Threats, realities and opportunities of grassland farming in the central Tablelands

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Abstract: *Grassland farming on the central Tablelands of New South Wales is faced with many challenges. From a resource perspective it is diverse and has evolved in response to soil, land capability, climatic and investment constraints. From a resource use perspective, the operating environment for grassland managers is strongly influenced by external demands from non-traditional users of grassland resources. These interactions are reviewed and investigated to enhance the understanding of the threats, realities and opportunities of grassland farming in the region. In addition, the historical returns from grassland farming in the region are disaggregated to demonstrate the contributions to personal wealth creation of the competition for grassland resources, as well as their use as a harvestable resource. The results of the study indicate that inherent capital appreciation of land and the opportunity for subdivisional development have the greatest impact on returns from investment in grasslands. However, it also highlights the opportunities for these returns to be enhanced through prudent and efficient management of the livestock enterprises being run on the resource. Using the process applied in this study, it is also possible for agricultural investors to spatially analyse where appropriate investments exist in grasslands.*

Key words: Grassland resource competition, livestock enterprise demographics, pasture production and variability, risk and returns

Introduction

The central Tablelands of New South Wales (NSW) covers an area of approximately 13,700 square kilometres. Bathurst was proclaimed a town 1815 and is Australia's first inland settlement and the oldest inland city. The central Tablelands maintains a population of around 110,000 and includes the major regional centres of Orange, Blayney, Oberon and Lithgow. Historically, agricultural enterprises have largely dominated the economy in the region, even through the gold rush era of the 1850–70s, however, more recently the region has developed a diverse modern economy based on manufacturing, agriculture, forestry, education, mining, and tourism. As the region continues to develop, there is increasing competition for the grassland resources that exist in the region. This competition not only comes from some of these diverse industries, but also extends to the demand for its amenity value and its use for lifestyle purposes, biodiversity and broader catchment values.

The aim of this paper is to provide an overview of the current state of the region. It also reviews the threats, realities and opportunities to grassland farming in the region. This includes the influence of the increasing competition for grassland, soil and human resources on the regions potential for food and fibre production.

Agro-ecology of the central Tablelands

The region lies in the temperate climate zone and the region experiences no distinct dry season. The lower altitude areas tend to have a warm summer, whereas the higher altitude areas have a mild summer (Figure 1). The whole region is prone to severe frosts, with higher areas receiving occasional snowfalls. Rainfall tends to exhibit slight summer dominance within the Bathurst basin and to the north of this area, with the long-term annual average rainfall around 630 mm per annum, although rainfall variability increases during the summer and early autumn. In the higher altitude areas of the region,

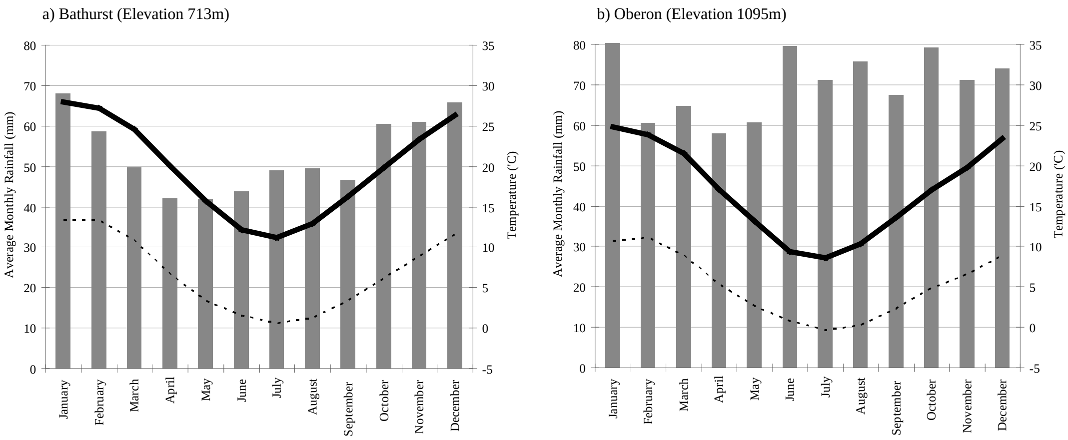


Figure 1: Average monthly rainfall (bar) over the period of 1908–2011, mean maximum (▬) and mean minimum (- -) temperatures for a) Bathurst and b) Oberon since 1966 (BOM, 2011).

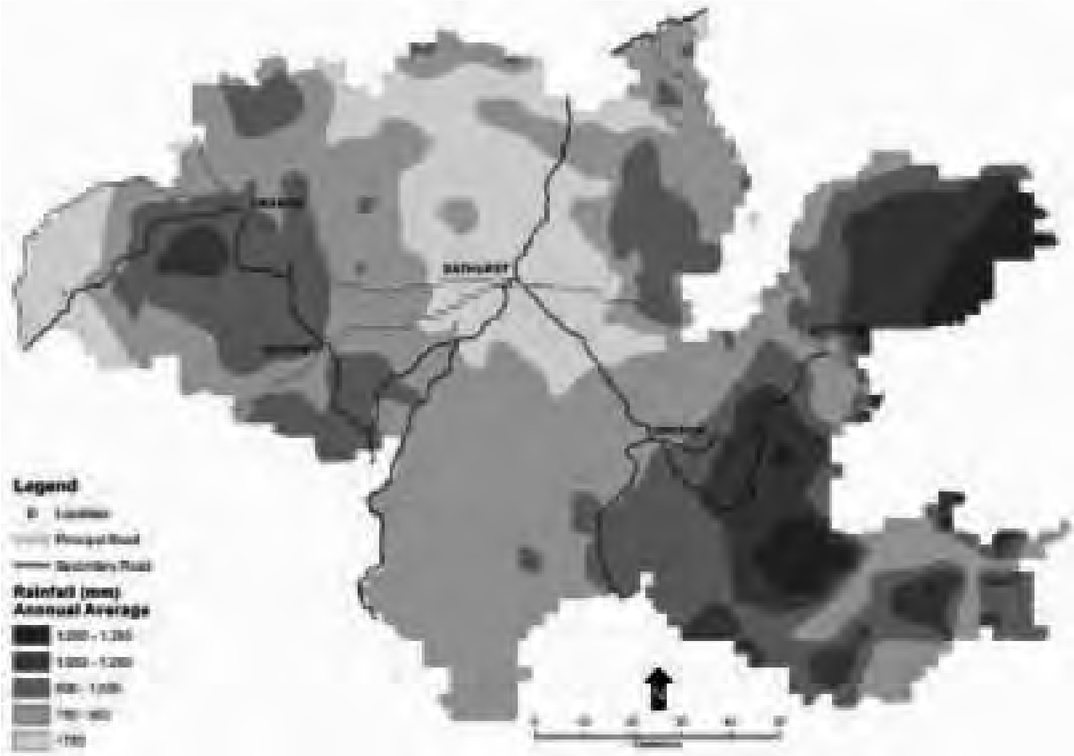
rainfall exhibits a uniform distribution with a long-term average annual rainfall of over 800 mm per annum. The lower altitude areas have lower autumn, winter and early spring rainfall, and warmer summers than the higher altitude areas.

The spatial distribution of average annual rainfall and land capability classes (Emery 1986), are shown in Figures 2*a* and 2*b*. It shows that the areas surrounding and north of Bathurst receive the lowest annual rainfall (600–700 mm per annum), while, apart from the pocket of higher average annual rainfall surrounding Orange, the highest rainfall (>1000 mm) in the region is received in the higher altitude areas in the eastern part of the region. These climatic effects are reflected in the predicted pasture growth curves for these areas within the region (Figure 3).

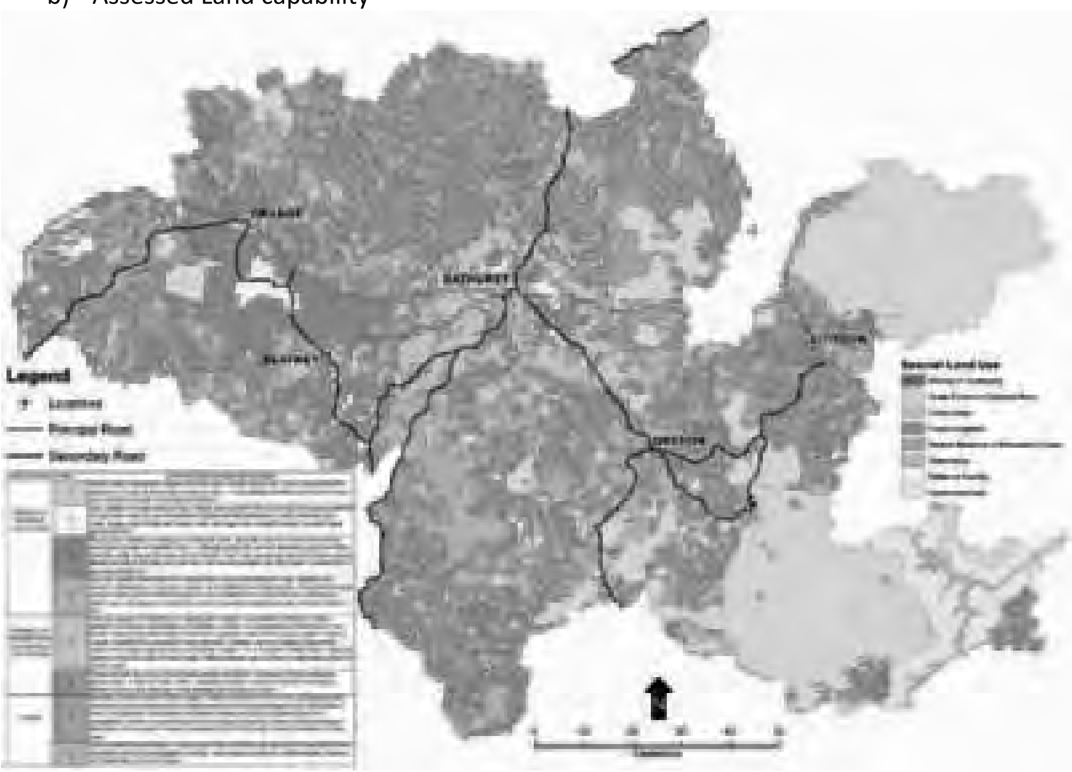
The spatial distribution of the different land capability classes is strongly influenced by the predominant soil types, as well as its topography. To the south of Bathurst we mainly find granite derived soils with some slate/shale and basalt derived soils interspersed on predominantly class 3, 4 and 5 lands. To the north, slate/shale and granite derived soils predominate on class 5, 6 and 7 lands. In areas both east and west of Bathurst (south of Oberon and Orange), we find extensive areas of basalt derived soils interspersed amongst granite and slate/shale derived soils, especially at higher altitudes on class 2–4 country. In the lower areas of the landscape immediately around Bathurst, we find granite derived soils (Red Gradational or Red Podzolic soils) predominating on class 2, 3 and 4 lands, with some large areas of class 1 land on alluvial soils along the Macquarie river and its tributaries. These areas contribute markedly to the regional economy through valuable horticultural and lucerne industries. On the surrounding ridgelines around the Bathurst basin we find granite and slate/shale derived soils distributed across class 3, 4 and 5 lands. The predominant land capability class in the region is class 4 land (19.1%), followed closely by class 6 (18.7% grazing only) (Figure 2*b*). Only 11.4% of the region is capable of maintaining regular cultivation, with 31% suitable for grazing with occasional cultivation. In total, 14.3% is classed as not suitable to agricultural enterprises (class 7 and 8 land). State forests and national parks dominate the remainder of land in the region, with 21% of the region used for these purposes.

In combination, the regions soil types, rainfall distribution and land capability have strongly influenced the evolution and spatial distribution of agricultural land use (Figure 2c). The role of native pastures in the region is significant and highlights the challenging environment being managed by land holders north of Bathurst. It is a lower rainfall environment on class 5–7 country with low temperatures for 4–6 months (especially for frost sensitive species). Soil structure and

a) Average annual rainfall



b) Assessed Land capability



c) Land use

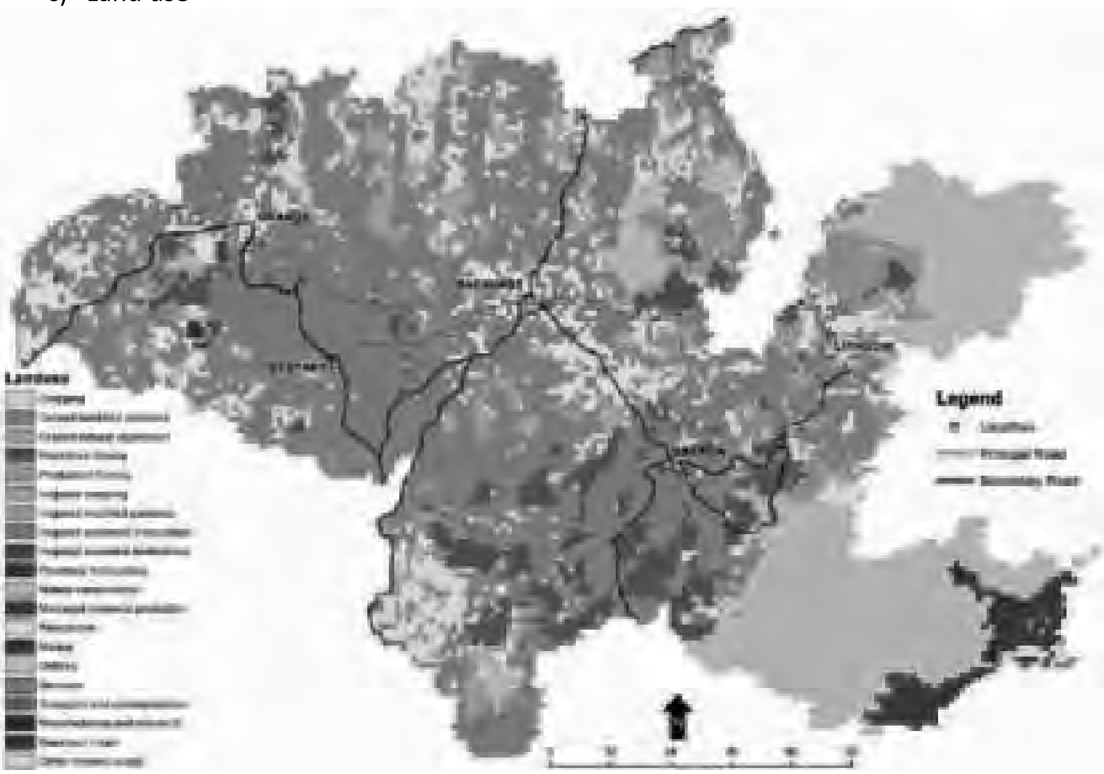


Figure 2: Spatial distribution of a) Average annual rainfall over period of 1910 to 2010 (BOM, 2011); b) land capability (OEH, 2008) based on the method described by Emery (1986) ; and c) land use in the central Tablelands region (ABARE, 2009).

fertility is poorer and the landscape dominated by native pastures. In total, just 8% of the region (1115 km^2) is used for grazing natural vegetation. Of greater importance is the role of modified pastures (with sown introduced species) found predominantly south of the Great Western Highway, with 45% of the region (6229 km^2) used for grazing modified pastures. Although representing a higher rainfall zone within the region, inherent soil fertility issues and the diversity of landscapes, presents a challenge to the sustainable use of these modified pastures in combination with native and naturalised species, for extensive livestock production.

The most prevalent soil fertility issues in the region include soil acidity and deficiencies in phosphorus (P), nitrogen (N), and in many instances sulfur. Molybdenum, selenium and potassium deficiencies are also common, and often their correction produces significant benefits to pasture production and animal health. Aluminium toxicity is also often a problem in strongly acidic soils.

Regional grasslands

Native grass-based pastures are widespread throughout the region with the dominant species being wallaby grass (*Austrodanthonia* spp.), redgrass (*Bothriochloa macra*) and weeping grass (*Microlaena stipoides*) (Garden *et al.* 2001). Other co-dominant and sub-dominant species include poa tussock (*Poa* spp.), kangaroo grass (*Themeda australis*), spear grass (*Austrostipa scabra*) and purple wire grass (*Aristida ramosa*), particularly on the granite and slate/shale derived soils north of the Great Western Highway. Other species that are commonly found in native pastures across the whole region include annual grasses such as silver grass (*Vulpia* spp.) and brome (*Bromus* spp.), and legumes such as subterranean clover (*Trifolium subterraneum*) and native glycine (*Glycine* spp.).

Modified pastures are also found throughout the region, but particularly in the higher rainfall areas where Red Earth and Red Podzolic soils predominate. The dominant species in these pastures are subterranean clover, perennial ryegrass (*Lolium perenne*), annual ryegrass (*L. rigidums*), white clover (*T. repens*) and silver grass (Kemp and Dowling 1991). Other sub-dominant species include brome, phalaris (*Phalaris aquatic*), cocksfoot (*Dactylis glomerata*), barley grass (*Hordeum leporinum*), and other native grasses such as wallaby grass and redgrass. These modified pastures are often limited in their productivity and persistence due to sub-optimal soil fertility regimes and grazing management. In addition, across all landscapes and pastures found within the region, perennial weeds such as serrated tussock (*Nasella trichotoma*), chilean needle grass (*N. neesiana*), and St. Johns wort (*Hypericum perforatum*); and in class 4 lands and above, biddy bush (*Cassinia* spp.), may also be found in economically damaging concentrations (Dellow *et al.* 2002).

The influence of the region's agro-ecology on potential pasture production can be examined using GrassGro modelling (Moore *et al.* 1997). This decision support tool was used to estimate the expected median pasture growth rates for a typical modified pasture, which maintains introduced species, in the low altitude/low rainfall zones of the region (Figure 3*a*), as well as in the high altitude/high rainfall zones (Figure 3*b*). On average, both zones are expected to produce around 8.5–8.7 tonnes of dry matter per hectare per annum (t DM/ha/yr), whereas, native pastures north of Bathurst on granite and shale/slate derived soils would be expected to only produce around 3–5 t DM/ha/yr. The distribution of pasture growth during the growing season is notably different between low and high altitude zones. Although maintaining similar average growing season lengths of around 10 months, the higher altitude zones have a noticeably lower pasture growth rate potential during the winter months. This winter 'bottleneck' can potentially severely constrain the potential utilisation of pasture resources and reduce productivity if not appropriately managed. Adjusting the timing of peak feed demand by livestock enterprises, the use of tradable stock, fodder cropping, and fodder conservation are popular methods of improving pasture utilisation and increasing winter carrying capacity. These strategies also interact with the risk profile of the enterprises being operated (Behrendt *et al.* 2000).

Figure 3 indicates the variation in daily pasture growth rates for modified pastures between the two zones. The higher altitude zones maintain marginally less variation in their pasture growth rates, *albeit* at much lower levels during the winter periods. The advantage gained from the higher altitude regions is the relatively mild summer and higher rainfall during the autumn, winter and early spring; which in combination

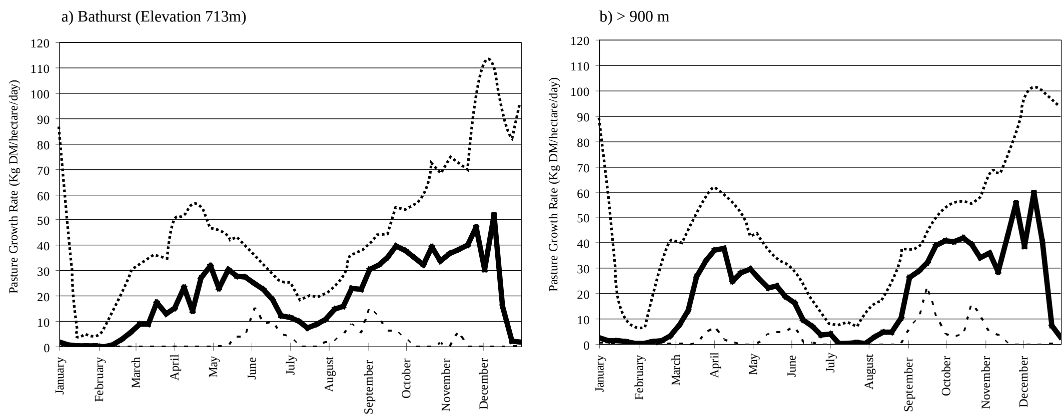


Figure 3: Variability of pasture production at Bathurst (a) and in the higher tablelands regions above 900 metres altitude. Pasture growth percentiles shown are 10th percentile (····), median (▬) and 90th percentile (---) levels for GrassGro simulation data over the period of 1980 to 2009.

with lower evapotranspiration rates, increases potential autumn pasture growth rates and maintains higher minimum spring pasture growth rates. In combination though, given the large within and between season variability, the autumns tend to be unreliable for pasture growth (Leech and Keys 2000). This can have severe implications for the winter feed gap, especially when the autumn does not produce an opportunity for pasture growth.

Grassland farming practices

Traditionally the grasslands in this region were utilised by the grazing of native pastures by herds and flocks that settlers established after the region was settled during the early 1800s. This continued until around 1950s when the benefit of superphosphate and subterranean clover to total DM production was demonstrated (Crofts 1997). In the 1950–1970s, there was a rapid introduction of perennial pastures and these responded better to the increased levels of N fixed by the introduced clovers with elevated soil P levels.

Data on the numbers of sheep and cattle collected annually since 1990 were obtained from the database held by the Tablelands Livestock Health and Pest Authority (TLHPA). This data has been used to analyse the recent changes in livestock enterprise demographics and grazing pressure in the study region (Figure 4). Because there had been a number of amalgamations over this time, only data from properties located within the study region (Figure 2) were analysed, which excluded the broader constituency of the TLHPA.

There are a number of reasons hypothesised as causing the changes in enterprise demographics detailed in Figure 4. The demise of the reserve price scheme for wool in February 1991 triggered a shift from dedicated sheep producers to increasing numbers of specialised cattle producers. Secondly, the prolonged drought over the period 2000–09 favoured reduced stock numbers. Thirdly, an increase in the demand for and availability of off-farm work stimulated a move into enterprises such as cattle with lesser labour demands. Finally, with the increase in the number of rural subdivisions, hobby farmers sought enterprises requiring lower labour inputs.

Another contributing factor to the change in enterprise demographics is the increasing beef prices observed during the late 1990s during a period where sheep and wool prices remained stable at relatively low levels. This may have induced a change from sheep to cattle. More recently, with increasing and high sheep prices and profitability, the cost of shifting back into sheep from cattle may be impeding change. The data presented in Figure 4c also indicates that the average scale of central Tablelands enterprises is small compared with state standards. It also indicates that specialist cattle producers scale stayed relatively constant over the reported period, and the main enterprise change (from sheep to cattle) occurred by mixed enterprise operations shifting from sheep to cattle, although some attrition occurred in number of specialist sheep producers since 2000–01 (Figure 4b). The notable reduction in sheep numbers from around 2 million in 1990 to 500,000 in 2010, is consistent with national trends (Curtis 2009), albeit at a slightly higher rate of decline. Although there has been an increase in number of cattle enterprises, their scale is reducing. From a producer's perspective this creates issues for marketing and market power, and from a buyers or processors perspective, it presents a supply chain management issue as the market is becoming increasingly fragmented. The introduction of the CLTX was a positive step towards dealing with this imbalance of market power that was being created in the regions traditional market places due to an increasingly fragmented industry. The same issue has been faced by prime lamb producers and their customers.

Evidence also suggests that many of the sheep enterprises tend to be operated in the lower stocking rate areas. Their average stocking rate has been in the vicinity of 3–5 dry sheep equivalents (DSE)/ha, whereas cattle and mixed enterprises average 5–8 DSE/ha. Merino sheep based enterprises dominate the area north of the Great Western Highway, and given the agro-ecology of this zone, it provides less opportunity to move into cattle and away from Merino based enterprises. Typically, Merino enterprises are also found on the higher land classes (5 and above), whereas prime lamb and cattle enterprises are found on modified pastures in the southern and eastern parts of the region on class 3–5 country.

In summary, the regions soils and pasture resources can achieve high levels of production, especially in the higher rainfall zones. The length of the potential growing season at 9–10 months provides a feed profile capable of sustaining high levels of livestock production. However, the risks of production at lower altitudes and the winter bottle neck at higher altitudes, means that grassland managers need to develop flexible management systems that try to make the most of pasture resources when they become available. At the average district stocking rate of 2–5 DSE/ha within low rainfall zones north of Bathurst, and 6–10 DSE/ha in high rainfall/high altitude zones, most producers will, on average, only utilise 20–30% of pasture grown. There is a significant capacity for the central Tablelands to increase regional meat and wool production. The challenge is how this will be achieved given climate risk and external competition for grassland resources.

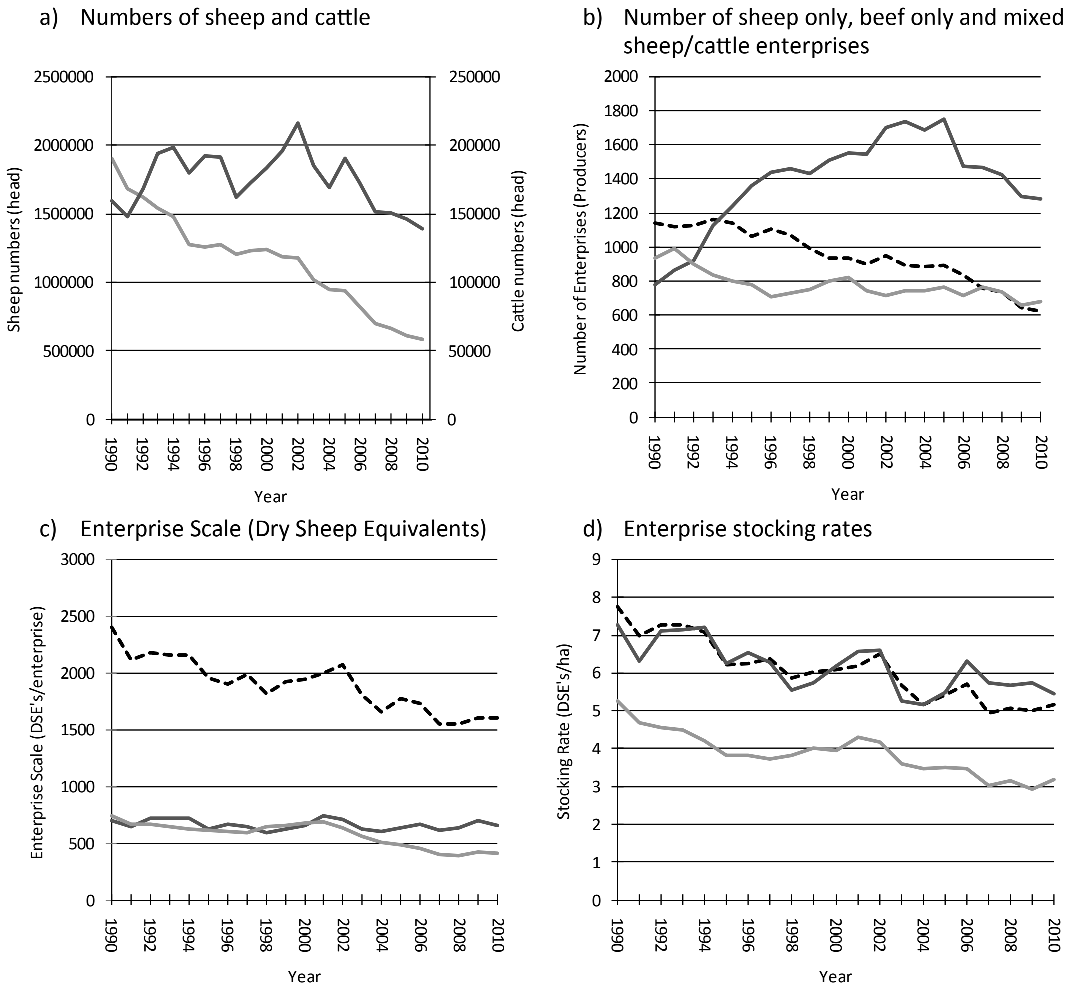


Figure 4: Changes in enterprise demographics and grazing pressure within the study region for cattle (▬), sheep (▬) and mixed cattle/sheep (– –) enterprises (Source: TLHPA data 1990-2010).

Challenges of managing a grassland-based business

Investment into soil fertility in parts of the region have produced known and substantial benefits to production and economics, especially in the high rainfall zones of the region in conjunction with modified pastures (Vere 1998; Behrendt 2005). Single superphosphate applications plus aerially sown subterranean clover on native pastures on the granite and shale/slate derived soils in hill country north of Bathurst, have also shown to be capable of sustainably increasing carrying capacity from 2 DSE/ha to 6–8 DSE/ha over 12 years. That is, an increase of around 5 DSE/ha for every tonne of single superphosphate applied (Crofts 1989). These increases in stocking rate were found to be maintained with continued applications of 125 kg/ha of single superphosphate every second or third year. Such responses on native species dominated pastures is also supported in acidic country in the Newbridge area south of Bathurst using both reactive phosphate rock and single superphosphate (Keys and Clements 2006). If consideration is given not only to the need for higher pasture production to improve the livestock production economics, but also consider the interaction between soil fertility and the resilience of modified and native pasture systems, then the application of fertiliser in Tablelands grassland systems would not be considered a discretionary expense, even with the increasing costs of single superphosphate (Scott and Cacho 2000; Behrendt *et al.* 2009).

A significant challenge to grassland farmers in the central Tablelands of NSW is the increasing demands for the regions soil and pasture resources. The average grazing area for a rural holding in this region has steadily declined since 1990, from around 195 ha down to 165 ha in 2010. This coincides with the continued growth in the number of separate land titles within the region, which has found to be economically beneficial to the region (WRI 2005). The ongoing subdivision of grazing lands, conceptually, is a double edged sword, as it provides both a significant threat and opportunity to grassland farming in the region.

Grassland risks and returns

In reviewing the historical changes in rural land markets in the region, it demonstrates the effect of competition for grassland resources, climate and commodity prices on the profitability of managing grasslands (Table 1 and Figure 5). Land value data was sourced from the NSW Land and Property Information Authority (2010), with historical enterprise returns estimated using GrassGro simulation data, annual average commodity price data, and historical farm survey data for the region.

Grazing properties in the Orange and Bathurst areas have historically achieved higher rates of land capital appreciation than at Oberon. The demand from these properties is largely being driven by investor speculation relating to the future subdivision potential, as well as rural lifestyle investors (some focused on intensive agriculture), rather than the professional grazier. The potential gains from subdivision, even from only small developments (2–3 concessional lots) are significant. The value of converting grazing country to hobby lots is an 2–3-fold increase in land value, with conversion into rural residential being 23–33-fold increase in land value (less the costs of development). This does present a significant opportunity to the Tablelands grassland farmer for personal wealth development, especially those landholders within commuting distance of major regional centres. But, it also presents a threat to maintaining of expanding agricultural production from the traditional industries (beef and sheep), as the higher land prices makes investment uneconomical. However, the overall benefit to the gross regional product is positive from such development, with the change in agricultural production demographics from the traditional enterprises to more intensive enterprises, having been shown to have flow-on effects into the broader economy (WRI 2005).

Typically, the returns on investment in grassland resources in the region are derived from both the capital appreciation of the grassland resource and the potential yield or return from operating traditional livestock enterprises. For the more risk averse investor, an investment in grazing

Table 1. Regional livestock and land value data (LPIA 2010); and rates of return from investment in grasslands over the period of 1996–2010, in the central Tablelands, NSW. All figures are in nominal terms, with real terms figures in parentheses.

Measure	Property type						
	Grazing			Hobby		Rural residential	
	Bathurst	Oberon	Orange	Bathurst	Orange	Bathurst	Orange
Area (ha)	683	191	238	40.2	39.9	2.46	2.17
Scale (DSEs)	3,100	2,400	3000				
2010 Land value/ha ($)	3,411	3,398	5,420	10,771	12,657	112,602	123,502
2010 Land value/DSE ($)	752	270	430				
Investment performance measures							
Compound rate of gain in livestock assets	4.7% (2.3%)	5.3% (2.8%)	5.3% (2.8%)				
Compound rate of gain in land assets	6.2% (3.9%)	3.8% (1.5%)	8.2% (6.6%)	6.6% (4.3%)	8.8% (6.4%)	8.4% (6.0%)	8.0% (5.6%)
Average nominal annual yield from grazing enterprises (Return on total assets including capital appreciation)	6.6%	6.0%	10.2%				

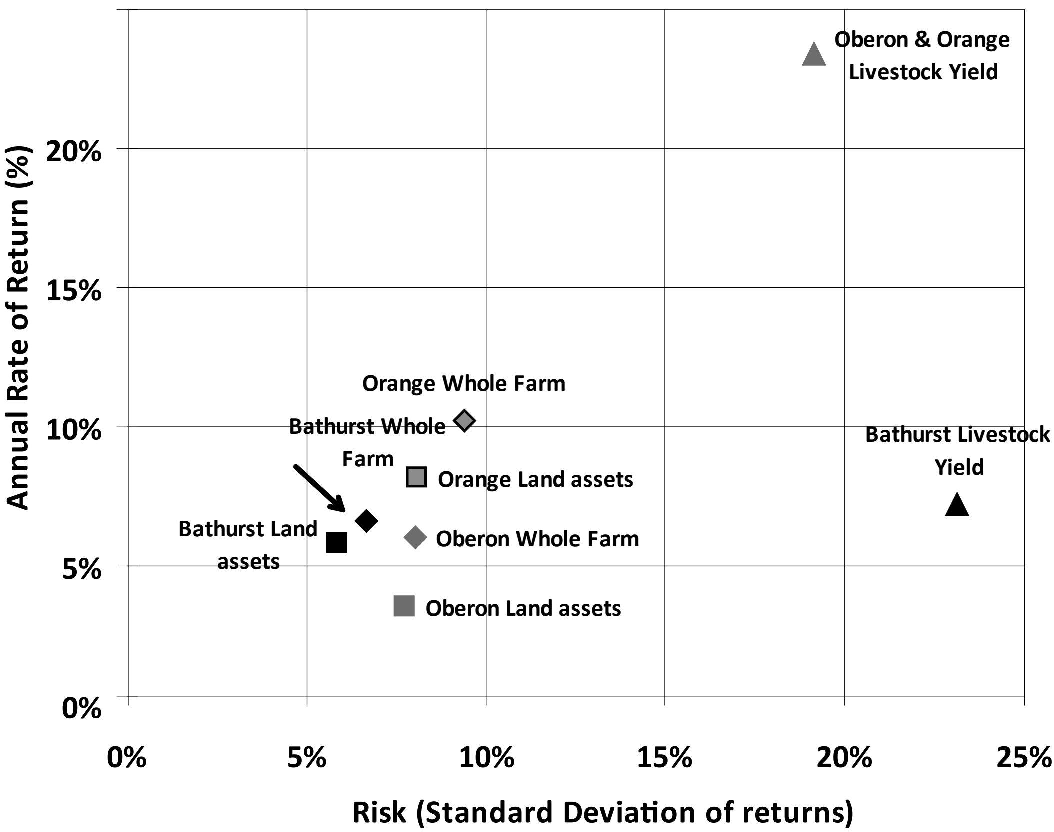


Figure 5. Annual average returns and risks on investments in (■) grazing land, (▲) livestock and (◆) whole farm operations in the Bathurst, Oberon and Orange areas.

land around Bathurst will represent the least risky investment. In disaggregating the whole farm returns, it can be shown that this is not due to its risk and return profile from the livestock enterprises being run in that region, but rather due to the lower risk capital appreciation of land assets. The livestock enterprises around Bathurst actually represent the most risky investment with concurrent low returns. For the more risk neutral investor, investing in grazing land at Orange would represent a more appropriate investment. For both the Oberon and Orange areas, which reflect the high rainfall/high altitude zones of the region, livestock returns significantly outperform those achieved within the lower rainfall zones of the region, and with significantly less risk. This results from the higher rainfall and longer growing season areas being capable of maintaining higher annual average stocking rates, as well as having lower risks of production than those lower rainfall regions surrounding and north of Bathurst.

The variability around this typical representation of historical enterprise and whole farm performance is substantial. There is evidence of high performing producers in the central Tablelands regions achieving annual whole farm yields (returns on assets including capital appreciation) in excess of 10%, even in the lower rainfall areas surrounding Bathurst. This diversity is being achieved through efficient and flexible management systems, using profitable livestock enterprise structures with higher than district average stocking rates. Enterprise scale itself is not a key driver of productivity in farming systems, but rather the capacity of smaller land holders to cost-effectively access advanced technologies (Sheng *et al.* 2011). There are obviously opportunities emerging for service providers of such technologies to fulfil such a need in this region. Given the cost of expansion, intensification of a grassland farmer's existing operation and accessing of technologies provide the best opportunity for improving profitability of enterprise committed managers. Although it would be expected that significant gains in scale and technology adoption could be achieved through amalgamation of livestock enterprises across properties through ingenious land development, share farming and leasing arrangements.

Conclusions

The central Tablelands region of NSW is a challenging and diverse environment. The current practices applied and the distribution of land use in the region is strongly correlated with the agro-ecology of the region. In addition, competition for grassland resources from non-traditional uses (traditional uses being for broad acre livestock production) has caused the evolution of a region characterised by small scale holdings, high land values of grassland resources, and reducing regional production from traditional agricultural enterprises. The realities are that this competition for grassland resources is unlikely to change, and it would be expected to intensify in the future.

The challenge for grassland managers is to operate within this environment or develop a strategy to capitalise from it. The objective in the interim is always the sustainable and profitable stewardship of the grassland resource, and opportunities do exist for this to occur through prudent management of inputs and the enterprises that harvest the resource. Productivity, under increasing climate variability which is constrained by soil and pasture resources (which is especially dependent on location and previous investments into production capacity) and its interaction with high land prices, will challenge the future viability of traditional agricultural enterprises. In combination such factors will impede entry to and expansion of traditional grassland based enterprises in the region.

Substantial opportunities do exist though, for cashed up investors to secure the last remaining high return/lower risk larger scale grazing properties in the region, especially in the higher rainfall/higher altitude regions. Such properties retain the additional advantage of potential future subdivisional development if the demand from non-traditional users of grasslands is maintained. The substantial risk to such a strategy is that political decisions may be made to constrain Australia's diminishing capacity for food security without proper planning and consideration of the multiple uses of grassland resources. This desire for food security would come at a cost to both regional communities and the personal wealth creation of the current cohort of grassland managers.

Acknowledgments

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