Pastures for animal production: Understanding the challenges

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Abstract. *Tropical and temperate pastures provide a low-cost and effective feed-base for almost all New South Wales livestock enterprises, yet significant constraints limit the potential performance and profitability of such systems. Total dry matter yield and the proportion of dry matter yield utilised remain the most common factors that constrain productivity. Management strategies that address these challenges remain the most appropriate and rewarding ways to lift profitability for most livestock producers. Where a system is already being managed for optimal harvest of dry matter yield, opportunities exist to manipulate ways to improve feed conversion efficiency. This paper explores potential nutritional constraints for pasture-fed sheep and cattle and highlights opportunities to improve feed conversion efficiency through pasture management and the use of complementary supplements.*

Introduction

The use of grazing sheep and cattle to harvest pasture in situ remains the cornerstone of the simple, low-cost animal production systems of New South Wales (NSW). These systems are characterised by a diversity of grass/clover and herb blends, ranging from native pastures to tall fescue, phalaris and annual and perennial ryegrass pastures, with pastoral systems dictated by environmental and climatic constraints, stock types and management techniques.

Most traditional pasture-based systems are characterised by the synchrony of peak demand by stock with the peak periods of pasture growth. The simplicity and efficiencies of a supply-demand driven pastoral system are tempered by the challenges of matching pasture supply with animal demand. Inconsistent pasture production as a result of drought, hot or cold climatic conditions, and limitations of soils, drainage and pasture species reduces the effectiveness with which animals may be reliably sustained by pasture. Nutritional imbalances associated with pasture, including high or low levels of structural and non-structural carbohydrates, crude protein, trace elements and minerals and the presence of anti-nutritional compounds can limit the performance of grazing sheep or cattle.

A growing number of traditionally lower input NSW beef systems are now strategically incorporating supplementary feeds into pasture-based systems, recognising the potential vulnerabilities and inefficiencies of pastures as an ideal feed for cattle.

This paper will identify practical opportunities to optimise the productivity of cattle and sheep within pastoral based systems.

1. Quantitative aspects of feeding sheep and cattle on pasture

Within temperate regions of NSW, the generally favourable climate promotes the growth of highly digestible, high crude protein (CP) pastures for the cooler months of the year, particularly between the months of April and October. Tropical species of pasture offer greater challenges, being characterised by a lower CP, less digestible sward that is less favourable for efficient animal production.

While extremely cost competitive, the potential disadvantages of pasture-based systems are numerous. Inadequacies and potential constraints of grazing vs. more intensive management systems, including feed-lotting, are summarised in Table 1.

2. Productivity by NSW pasture-fed sheep and cattle: potential inefficiencies

Potential live-weight gain and reproductive performance of pasture-fed sheep and cattle are often below genetic potential, and are lower than those reported for animals offered high quality supplements and/or full total mixed rations (TMR).

Beef cattle that grow more quickly are more efficient than those growing more slowly because faster growth rates ‘dilute’ the fixed costs of maintenance over a proportionately greater weight gain. For example, a 200 kg live-weight beef heifer has a daily energy demand for 33.7 mega joules of metabolisable energy just for maintenance requirements – that is, this energy intake will just cover her daily requirements to survive with no weight-gain (Table 2). If the 200 kg heifer is offered poor quality pasture and grows at 350 g/day live-weight, her fixed maintenance costs are being ‘diluted’ down

Table 1. Advantages and disadvantages of grazed pasture systems, NSW style versus Total Mixed Ration (TMR) systems for feed-lotting

Factors	NSW pastoral systems	Feed-lotting
Manure disposal and spreading	None	Extensive disposal facilities required
Capital investment	Can be minimised	Can be significant
Working expenses	Can be minimised	Can be significant
Metabolic cost of walking and grazing	Can be an important cost for lower stocked properties with expectations for high per head productivity	Lesser for feedlot situations
Vulnerability to external market forces	Less directly affected by prices of forages, grains but vulnerable to fertiliser, herbicide etc costs.	Vulnerable to market volatility (forage, grain and protein meal prices)
Per head performance (weight gain etc)	Will be limited by nutritional and intake variation	Can be increased to approach limits of genetic capacity
Protection from adverse conditions	Limited unless irrigated	Better (in most cases) but still vulnerable to drought affecting supply and price of purchased feeds and stock
Harvest and storage of forages	Minimal required, *in situ* grazing efficient, however wide range of pasture utilisation between systems	All forages stored
Vulnerability to effects of climate on forage growth	Vulnerable if supplementary feeds not in system	Less vulnerable on short term basis but vulnerable to forage and grain prices influenced by drought
Losses associated with forage storage	Can be significant (shrinkage losses for silage and at feed out) but lesser proportion of total diet consumed	Can be significant (shrinkage losses for silage and at feed out). Losses high relative to total diet consumed
Control of nutrient profile of daily diet	Large variation in nutrient profile of pasture, day to day/season to season	Less variation in silages/concentrates as feed base
Dry matter intake	Can be unpredictable; often restricted by supply, not need	Known and consistent within small limits
Dietary palatability	Inconsistent, uncontrolled	Can be controlled
Anti-nutritional factors associated with each system	Phalaris staggers, endophyte (perennial ryegrass); Fusarium; nitrates	Silage/grain associated mycotoxicoses; nitrates in stored feeds

over 350 g of live-weight. That is, 78.7 per cent of her daily energy needs are being used simply to survive. Conversely, if the same heifer is being fed a better quality pasture, is being offered more kg dry matter (DM) and grows at 950 g/day, her 'fixed' costs of maintenance are diluted down over more live-weight gain.

3. Animal production from pasture: key factors involved

Several aspects of the nutritional profile of pasture may limit the productivity and performance of pasture-fed stock. The more important limiting aspect of pasture as a complete feed for cattle and sheep is the inconsistency between pasture DM supply versus DM demand.

(a) Control of feed demand

The annual feed demand for a pasture-based system is defined by the following:

(i) Stocking rate – Animals per hectare (expressed as DSE/ha) is a key determinant of DM demand. Inappropriately low stocking rates can equate with low DM demand, and the potential for pasture wastage, unless surplus grass is conserved. High stocking rates can be extremely efficient, provided individual animal productivity (weight-gain, wool production and/or reproductive performance) is not compromised.

(ii) Calving or lambing date – Different properties are characterised by a range of calving or lambing patterns, which makes any general comparisons or recommendations difficult. Generally, the peak demand for a property is matched with the peak supply of feed. A later than planned start to calving or lambing and an inappropriate calving/lambing spread will mean greater difficulty with matching feed supply with demand, particularly for properties with short growing seasons. Strategic use of supplements may allow earlier calving

Table 2. Daily mega joules of metabolisable energy (MJME) requirements for a 200 kg live-weight heifer gaining weight at a range of different daily live-weight gains (between 350–950 g/head/day), and the percentage of energy needed for live-weight gain (expressed as a total of daily energy intake)

	Predicted live-weight gain (g/head/day)				
	350	500	650	800	950
MJME for maintenance	33.68	33.68	33.68	33.68	33.68
MJME for live-weight gain	9.10	13.31	17.73	22.37	27.25
Total daily MJME intake	42.78	46.99	51.41	56.05	60.93
MJME for weight gain (as % of total MJME)	21.3	28.3	34.5	39.9	44.7

or lambing, to take advantage of a better matching between peak supply of pasture and peak demand by stock.

(iii) Per head feed demand – The daily nutrient demand by individual animals is a key determinant of the total demand for DM. In turn, the daily nutrient demand is set by your ambitions for 'per head performance' and productivity for finishing lambs or young cattle, and the physiological state of animals (eg. pregnant or lactating).

(b) Pasture production and harvest

The basic requirements for pasture growth include the correct balance of soil nutrients (nitrogen, phosphorus and potassium), soil pH, temperature, moisture and soil drainage and solar radiation. Not all pasture that is grown is harvested by animals or conserved; the balance is lost from the system by death and decay. Best-practice pastoral farming should aim to optimise:

- *Pasture grown* – through 'top-shelf' agronomic practices (including appropriate plant nutrition) and by controlling variables such as moisture through irrigation where possible, and the selection of the appropriate pasture species and cultivars for that system.
- *Pasture harvested* – influenced largely through grazing management and by stocking rate, utilising stock and areas out for cropping, 're-grassing' or forage conservation. Poor pasture utilisation remains one of the key constraints that limits the effective conversion of pasture DM to live-weight gain.

(c) Net herbage production

Net herbage production is the balance between new growth and senescence of older tissues (Figure 1).

For cattle grazing ryegrass, pasture mass must be maintained between 1,400–2,800 kg DM/ha, and preferably between 1,500–2,500 kg DM/ha (Holmes *et al.* 2002) to optimise net pasture production. Target pasture heights are lower for tall fescue 'cattle pastures'

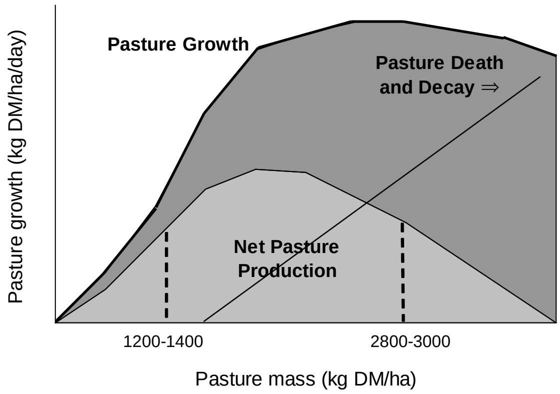

Figure 1. Net pasture production from a cattle-grazed perennial ryegrass pasture, as influenced by pasture death and decay (Adapted from Langer, 1990).

and are dependent on the time of the year because lower residuals are required to ensure removal of seed heads and to optimise pasture quality.

(i) Allowing pastures to go rank – Grazing any grass when the lower leaves are being lost through death and decay is one of the key reasons contributing to the sub-optimal profitability of pastoral farming. Loss of green material in the base of the sward equates to net loss of DM; a deterioration of pasture quality and poor conversion of DM to live-weight gain. In most cases, developing strategies to improve the utilisation of pasture by grazing animals is the most immediate and likely to improve profitability for any pastoral system. Other unwanted outcomes from allowing pasture to become tall and rank include:

- Higher pasture mass causes a lower density of tillers, with the average size of tiller larger than for more intensively grazed swards. Clover populations may be reduced at a higher pasture mass due to shading
- Poor harvesting efficiency – tall rank pastures become clumpy and sheep particularly will not utilise these well. Even for cattle, tall pastures are harvested inefficiently because the pasture is not

easily removed during grazing equates to more residual grass remaining

- Poor palatability – palatability of the grass component of tall swards is poorer than short better quality pasture.

Accumulation of seed heads may increase problems of:

- Poor pasture quality
- Ergot infection of grass seed heads and associated risks of ergot toxicity
- Greater risk of endophyte toxicity for older cultivars of perennial ryegrasses
- Seed drop by potentially unwanted grass species.

(ii) Low pasture mass

- Tiller density is increased by grazing pastures to low post-grazing residuals provided the sward is not overgrazed
- Grazing of grasses to inappropriately low residuals will reduce plant reserves of water-soluble carbohydrates, reduce root development and the production of new shoots, and potentially decrease net DM production
- Overgrazing opens up a sward, increasing challenges of broad-leaf weeds and unwanted grass species
- Grazing to low post-grazing residuals may increase intake of some anti-nutritional factors. Ingestion of the perennial ryegrass endophyte toxins ergovaline, lolitrem B and other endophyte alkaloids are greatest in the base of the sward (Fletcher 1998).

(d) Helping animals to manage grass quality within the optimum grazing horizon

Higher stocking rates, either by running more DSE/ha, or by cropping more areas or taking surplus pasture out for silage or hay, favour improved grass quality through improved utilisation of the sward. In some situations, it will be necessary to control surplus pasture, even for higher stocked properties by buying in additional stock or conserving some surplus as hay or silage where topography permits.

Care is needed when using valuable stock classes to clean up stemmy very poor quality pastures during spring months when grasses are heading. For example, if spring-joined beef cows are used to clean up rank stemmy tall fescue pastures, 'in-calf rates' are likely to end up below target. In many cases, it is better to conserve a surplus of poor quality pasture as silage or hay (and accept that the quality will not be much good) rather than forcing high value or vulnerable stock to clean paddocks out.

4. Grazing systems and sheep and cattle nutrition: a practical 'boots on' approach

For most pastoral producers, the principles of advanced ruminant nutrition have been, and for many will remain, irrelevant. Animal live-weight gains are typically low, well below the genetic capability of the animal. Animal production often has a greater relationship to soil type, environment, pasture species, pasture cultivars and to the vagaries of climate than to the application of an advanced knowledge of animal nutrition. In many cases of sub-optimal pasture nutrition and poor live-weight gain per hectare, basic fundamentals including simply growing and harvesting (utilising) more DM should be addressed well before seeking resolution of the specific nutritional constraints of pasture. A small but growing number of producers are applying more advanced feed and animal management techniques to pasture-based systems in order to significantly improve productivity.

(a) The challenges of meeting the nutritional demands of pasture-fed stock

As discussed previously, grazed pasture in most localities is rarely available in consistent quantities throughout the season. Deficits in supply of DM must be met by appropriate supplementation, in combination with appropriate pasture management, agronomy and fertiliser to maximise net herbage production. Individual farmer choice and circumstance will determine stocking rate and hence availability (or not) of surplus pasture to be carried over as hay or silage to supplement periods of inadequate growth. Where annual feed demand exceeds the ability of the farm to grow the total required DM, off-farm feed must be sought, giving opportunity to choose feeds most appropriate to complement pasture or stock must be removed. Purchased and/or stored feeds can be readily tested for nutrient composition, feed value and relevant physical and chemical characteristics. Provided harvesting, manufacturing, storage, handling, transporting and mixing management are appropriate or relevant, composition for most feeds will remain stable as tested.

Grazed pasture can change in composition throughout the day. Such changes are insignificant to the average ruminant – total DM intake is most often the first limiting factor on animal performance, not minor changes in nutritional composition. Pasture composition throughout the area available to graze will also change. Legume-to-grass ratios vary, as do grass species. Any feed testing samples of pasture will be specific to that sample only, and are often not representative of the pasture intake by all animals. The practicality and economics of testing numerous pasture samples throughout the day, everyday, is unrealistic. To a limited extent, pasture management (especially manipulation of rotation length, strategic use of N fertiliser, varying pre- and post-grazing levels when rotationally grazing) can be used to optimise consistency of pasture, but a degree of variability remains.

(b) Maximising dry matter intake

For feed lots, TMR are formulated to optimise DM intake. For pasture systems, the management of both pasture and animals must be fine-tuned to maximise intake for pasture-fed animals. Pasture is not a nutrient-dense feed, and as grazed is sometimes of very low DM per cent, particularly over the winter and spring. To optimise nutrient intake from pasture, animals must consume huge volumes of wet feeds. During periods of rapid growth, especially in spring and autumn, pasture DM per cent may be as low as 10–15% wet weight for high quality, well managed temperate pastures. Total mixed rations can be formulated at 40–60% DM, necessitating a much lower dietary wet weight intake. For wet pasture, stock must take more mouthfuls, often in more energy demanding circumstances, to obtain equivalent DM intakes.

Optimising DM intake in grazing animals requires excellent animal management to ensure that motivated stock want to, are able to, and can process high volumes of wet pasture. Pasture must be presented to the animals in such a manner as to enable maximum 'swallowable' bite sizes, collected in minimum time, for maximum hours per day. Deficiencies in animal management can frequently be 'hidden' by excellent ration formulation in a TMR feedlot situation. Deficiencies in animal management in a grazed situation result in significantly lower nutrient intake and/or excessively high rates of condition loss.

(c) Dry matter intake challenges for pasture-fed dairy stock

Dry matter intake is calculated as:

$$\text{Dry matter intake} = T \times R \times S$$

Where T = time available for grazing; R = bites per unit time; S = average bite size

(i) T or time available for grazing – Adverse weather conditions can limit the time spent grazing. Sheep and cattle huddling for shelter in driving rain, for example, may spend less total time grazing but need to meet higher maintenance requirements. Conversely, stock that seek shade under hot conditions or spend considerable time walking to sources of stock water have a reduced grazing time.

(ii) R or bites per unit time – This is influenced by feed or pasture characteristics and by animal factors. Leafy, high digestibility dense pasture is quickly collected – bite numbers per minute can be equal to that for TMR fed stock on a feedlot, provided bite size does not limit speed and ease of swallowing. Most cattle TMRs consist of food particles of less than 25 mm in length – pasture as grazed can be of significantly longer length, impeding the ability of some cattle to quickly propel each bite down the oesophagus.

- It is unlikely that low DM% pasture *per se* limits performance, but to collect 10 kg DM of wet grass may necessitate a wet volume intake of 100 kg of 10% DM pasture. Cattle do adapt to high wet volume diets by better and bigger rumen capacity.
- As pasture ages or enters the reproductive stages, shear time may increase, slowing the rate of collection, and decreasing the number of bites per unit time, compromising performance. Shortening rotation length, strategic N use or removal of some feed to be conserved may aid intake. Surface moisture on external leaf surfaces can change the coefficient of friction, and hence slow down bite rate via slower swallowing times. This has implications for ruminants grazing in wet weather, when energy requirements are likely to be increased, or following heavy dew.
- Animals must also be managed to want to eat that extra mouthful. Clinically or sub-clinically ketotic animals (ewes pre-lambing, beef cows after calving) and/or rumen acidotic animals have depressed appetites – they take less bites per unit time, and eat for less total time.

(iii) Average bite size (S) – Average bite size will primarily be influenced by pasture length. Long pasture does not, however, guarantee maximum bite size, especially where the proportion of stalky material is high. Collecting handfuls of grass is a practical method of determining the average sheer height and 'ease' of collection by cattle. Try wrapping pasture around your fingers and tearing off the pasture – this is exactly how cattle need to graze, by tearing pasture off with their tongues (compared with sheep that graze by biting off pasture). Cattle grazing tougher pasture frequently need to 'tug' –slowing rate of bites, and the bite size collected may be less than optimum.

Short pasture (less than 15–20 cm for cattle) may restrict bite size, there being physically less material available to collect – this can be of consequence when having to compromise between short pasture to maintain quality (eg. tall fescue that is heading) and optimal per head animal productivity.

Pasture plant and leaf density will influence final bite size as well as bite rate. In some poor quality, low-density pastures, animals have to take more steps between bites and each bite collected may contain less material, limiting total DM intake.

(d) 'Balancing' some specific nutritional challenges of pastures

While there is much debate on the potential performance limitations placed on grazed sheep or cattle by changes and deficiencies in the nutritional composition of pasture diets, the opportunity to fine-tune or to 'rebalance' dietary intake is limited for most producers.

In a high performing TMR fed feed-lot animal, rumen function and live-weight gain potential are optimised by ensuring a constant supply of feed to the animal with a consistent known nutritional composition, chosen to stimulate maximum potential production. Even when the nutritional deficiencies of pasture are known, and can be supplemented by offering other feeds (eg. silage or grain), what is actually in the rumen at any given time may have little resemblance to the ration as formulated. True TMR diets are impossible to mimic if grazed pasture is a significant proportion of the total diet. Complementary feeding by offering supplements to pasture-fed sheep or cattle is targeted at improving total DM and nutrient intake, encouraging better rumen function, enhancing animal health and grossly balancing nutrients at a rumen level.

(i) Crude protein (CP) and amino acids

Too much CP – Sheep and cattle reared on high quality grazing systems develop a tolerance for high intakes of highly degradable dietary CP. Rather than limit the CP intakes, it is more economical and practical for producers to enhance 'capture' of CP by providing more dietary starch and sugars, thus producing more microbial protein, less ammonia or to dilute total dietary CP intake by using low CP feeds as part of the diet. This is of particular relevance when transitioning sheep or cattle off poor quality, low protein summer pastures onto post-autumn break 'flush' feed. The amino acid profile of pasture might not be considered optimal for maximum live-weight gain but realistically, amino acid nutrition is of limited relevance for pasture-fed cattle and sheep. Total CP intake over the summer when pasture quality is poor is more likely to constrain animal productivity than deficiencies of specific amino acids. Exceptions may include intake of sulphur- (S) containing amino acids for wool production, due to the requirement for S-containing amino acids during wool growth.

Insufficient CP – More commonly for young sheep or cattle on poorer quality summer grass-dominant pasture, CP deficiency may constrain potential live-weight gain. Older sheep and cattle have lesser requirements for CP and better tolerate pastures that contain low levels of CP. For young sheep and cattle, the financial benefits of supplementing a poor quality pasture with a high CP supplement (eg. concentrate that contains canola or soybean meal), or summer crops where climate is favourable must be evaluated on a cost-benefit basis. Under some circumstances, urea can be fed to sheep and cattle, however, care is needed with the delivery of urea (ideally urea needs to be blended with a carbohydrate source such as grain or molasses to improve the utilisation of urea and to reduce risk of urea toxicity). Expectations of animal productivity from urea-supplementation should be considerably lower than for animals supplemented with sources of true proteins.

(ii) Non-structural carbohydrates – Non-structural carbohydrate (NSC) is often the second most significant limiting nutritional factor in pasture-fed, high performance sheep or cattle, after total DM intake. On high quality, N boosted/high CP pasture, a significant amount of dietary N is lost via degradation to ammonia because of a lack of complementary intake of NSC. Consequent conversion to urea is energy-demanding, further exacerbating loss of live-weight gain potential. Rapidly fermentable sources of NSC such as cereal grains or molasses may contribute to lowered rumen pH, particularly if the supplement is fed out only two to three times per week. Sub-clinical acidosis can depress total DM intake, impair rumen function (particularly cellulose and hemicellulose digestion), and reduce feed conversion efficiency. Pasture intake falls, and substitution can occur (substitution means wastage of pasture when supplements are fed). Of concern is the possibility that rumen acidosis may also contribute to a greater incidence of lameness in cattle (Westwood *et al.* 2003). Depression of rumen pH is most commonly attributed to high concentrate and poorly designed TMR diets, but the potential for pasture-only diets to cause sub-acute acidosis should not be ignored. As previously mentioned, anything that depresses the appetite in sheep or cattle operating on a less than perfect diet will have significant effects on performance.

(iii) Fibre – Neutral detergent fibre (NDF) levels in pasture vary with climate, season, species and cultivar composition, grazing management and fertiliser regime. For maximum live-weight gain and production potential and high DM intake, pasture management aims to provide highly digestible, leafy, 'easy-to-collect' feed. By its very nature, such pasture may have inadequate physically effective NDF (peNDF) for cattle (and occasionally sheep), characterised by less cud-chewing (fewer than 45 chews per cud for cattle), lower rumen scores and loose faeces. Where CP levels are also high, dung may be extremely fluid, dark and bubbly. Excessively loose faeces are unacceptable in cattle for which there is a high live-weight gain expectation. Lengthening the rotation length or supplementation with long stem fibre (eg. hay, cereal straw) may be necessary to improve rumen pH and function. Use of

buffers and rumen modifiers with supplementary feed may help.

(iv) Macro and trace minerals and vitamins – As well as variability of macro-nutrients, the mineral and vitamin content of pasture is inconsistent. Concentrations of minerals and the presence of other antagonistic factors that impede uptake and the absolute DM intake combine to determine actual mineral availability. For most sheep and cattle fed sufficient quantities of leafy pasture, macro, trace mineral and vitamin deficiencies are rarely directly limiting on live-weight gain or milk production. Limitations can occur on very poor quality grass dominant summer pasture and are influenced by soil type and previous fertiliser history. The low phosphorus concentration of tropical grasses and legumes are well known, particularly for mature and stemmy tropical pastures. Other nutritional attributes of tropical pastures may limit productivity, for example, low concentrations of calcium in tropical pastures vs. temperate pastures, however, high performance stock classes with an above average demand for calcium (eg. lactating dairy cattle) are unlikely to be wholly reliant on tropical pastures as a high substantial proportion of the diet. Conversely, magnesium concentrations are lower in temperate than tropical pastures and supplementation of pregnant or lactating beef cattle with magnesium is often appropriate. As performance expectations increase; especially for extremely rapid live-weight gain, production requirements for minerals do become more significant. Feed and animal levels can be tested, monitored and adjusted as per the National Research Council (NRC) 'Nutrient Requirements of Sheep' or the NRC 'Nutrient Requirements of Beef Cattle', with recommendations as appropriate.

(v) Anti-nutritional factors – Anti-nutritional factors present in pasture do directly limit performance. The perennial ryegrass-associated fungal toxins (lolitrem B, ergovaline, sporidesmin) have significant effects on production, animal health and profitability where older cultivars of perennial ryegrass form the feed-base for pasture-fed sheep and cattle. Phalaris staggers remains a risk factor for sheep grazing phalaris. Nitrate toxicity is a risk factor for cattle and sheep grazing annual pastures sown for winter feed production.

Conclusions: lifting per head productivity for pasture-fed sheep and cattle

The significance of pasture quality as a potential limiter for animal productivity is largely influenced by a producer's expectation of per head and per ha productivity. Too many NSW properties are growing insufficient DM per ha and are under-utilising pastures grown, and these two key factors dictate both per head and per ha live-weight gain. For many producers, it is more important to consider ways to grow more forage (kg DM/ha) and to harvest/utilise more of the DM grown. Better NSW producers achieve 70 per cent utilisation or more of pasture grown, with benefits of better live-weight gain per hectare and improved per head performance due to better pasture quality. Gains occur through improved pasture management, control of stocking rate and optimum pasture mass (DM/ha).

Opportunities exist for producers who are already achieving excellent pasture DM production and utilisation to improve per head productivity by complementary feeding – that is, supplementing high performance pastures with relatively small quantities of supplements, including extra starch to increase the daily energy intake, or fibre to improve rumen function on high quality lush pasture. Understanding the nutritional constraints of pastures throughout the year is the key to the development of strategic use of complementary supplementation. The realisation of profit from such opportunities relies on a presumption that the DM yield and utilisation (harvest) of pasture is already at optimal levels and profit is sensitive to both supplementary feed prices and cattle or sheep sale prices.

Conversely, changes to pasture management can often be relatively simple and cost-effective to implement, such that pasture utilisation can be improved. All production systems should critically evaluate DM grown and harvested per ha and seek efficiencies in this area. For specific stock classes at times of the year when they are rewarded by sufficiently high premiums, additional benefits may be gained from complementary feeding.

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