Chapter 4
(Pasture) Dry Matter – What is it, how do we use it?

4.1 What is in this chapter?

This chapter is essential reading.

This chapter introduces the concept of dry matter (DM) in the context of pasture and other feed-stuffs.

It explains how DM can be used as a unit of currency in pasture feed budgeting and explores how DM units can be viewed and used in relation to other units used to describe feedstuffs such as metabolisable energy (ME), crude protein (CP), soluble (SS) sugars,and soluble starches (SSS).

4.2 Introducing the concept of Dry Matter

Dry matter (DM) is the basic unit or 'currency' used in feed budgeting.

Just as in financial budgeting where income (*supply* of money) and expenditure (*consumption* or demand for money) are measured in dollar ($) units, in feed budgeting, feed *supply* and feed *demand* can be measured in DM units.

Dry matter is the portion of the feed remaining after all the moisture has been removed.

The dry matter portion of feed contains the plant materials and contents minus the water. These include materials that form the structure of the plant as well as all plant-cell contents including their constituent sugars, proteins, vitamins and minerals.

Why Dry Matter?

Establishing measurement units that accurately describe the supply of and demand for pasture has its challenges. Units you may encounter in feed budgeting include dry stock equivalents (DSE), ewe equivalents (EE), cow days, sheep days, megajoules of metabolisable energy (MJME) and kilograms dry matter (kgDM).

The situation can be made even more confusing where the nutritional make up of feed-stuffs including pasture are described. Terms such as crude protein (CP), neutral detergent fibre (NDF), soluble sugars % (SS), Soluble Starch% (SSS) and Fat% are all likely to be encountered at some time.

This book strongly urges you to ***work with kgDM in the first instance*** and treat it as ***the default unit***.

If or when necessary other units can be easily be related back to kgDM with most able to be expressed in terms of kgDM. For example, MJME/kgDM or NDF/kgDM etc.

These statements will make more sense as more detail of how DM relates to other units is presented.

For the moment though, it is important to understand how we can justify using kgDM as default unit. This way you will also understand the limitations to its use.

Justification for using kgDM as the default unit for feed budgetin

1) 'kgs' as a unit can readily be related to whether one is an agricultural scientist or a junior pasture manager. Compare for example trying to understand what 55 MJME of pasture represents compared to understanding what 5 kgDM of pasture represents, even though they more or less describe the same thing in

terms of what they deliver an animal in feed value. Kilograms of Dry Matter (DM) is inherently easier for the human mind to comprehend, especially when faced with an area of pasture to feed stock with or when dealing with a truckload of feed supplements for stock use.

2) DM is a much easier unit to measure or assess in the field than Metabolisable Energy (ME). The ME content of pasture or other feedstuffs is totally impractical to measure directly in the field. By contrast there are several devices and methods for measuring or assessing the DM of pastures and other feed-stuffs that can be used directly in the field.

3) kgDM is a very convenient 'accounting' basis with which to compare and account for amounts of feed-stuffs. For example, it is much easier account for 12 kgDM of pasture plus 4 kgDM of silage when meeting the feed requirements of a milking cow than compared to 66 kg wet weight of fresh pasture and 9 kilograms wet weight of silage, even though both say exactly the same thing!

Consider a further example, where we are required to supply half the daily feeding requirements for a lactating dairy cow with feed supplements. We are told that the total feed requirement for a milking cow is “16 kgDM per day”, and that “she is already getting half her requirements from pasture.” Clearly we already know that what ever is the feed supplements we choose, it will need to total 8 kgDM – that being half of the total daily 16 kgDM amount the cow requires.

If we think in dry matter (DM) terms we could consider feeding 8 kgDM of any suitable feed-stuff; for example, 8 kgDM of hay, or 8 kgDM of silage, or 8 kgDM of forage turnips or even a mixture of each to make up 8 kgDM total.

If we worked in *wet weights*, we would have to know and then remember that half the daily feed requirements of this milking cow would be represented by 10 kg of fresh hay, or 27 kg of fresh silage, or 88 kg of fresh turnips.

So which system is easier to work with?

In choosing the kgDM system we're assuming the only difference between two different feed-stuffs in their fresh form is the water content. By taking water out of the equation, we can assume that 1 kg of completely dried out material of one type of food stuff will deliver the same nutrition as a completely dried out material of a different food stuff, allowing us to account on a purely kgDM basis.

We are of course also assuming that 1 kgDM of one foodstuff type will will deliver the same nutritional outcomes as 1 kgDM as a different type of foodstuff.

For the most part, this is a fair and certainly very useful assumption.

We can compare metabolisable energy values (ME) of different types of feedstuffs to see if these assumptions are valid. ME is a very useful way of comparing relative feeding values between feed-stuffs. This will be discussed in more detail later but for the moment accept that ME is a good way to 'compare apples with apples”

Table 4.1 illustrates how the moisture content between different feed supplements varies much more than their ME values.

Pasture and Feed supplements comparison		
Supplement	**MJME/kgDM**	**DM%**
Hay (pasture)	8	85
Pasture (spring)	12	13
Silage (pasture)	9.4	43
Turnips	12.5	9

Table 4.1: Comparison of ME and DM between various feed supplements and spring pasture
Source: Adapted from Appendix 6

A milking cow's kgDM feed requirements are based on the assumption that each kgDM has a ME value of about 11 MJ (seeAppendix 12). It is a simple matter to assume each feed supplement option has a similar ME content and to then calculate the feed requirements for supplement in DM terms. If the ME values vary by say more than 10 to 15% from the 11 MJME/kgDM assumption, as in the case of hay which is 8 MJME/kgDM, it is then a simple matter to adjust the feed allowance of that supplement upwards by a proportionate amount when dispensing to the stock. In this instance, by about 20 to 25%. The reality is that feed-budgeting is not an exact science but if efforts are made to work to within 80 to 90% of the theoretical values, tremendous productivity gains are possible.

Approaching pasture feed budgeting this way makes *kgDM* a very useful first unit of choice to use.

For the supply side of feed budgeting, we can express pasture *growt* in terms of kgDM/ha/day and the amount of pasture *on hand* in terms of kgDM/ha. Likewise we can express feed supplements such as hay, silage, fodder crops and meal in terms of kgDM.

On the demand side of feed budgeting, we can express an animal's demand for feed in terms of kgDM/animal/day, and even factor in production outcomes based on kgDM input requirements , for example, kgDM intake/kg live weight gain, or kgDM intake/kg of milks solids produced. This will be discussed in more detail later. We can also add and subtract kgDM units and so determine feed surpluses and deficits.

Table 4.3
Cash Flow forecast – dairy farm

	June	July	August	Sept	October	November
Income						
kg milk solids	850	2110	3400	5200	6000	5900
$	$4,250.00	$10,550.00	$17,000.00	$26,000.00	$30,000.00	$29,500.00
Expenditure						
$	$6,800.00	$7,250.00	$8,500.00	$8,000.00	$8,000.00	$7,900.00
Surplus (- Deficit) $	-$2,550.00	$3,300.00	$8,500.00	$18,000.00	$22,000.00	$21,600.00

Pasture Feed budget forecast – dairy farm

	June	July	August	Sept	October	November
Pasture supply						
Pasture growth rates kgDM/ha/day	20	22	32	40	60	70
total for month kgDM/ha	620	682	960	1240	1860	2100
Animal Demand						
Animal demand kgDM/ha/day	12	32	59	59	59	59
total for month/ha	360	960	1770	1170	1829	1170
Surplus (- Deficit) kgDM/ha for month	260	-278	-810	70	31	930

Table 4.2: Example showing conceptual similarities between a forecast cash flow budget and a forecast feed budget for the first 6 months of a seasonal dairy production season

There are many conceptual similarities between a forecast cash flow and a forecast feed budget, (see table 4.3) where income and expenditure are represented by pasture supply and animal demand and where dollars $ and kgDM are the unit currencies respectively.

When using kgDM as a default currency unit for feed budgeting, we need to be mindful that a kgDM unit actually tells us nothing about either the total feed value of a feed-stuff, or the nutritional components of a feed-stuff that make up its feed value. We are simply assuming that they are sufficient. Clearly this is not always the case and it is then that we rely on information provided by units such as MJME to express total feed value, and units such as CP, NDF, SS% and starch SSS% and Fat% to express the component make up and their relative proportions.

What these units are and how we might use and interpret them will be described in more detail later. For the moment though, we will assume that they are all quite adequately accounted for when using just kgDM units. Trying to incorporate units such as CP, SS, NDF from the outset is only likely to confuse and frustrate the learning process.

Mastering the basics of feed-budgeting by simply using kgDM units will deliver enormous benefits in itself. If having mastered the basics, you are looking for the 'next step' (you *will* know when), perhaps consider then learning more about other units and what they can tell you about a feed-stuff and its potential for improving animal production.

Mastering feed budgeting using units of basic DM will deliver massive benefits to the average pasture farmer.

4.3 Dry Matter percentages of pasture

Actively growing summer pasture typically has a dry matter percentage (DM%) of 18%. This can vary from as low as 11% DM in rapid growing spring conditions to as high as 30% in dry summer conditions -see table 4.4. Day to day variations can be 3 to 4 percentage points, mainly owing to variable weather factors. These small daily variations are not observable visually, nor for practical purposes do they actually matter.

In typical dairy pastures growing in temperate conditions – including irrigated pasture situations in otherwise more arid climates, extremes occur relatively infrequently. Accordingly it is reasonable to assume a default value of 18% DM for pasture for all but the most obviously high or low moisture content situations. Moisture content of pasture can be assessed using one of the methods outlined in Appendix 10 .

Typical Dry Matter % and Metabolisable Energy content of pastures in New Zealand

	DM%	ME MJ/kgDM
Pasture ryegrass/white clover dominant		
North Island of New Zealand		
Spring	12-15	11.5-12.5
Summer leafy	15-20	10.5-11.5
Summer dry stalky	20-30	9.5-10.5
Autumn/winter	13-18	11.0-11.5
Irrigated South Island		
Spring	13-20	11.5-12.5
Summer leafy	13-20	11.0-12.5
Autumn/winter	13-20	11.0-12.0
Southland		
Spring	12-24	11.0-12.5
Summer leafy	13-22	10.0-12.5
Autumn/winter	12-25	11.0-12.5
Kikuyu		
Leafy	20-30	9.0-11.0
Stemmy	40-60	7.0-9.0

Table 4.3: Typical Dry Matter % and Metabolisable Energy content of pastures in New Zealand

Pasture Dry Matter per Hectare

The amount of pasture in a paddock can be expressed in terms of kilograms dry matter per ha. i.e. kgDM/ha

A typical dairy pasture ready for grazing would contain around 3000 kgDM/ha. This means is that if all the plant material from one hectare of this dairy pasture was cut exactly at soil surface height, then bagged and removed for drying in a giant oven at 80 C° for 12 hours in order to drive off its moisture content, the total weight of the *dried* pasture[1] would be around 3000 kg.

Total, available and residual pasture DM- important distinctions

We need to be very clear about what is meant by total pasture DM and the pasture DM that is available to actually 'go down the throat' of a grazing animal.

Although the total amount of pasture DM in the one hectare example just given is around 3000 kg, only a portion of that 3000 kg is available for 'down the throat consumption' by stock to eat.

This is because stock will always leave some pasture behind as a residual. Figure 4.1 illustrates this.

Figure 4.1 illustrates a stylised dairy pasture situation showing more or less ideal pre grazing and post grazing pasture covers expressed in kgDM/ha for lactating dairy cows grazing temperate ryegrass/clover pastures.

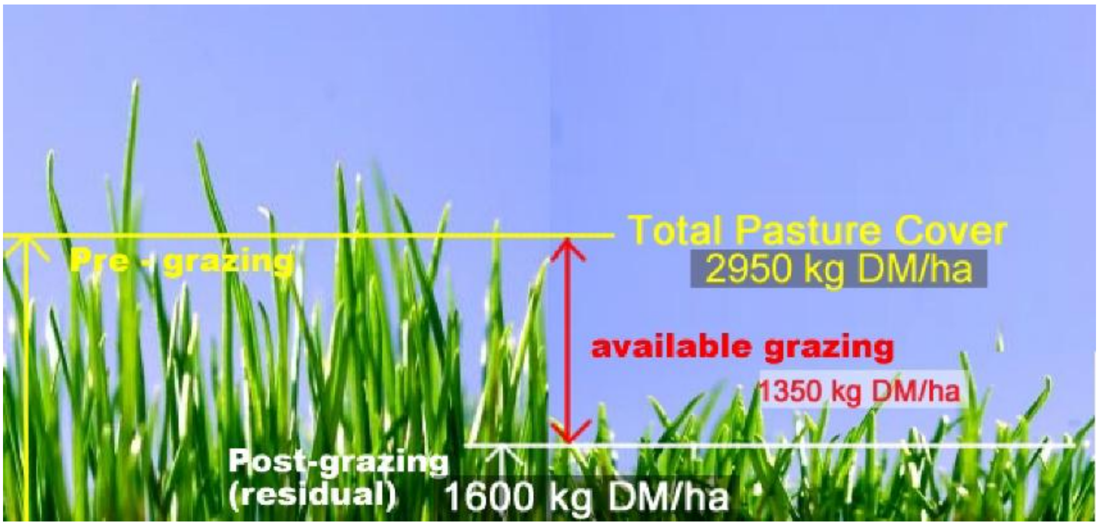

Figure 4.1 Stylised dairy pasture situation showing ideal pre grazing and post grazing pasture covers.

In this instance we see that the *total* amount of pasture in the paddock is 2950 kgDM/ha whereas the amount stock get to consume is just 1350 kgDM/ha, only 45 to 50% of the total. This is because we typically want to leave a 1500 to 1600 kgDM/ha pasture *residual* once the cows have grazed and left the paddock.

1 Of course in practice, we wouldn't cut and dry a whole paddock in order to determine the DM value! This can be done by doing a CWD – Cut, Weigh and Dry sampling. A CWD typically involves cutting then weighing pasture from each of several half square metre areas randomly selected over a paddock. Sub samples are taken and oven dried for moisture content determination. The results are then extrapolated for kgDM/ha results. Appendix 10 details a CWD protocol.

The available portion of pasture as illustrated in Figure 4.2 is essentially the '*down the throat*' amount of pasture a grazing animal will consume. In the above context you may encounter any of the following terms; ' pasture cover', 'total cover', 'DM on offer' and 'total pasture amount'. They are all expressed in kgDM/ha; they are often used interchangeably, and all refer to the same thing.

4.4 DM content of other feed-stuffs

We have already established that DM is useful information when

1. determining the feed requirements of grazing animals
2. determining the quantities of pasture.

DM is also a useful basis to describe feed-stuffs other than pasture, including that of pasture supplements (hay, silage) and in some circumstances, is also a useful means of determining *volumes* of feed-stuffs.

Using DM for determining animal feeding requirements

Expressing feed-stuffs in terms of kgDM is useful when determining feeding requirements for grazing animals .

To illustrate this, take the example of a 500 kg live-weight dairy cow producing 2.0 kg milk solids per day.

Research tells us she will require around 19 kgDM per day of quality pasture *or its equivalent* to meet her maintenance and lactation needs.

As inferred from above, the feed does not necessarily have to be from pasture.

Other feed-stuffs such as maize silage, sorghum, millet, and grain meals could partially or totally substitute the diet.

Each feed-stuff has its own moisture content percentage (see Appendix 5, Appendix 6, Appendix 7 and Appendix 8). If we compare various feed-stuffs on a 'wet' basis, this can make it difficult to ascertain feeding requirements, particularly when we wish to meet a dairy cow's daily feed requirements with a mix of feed types.

Table 4.8 shows the dry matter percentage contents of some common feed-stuffs for grazing animals.

Feed-stuff	Dry matter %	Moisture %
Water	0	100
Short, leafy, rapidly growing spring pasture	10	90
Leafy early summer pasture	20	80
Pasture Pit Silage	30	70
	40	60
Baleage /Haylage	50	50
	60	40
	70	30
Meadow Hay	80	20
Grains – Maize, Wheat,	90	10
	100	0

Table 4.4 DM percentages of some common feed-stuffs

As table 4.4 shows, the water content of early spring pasture is almost 10 times that of grains such as maize yet only 5 times that of baleage/haleage. It could be difficult to work out the actual physical amounts of each feed type to supply an animal if we wanted to supply say a third of their *nutritional* requirement over three different feed types when the water content of different feed types varies so much (so long as drinking water is plentiful, water content in feed-stuffs has essentially no nutritional value to stock) .

Daily feed requirement for a lactating dairy cow producing 2 kg milk solids per day		
Dry Matter Basis		**Wet Matter Basis**
	kgDM	
Pasture	13	87 square metres of pasture
Green feed turnips	3	30 kg of fresh turnips or 3.75square metres of turnip crop
Maize meal	3	3.33 kg of maize meal
Total	**19 kgDM**	**??**

Table 4.5 Comparison of feed-stuffs on a dry and wet matter basis

Table 4.5 compares calculating a cow's daily feed requirements on a dry matter basis and wet matter basis.

Using the DM basis is much easier when you want to mix and match various feed-stuffs for a composite diet. While you will eventually need to work out the “wet' feed requirements, in the first instance, it is far easier to work with kgDM equivalents.

Using DM values to calculate wet weight amounts

We can use DM values to work out the 'wet weight' equivalents in terms of weight, area or volumes including those of standard bale size options.

Consider the following typical feed-stuffs expressed in quantities you are likely to encounter.

Physical amount of a feed-stuff	kgDM
1 ha paddock of fresh pasture grazing	1500
1 small hay bale (meadow hay)	17
1 tonne bag of maize meal	880
1 tonne of pasture silage	350
1 cubic metre of pasture silage	206

Table 4.6: kgDM content of various feed-stuff quantities

In table 4.6, how do we know that one small bale of hay contains 17 kgDM or that one tonne of maize meal contains 880 kgDM?

The key of course is knowing the DM% of the feed-stuff and working back.

Appendices Appendix 5,Appendix 6, Appendix 7 lists DM% for several feedstuffs. Appendix 8 lists the dimensions and weights for several baled and pit ensiled feed-stuffs.

4.5 Worked examples using DM

Worked Example 1

How to calculate the wet weight given a DM requirement

A herd manager has determined that she wants the heifers to be fed 2 kgDM each of pit grass silage. There are 180 heifers to be fed. How much actual silage (in cubic metres) will she need to take from the silage pit for feeding out?

Answer:

I. Determine the total kg of DM required.

   i.e. 180 cows x 2 kgDM = 360 kgDM

II. Determine how many cubic metres this represents as silage in the pit

From Appendix 8 we see wilted silage has a density of 580 kg of silage (wet weight) per cubic metre.

It also shows that it has a DM% of 30 percent thereby yielding 175 kgDM per cubic metre (580 x 30% ≈ 175 kgDM/m^3)

Since 360 kgDM are required, the herd manager needs to feed out $\frac{360}{175}$

= 2.057 cubic metres

ie round out to 2 cubic metres of the silage from the pit.

Worked Example 2

How to calculate DM from the wet weight values of a feed-stuff.

1) Look up Appendix 6 for the DM% value of the feed-stuff.
2) Multiply the 'wet' weight of the feed-stuff by the DM%

ie 20 kg $x \frac{85}{100}$ = 17 kgDM for a standard small hay bale

25 kg $x \frac{88}{100}$ = 22 kgDM for 25 kg bag of maize meal

100 kg $x \frac{10}{100}$ = 10 kgDM for 100 kg of freshly harvested turnips

Worked Example 3

– how to calculate the wet weight amounts of feed when given kgDM requirements.
NB This is similar to worked example 1

One of the more likely of situations you'll encounter when doing DM calculations is working out 'wet weights' from a kgDM requirement. i.e. we know how many kgDM of a feed-stuff we need to feed to an animal but do not know how many kilograms this represents in its 'wet' form.

Assume we want to supply 3 kgDM each of hay, maize meal and turnips. How many kg of each feed-stuff does represent in their 'wet' forms respectively?

1) Look up Appendix 6 for the DM% of the feed-stuff concerned.
2) Divide the kgDM required by the DM%

ie

$\frac{3\text{kg DM}}{80\%}$ = 3.75 kg of hay

$\frac{3\text{kg DM}}{88\%}$ = 3.4 kg of maize meal

$\frac{3\text{kg DM}}{10\%}$ = 30 kg of fresh turnips

In practical terms, 3.75 kg of hay represents roughly $1/5^{th}$ of a 20 kg small bale of hay, 3.4 kg of maize meal about $1/7^{th}$ of a 25 kg bag of maize meal and the 30 kg of fresh turnips about 30 square meters of turnip crop (assuming a 10 tonne DM/ha yield for a crop of turnips).

4.6 DM vs ME ,CP, NDF, SS, SSS for pasture feed budgetin

As already pointed out in this chapter, while kgDM is very useful unit to use in feed budgeting, it tells us nothing of the feeding value of a feed-stuff or anything about the various component parts that provide feeding value to a feed-stuff. For example, quality clover hay and barley straw might have very similar DM% values yet quality clover hay is obviously more nutritious.

For this we need to consider other types of measurement units.

Metabolisable energy or ME values are normally used for determining *overall* feed value of a feed-stuff. A more in-depth analysis of feed value can be provided by measurements units already mentioned, these of CP, NDF, SS% SSS% and Fat%.

The remainder of this chapter will look in more detail at what ME is, what its context is in terms of kgDM and what extra information the measurement units of CP, NDF, SS%, SSS% and Fat% % might be able to contribute in the context of pasture feed budgeting.

ME and its place in pasture feed-budgetin

There is a strong argument that energy should be the ultimate unit to use in pasture feed budgeting. We are after all really in the business of turning the energy from sunshine into production via pasture. Units of energy are already widely used in describing the feeding requirements of stock and the feeding value of various feedstuffs including that of pasture. While this book argues largely sticking to kilograms dry matter, an explanation about using energy units in pasture feed budgeting is warranted.

Energy in feed budgeting is almost exclusively expressed in terms of Megajoules (MJ) of metabolizable energy (ME).

Metabolisable Energy, (ME), is the energy that is *available* to animals from pasture and other feeds. It is the energy that an animal can use for its metabolic activities such as maintenance, activity, pregnancy, milk production and weight gain and fibre production. ME does not include the energy in faeces or urine or that given off as body heat or that contained in ruminant belching of methane or of flatus.

> ***ME is the energy in a feed-stuff that a animal can use for its metabolic activities ie maintenance, activity, pregnancy, milk production, gain in body condition.***

Another way of looking at ME of feed-stuffs is to think of feedstuffs in terms of its energy density or *Metabolisable Energy per kg of dry matter* (MJ) ME/kgDM. The Megajoules units are metric equivalent to calories. This is a key relationship that links ME to kgDM units.

Metabolisable Energy is not easy to measure and requires very sophisticated laboratory conditions and equipment including that of bomb calorimetry to.

Comparative methods for ME measurement have been developed that are quicker, simpler and more affordable. These are commonly used by commercial analytical laboratories in feed analysis. As with most comparative methodologies,assumptions have to be made as part of the measurement methodology, meaning results will never be 100% accurate for all situations.

There is a wealth of well tested data already available on ME values of different feed-stuffs. There is also comprehensive animal ME requirement information available for most domesticated species and classes of grazing stock. There are several appendices in this book which provide this information.

As already stated, pasture feed-budgeting is most easily carried out where kilograms of dry matter (kgDM) is the basis of accounting. For pasture, we would typically assign an ME value of 11 MJME/kgDM. However pasture quality will vary and so will its ME values - see table 4.7. For variations of 10% or more, it is a straight forward enough matter to adjust a grazing animal's kgDM feed requirements proportionately up or down according to the pasture's ME value.

ME values of different stages of pasture growth			
Pasture	**% DM**	***Relative ME Value on DM Basis**	**ME Concentration (MJME/kgDM)**
Short leafy	15	1.1	11.7
Mixed-length leafy	18	1.0	10.8
Dry stalky	28	0.8	8.1

Table 4.7: ME values of different stages of pasture growt

CP, NDF, SS%, SSS%, Fat% and their place in pasture feed-budgetin

Animal feed-stuffs are commonly further quantified and qualified in terms of CP, NDF, SS%, SSS% and fat%.

These units of measurement provide further nutritional information about a feed stuff. Appendix 5 details these for several different feed-stuffs while Chapter 5 section 5.10 explains what these terms mean. The components that these units represent need to be both present and in balanced portions for a feed-stuff to be nutritional. It should be noted however that these units indicate little of a feed stuff's vitamin and mineral content or of its palatability, all of which are important factors in nutrition.

*Usually, w*e can be confident that an ME value will be a reliable indicator of the suitability of a feed stuff for most common feedstuffs. One reason for this is that the ME value essentially takes into account the metabolisable energy associated with proteins in the CP, and the metabolisable carbohydrates in the NDF% SS%, SSS% and fat%.

What an ME value can't tell you however is what the values or proportions of CP, NDF, SS%, SSS% and fat% that go to make up a feed-stuff are or even if they are present. For example, the feed supplement molasses has a ME Value of 11.6 MJME/kgDM, and we might expect this to be a feed supplement equivalent to that of pasture which has very similar ME values.

Feed Analysis of Spring Pasture and Molasses against the nutritional requirements of a milking cow							
	DM	**ME**	**CP**	**NDF**	**SSS**	**Starch**	**Fat**
	%	MJME/kgDM	%DM	%DM	%DM	%SSS	%
Pasture, spring	12 – 15	11.5-12.5	20-30	35-45	7 – 25	2 – 4	4 – 6
Molasses	75	11.6	4 – 6	0	65	0	0
Requirements of a milking cow 25 l/day	N/A	11	16-18	28-32	max of 38	max of30	max of 6 to 7

Source: Adapted from Appendix 5 and Table Error: Reference source not found

Table 4.8: Feed Analysis Comparison of Spring Pasture and Molasses against the nutritional requirements of a dairy cow producing 25 litres of milk per day

However an examination of Table 4.8 shows that molasses while providing sufficient energy is extremely low in CP and NDF, supplies excessive amounts of soluble sugars no doubt leading to problems of acidosis if it were the sole feed stuff.

This highlights the importance of being very careful and of knowing what you are doing when feeding supplements. If at all unsure, seek the services of a competent feed stuff nutritionalist.

Fortunately, most pastures and forage crops are extraordinarily well 'balanced' feed stuffs for a grazing ruminant.

Table Error: Reference source not found illustrates this well where the nutritional requirements for maintenance and production of a large dairy cow producing 25 litres of milk daily are compared to what a daily intake of 20 kgDM of typical quality pasture are likely to deliver.

Daily Nutrient Requirements Of Large Breed Cows (Live Weight # 680 kg) In mid lactation producing 25 litres of milk/day

Milk production	25 l/day	Typical values for ryegrass/clover in NZ pasture swards	Perennial Rye – (Ideal levels; readily achievable with balanced fertiliser programs)	Clover (Ideal levels; readily achievable with balanced fertiliser programs)
kgDM Intake	20			
DM%	N/A	10-30	12 - 20	12- 20
TDN%	78			66
ME MJ/kgDM	11 (assumed for pasture)	10.5 to 12.5	11	11.5
CP % DM	16-18	15 to 30	26.5	24
SSS % DM	38 max	7 to 30		
Starch % SSS	30 max	2 to 4		
Fat %	6-7% max	3 to 6		
NDF%	28-32	30 to 50	45.8	33
Dietary N%	3	1 to 6	4.5	5
Dietary P%	0.32	0.2-0.6	0.5	0.45
Dietary Ca	0.62	0.2 to 1.5	0.66	1.55
Mg%	0.18	0.1 to 1.7	0.25	0.25
Cl%	0.24	?	?	?
K%	1.0	1.5 to 4.5	2.45	2.65
Na%	0.22	0.03 to 0.6	0.26	0.16
S%	0.2	0.1 to 0.6	0.50	0.4
Co ppm	0.11	0.04 to 0.3	0.08	0.2
Cu ppm	11	3 to 15	10	14
I ppm	0.6	0.1 to 1.5	0.5	0.5
Fe ppm	12.3	50 to 200	75	115
Mn ppm	14	20 to 300	30	22
Se ppm	0.3	0.005 to 0.1	0.31	0.65
Zn ppm	43	20 to 80	30	35
Mo ppm (plant requirement mostly)	?	0.1-20	4.45	20
B ppm (plant requirement mostly)	?	5 to 26	5	23

TDN% = total digestible nutrient, ME=metabolisable energy, CP=crude protein, NDF=neutral detergent fibre, SSS=soluble sugars and starch.

Table 4.9: Daily Nutrient Requirements Of Large Breed Cows (Live Weight # 680 kg) In mid lactation producing 25 litres of milk/day Source: Holmes and Wilson, 1987; NRC, 2000; Personal communications including authors own findings.

As can be seen, a cows requirements are for the most part well catered to by pasture. Therefore, so long as we are working with reasonable quality pasture, we can use a kgDM of pasture as *standard* for quantifying feed supply and demand and feel safe in the knowledge that it will for the most part also be nutritionally adequate.

Given that grazing ruminants evolved grazing pastures, this should not be so surprising.

Examination of Table 4.9 does show however that pasture supplies Crude Protein and accordingly dietary N in excess to a cows requirements. Cows cope with this situation by excreting excess nitrogen in their urine. Excessive dietary nitrogen intakes can cause metabolic problems for stock especially in low sunshine - early spring conditions when pastures can have low energy content coupled with high nitrogen concentrations especially if recently having been boosted with nitrogen fertilisers. This is commonly interpreted as 'spring eczema' in dairy cattle. Supplementing stock with even small amounts high energy feed-stuffs such as maize meal or molasses can then prove very beneficial in countering such metabolic problems.

Also of note in Table 4.9 the large variation of the minor and trace elements found in pastures. In many instances these levels may not meet the animals dietary requirements. Minerals can readily be supplemented to stock in the form of licks, water dosing or proprietary mixes that can be mixed into feed supplements. The best long term solution is to incorporate these via balanced fertiliser programs. This way, not only do the stock receive their dietary requirements, so too do the plants, and all those organism associated with soil biology, the requirements of which science is only starting to learn about. In adopting this approach you will more than likely observe an explosion in soil life and enjoy the benefits that go with it – improved soil structure, greater moisture retention, improved nutrient cycling. You will also likely see improved pasture palatability and more-even grazing of pastures, and find that your stock exhibit much improved health and contentment while producing very well.

If the assumptions for using kgDM are well understood, one can be very confident that feed budgeting using kgDM will result in quality decision outcomes.

Based on Table 4.9, we can work on the premise that quality pasture will meet the nutritional requirements for grazing ruminants without the need for additional feed supplements while attaining high levels of production. Because pasture is such a naturally 'balanced' and 'nutritionally complete' feed-stuff, one should be able to confidently quantify and qualify pasture feed demand and pasture supply simply in terms of kgDM and for the most part not have to worry about parameters such as NDF, CP, ME etc used to qualify feed requirements and nutritional content.

Experience within New Zealand over many decades has demonstrated conclusively that kgDM can be used as the main unit in pasture feed budgeting for both the supply and demand sides of pasture feed budgeting. Doing so results in very effective pasture management and stock feeding decisions.

Fine tuning with ME, CP, NDF, SSS values etc can always be made at a later date.