate influences.

2. Methods

2.1. Modelled enterprises

Fourteen representative enterprises were examined that included the production of Merino fine wool, prime lamb, beef cattle, milk, wheat and canola. The enterprises were based on Browne et al. (2011) and their main attributes are typical of enterprises in the study area, as reported in regional benchmarking reports (English et al., 2008; Gilmour et al., 2009, 2010, 2011; Tocker et al., 2009, 2010; Tocker and Berrisford, 2010, 2011) are shown in Table 1. The profitability of these enterprises was assessed in three rainfall environments (dry, average, high) and three price states (low, median, high). So nine (3×3) scenarios formed the backdrop for the analysis of farm profitability. The representative enterprises were in the high rainfall zone of southwest Victoria, with dairy enterprises located at Terang (38°16′S, 142°53E) and the beef, sheep and grain enterprises nearby at Hamilton (37°16′S, 142°03′E).

Enterprises with livestock had their livestock production modelled using the validated mechanistic biophysical models GrassGro (Moore et al., 1997; Clark et al., 2000; Cohen et al., 2003) and DairyMod (Cullen et al., 2008; Johnson et al., 2008). These models are designed as decision-making tools that explore scenarios across sheep, beef and dairy farms. The models drew on 30 years of SILO patched-point daily weather data sets (see http://www.longpaddock.qld.gov.au/silo/) for the Hamilton Research Station and Terang. These models were used to describe different pasture production systems, with their associated stocking rates being adjusted downwards from potential rates to rates commonly observed in farm surveys (English et al., 2008; Gilmour et al., 2009, 2010, 2011; Tocker et al., 2009, 2010; Tocker and Berrisford, 2010, 2011).

Pastures used on most beef and sheep enterprises were assumed to be based on an early annual grass (*Lolium rigidum*) with a fixed legume content of 25%. However, a more productive pasture system was also examined based on perennial ryegrass (*Lolium perenne*) with an additional legume content fixed at 30%. Most dairy enterprises were assumed to use perennial ryegrass and white clover (*Trifolium repens*) pastures. A more productive dairy pasture was also examined that involved using a perennial ryegrass more resistant to cold temperatures that produced more feed in winter (Cullen et al., 2008).

Because these various pasture systems produced different qualities and quantities of feed during a production year, their associated stocking rates and levels of livestock production (wool, milk, liveweight gain) also differed between the pasture systems. The more productive systems were assumed to be associated with 'top' performing enterprises whilst the lesser, more typical