Integrating grazing and forage systems on marginal cropping lands

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Abstract

Planned grazing systems are being introduced to beef cattle enterprises across the marginal cropping lands of Queensland, as they are on more extensive grazing properties. Systems range from continuous grazing with opportunistic summer rest periods to cell systems with more than 60 paddocks. The aim of planned grazing is to increase production, improve sustainability and increase economic viability from both the pastured and cropping lands of a property. Managing the more intensive grazing systems on native or sown pastures with strategic summer and winter forage crops is a challenge under the variable rainfall conditions. Under favourable conditions, integrating summer and winter crops with summer-growing grass-based pastures offers a wider range of options for breeding, finishing and marketing cattle. The integration of pasture grazing systems with opportunistic forage cropping systems on marginal cropping lands is discussed, and a current research project assessing grazing systems is described.

Introduction

A ‘grazing system’ broadly describes the management of grazing animals across space and time; grazing systems range from low-intensity continuous grazing to highly intensive rotation systems. The system chosen has to suit the abilities and lifestyle of the manager while producing economically viable, environmentally sustainable and socially acceptable outcomes. The manager considers factors such as: the species and classes of animals; mixes of these; stocking rates or stock numbers for the available area; periods of grazing and pasture rest (for recovery and seeding); the intensity and frequency of grazing; animal distribution; and the marketable product. The grazing system and its management under the variable climate of southern Queensland can have a significant effect on the pasture’s ability to provide both soil protection and viable animal production.

On marginal cropping lands, pasture grazing systems often have to integrate with cropping of various intensities. They range from using a small proportion of land for opportunistic summer or winter forage crops to supplement a pasture-based system, to grain cropping being the main enterprise with livestock occupying an opportunistic role. The usual beef production systems fall into 3 categories: breeding and selling weaners; growing young animals for sale to feedlot operators (backgrounding); and finishing animals for slaughter.

Having a proportion of land under cropping can benefit pastures by providing rest periods for pasture recovery and seeding in summer, or can cause their degradation if cattle are concentrated at too high stocking rates for too long. The latter can occur in early summer when crop lands are being prepared and pastures are most susceptible to damage by overgrazing. Finding the balance between areas of pastures, cropping and stock numbers, times of crop feed availability and stocking rates is the manager’s challenge in maintaining soil protection and economic animal production from mixed pasture and crop enterprises in a marginal environment.

Grazing systems

Grazing systems — the management of the location, duration and timing of grazing of animals — used in the marginal cropping lands range from continuous grazing with opportunistic rest
periods, to planned paddock rotations, to intensive cell systems (McCosker 2000) with more then 60 paddocks. Grazing of crop residues and sown forage crops in conjunction with native and sown grass pastures adds other options for manipulating pasture condition and productivity, thus enhancing business viability.

On these marginal cropping lands, climate variability within seasons, and especially rainfall variability between years, has a major effect on the productivity and condition of sown and native pastures. The variability of stock numbers and inter-seasonal grazing pressure interacts with the responses to rainfall of both pastures and associated crops.

Producers often report that their traditional management practices are not maintaining pasture and land condition and they are introducing different grazing systems. Integrating pastures with forage and cropping provides an opportunity to increase overall property animal production and add value to the sale animals.

The more advanced grazing systems take into account the condition and stage of growth of the pastures, and match stock numbers to the carrying capacity of the pasture to maintain or improve its condition. To do this, the grazing system must be planned, and both stock and pasture condition monitored. As the grazing systems become more intensive, pasture monitoring, feed budgeting, defoliation management, pasture composition manipulation, animal control and more detailed record keeping become integral issues. More details on the role of grazing systems in pastoral intensification have been reported by McIvor and Hall (2006).

Some producers report advantages associated with increasing grazing intensification that are not directly related to the grazing system. Often this results from the manager being more hands-on, planning ahead, for example individual paddock feed budgeting, and considering the health of the pasture within the current season to be as important as the condition of the animals. This allows for proactive stock management well before there is any damage to the pastures from overgrazing. Ultimately, stock numbers are the broadest driver of animal performance, profitability, pasture recovery rates and pasture/soil sustainability. Proactive managers manipulate their stock numbers by purchases, sales or removal to agist-

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<th>Table 1. Property, financial, management and personal considerations/expectations in increasing intensity of grazing systems.</th>
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<td>Grazing system features</td>
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ment to manage their pastures, cattle condition, cash flow and profitability.

There is a range of property, financial and personal attitude issues to consider in the development, management and success of increasing intensity of grazing. Some features of grazing systems and the associated expectations of producers are listed in Table 1. Many of these have not been validated.

**Pasture options**

The marginal cropping lands have a wide range of options for pasture systems in relation to soil types that vary from shallow infertile sandy to deep highly fertile heavy clays. The opportunity of rain every month through summer and winter also increases the possibility of growing summer pasture grasses and legumes, and sown winter legumes, in association with summer and winter forage crops. However, the large variability in rainfall also increases the possibilities of establishment failure and poor production from these fodder options.

**Grasses**

The main sown pasture species used across the region is buffel grass (*Cenchrus ciliaris*). Other species in use include Premier digit grass (*Digitaria eriantha*) on light soils, and Bisset creeping bluegrass (*Bothriochloa insculpta*) and Bambatsi panic (*Panicum coloratum*) on the heavier soils. Other useful grasses in specific roles include: rhodes grass (*Chloris gayana*) as a coloniser; green panic (*Panicum maximum*) for fertile and shaded sites; and purple pigeon (*Setaria incrassata*) for clay soils. There are no well adapted winter-growing pasture grasses.

**Legumes**

Summer-active pasture legumes include the pasture species Caatinga stylo (*Stylosanthes seabrana* cvv. Primar and Unica), desmanthus (*Desmanthus virgatus* cv. Marc, *D. pernambucus* cv. Bayamo, *D. pubescens* cv. Uman) and butterfly pea (*Clitoria ternatea* cv. Milgarra). The common forage legumes are burgundy bean (*Macroptilium bracteatum* cvv. Juanita and Cadarga), lablab (*Lablab purpureus* cvv. Highworth and Endurance) and lucerne (*Medicago sativa*) varieties. All of these legumes are better adapted to heavier textured and more fertile soils. The shrub legume leucaena (*Leucaena leucocephala* cvv. Cunningham, Peru and Taramba) may have a role on more fertile soils, but production ceases with frost. Naturalised burr medic (*Medicago polymorpha*) and sown *Medicago* cultivars can play an important nutritional role in years of high autumn or winter rainfall, especially if this follows a dry summer. These species are suited to the heavier textured soils. There are no well adapted winter pasture legumes for light soils.

Grazing systems on the sown pastures vary according to the pasture growth rate and need for seeding, and are similar to managing native pastures, whereas forage crops are most effectively managed when their yield, growth rate and seasonal conditions are considered. The 3 broad grazing systems (continuous with some spelling, rotational and cells) can all be successfully used with sown pastures. Annual spelling during growing periods and setting stocking rate to match the available feed and its growth rate are important considerations for sustaining the grasses. All species are tolerant of heavy grazing and high utilisation rates, especially during dormant periods, providing there is sufficient rest from grazing during the subsequent growing period. Average utilisation rate of the better adapted sown pastures in this environment is around 30–40%.

**Fodder crop options**

Forage sorghum (*Sorghum* spp.) hybrids are the main summer fodder crop, but are best suited to the more fertile loams and heavy clay soils. Hay production for on-farm feeding or sale can be integrated with grazing.

Forage oats (*Avena sativa*) cultivars are the main option to maintain feed quantity and quality during the cooler months. Depending on rainfall amount and distribution, oats can provide a cattle-finishing quality forage between April and October, when all summer forages are of poor quality.

Grazing grain crop residues from wheat, barley or sorghum, also provide opportunities for integrating the pasture and forage crop grazing systems. Spelling pastures during cropping
phases, especially in summer months after rain, can provide major benefits for pasture regeneration, production and seeding. Forage crops are usually reserved for responsive young stock, which are marketed as they reach the target condition and weight. Electric fencing for strip grazing is an option for managing grazing pressure on crops and allowing regeneration during the season.

Research investigating inputs and outcomes of various grazing systems on native and sown pastures is currently underway in the marginal cropping lands.

Grazing systems research project

Intensive grazing systems, such as rotation and cell grazing, are being adopted by an increasing number of beef producers, including those in the marginal cropping lands. This interest has prompted a research project with Queensland DPI&F, CSIRO and MLA to investigate the environmental, productivity, economic and social interactions of a range of commercial grazing systems across the main land types on commercial beef properties.

Twenty-one grazing systems are being assessed in 74 paddocks covering some 12,700 ha on 9 commercial properties. There are 54 cell paddocks (total 3100 ha), 13 rotation paddocks (5700 ha) and 7 continuous or set-stocked paddocks (3900 ha). Two sites are in the marginal cropping region near Condamine and Surat. The soils and pastures of these sites include red sandy loams with buffel grass in cleared poplar box country, brown clay loams on poplar box creek flats, and heavy grey clays with native pastures or buffel grass in cleared brigalow country.

At the end of each growing season, pastures are assessed for yield, botanical composition, cover and utilisation levels using Botanal (Tothill et al. 1992). Landscape health is recorded as land and soil surface condition by the Landscape Function Analysis method (Tongway and Hindley 1995). Ground cover, stability and woody regrowth are measured annually, while cattle production (live-weight and reproductive performance) is measured periodically throughout the year and seasonal diet quality by near infra-red reflectance spectroscopy (NIRS) is measured monthly within each grazing system. The economics of the systems are being assessed taking into consideration the infrastructure capital, running costs and returns. System management, monitoring, planning and ‘why and how’ decisions to successfully operate the various systems are being examined from property grazing records and personal interviews.

Pasture composition and yield

In the marginal cropping region of the Maranoa in 2006, buffel grass was dominant in the intensive systems (95%) whereas native perennial grasses (37%) and forbs (7%) were more prevalent under continuous grazing. This composition reflected the pastures chosen for the more intensive management systems. Grazing systems can influence the composition of a pasture, mainly by the length of spelling for desirable grass regeneration and seeding in the summer growing period.

At the end of the low-rainfall summer of 2006, average dry matter yields under rotational and cell grazing on 2 soil types were 2060 kg/ha compared with 910 kg/ha under continuous summer grazing. However, the soil surface was protected by a total cover of over 50% in all 3 systems. This occurred despite the drought, indicating that managers were considering pasture health when managing their cattle grazing systems.

Cattle production

Continuously grazed systems have lower stocking rates, but with longer graze periods, than the other systems. For example, a native and buffel grass pasture on a loamy soil in poplar box woodland could support 250 kg steers at 0.34 head/ha over a year, with the pasture receiving 3 rest periods of 1–4 weeks. This compares with an adjacent cell system where 300 head of similar cattle were grazed for 7 grazing periods per paddock during the year averaging 2.6 days per grazing in some paddocks, at stocking rates to 9 head/ha.

The level of cattle growth rates expected in the marginal cropping zone can be gauged by performance in a dry summer near Condamine. Steer (275 kg) growth rates of 0.77 kg/hd/d were achieved over 4 summer months with urea-medicated water on buffel grass pastures in cells on light soils. Similar unsupplemented steers in a continuous grazing system on a mixed pasture of buffel and native grasses on the same soil, were gaining at 0.57 kg/hd/d at the end of summer.
The same cattle receiving a supplement of whole cottonseed in a 3-paddock rotation with buffel grass pastures on clay soils gained 1.4–1.7 kg/hd/d over the summer.

In the marginal cropping zone near Surat, steers on sown Caatinga stylo, Bambatsi panic and native Queensland bluegrass (*Dichanthium sericeum*) pasture on a good brisialow soil have gained 0.66 kg/hd/d in summer months and 0.48 kg/hd/d in winter months (Hall and Douglas 2000). This was equivalent to a liveweight gain of over 100 kg/ha/yr. Steers have averaged 0.93 kg/hd/d over 9 months between June and February grazing forage oats in winter and green grassy pastures in summer on a heavy clay soil (T.J. Hall unpublished data).

There are limited recorded data on liveweight gains from the range of forage systems available and across the range of seasons experienced in the marginal cropping zone; however, NIRS technology can provide a guide to diet quality and cattle performance on a range of forage types.

**NIRS diet quality**

Planning pasture and forage options and their associated grazing systems can be assisted by using faecal NIRS analysis to identify the seasonal quality of the cattle’s diet over the life of the forage. For example, crude protein in a buffel grass pasture on red soil poplar box country was over 10% when the grass was green in March, but insufficient for cattle maintenance at 5% when mature during a dry winter (June-July) (Figure 1). There was a spike in diet protein level when naturalised burr medic growing after winter rain in August made up 46% of the diet for a short time.

Incorporating summer forage crops such as lablab and sorghum can extend the period of good-quality feed, and therefore a higher rate of liveweight gain, well into autumn, after which winter forage, such as oats, can replace the rapidly declining quality of grass pastures or summer forage crops. Forage oats during winter can rapidly increase feed quality at this nutritionally difficult time of the year and also allow spelling of the grass pastures, which may improve the chance of rapid pasture regrowth from spring and early summer rain. NIRS results from steers grazing oats show protein levels of 15%, with digestibility of 65%, increasing from near maintenance levels on dry buffel grass (Figure 1). The average crude protein levels in the diet of the buffel, sorghum and oats forages were 7.3, 9.7 and 13.7%, respectively, at average digestibility levels of 55, 58 and 62%, respectively. Rainfall amount and monthly distribution will have a major impact on the ability to produce these different seasonal forages and on annual cattle performance from integrating forage systems. The forage systems will have a much larger effect on cattle performance than will the actual grazing system used for each forage.

**Figure 1.** Maintaining crude protein (%) over 13 months by combining a sequence of 3 forage types: buffel grass, forage sorghum-lablab, and oats in the marginal cropping zone.
A combination of these 3 forage types provided a diet with about 8% crude protein or higher throughout the year, although digestibility declined to 53% in June when the sorghum was consumed and oats forage not yet available. Managing cattle nutrition during transition periods from grazing one forage to another is an annual problem, exacerbated in poor rainfall years. Where forage crops provide a low proportion of the annual feed supply, a larger percentage of the herd must be grazed on grass pastures declining in quality during winter and spring, which will limit their performance. Options of lot-feeding, agistment or selling can be used to preserve both pasture and animal condition during this annual period of nutritional stress.

Monthly NIRS analyses predicted an average liveweight gain of 0.96 kg/d over the 9 months, with a gain up to 1.4 kg/d when grazing oats (Figure 2). Cattle remaining on the dry buffel pasture in this below average rainfall year had a declining growth rate from March, with the exception of a short period in August when medic grew following winter rain. The average predicted liveweight gains over the grazing periods on the buffel, sorghum and oats forages were 0.59, 0.85 and 1.12 kg/hd/d, respectively.

Besides being a tool for managing the nutrition and supplementation programs of cattle on pastures and forages, NIRS could be used in making decisions to agist stock, for example short-term backgrounding, to utilise a surplus pasture or crops and in calculating the value of the forage based on yield and quality.

**Conclusion**

By combining various grazing systems and forage sources, high-quality feed can be made available to cattle throughout the growing season, mainly based on grass pastures, providing seasonal rainfall suits the growth patterns of the forages. In addition, by incorporating spelling systems, pastures can recover and seed while soil moisture levels and ambient temperatures will still support growth. Diet quality can be maintained at a higher level into autumn with carry-over summer forages, such as sweet sorghum and lablab, before introducing high-quality forage oats for winter and spring. Managing the transition periods between the grazing times for the different forages can be difficult, especially in drier years. In years with high winter rainfall, naturalised medic can supplement the diet while grass pastures are at their lowest quality. Pasture productivity and sustainability can be maintained by incorporating planned grazing systems during the pasture grazing periods and taking advantage of the additional spelling opportunities provided while crops are being grazed.

**Figure 2.** Liveweight gain (kg/hd/d) over 13 months for steers grazing buffel grass, sorghum-lablab and oats forages in the marginal cropping zone, as predicted by NIRS (experimental analysis).
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References


