



NSW DEPARTMENT OF
PRIMARY INDUSTRIES

Realistic Rations - Readers' Note

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Costing pasture & supplements

Aims of this section

Pasture is the most important source of feed for dairy cattle in Australia. It can supply a well balanced diet very cheaply—this is important if we are to maintain our dairy industry’s competitiveness in the world export market.

But there are occasions when pasture alone is not the best feed for the cow.

In this section you will gain a greater knowledge of:

- when and why pasture may not be adequate for feeding cows
- how much pasture can cost as a feed
- when and why feed supplements are used
- how to feed supplements
- how to use cost to compare supplements.

Knowledge level required

To understand this section you will need some knowledge about pasture types and how they are established and used. This information is given in the DairyLink manuals *Establishing Pastures* and *Managing Pastures*.

Why not feed pasture alone?

Pasture is recognised as the cheapest source of feed for dairy cattle. It does not need to be harvested or stored and it doesn’t need special facilities for feeding out. The cow harvests what she requires. But you must still make sure that the quality and quantity of the pasture available is adequate for your cows’ needs.

How good is pasture as a feed?

The quality of pasture can vary from excellent to very poor, depending upon the species of pasture and its maturity. Tables 2.1 and 2.2 compare different pasture species at different stages of growth.

Table 2.1 shows that the younger the pasture, the greater the energy and protein content and the overall digestibility. So should we feed cows only young pasture?

The answer is both yes and no. It depends upon the physiological state of the cow, her genetic potential for milk production and the nutrient balance in the pasture.

Table 2.1: Changes in protein and energy with maturity and after grazing in a ryegrass pasture (from Feed Evaluation Service Database)

Stage of maturity	Dry matter (%)	Metabolisable energy M.I.ME/kg.DM	Crude protein (%)
Young ñ early vegetative	10	11.2	24.6
Flowering	22	9.1	13.8
Regrowth (32ñ38 days)	14	10.9	21.8

Table 2.2: Changes in energy, protein and yield in an oat crop as it matures (from Cole VG, 1981, Guide to Fodder Crops for Livestock, Macarthur Press

Stage of maturity	Metabolisable energy MJME/kg DM	Crude protein (%)	Yield kg DM/ha
Immature	12.8	28	2000
Early bloom	12.0	15	6000
Full bloom	8.3	10	8750

Energy

Young lush pasture has a very low dry matter content. Remember that all nutrients in a feed are compared with the dry matter content. In young ryegrass, the energy content is 11 MJ of ME per kg dry matter and the dry matter percentage is only 10%. The digestibility of the pasture is high (80%) and the fibre content (ADF) is low.

If we are feeding the cow from the example on page 1.18 (a 550 kg cow in late lactation producing 15 litres per day), you will remember that she required 149 MJ of ME a day. Her total dry matter intake (using the 'rule of thumb' equation on page 1.12) is 15 kg. At full appetite, the cow could eat 132 MJME from the lush ryegrass pasture ($15 \text{ kg} \times 11 \text{ MJ} \times 0.80$ [digestibility]), which is 17 MJ less than the energy she requires.

This intake is equivalent to 150 kg of fresh feed, of which 135 kg is water (10% dry matter means 90% water content). The cow would need a large number of hours grazing to take in this much fresh feed. If her grazing time was restricted, the energy deficit in the diet would be greater.

If the same cow was in early lactation, with the potential to produce a peak milk yield of 40 litres, her potential dry matter intake would be 20 kg. Her total energy requirement would be 270 MJ of ME a day.

At full appetite, this cow would be able

to consume only 176 MJME from the pasture.

Pasture that has enough energy for a late lactation cow can be unsuitable for an early lactation cow producing 40 litres. However, this pasture may be able to provide enough energy for an early lactation cow with lower production or a late lactation cow.

Energy is only one nutrient we need to consider in pasture. Even if enough energy is provided, deficiencies or excesses of other nutrients can occur. The protein, fibre, macro mineral, micro mineral and trace element contents now need to be considered.

Protein

Lush spring pastures (especially ryegrass and white clover) are usually high in protein (mainly RDP). Pasture is not a good source of UDP. Only 10% UDP is provided by most pastures. High-producing early lactation cows require at least 30% UDP in their diet.

If the RDP content of the pasture is too high, an excessive amount of ammonia will be absorbed from the rumen; this will need to be converted to urea before it is excreted in the urine. High blood levels of both ammonia and urea can reduce fertility. There is some debate about what pasture protein percentage or blood urea level is damaging to the cow and her fertility. New Zealand cattle reportedly can eat diets with RDP levels much higher

than those said to cause fertility problems in American dairy cattle and have no ill effects.

Kellaway suggests that RDP intakes greater than 11 g/MJME can lead to fertility problems.

Example: A ryegrass pasture has a crude protein content of 31%, energy level of 12 MJME and dry matter content of 15%. Could this pasture cause a fertility problem?

In most pastures 90% of the protein is RDP. The amount of crude protein for each kg of dry matter is $31 \times 15 = 465$ g protein/kg DM, of which 90% or $465 \times 90/100 = 418.5$ g is RDP.

If we divide the amount of RDP by the energy content of the pasture ($418.5/12$), we get 35 g/MJME, which more than three times over the threshold suggested by Kellaway. This pasture may be the cause of fertility problems in the herd.

Fibre

The proportion of ADF in the NDF fraction of a plant increases as a plant matures—the proportion of indigestible components in the plant increases.

Some pastures have higher levels of NDF at all stages of growth. Kikuyu and paspalum have considerably higher NDF levels than ryegrass and clover.

In young pasture, the low NDF % is accompanied by high crude protein percentages. Since the digestibility of the pasture is high, there will be a rapid passage of feed through the rumen. Excess protein will enter the rumen and be degraded. The nitrogen is converted to ammonia for excretion into the bloodstream and processing into urea. The effect of high ammonia levels was discussed in Section 1.

Mature pastures contain higher percentages of NDF with a higher proportion of indigestible components. The energy content of these pastures is lower because the indigestible fibre can prevent the rumen microbes from reaching and digesting the starches and sugars of

the pasture. There is a slower passage of the feed through the rumen. Cows may reach ‘gut fill’ before they can take in enough energy.

Minerals and trace elements

As indicated in the DairyLink *Managing Pastures* manual, the mineral content of pastures can vary considerably.

Most minerals and trace elements are supplied to the plant from the soil. Some soils can be naturally deficient or can become depleted after long-term cropping or grazing. Fertilisers can replace some lost minerals, such as phosphorus, potassium and sulphur. The change in soil pH after fertiliser use can make trace elements such as selenium and cobalt unavailable to the plant. Irrigation and heavy rainfall can leach minerals from the soil or can change the oxygen content of the soil, and this can change minerals into forms that are unavailable to the plant.

Legumes are usually low in trace elements such as selenium, and grasses can be low in copper. Pasture species such as kikuyu can be deficient in calcium and sodium but can contain very high levels of potassium.

Summary

Pasture, although a very good feed source, may not be an adequate feed for high levels of milk production, weight gain, fertility and overall health throughout the year. Supplements can replace the shortfall in pasture quality and quantity or optimise rumen microbial activity during times of excess nutrients.

Substitution

Cows will reduce their intake of pasture if they are offered a dietary supplement. The **rate of substitution** is the reduction in pasture intake divided by the weight of the

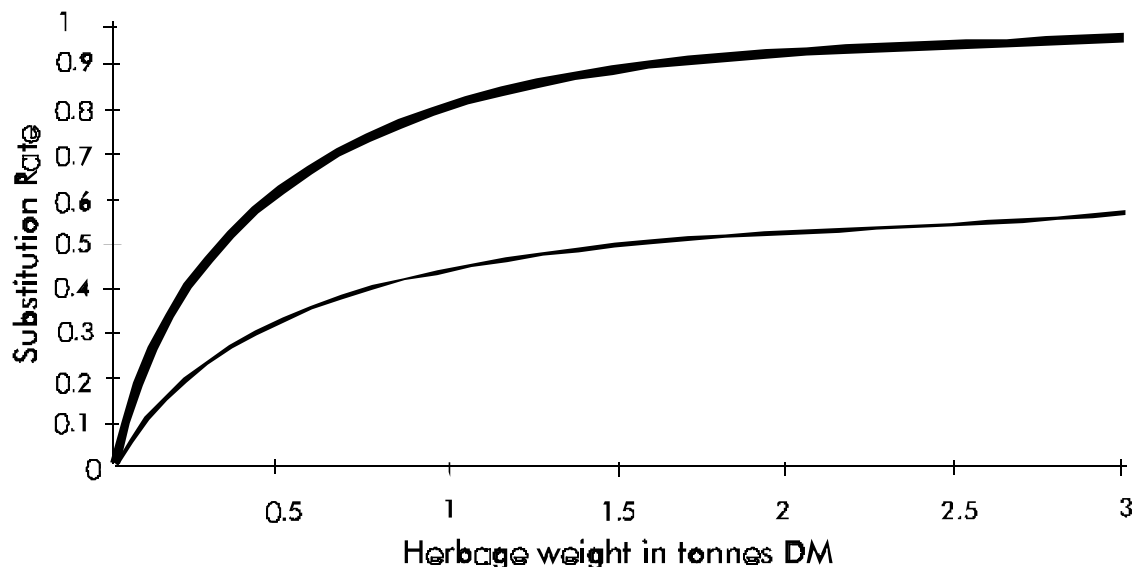


Figure 2.1: Predicted substitution rates for a supplement of 80% digestibility on pastures averaging 70% (heavy line) and 50% (light line) (from Kellaway & Porta 1993)

supplement given. For example, if hay is given to a grazing cow, the cow’s intake of pasture will decrease by the same amount of hay consumed. The substitution rate of hay is 1.0.

When concentrates are fed, the rate of substitution can vary depending on the amount and quality of the pasture fed, the quantity of the supplement eaten and the degree of processing of the supplement.

Figure 2.1 shows the effect of the availability and digestibility of the pasture on the substitution rate of a concentrate with a digestibility of 0.8.

The substitution rate is less when cows are grazing a pasture of low digestibility or when the availability of pasture is low. The rate of substitution increases with the proportion of concentrate in the diet from 0.6 (if feeding less than 25% of the diet as concentrate) to about 1.2 (if more than 50% concentrates are fed). Substitution is higher if the concentrates are rapidly fermented (for example, wheat starch) than if they are slowly fermented (whole oats).

How much does pasture cost?

Example: Here is an example of the cost of both dryland and irrigated pasture production for 100 milkers on a 74 ha farm (adapted from Kellaway)

Item	\$/ha/year
Seed, fertilisers and chemicals	194
(Single superphosphate	
Perennial ryegrass	
White clover	
Greentop (20:5:0)	
Nitram	
Muriate of potash	
Annual ryegrass	
Sprayseed®)	
Tractor depreciation	28
Tractor maintenance and fuel	25
Machinery depreciation and repairs	82
Fencing depreciation and repair	12
Labour	242
Rates	40
Dryland total	623
Extra costs for irrigation:	
Irrigation electricity	94
Irrigation depreciation and repairs	74
Irrigation pump deprecation	4
Irrigation fittings	6
Irrigation total	800

(Cost of buying water for irrigation not included.)

Assume that the pasture production for both dryland and irrigated farms is 15 tonnes DM per hectare. Then the dryland cost of pasture is \$41 per tonne DM and the irrigated cost of pasture is \$53 per tonne DM.

This example estimates the cost of growing pasture, both for dryland and irrigated pastures. This cost is the **minimum** for each kg of pasture dry matter produced. Unfortunately, a cow does not eat all of this dry matter. It will not eat the pasture to the ground.

As outlined in the *Managing Pastures DairyLink* manual, the persistence of a pasture is affected by the dry matter left after grazing (the residual). For example, if cows are grazing a ryegrass pasture in a good season (when there is adequate rainfall or there is access to irrigation), then the pasture can be grazed down to 5 cm or 1000–1500 kg dry matter without any adverse effect on future production. In a dry season, a greater amount of pasture should be left—about 7–9 cm or 2000 kg dry matter.

When you are calculating the cost of pasture, make sure you assess the amount of pasture left behind after the cows have grazed. This value can help you calculate the approximate use of the pasture, which is:

$$\text{Percentage of pasture used} = \frac{\text{Total dry matter yield} - \text{residual dry matter}}{\text{Total dry matter yield}}$$

Once you have calculated the total percentage used you can then work out the total cost of the pasture as a feed.

If the total use of the pasture is 50% and the cost of growing the pasture is \$67 per tonne DM, then the cost of the pasture as feed is \$124 per tonne DM. The poorer the use of the pasture, the more expensive the pasture costs as a feed. In a study of three dairy farms in the Sydney basin and

South Coast of NSW, Kellaway found that pasture use ranged from 11% to 40% at different times of the year. The cost of pasture at low utilisation rates approaches the cost of some bought supplements on a dry matter basis!

Why use supplements?

You can get many benefits from using supplements. They can be categorised into two classes: short-term and long-term.

Short-term benefits

Increased milk production and quality

The responses in milk production to feeding supplements normally occur with 1 to 3 weeks, depending on a number of interrelated factors (such as the stage of lactation, degree and level of underfeeding, genetic potential and weight).

Problems with low milk fat percentages or sudden falls in milk protein can be corrected by adding the correct supplement, depending on the severity of the underfeeding. Responses are quite variable.

Milk response to supplementation is greater during early lactation. On most farms, the increased milk production benefit received from feeding supplements to early lactation cows compensates for the cost of feeding the supplements. Long-term responses to concentrates average 1.2 L of milk per kg of concentrate. Short-term responses range from 0 to 0.5 L of milk per kg of concentrate.

At times of low pasture growth, supplements like cereal grains can help maintain milk production until pasture growth improves or until a cheaper source of supplement (such as high quality forage crops) becomes available.

Supplying the nutrients missing in pasture

Pasture can be inadequate in energy, protein, minerals and trace elements at different periods of the year. Milk production can suffer if the right mix of nutrients is not present in the ration.

Providing sufficient nutrients to early lactation cows

After calving, the cow's rumen capacity is too small in relation to the dry matter intake needed to reach her potential milk production. The cow needs a **nutrient dense** ration where the quantities of all the nutrients such as dry matter, energy, protein and fibre are increased in the ration to compensate for her lower appetite. Rations with high amounts of water (low DM %) fill up the rumen before the cow can get enough nutrients for her energy requirements.

Supplementing pasture with energy feeds such as cereal grains can provide a ration that is more energy dense. Other supplements may be needed to meet the protein, mineral and trace element requirements.

After the cow has reached full appetite and her milk production starts to decline (that is, after peak lactation), the nutrient concentration of the feed can be reduced. Most cows will be able to get their nutrient requirements from pasture, although high-producing cows will still need some supplementation.

Long-term benefits

Better pasture use

The DairyLink *Managing Pastures* manual outlines the best ways to manage pastures.

High pasture utilisation, although ensuring pasture quality, can cause insufficient pasture intake for high producing cows. Supplements can make up the shortfall in dry matter intake.

Supplements can be used to reduce overgrazing and meet shortfalls when pasture growth is slow.

Improved body condition of the cows

Lactation length, persistence of the peak milk yield and fertility are all influenced by the cow's overall nutrition.

The cow's body reserves at about the time of calving can influence the amount of milk produced at the time of peak yield. The better the condition of the cow (providing she is not too fat), the greater the chance of her reaching her expected peak milk production.

Cows in good body condition after calving start their heat cycling and conceive in a shorter time than cows in poorer body condition. Fertility is therefore influenced by how the cow was fed during late lactation, during the dry period and the period after calving when most cows are in negative energy balance.

Pasture shortages at certain times of the year may prevent weight gains in lactating cows and dry stock.

Reduced rate of involuntary culling

Voluntary culling is a management decision to cull cows because they are unsuitable in milk production, milk composition or body conformation. Voluntary culling is done to improve genetics and overall milk production.

Involuntary culling means the culling of a cow because of disease or poor production. The cow 'selects' herself to be culled. Cows of high genetic merit may be wasted through involuntary culling because

they have a condition that may not have occurred if feeding was adequate.

Increased farm profitability

The use of cost-effective supplements can increase milk production and increase your profits. Other long-term economic benefits are:

- better fertility (fewer services for each successful conception, reduced overall semen cost, reduced cost of treatment of non-cycling cows)
- reduced involuntary culling costs (the cost of raising an increased number of replacement heifers minus the income from the sale of the culled cows)
- reduced costs of disease treatment, especially of cows at calving and early lactation. The metabolic diseases that occur in early lactation are usually the result of inadequate or imbalanced nutrition.

How do I use supplement sensibly?

Basic requirements for feeding supplements

Feeding a supplement involves more decisions than choosing a feed. This

section deals with the practical aspects of feeding supplements.

Storage

All supplements must be stored before they are used. It is not feasible or economic to transport supplements to the farm only when they are needed.

Store the supplements so that they don't deteriorate. If a supplement is exposed to moisture or excessive heat and humidity (or air if it is stored as silage), moulds and fungi can grow. These can cause the

nutrient content to drop and create health problems in the cattle being fed the supplement.

Silos, feed sheds, feed bunks, silage pits and plastic-wrapped feed bales can provide suitable storage for different classes of feed.

Feeding-out

Dairy bails. Many dairies feed supplements in the dairy bails. If you are feeding in the dairy shed, the minimum requirements are a feeding trough and a means of transferring the feed to the trough. The equipment required to do this can range from a bucket to different types of manual and automatic feed dispensers, feed augers for transferring the feed from the storage to the dispensers, or fully computerised feeding systems.

Advantage of feeding in the dairy bail:

- the farmer can regulate the quantity of each cow's supplement depending upon her milk production or stage of lactation.

Disadvantages of this form of feeding:

- each cow receives a ration of the same composition, despite differences in lactation stage or production
- only feeds that can readily moved by augers can be used, and this can restrict the use of by-product feeds
- dusty feeds can cause respiratory problems in dairy workers and could cause quality problems in milk.

Feed troughs. Feeding a supplement on the ground is a wasteful exercise and can dramatically increase the overall cost of using the supplement. At least 50% of the supplement might not be eaten because it has been trampled by the cows.

Troughs can be used to feed out all types of supplements, including forage supplements. However, unless special

feeding equipment (such as a feed wagon) is used, feeding-out can be labour intensive, especially if the trough is above ground level. Clean the troughs and remove all uneaten food before you add new feed; doing this is labour intensive too.

There should be enough space at the feed trough for all cows. If there is not enough space, heifers and the less dominant cows in the herd will be disadvantaged.

Feed pads. A feed pad can be set up using a fence line or an electric fence to stop the cows walking on the feed, or it can be a concrete-based feeding area with head bails in a feed shed.

As with trough feeding, the use of feed pads can be labour intensive if you do not use equipment to feed out and to clean the uneaten feed from the pad.

Pelleting

Pelleted feed is available commercially.

The main advantage of using pellets is the convenience—there is no need for capital equipment such as a feed mixer or for a labour unit for processing the feed, there is little dust if the pellets are fed in the dairy bails, and there is no risk of cows selectively eating part of the ration and neglecting another.

The main disadvantage with using pellets is the lack of control the farmer has over the composition of the feed in the pellet and the quality of the feed ingredients. One component in the feed—such as the cereal grain source—can be changed between shipments, and this can lead to digestive problems in the cow. The ingredients cannot be changed to ‘fine-tune’ the ration if there is a change in the quality of the forage component.

When you buy pellets, ask for the nutrient analysis of the pelleted ration. The analysis should show the energy

content, the protein quality (including RDP and amino acid content), the proportion of crude protein percentage which is urea, and the quantity of added minerals, vitamins and other additives. Get this information for every new shipment of pellets.

Pre-mixed supplements

Local feed merchants and feed companies can supply supplements ready for use on the farm. You can decide on the mix, or a private nutrition consultant or a nutritionist employed by a feed company can do it.

The advantages of using these mixes over pellets is that you have more control over the ingredients, which can be adjusted to suit changes in other parts of the ration. The mix can be fed directly into the dairy bail or a feed trough, or mixed with a forage before feeding out. A feed mixer and labour is required.

Home mix

Mixing the cow’s ration on-farm allows you to buy the ingredients you want and then mix them to your cows’ requirements to a recipe devised by you or a nutritional consultant. You can buy ingredients like grains and by-products more cheaply in bulk, but you need plenty of storage. If you don’t have enough storage and have to buy bagged feed, the price of the supplement will increase dramatically.

The capital equipment required for home mixes can be expensive. The minimum requirement is a good feed mixer. If cereal grains have to be processed, you will need a rollermill or hammermill. If you are using more than one supplement, you might need a number of augers. If the feed mix has multiple ingredients and/or forage must be added, then you will need a feed wagon capable of weighing ingredients as they are added. Without the correct equipment, home

mixes can be very labour intensive as well as inaccurate. Making a poorly mixed supplement can be an expensive exercise.

The cost of supplying a good home mix may exceed any savings you make by buying cheaper ingredients, especially in small dairy herds. The economies of scale occurring in larger dairy herds (greater spread of fixed costs over greater total milk production) make home mixes more profitable than other methods of supplementation.

How do I choose a cost-effective supplement?

Many supplements have similar nutrient values. Which supplement should I use?

One method of selecting supplements is by their **unit cost**. This is the cost per unit of nutrient (which can be energy, crude protein or UDP).

The basic formula is:

$$\frac{\text{Cost per tonne delivered of feed)}}{1000 \times (\text{nutrient content in diet}) \times \text{DM \%}} \\ \text{in \$/ MJ.}$$

So if barley is \$190 a tonne delivered, the DM content is 90% and the energy content is 12 MJME/kg DM, then the cost per unit of energy is:

$$\frac{190}{1000 \times 12 \times 90/100} \quad \text{or } 1.7\text{c/MJ.}$$

Supplements may provide more than one nutrient, so you should work out the cost of the other nutrients using the equation above. For example, brewers grain provides both energy and protein and can be a source of UDP.

Remember, though, that cost is only one factor involved in selecting supplements. You should consider all the ingredients in the ration when you select a supplement.

