Balancing profit with climatic and environmental risks

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Abstract

The GrassGro™ decision support tool was used to simulate the impact of increasing stocking rate for a prime lamb enterprise on improved pasture at Cowra (NSW). Average annual gross margin (GM) and variability in GM suggested an economic optimum stocking rate of 7 ewes/ha. Further analysis showed that while gross margin per ha increased up to 7 ewes/ha there was a significant increase in the risk of leaving soil bare and at risk of erosion once stocking rate exceeded 5 ewes/ha. The quantity and frequency of supplementary feeding also increased dramatically once stocking rate exceeded 5 ewes/ha. At 5 ewes/ha pasture utilisation was 35%, suggesting that recommendations of a target of 50% utilisation may carry a significant risk of pasture and soil degradation.

Key words

Climate, drought, risk, stocking rate, productivity, supplements, ground cover, pasture utilisation.

Introduction

A key message of grazing enterprise benchmarking in recent years is that increasing stocking rates will increase profits. Stocking rate is seen as a key profit driver, since higher pasture-utilisation rates lead to increased productivity per hectare and reduced cost of production, through overhead costs being spread over more units of product (Holmes, Sackett and Associates 2002, Holmes, Sackett and Associates 2003). The logic is sound and the premise that many properties in higher-rainfall eastern NSW are under-stocked has considerable merit. Since carrying capacity varies with soil type, climate, pasture type etc., a recent trend has been to suggest a pasture-utilisation target rather than a stocking rate. A pasture-utilisation rate of 50% (Holmes, Sackett and Associates 2003) has been suggested as a reasonable target for most grazing enterprises.

In pursuing high stocking rates we must recognize that, in our highly variable climate, risk also increases. A dynamic grazing systems model like GrassGro™ can analyse the impact of climate on production risk and, especially, can help to set sustainable long-term stocking rates in balance with carrying capacity. The GrassGro™ decision support system (DSS) uses site-specific historical weather data, along with information about soil and pasture characteristics, to model pasture growth and animal performance over long historical time frames (Moore *et al*. 1997, Freer *et al.* 1997). Animal production is integrated into an economic framework to provide a picture of temporal variation in enterprise profitability, while over the same time-frame, physical pasture parameters such as herbage mass can be monitored.

Methods

Donnelly *et al.* (1998) demonstrated a methodology for assessing the financial riskiness of any grazed pasture system using the GrassGro™ decision support tool. Simulations across a long run of years allow comparison of the gross margin and its variability as stocking rate is varied. For this paper, a phalaris pasture at Cowra was simulated for the calendar years 1965 to 2000 at 6 stocking rates ranging from 3 ewes/ha to 13 ewes/ha. The livestock enterprise simulated was a second-cross lamb producing enterprise lambing in August. All costs and commodity values were averages over the period 1999-2003 adjusted for CPI (Warn *et al.* 2005). The cost of extra livestock capital has been included using a value of $80/ewe at 8% interest. The simulations described assume set stocking, and animals were fed grain supplements when required (at a cost of $150/tonne), to maintain a minimum fat score of 2.

Economic outputs were a gross margin (GM) for every year of each of the 6 simulations. This was used to produce a box-plot of GM at each stocking rate. Other outputs, including minimum residual herbage mass before the autumn break and the amount/frequency of feeding, were used to illustrate how increased stocking rate alters the riskiness of the system.

Results and discussion

Selecting the optimal stocking rate

A basic tenet of grazed pasture systems is that optimal economic performance per hectare is achieved at a higher stocking rate than that which results in maximum individual animal performance, but at a lower stocking rate than for maximum production per hectare (Bell 2003). The difficulty is in defining what this optimum stocking rate might be for any given parcel of land, in the light of individual farmer skills and attitudes.

Figure 1 is a box-plot of the annual GM for each of the stocking rates applied to the Cowra pasture system described. The average GM is represented by the + symbol while the box represents the upper and lower quartile around the median (thus 50% of all years lie between the upper and lower bounds of the box). The "whiskers" above and below the box represent the best and worst 25% of years. Average GM increases with stocking rate up to 7 ewes/ha and declines again beyond this level. Between-year variation (risk) also increases with increased stocking rate. The "economic" optimum is 7 ewes/ha, since increased variability in GM is not offset by further increases in average GM.

Risk is a two-edged sword, the "down-side" resulting from poor seasons and the "up-side" from better seasons. In this example the economic benefit from good seasons balances or exceeds the economic "risk" from poor seasons at stocking rates up to 7 ewes/ha. Beyond 7 ewes/ha the "down-side" begins to overpower the "up-side". If typical overhead (fixed) costs of $130/ha are also applied, the apparently "low-risk" option of running 3 ewes/ha, results in a trading loss in more than 40% of years. Not only are losses less frequent at 7 ewes/ha (28 % of years) but also average and peak profits are much higher.

It is important to understand that 7 ewes/ha will not be the optimal stocking rate for all phalaris pastures at Cowra. Small changes in soil depth and water-holding characteristics can vary carrying capacity dramatically. GrassGro™ simulation by Salmon (2006) for two properties in the Yass district showed that just 50mm less annual rainfall (710mm vs 760mm) along with shallower top soil and higher elevation reduced sustainable carrying capacity by one third (12 vs 18 wethers/ha). Similar differences between individual farms might be expected in most slopes and tableland districts.

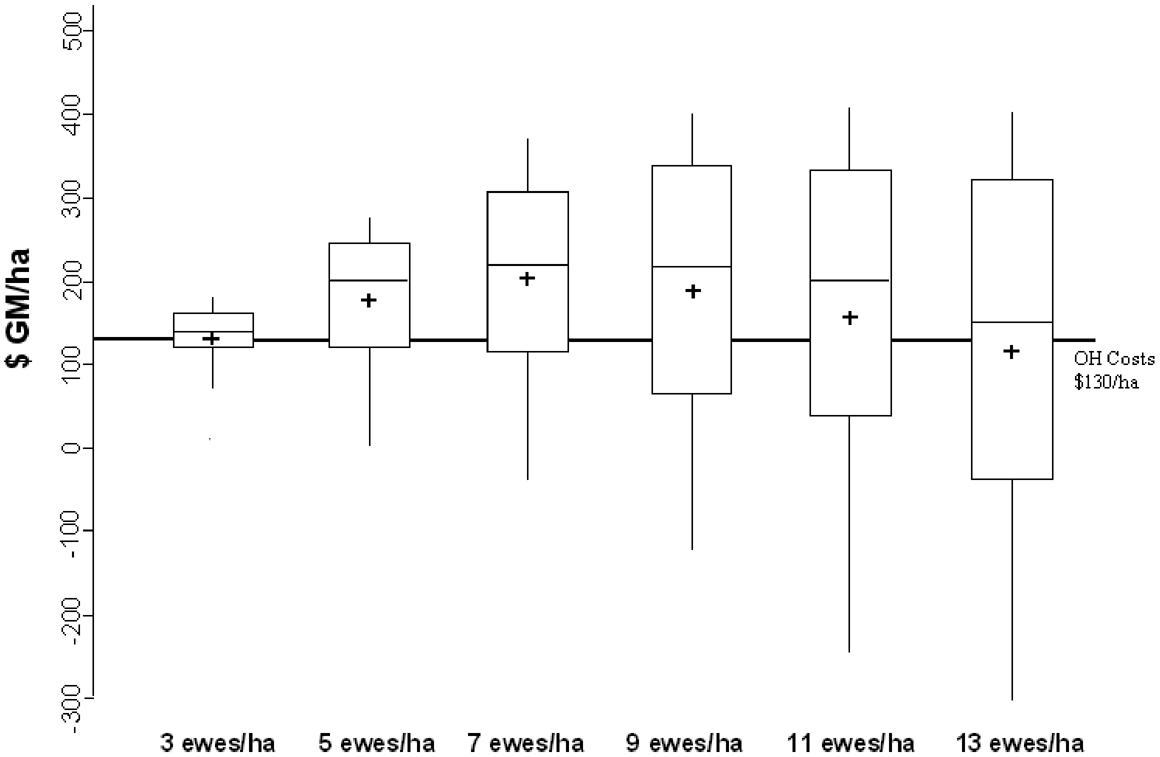

Figure 1. The range in gross margin during the period from 1965 to 2000 derived from GrassGro™ simulations of a second-cross lamb enterprise grazing phalaris-based pasture at Cowra.

How sustainable is the economic optimum?

Farmers often make "excuses" for sub-optimal stocking rates and economic performance but, in many cases, there are real and valid reasons why their own farm enterprises do not reach their theoretical carrying capacity. Common reasons for "sub-optimal" stocking rates are to avoid excessive supplementary feeding and a genuine concern for the environment. GrassGro™ can give some insight into these issues.

Some farmers use hand feeding as a regular management strategy while others see it more as a drought survival strategy. For many graziers the amount and frequency of feeding are important in choosing a farm stocking rate. Figure 2 shows the probability of annual feed requirements exceeding any given amount for the Cowra GrassGro™ simulations previously described. At 3 ewes/ha there is only a 20% probability that any feeding will be required at all i.e., feeding occurs only one year in five. At 11 and 13 ewes/ha some handfeeding is needed every year. At the economic optimum of 7 ewes/ha, feeding occurs seven years in ten but the total feed quantity will exceed 50 t in just 25% of years.

Increased feeding also leads to increased labour. The gross margins in Figure 1 account for the marginal cost of this extra labour requirement, but part-time farm labour is a scarce commodity. On some farms, the potential stocking rate may be reduced because available labour is already fully utilised and a small increase in stocking rate could not fully utilise another full labour unit. Labour efficiency affects farm profitability and, in one study the most profitable farms ran almost 20% more stock per labour unit than the average (Holmes, Sackett and Associates 2002). The Farm Monitor Project (south-west Victoria) in 2004/5 showed that small farms (<500ha) spent 16% more per hectare on supplementary feed than large farms (>1000ha) but large farms were running almost 50% more livestock per labour unit than small farms. (Anon. 2005). This illustrates the balance required between achieving the most technically efficient stocking rate and labour efficiency.

Environmental sustainability is a high priority for most farmers. Maintaining ground cover is a key sustainability indicator. GrassGro™ can indicate the probability of herbage mass falling below threshold levels, as an indicator of ground cover. At Cowra, 800 kg/ha of total dry matter would represent about 70% ground cover in a productive perennial grass pasture (L Warn, pers. comm.). A ground cover of 70% is a practical threshold below which soil erosion begins to accelerate (Costin 1980). Figure 3 shows how often this critical level of ground cover might be breached during the period from January to April, when there is a higher risk of intense storm rain. At 3 and 5 ewes/ha ground cover is compromised in just 5% (1 in 20) of years. At 7 ewes/ha ground cover will fall below 70% in 23% of years (almost once every 4 years) but at 9 ewes/ha the ground-cover thresholds are breached two years in five. Although 7 ewes/ha may

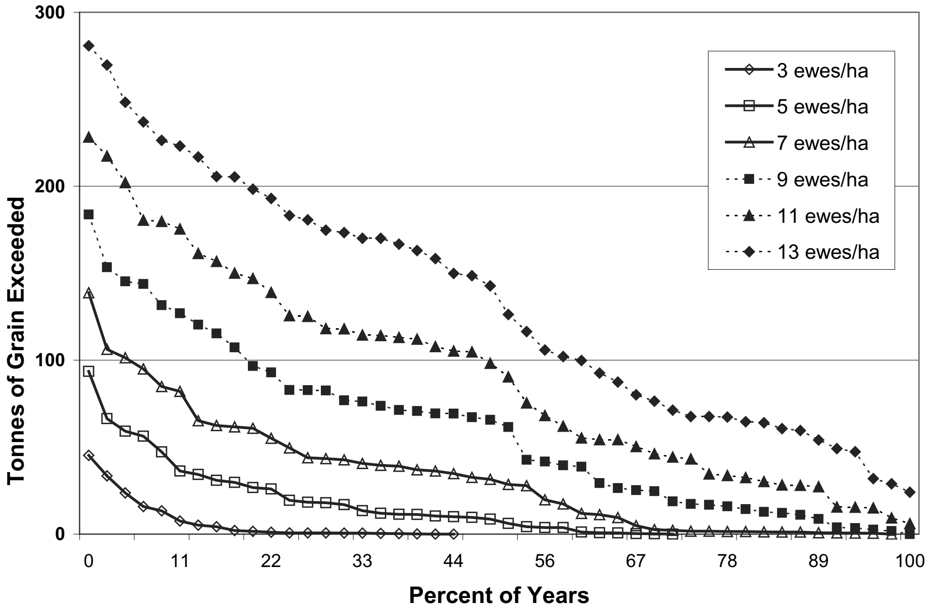

Figure 2. The frequency of feeding and total feed required (per 100ha) at 6 stocking rates for a second-cross lamb enterprise at Cowra.

achieve optimal profit, when set-stocking, long-term productivity may be compromised by soil loss and pasture degradation. To run 7 ewes/ha sustainably, a combination of more intensive management such as seasonal feed-lotting, de-stocking and rotational grazing will be needed in order to maintain adequate ground cover.

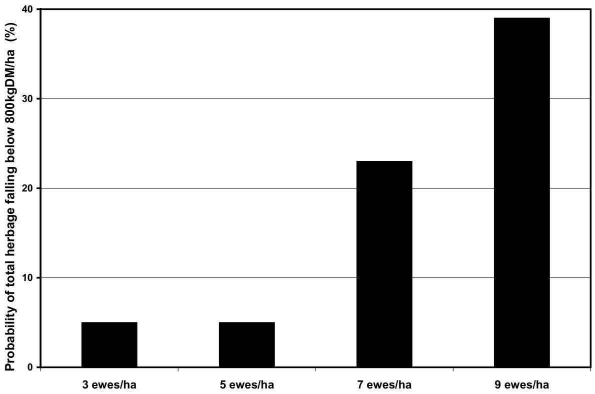

Figure 3. Probability, for a range of stocking rates, that herbage mass in a phalaris pasture at Cowra will fall below 800 kg/ha (approx. 70% ground cover) before the end of April.

Is 50% pasture utilisation a reasonable target?

Average pasture utilisation between 20% and 40% is typical for eastern NSW grazing properties. (Holmes, Sackett and Associates 2003, P. Graham pers. comm.). A target of 50% utilisation (Holmes, Sackett and Associates 2003) suggests much room for improvement, but generalisations are often wrong and optimal utilisation rates vary widely. Stocking rate, lambing/calving time and enterprise mix all impinge on the potential for high pasture utilisation. Other less obvious factors are climate and pasture types, in so far as they affect the length of growing season. Farms in climates with cool-season rainfall dominance, higher rainfall reliability and rain falling over more months of the year have longer and more reliable growing seasons.

Figure 4 compares percentiles of available green herbage for a phalaris-based pasture at Cowra, NSW (on granite soil) with the same pasture at Hamilton, Victoria (on basalt). The median growing season length is one month shorter at Cowra than at Hamilton. Moreover, at least one year in seven (15% chance) there will be green herbage at Hamilton in any month but February, while at Cowra there is little chance of having any green herbage between January and March inclusive.

The most profitable stocking rate (7 ewes/ha) at Cowra utilises 45% of pasture grown. At Hamilton, the same analysis indicates an optimal stocking rate of 11 ewes/ha and a pasture utilisation rate of 56%. If feeding and ground-cover issues serve to reduce the optimal stocking rate to 5 ewes/ha at Cowra, then average pasture utilisation is just 35%, which is already a commonly achieved level. Whilst 50% utilisation might be a reasonable average target utilisation rate across south-eastern Australia, it is not a reasonable target for each and every farm and circumstance.

Conclusion

The risks that come from climate variability are some of the most difficult to manage on grazing farms. Weighing up economic output with the risk of causing damage to soil and pastures is fraught with uncertainty. Uncertainty can lead to inaction. Analysing the experiences of the past is the most objective way to quantify risk and to optimize management for the future. Models such as GrassGro™ which integrate historical weather data into pasture and animal performance, are powerful tools that help define sustainable stocking rates and quantify some of the production and financial risks.

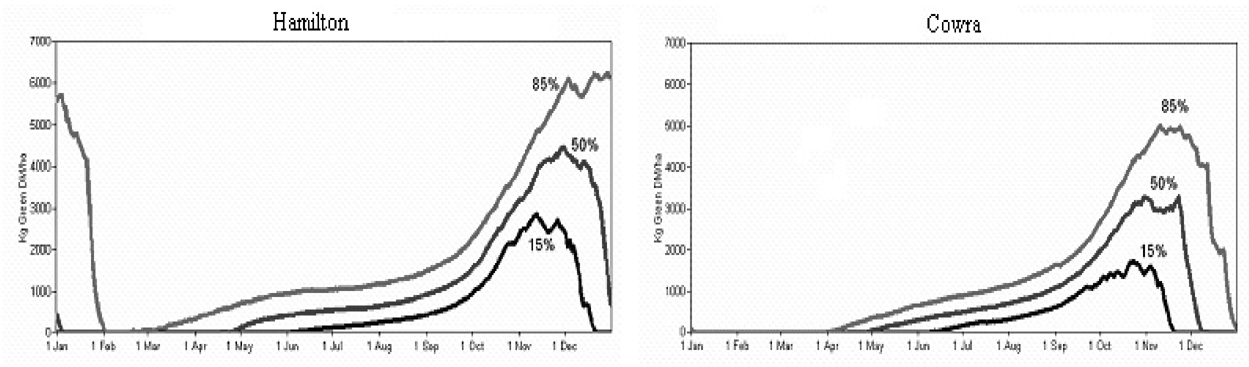

Figure 4. Percentiles of green herbage mass for phalaris-based pastures at Hamilton and Cowra, grazed at 11 and 7 ewes/ha respectively.

Better risk assessment can help farmers push their grazing systems closer to the limits and increase profits, while maintaining the environment. Despite this, more fine-tuned strategic management will also require a more flexible approach to tactical management for poor seasons. Trading livestock or otherwise moving them off pasture becomes essential tactical management in poor seasons.

Sustainably increasing stocking rates will potentially increase profits, but the decision should be part of an increased understanding of whole-farm management. Land efficiency is just one aspect that must be considered along with labour, animals, costs and marketing. The most profitable farms find the right balance between all these key areas. A simple summation of all the most technically efficient management options does not always yield the greatest profit. Sometimes this is due to antagonism between best practices in different aspects of management, but more often it is simply about optimal allocation of limited resources.

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