Potential impact of climate variability on profitability of native pasture improvement in northern NSW

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Abstract. *The Sustainable Grazing Systems (SGS) Pasture Model and daily climate data from 1901 to 2000 were used to simulate daily intake for Merino wethers on unfertilised perennial native grass-based pasture and Merino ewes on the same native pasture with added fertiliser and subterranean clover. A 15-year discounted cash flow comparison of changing from the Merino wether enterprise to the Merino ewe enterprise over 400 ha was undertaken. Probability distributions for supplementary feed requirements to maintain stocking rates were inputs into the cash flow model. Comparisons of the cash flow outcomes were made between the periods 1901–1950 and 1951–2000. The results showed the higher likelihood of negative outcomes for the first half (1901–1950) of the twentieth century, which was drier than the second half. This has implications for native pasture improvement in northern NSW if the climate change scenarios of drier conditions, similar to those from 1901–1950, occur in the future.*

Introduction

A recent report by Fairweather and Cowie (2007) observed that since 2000 the New South Wales (NSW) state average annual rainfall has been similar to the annual averages in the first half of the twentieth century, which was about 20 per cent% lower than the average rainfall from 1951–2000. In northern NSW, native pasture improvement using applied fertiliser and oversowing either annual or perennial legumes has successfully improved pasture productivity and carrying capacity, but most of this improvement occurred after 1950 when annual rainfall was higher. For Gowrie in northern NSW, an analysis of annual rainfall in the first and second halves of the last century showed that while the mean long term (1874–2006) average annual rainfall was 669 mm it varied from 635 mm (1901–1950) to 706 mm (1951–2000). The question asked in this paper is that under a climate change scenario, what would be the impact on the success rate of native pasture improvement if rainfall variability was more like that in the first half of the twentieth century?

Methods

The SGS Pasture Model (Johnson *et al.* 2003) was used to compare supplementary feeding requirements for two sheep enterprise scenarios (Merino wethers stocked at 2.8 dry sheep equivalents (DSE)/ha and Merino ewes and lambs stocked at 7.5 DSE/ha, with ewes rated at an average of 2 DSE/head) and the economic benefits of applying fertiliser and subterranean clover and changing from one to the other were compared in a discounted cash flow, partial development budget. A discounted cash flow approach was necessary because the proposed pasture improvement scenario involves streams of cash in and cash out over a number of years. The partial development approach was required because the proposal involves adding to existing investment in land and stock and other farm capital. Therefore only the extra costs and returns involved are included in the analysis (Malcolm *et al.* 2005).

The SGS Pasture Model was parameterised as described by Johnson *et al.* (2003) and Lodge and Johnson (2007) and daily climate data were sourced from the SILO Data Drill (Jeffery *et al.* 2001) for the Gowrie district, 20 km south-west of Tamworth (31^{0}18'S; 150^{0}54'E). It was assumed that mature Merino wethers had an average liveweight of 50 kg and cut an average of a 20 micron, 5 kg/head fleece. Supplementary feed was provided daily if the pasture provided <60% of their daily metabolizable energy (ME) requirement and this was assumed to remove variation in wool cut and quality. Mature Merino ewes had an assumed average liveweight of 50 kg, cutting an average of a 19 micron, 4.5 kg/head fleece with spring (mid-September) lambing. Supplementary feed was provided if daily milk production was <95% of potential, or the pasture provided <90% of the daily ME requirement.

Pasture establishment costs included subterranean clover sown at a rate of 5 kg/ha and fertilised with 125 kg/ha of single superphosphate. Pasture costs including subterranean clover, fertiliser and sowing cost were $100/ha. Fertiliser topdressing for the ewe enterprise was assumed to occur every second year (62.5 kg/ha of Goldphos 20; 16.6% phosphorus (P) and 20% sulphur) which provided approximately 1 kg P/DSE/year at a cost of $31.25/ha.

Average gross margins (for wethers $18.58/DSE, and ewes $28.33/DSE) were used in the model with annual supplementary feed costs additional. A risk distribution for supplementary feeding for each enterprise was defined from the SGS Pasture Model output (in t/ha) using the Bestfit® module of the @RISK software add-in for Microsoft® Excel (Palisade 2000). The supplementary feed distributions were then entered into an annual-basis discounted cash flow budget with a 15-year investment period. The discounted cash flow analysis technique is described by Malcolm *et al.* (2005).

Key outputs included cumulative nominal net cash flow after tax with inflation and net present value (NPV). A tax rate of 10.5% was used to allow for the tax deductibility of capital expenditures (such as pasture improvement), investment interest payments and tax averaging (Malcolm *et al.* 2005).

Results and discussion

Cash flow outcome ranges were compared for 1901–1950 and 1951–2000 (Figure 1). The centre line of the each range represents the trend in the mean cashflow. The two outer bands above the mean are one standard deviation above the mean and the 95th percentile. The two outer bands below the mean are one standard deviation below the mean and the 5th percentile. While the means for each were very similar, the cash flow range for 1901–1950 had a much higher variability than for 1951–2000. This indicated that there was a much higher likelihood of the proposed pasture improvement/enterprise change scenario resulting in negative economic outcomes if rainfall was more like the 1901–1950 period.

The average NPVs for each period were almost identical. However, there was a 13.68% probability that NPV outcome would be negative using the 1901–1950 rainfall data, compared to the 1951–2000 period (0.22%). This also reflects the greater variability in income as shown by the range of cash flow outcomes for each period.

These analysis indicated a higher likelihood of negative economic outcomes for the drier period from 1901–1950 compared to the wetter period from 1951–2000. This has implications for the future management of pasture improvement in northern NSW if drier conditions similar to 1901–1950 occur in the future.

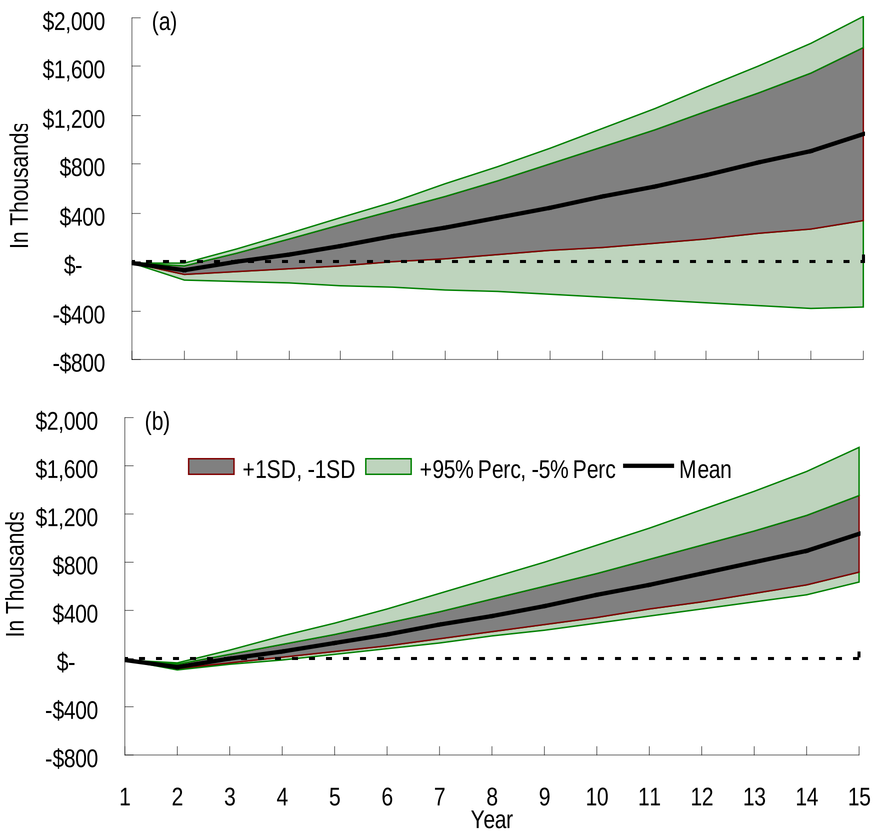

Figure 1. Cash flow outcome range for the periods (a) 1901–1950 and (b) 1950–2000.

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