Managing sustainably and profitably in a highly variable climate: results from the long term Wambiana grazing trial

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Abstract

Failure to manage for rainfall variability frequently results in a decline in land condition and economic loss. While sustainable management strategies exist, adoption rates are often low due to the perceived unprofitability of such strategies. We present data from a long term grazing trial comparing the performance of different cattle stocking strategies over 24 years of highly variable rainfall. Strategies involved combinations of different stocking rates, flexible versus fixed stocking, and wet season spelling.

Moderate stocking rates with or without spelling, maximised individual animal production and profitability. Although total liveweight gain per hectare was highest at heavy stocking rates, profitability was lowest due to drought feeding costs and reduced product value. Resource condition also declined drastically under heavy stocking, reducing carrying capacity and drought resilience. Land condition was initially maintained under moderate stocking, but in the long term declined partly due to the failure to reduce stocking rates in drought. Flexible stocking was as profitable as fixed moderate stocking, and provided it was applied in a risk averse manner, should have superior outcomes in terms of land condition, as indicated during the recent drought.

Keywords: stocking rates, pasture condition, cattle production, savannas,

Introduction

Rainfall variability is a major challenge to sustainable and profitable grazing management in northern Australia. Failure to manage for rainfall variability frequently results in a decline in land condition and economic loss. While a number of management recommendations exist to manage for this variability, adoption of these strategies has been relatively slow. One important factor limiting adoption is the lack of empirical evidence showing the relative benefits of recommended strategies. Here we present data from a long term grazing trial comparing the relative performance of different cattle stocking strategies over the last 24 years.

Procedure

The trial was established in 1997 on 'Wambiana', 70 km SW of Charters Towers, Queensland, Australia. Long term (111 year) mean annual precipitation is 640 mm (C.V. = 40%). The study area is an open *Eucalyptus* savanna in the *Aristida-Bothriochloa* pasture community (Tothill and Gillies 1992). There are five grazing treatments each replicated twice, in two blocks of five paddocks (93 to 117 ha). Treatments are described in detail elsewhere (O'Reagain *et al* 2009; 2018) but briefly are: *(i)* Moderate fixed stocking (MSR), at the estimated long term carrying capacity (LTCC) of 8 -10 ha/animal equivalent (AE= 450 kg steer), (ii) *Heavy stocking (HSR)* at twice the LTCC i.e. around 4-5 ha/AE and (iii) Rotational wet season spelling (R/Spell) stocked at 8-10 ha/AE. There were also two variable stocking strategies (VAR and SOI) with stocking rates adjusted annually based on available forage. In 2010 these were modified to become the (iv) Flexible stocking (Flex) and (v) Flexible stocking with wet season spelling (Flex+Spell) strategies. All strategies were applied as 'management philosophies' i.e., applied

adaptively in consultation with the project's grazier advisory committee to ensure maximum relevance to the grazing industry.

Paddocks were stocked with two and three year old Brahmans steers managed following industry best practice. Drought feeding was provided as required to maintain animal welfare. Cattle were weighed at the start and end of each grazing year (May) and carcass data compiled from meatworks feedback sheets. Gross margins were calculated as described by O'Reagain *et al.* (2011) but with the interest on livestock capital at 5%. The density of 3P grasses (palatable, productive, perennial grasses) was estimated based on the average number of 3P tussocks in 100 quadrats ($0.25m^2$) on permanent monitoring sites on all soil types; here only the data from the dominant *Eucalyptus brownii* community is presented. Paddock scale pasture yields were estimated at the end of the wet season (May) using the Botanal methodology (Tothill, Hargreaves *et al.* 1992) along transects that bisected all soil types. Species data was grouped into functional groups i.e. 3P grasses, 2P grasses (perennial, productive and/or palatable), annual grasses, 'other' (other grasses, sedges, forbes, legumes) and unpalatable wire grasses (*Aristida* and *Eriachne* species).

Results

Stocking rates

Rainfall varied markedly (246-1223 mm) over the trial period with two distinct wet and dry cycles and 2014/15 the fourth driest year on record. The heavy stocking rate (HSR) initially performed well with the early good seasons (O'Reagain *et al.* 2009), but stocking rates had to be sharply reduced in drought years (Figure 1b). Drought feeding also had to be provided to the HSR in seven of the 24 years of the trial compared to only once (2015) in the other treatments. As pasture condition deteriorated with time, resilience declined with management interventions in the HSR required far sooner in the second compared to the first dry phase.

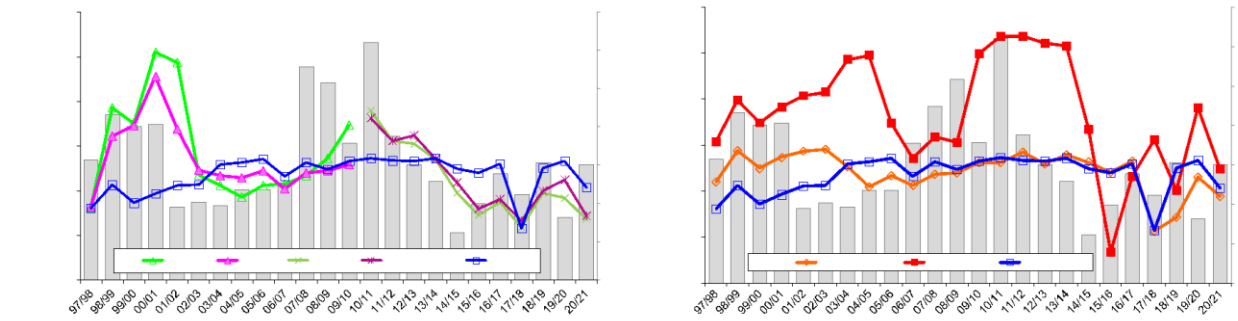

Figure 1: Annual rainfall and stocking rates (AEs/100 ha) for (a) the moderate stocking rate (MSR) and the variable-flexible strategies; note the change in treatments in 2010. And (b) the MSR, heavy stocking rate (HSR) and rotational spell (R/Spell). See text for details.

Both variable stocking strategies were initially heavily stocked due to the good seasons (Figure. 1a), but stocking rates had to be sharply cut with the advent of drought in 2001/02 to arrest overgrazing and poor animal performance (O'Reagain *et al.* 2009). While this avoided the need to drought feed, the overgrazing going into the drought had a long term, negative impact on pasture condition. This experience emphasised the critical need to be risk averse in varying stocking rates and to set maximum limits to stock numbers in even the best years. These stocking strategies were adapted accordingly and run in this fashion from 2005 onwards.

The fixed, moderately stocked MSR and R/Spell largely maintained pasture condition through the first 15 years of the trial despite the 2002-2007 drought (O'Reagain *et al.* 2018). However, in the second, more severe drought (2014/15 onwards) animal production suffered relative to Flex and Flex+S where stocking rates had been reduced. The fixed stocking rates in the MSR & R/Spell in these drought years also resulted in very heavy pasture utilisation rates. Despite relatively good, well distributed rainfall (554 mm) in 2016/17, by late December 2017 ground

cover and pasture yields were extremely low (<200 kg/ha). To avoid severe degradation in the early wet season when pastures are most sensitive to grazing (Ash *et al.* 2011), both treatments were destocked from January – May 2018. This was based on the philosophy that under similar circumstances a 'moderate stocker' would act similarly.

Animal production, economics and pasture condition

Average live-weight gain per head (LWG/hd) over the 24 years was highest in the MSR, R/Spell and Flexible strategies (Table 1). However in dry years, the Flexible stocking strategies often gave the best LWG/hd due to their reduced stocking rates. In contrast, LWG/hd was by far the lowest in the HSR due to reduced feed availability and generally lower diet quality. Consequently, carcasses from the HSR were generally lighter and returned a lower price per kg than those from other strategies (O'Reagain *et al.* 2018).

Total liveweight gain per hectare was highest in the HSR (Table 1) but this was only achieved with expensive drought feeding in seven of the 24 years of the trial. Consequently, average GM/ha in the HSR was only about half ($7/ha) that of the other strategies ($13 $/ha). Income variability was also far greater in the HSR with this strategy having a negative GM/ha in 11/24 years compared to 2/24 years in the MSR and R/Spell and 3/24 years in the Flexible stocking strategies.

Table 1. Average liveweight gain (LWG) per head (hd), LWG per hectare (ha), years (Yrs.) drought feeding was needed, gross margin (GM/ha/yr) over 24 years and 3P grass density in 2021.

Treatment	LWG/hd (kg)	LWG/ha (kg/ha)	Yrs drought feed	GM/ha ($/ha)	3 P density* (tussocks/m^2)
Flex	115	15	1	$13	1.3
Flex+Spell	115	16	1	$13	3.7
HSR	100	19	7	$7	0.5
MSR	117	14	1	$13	2.1
R/Spell	116	15	1	$13	2.4

***E. brownii* community only**

Pasture condition

Heavy stocking resulted in a major decline in pasture condition in terms of the density and yield of 3P species relative to the other four treatments (Figure 2). This not only shows the deleterious effects of heavy stocking in this variable environment but also shows that adopting basic principles of good management at least partly ameliorated the effects of the recent severe drought relative to heavy stocking. After 24 years it is nevertheless surprising that the differences in pasture condition between the remaining four treatments are relatively small; although TSDM in May 2021 was highest in the Flex+Spell, after 24 years there is still little difference in 3P species yield (Fig.). This possibly reflects the legacy effects of heavy stocking in the VAR and SOI strategies at the start of the trial and/or the continuing impact of the recent drought.

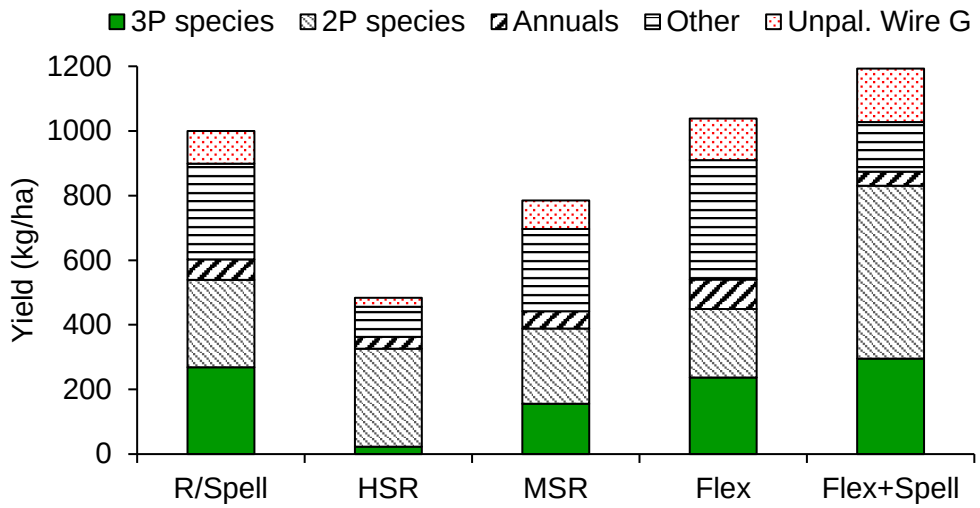

Figure. 2. *Pasture species composition in the five grazing strategies in May 2021 after 24 years of application. See text for species group abbreviations.*

Experiences through the trial nevertheless clearly highlighted the benefits of flexible stocking rates resulting in greater pasture availability and less overgrazing in the later drought years than in the fixed stocking strategies (pers. obs.). Wet season spelling also obviously benefited pastures but to a lesser extent than reducing stocking rates in drought. The benefits of flexible stocking on pasture condition would probably have been far greater if the MSR and R/Spell had not been destocked for the 2017/18 wet season thus avoiding severe damage to these treatments.

However the fact that pasture condition has declined in even the 'best' treatments is cause for concern and a sobering outcome. While the recent drought undoubtedly caused significant damage through marked mortality of perennial grasses (Jones pers.comm.)[1], recovery with the recent better seasons has been extremely slow. Similar observations have been made on properties throughout north Queensland. Hopefully this situation will resolve with a consistent run of wet years but if not, carrying capacities on many properties may be permanently compromised.

Conclusion

Our data clearly show that heavy stocking was less than half as profitable as the other strategies and resulted in a severe decline in pasture condition and loss of resilience. However, results also indicate that constant stocking even at LTCC without reducing stocking rates in dry years will also cause overgrazing and a decline in pasture condition in the longer term. Evidence from this work and other trials also highlights the importance of wet season spelling. In conclusion, risk-averse flexible stocking with wet season spelling is likely to be the most profitable and sustainable strategy for managing climate variability.

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