7 Managing your feeding

Combining the available forages with the best balance of home-grown or purchased concentrates to meet the daily dietary needs of the herd throughout its lactation is recognised as the key to ensuring the most cost-effective milk production.

Computerisation has made relatively complex diet formulation and rationing far more effective and accessible to dairy herds, allowing feed resources to be matched to nutritional needs increasingly precisely and economically.

It is vital to ensure diets are adequately allocated and performance is effectively monitored to account for natural variations in cow requirements, feed value and seasonal conditions as well as to allow any problems to be identified and addressed before they become serious.

What's in this section?

- **Assessing daily cow feed requirements**
- **Formulating and allocating the most effective dairy diets**
- **Monitoring performance to fine-tune feeding.**

Contents

Summary

- Successful rationing involves achieving the best possible balance between a number of key nutritional, practical and financial factors
- The amount of feed DM cows eat is the single most critical constraint in rationing since it determines how concentrated the ration needs to be to deliver the amounts of energy, protein and other nutrients required each day
- Cows' daily energy requirements depend on their specific requirements for maintenance, reproduction, milk production and body reserves
- While herds with modest yields on simple feeding systems using traditional ingredients are likely to find Crude Protein (CP) a sufficiently good basis for their protein rationing needs, RDP/UDP is an essential minimum in high performance herds
- Accurate details of the animals, feeds available and feeding system employed are essential for successful manual or computer diet formulation
- Accurate daily allocation of the diets is as important to success as their accurate formulation
- The critical importance of sufficient good quality water to dairy cow performance makes good management of water supplies essential throughout the year
- Effective regular monitoring of performance is important to ensure the diets are actually delivering the required results
- Even those who formulate all their own diets find it useful to get a second opinion from an outside expert every now and then.

See also...

Section 2:	Planning your nutrition
Section 3:	Planning your feeding
Section 4:	Assessing your feed options
Section 5:	Managing your forage feeds
Section 6:	Managing your non-forage feeds
Section 9:	Managing dry cow feeding
Section 11:	Factsheet 1: Metabolic disorders Factsheet 4: Body Condition Scoring Factsheet 9: Metabolic profiles
Section 12:	Worksheet 7: Manual diet formulation Worksheet 8: Lactation curve recording

Action plan

Cost-effective milk production requires you to.

1. Establish your cow requirements

Assess the daily DM intake capacities and key nutrient requirements of your main groups of cows (**Page 7:4**).

2. Formulate well-balanced diets

Formulate diets which meet the key nutrient requirements of your stock from your available feeds, either manually or with a computer (**Page 7:10**).

3. Allocate your diets accurately

Allocate your diets accurately through your feeding system, ensuring all stock have sufficient access to enough feed at all times (**Page 7:14**).

4. Manage your water wisely

Ensure all your stock also have sufficient access to enough good quality water from well-sited and maintained troughs at all times (**Page 7:15**).

5. Monitor performance continually

Employ a combination of milk production records and other techniques to continually monitor performance and fine-tune your feeding (**Page 7:17**).

6. Maintain good records

Keep good records of feeds, diets and feed plans for legal and farm assurance as well as performance monitoring purposes (**Page 7:24**).

The Grass+ programme provides practical advice on making the most of grass.

For detailed guidance on water at pasture see Factsheet 4.

The Pd+ programme provides practical advice on improving herd fertility.

For detailed guidance on feeding for fertility see Section 7.

Rationing essentials

Successful rationing involves achieving the best possible balance between a number of key nutritional, practical and financial factors.

The most important priorities in rationing are:

- To deliver an adequate supply of the nutrients required to meet the cows' needs
- To achieve a balance of ingredients that will optimise rumen function and nutrient utilisation
- To ensure the ration can provide the required nutrition within the cows' intake capacity
- To make the most of lowest cost (often home-grown) feeds for the greatest economy
- To provide rations which can be fed effectively with the equipment and facilities available.

Assessing dry matter intakes

The amount of feed DM cows eat is the single most critical constraint in rationing since it determines how concentrated the ration needs to be to deliver the amounts of energy, protein and other nutrients required each day (Section 2).

The primary determinant of dry matter intake in dairy cows is body weight **(Table 7.1)**.

Table 7.1: Daily dry matter intake estimator

Body weight (kg)	Estimated intake (kg DM/day)
450	13.5-15.8
500	15.0-17.5
550	16.5-19.2
600	18.0-21.0
650	19.5-22.8
700	21.0-24.5

Rule of thumb

Typical Holstein/Friesian cows can eat approximately 3-3.5% of their body weight in dry matter each day.

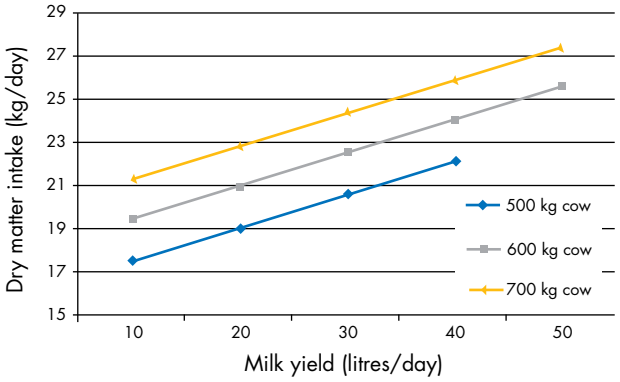
This means a 600kg cow has a dry matter intake of around 600 x 3 ÷ 100 = 18kg/day or 600 x 3.5 ÷ 100 = 21kg/day

Higher yielding cows in early to mid-lactation may consume 3.5-4.0% of their bodyweight in DM.

Breeds like Jerseys and Guernseys also tend to achieve similar, relatively high dry matter intakes for their size.

Milk production also has a major effect on intake, cows producing more milk at any time having greater appetites **(Figure 7.1)**.

Figure 7.1: Dry matter intake and daily milk yield



Source: DairyCo Feed into Milk, 2005

In addition to cow size and yield, daily dry matter intake varies with a number of other animal as well as food and management factors **(Section 2)**.

The most important additional intake factors to consider in rationing are:

- Body Condition Score
- Stage of lactation
- Forage quality
- Feed protein level
- Method of feeding
- Feed access time
- Diet presentation.

Assessing energy requirements

Of the various nutrients cows require, Metabolisable Energy (ME) is the first consideration in rationing **(Section 2)**.

Performance and well-being also depend upon achieving sufficient levels of protein, minerals and vitamins in the right balance.

Energy is, however, almost invariably the primary performance-limiting factor in most cases.

Cows' daily energy requirements depend on their specific requirements for maintenance, reproduction, milk production and body reserves.

Maintenance

Cows need a certain amount of ME each day to support their basic body functions.

Rule of thumb

Typical Holstein/Friesian cows require 10% of their bodyweight plus 10 MJ of ME each day for maintenance.

This means a 600kg cow requires (600 x 10 ÷ 100) + 10 = 70 MJ of ME/day for maintenance.

Reproduction

The amount of ME required to support pregnancy depends upon the stage of gestation, increasing markedly in the final few months with the growth of the unborn calf.

Rule of thumb

Typical Holstein/Friesian cows require around 40% more ME for maintenance and pregnancy each day in the dry period.

This means a 600kg dry cow requires 70 + (70 x 40 ÷ 100) = 98 MJ of ME/day for maintenance.

Milk production

The ME required for milk production increases with milk solids levels **(Table 7.2)**.

Table 7.2: Energy requirements for milk production (MJ ME/litre)

Milk protein % \ Milk fat %	3.5	3.6	3.7	3.8	3.9	4.0	4.1	4.2	4.3	4.4	4.5	4.6	4.7	4.8	4.9	5.0	5.1	5.2	5.3	5.4	5.5	5.6	5.7	5.8	5.9	6.0
3.0	4.9	5.0	5.0	5.1	5.2	5.2	5.3	5.3	5.4	5.5	5.5	5.6	5.7	5.7	5.8	5.9	5.9	6.0	6.0	6.1	6.2	6.2	6.3	6.4	6.4	6.5
3.1	4.9	5.0	5.1	5.1	5.2	5.2	5.3	5.4	5.4	5.5	5.6	5.6	5.7	5.8	5.8	5.9	6.0	6.0	6.1	6.1	6.2	6.3	6.3	6.4	6.5	6.5
3.2	5.0	5.0	5.1	5.2	5.2	5.3	5.3	5.4	5.5	5.5	5.6	5.7	5.7	5.8	5.9	5.9	6.0	6.0	6.1	6.2	6.2	6.3	6.4	6.4	6.5	6.6
3.3	5.0	5.1	5.1	5.2	5.3	5.3	5.4	5.4	5.5	5.6	5.6	5.7	5.8	5.8	5.9	6.0	6.0	6.1	6.1	6.2	6.3	6.3	6.4	6.5	6.5	6.6
3.4	5.0	5.1	5.2	5.2	5.3	5.4	5.4	5.5	5.5	5.6	5.7	5.7	5.8	5.9	5.9	6.0	6.1	6.1	6.2	6.2	6.3	6.4	6.4	6.5	6.6	6.6
3.5	5.1	5.1	5.2	5.3	5.3	5.4	5.5	5.5	5.6	5.6	5.7	5.8	5.8	5.9	6.0	6.0	6.1	6.2	6.2	6.3	6.3	6.4	6.5	6.5	6.6	6.7
3.6	5.1	5.2	5.2	5.3	5.4	5.4	5.5	5.6	5.6	5.7	5.7	5.8	5.9	5.9	6.0	6.1	6.1	6.2	6.3	6.3	6.4	6.4	6.5	6.6	6.6	6.7
3.7	5.1	5.2	5.3	5.3	5.4	5.5	5.5	5.6	5.7	5.7	5.8	5.8	5.9	6.0	6.0	6.1	6.2	6.2	6.3	6.4	6.4	6.5	6.5	6.6	6.7	6.7
3.8	5.2	5.2	5.3	5.4	5.4	5.5	5.6	5.6	5.7	5.8	5.8	5.9	5.9	6.0	6.1	6.1	6.2	6.3	6.3	6.4	6.5	6.5	6.6	6.6	6.7	6.8
3.9	5.2	5.3	5.3	5.4	5.5	5.5	5.6	5.7	5.7	5.8	5.9	5.9	6.0	6.0	6.1	6.2	6.2	6.3	6.4	6.4	6.5	6.6	6.6	6.7	6.7	6.8
4.0	5.3	5.3	5.4	5.4	5.5	5.6	5.6	5.7	5.8	5.8	5.9	6.0	6.0	6.1	6.1	6.2	6.3	6.3	6.4	6.5	6.5	6.6	6.7	6.7	6.8	6.8
4.1	5.3	5.3	5.4	5.5	5.5	5.6	5.7	5.7	5.8	5.9	5.9	6.0	6.0	6.1	6.2	6.2	6.3	6.4	6.4	6.5	6.6	6.6	6.7	6.7	6.8	6.9
4.2	5.3	5.4	5.4	5.5	5.6	5.6	5.7	5.8	5.8	5.9	6.0	6.0	6.1	6.1	6.2	6.3	6.3	6.4	6.5	6.5	6.6	6.7	6.7	6.8	6.8	6.9
4.3	5.4	5.4	5.5	5.5	5.6	5.7	5.7	5.8	5.9	5.9	6.0	6.1	6.1	6.2	6.2	6.3	6.4	6.4	6.5	6.6	6.6	6.7	6.8	6.8	6.9	6.9
4.4	5.4	5.5	5.5	5.6	5.6	5.7	5.8	5.8	5.9	6.0	6.0	6.1	6.2	6.2	6.3	6.3	6.4	6.5	6.5	6.6	6.7	6.7	6.8	6.9	6.9	7.0
4.5	5.4	5.5	5.6	5.6	5.7	5.7	5.8	5.9	5.9	6.0	6.1	6.1	6.2	6.3	6.3	6.4	6.4	6.5	6.6	6.6	6.7	6.8	6.8	6.9	7.0	7.0
4.6	5.5	5.5	5.6	5.7	5.7	5.8	5.8	5.9	6.0	6.0	6.1	6.2	6.2	6.3	6.4	6.4	6.5	6.5	6.6	6.7	6.7	6.8	6.9	6.9	7.0	7.1
4.7	5.5	5.6	5.6	5.7	5.8	5.8	5.9	5.9	6.0	6.1	6.1	6.2	6.3	6.3	6.4	6.5	6.5	6.6	6.6	6.7	6.8	6.8	6.9	7.0	7.0	7.1
4.8	5.5	5.6	5.7	5.7	5.8	5.9	5.9	6.0	6.0	6.1	6.2	6.2	6.3	6.4	6.4	6.5	6.6	6.6	6.7	6.7	6.8	6.9	6.9	7.0	7.1	7.1
4.9	5.6	5.6	5.7	5.8	5.8	5.9	6.0	6.0	6.1	6.1	6.2	6.3	6.3	6.4	6.5	6.5	6.6	6.7	6.7	6.8	6.8	6.9	7.0	7.0	7.1	7.2
5.0	5.6	5.7	5.7	5.8	5.9	5.9	6.0	6.0	6.1	6.2	6.2	6.3	6.4	6.4	6.5	6.6	6.6	6.7	6.8	6.8	6.9	6.9	7.0	7.1	7.1	7.2

Rule of thumb

Typical Holstein/Friesian cows producing milk at 3.8% fat, 3.2% protein require around 5.2 MJ of ME for every litre.

This means a cow giving 30 litres requires (30 x 5.2) = 156 MJ of ME/day for production.

Body reserves

Body reserves provide a balancing mechanism between the amount of ME cows need and the amount available in their daily diet **(Section 2)**.

Whenever intake is insufficient to support production – as in early lactation – energy is mobilised from body fat via the liver, allowing cows to milk off their backs and lose condition.

Equally, whenever intake is greater than the immediate needs of production – as in later lactation – it will be directed towards body fat, increasing liveweight and condition.

The complexity of the metabolic pathways involved means it requires more ME to gain weight than that released by losing it.

Rule of thumb

Typical Holstein/Friesian cows require 32 MJ of ME for every kg of body weight gain but only generate 28 MJ of ME for every kg of body weight loss.

This means that a 600kg cow needs 360 MJ of ME over a lactation to end up in the same condition she started in (Table 7.3).

Because liveweight changes are impossible to assess without weighing stock, Body Condition Score is commonly used as a measure of body fat reserves **(Section 2)**.

The amount of ME required to increase Body Condition Score or the amount of ME realised by losing it depends on liveweight **(Table 7.3)**.

Factsheet 4 provides practical advice on Body Condition Scoring.

Table 7.3: Energy and body condition score change (MJ ME) required

Body weight	Change in condition score over lactation				
(kg)	-1.0	-0.5	0	+0.5	+1.0
400	-880	-320	240	920	1600
425	-935	-340	255	978	1700
450	-990	-360	270	1035	1800
475	-1045	-380	285	1093	1900
500	-1100	-400	300	1150	2000
525	-1155	-420	315	1208	2100
550	-1210	-440	330	1265	2200
575	-1265	-460	345	1323	2300
600	-1320	-480	**360**	1380	2400
625	-1375	-500	375	1438	2500
650	-1430	-520	390	1495	2600
675	-1485	-540	405	1553	2700
700	-1540	-560	420	1610	2800

Rule of thumb

Typical Holstein/Friesian cows gain approximately 10% of their body weight for every unit increase in Body Condition Score.

As well as sufficient energy overall, cows need to have their ME in a balance of forms which optimises digestive health and efficiency.

In particular, they must have the right balance of dietary fibre with Fermentable Metabolisable Energy (FME) to maintain the best possible rumen fermentation **(Section 2)**.

Although these requirements are important for the most efficient utilisation of feeds and performance, they clearly remain secondary considerations to overall ME supply.

Assessing protein requirements

Over the years a number of different systems have been developed for assessing the protein requirements of dairy cows and meeting them through rationing.

Crude Protein

Herds with modest yields on simple feeding systems using traditional ingredients are likely to find Crude Protein (CP) a sufficiently good basis for their needs.

Although this system fails to take account of the different ways in which protein is involved in ruminant nutrition and the different types of protein provided by feeds, it has the virtue of simplicity and near universal use.

Regardless of their type or source, feeds will almost invariably have a stated, analysed or assumed CP content.

RDP/UDP

Rumen Degradable Protein (RDP) and Undegraded Dietary Protein (UDP) splits crude protein into the fractions available and unavailable for use by microbes in the rumen **(Section 2)**.

This system allows more sophisticated rationing to ensure the best value from both rumen fermentation and normal digestion.

While low yielding animals are generally able to fulfil their protein requirements from RDP alone, higher yielders require the best combination of RDP and UDP.

RDP/UDP is an essential minimum in rationing high performance herds.

Rule of thumb

Protein requirements can best be assessed by two simple equations.

RDP requirement (grams) = Energy supplied (MJ) x 11.8

UDP requirement (grams) = (RDP ÷ 100) x yield (litres)

Metabolisable Protein

Developed from the original RDP/UDP system, Metabolisable Protein (MP) is an even more sophisticated system **(Section 2)**.

In addition to the different types of protein, it takes account of a number of dietary interactions which affect protein utilisation, most notably the amount and form of energy supplied.

MP forms the basis of the Feed into Milk rationing software and is widely used in modern computer rationing programs.

Assessing mineral and vitamin Requirements

Cows also need to be provided with sufficient minerals and vitamins to avoid deficiencies or imbalances **(Section 2)**.

Although deficiencies can have a disproportionate impact on performance, the fact that most feed ingredients – especially forages – provide reasonable levels of most minerals and vitamins means they only need to be considered as a final check in rationing **(Section 4)**.

Over-feeding of minerals is a source of serious financial wastage in many herds and excess minerals can be as harmful as deficencies.

Diet formulation

Diet formulation essentially involves utilising the feeds available to meet the daily nutrient requirements of cows within their available intake capacities.

The best formulation processes ensure this is achieved in the most cost-effective way and with the greatest possible utilisation of home-grown forages for each group of cows **(Section 5)**.

Formulating diets manually

While perfectly sufficient for the simplest systems involving limited ingredients, manual diet formulation is generally considered too time-consuming and cumbersome for regimes in which rations are fine-tuned to performance regularly or more than a very few separate ingredients are used.

Formulating diets manually is, however, good practice for those who wish to understand the basis by which more sophisticated systems work in order to avoid common errors in their use.

Manual diet formulation involves the following steps (Example 7.1):

1. Establishing basic cow performance parameters
2. Establishing the nutrient values of the feeds available
3. Calculating cow energy requirements
4. Estimating dietary energy intakes
5. Checking protein supplies.

The main focus of manual diet formulation is to ensure the energy provided by the diet is sufficient to meet overall daily requirements.

The calculations need to be done repeatedly with different daily allocations of forage and concentrates until the right balance is achieved.

Worksheet 7 provides a pro forma for manual farm diet formulation

Example 7.1: Manual diet formulation calculations

1	**Cow performance**		
A	Body weight		600kg
B	Milk yield		30 litres/day
C	Butterfat		3.8%
D	Protein		3.2%
E	Pregnant		NO
F	Weight change		- 0.4kg/day
2	**Feeds available**		
	Grass silage		
G	Dry Matter		25%
H	Metabolisable Energy		11.0 MJ/kg DM
I	Crude Protein		140g/kg DM (14%)
	Dairy cake		
J	Dry Matter		87%
K	Metabolisable Energy		13.0 MJ/kg DM
L	Crude Protein *		180g/kg fresh (18%)
3	**Daily energy requirements**		
M	ME for maintenance	**(A x 10 ÷ 100) + 10** (Page 7-3)	70 MJ/day
N	ME for reproduction	(Page 7-3)	0 MJ/day
O	ME for milk yield	**B x 5.2** (from Table 7.2)	156 MJ/day
P	ME from body reserves	**F x 28** (Page 7-4)	-11.2 MJ/day
Q	Total ME required	**M+N+O+P**	**215 MJ/day**
4	**Daily energy intake**		
R	Dry Matter intake	**A x 3 ÷ 100** (Page 7-2)	18kg DM/day
S	ME from forage (at 10kg DM /day)	**H x 10**	110 MJ/day
T	ME from concentrates (at 8kg DM/day)	**K x 8**	104 MJ/day
U	Total ME supplied	**S + T**	**214 MJ/day**
5	**Protein supply**		
V	CP from forage (at 10kg DM/day)	**I x 10**	1400g/day
W	CP from concentrates (at 8kg DM/day)	**(L ÷ J x 100) x 8**	1655g/day
X	Total CP supplied	**V + W**	3055g/day
Y	CP content of ration	**X ÷ (10+8)**	170g/kg DM (17 %)

**WARNING: The protein content of concentrate feeds is often stated in terms of fresh weight so will require conversion into DM terms.*

Formulating diets by computer

Computer programs essentially follow the same process as manual diet formulation, matching animal requirements with feed supplies.

In undertaking repeated balancing calculations rapidly and reliably, computer programs make the whole business of diet formulation far more manageable for the majority of herds, allowing:

- A wide range of different feed ingredients to be utilised or compared
- Diets to be balanced for different energy and protein types at the same time
- Specific diets to be formulated for different groups of animals
- Rations to be adjusted regularly to match changing performance or ingredient availability
- Least cost diets to be formulated.

They can even provide detailed feeding recommendations for different systems.

Accurate details of the animals, feeds available and feeding system employed are essential for successful computer diet formulation.

As a cross-check, it is also valuable to have a good idea of the dietary specifications likely to be required for different levels of performance **(Table 7.4)**.

Table 7.4: Typical diet specifications for Holstein Friesian milkers (per kg feed)

	Milk yield		
	High (35 litres)	**Medium (25 litres)**	**Low (15 litres)**
% forage in the diet	45-55 %	50-60 %	> 60 %
ME (MJ)	11.8	11.2	10.7
Crude protein (%)	17-18	16.5-17	16-16.5
Oil (%)	4-6	3-5	2-4
NDF (%)	32-36	36-40	40-45
Starch (%)	16-20	12-16	8-12
Sugar (%)	5-8	4-6	2-4

Feed into milk

Developed from a major Government and industry-funded research project, Feed into Milk (FiM) is the nutritional model that forms the basis of most modern computer diet formulation programs as well as setting the standard for modern UK feed evaluations.

Incorporating key elements of the Metabolisable Protein system, feed into milk:

- New Near Infra Red Scanning (NIRS) standards for grass silage analysis
- New silage intake predictions
- Rumen stability values
- Rumen energy availability of different feeds depending on rations and production level
- Microbial protein yield calculated from rumen nitrogen and energy availability.

Feed into Milk software requires considerable details of the animals to be entered **(Figure 7.2)**.

Alongside this, the software features a comprehensive library of feed ingredient specifications which need to be regularly updated with precise feed analyses, from which available and potential ingredients are selected **(Figure 7.3)**.

Figure 7.2: Typical FiM based program animal screen

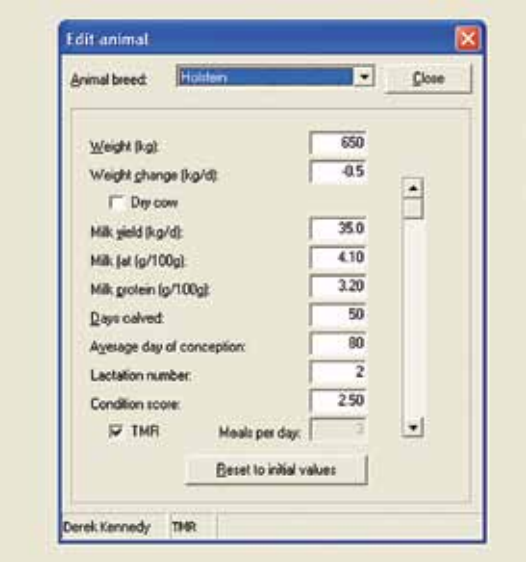
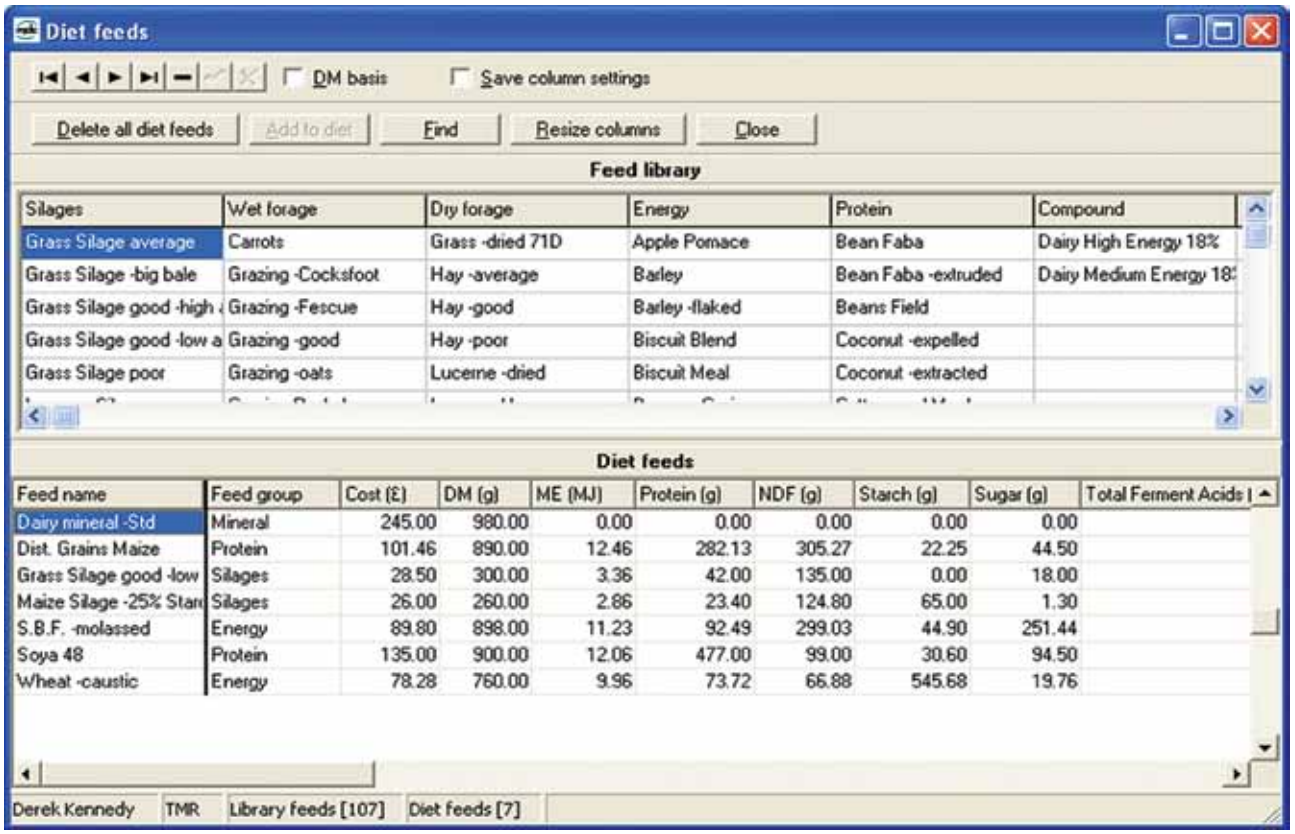


Figure 7.3: Typical FiM based programme feed ingredient screen

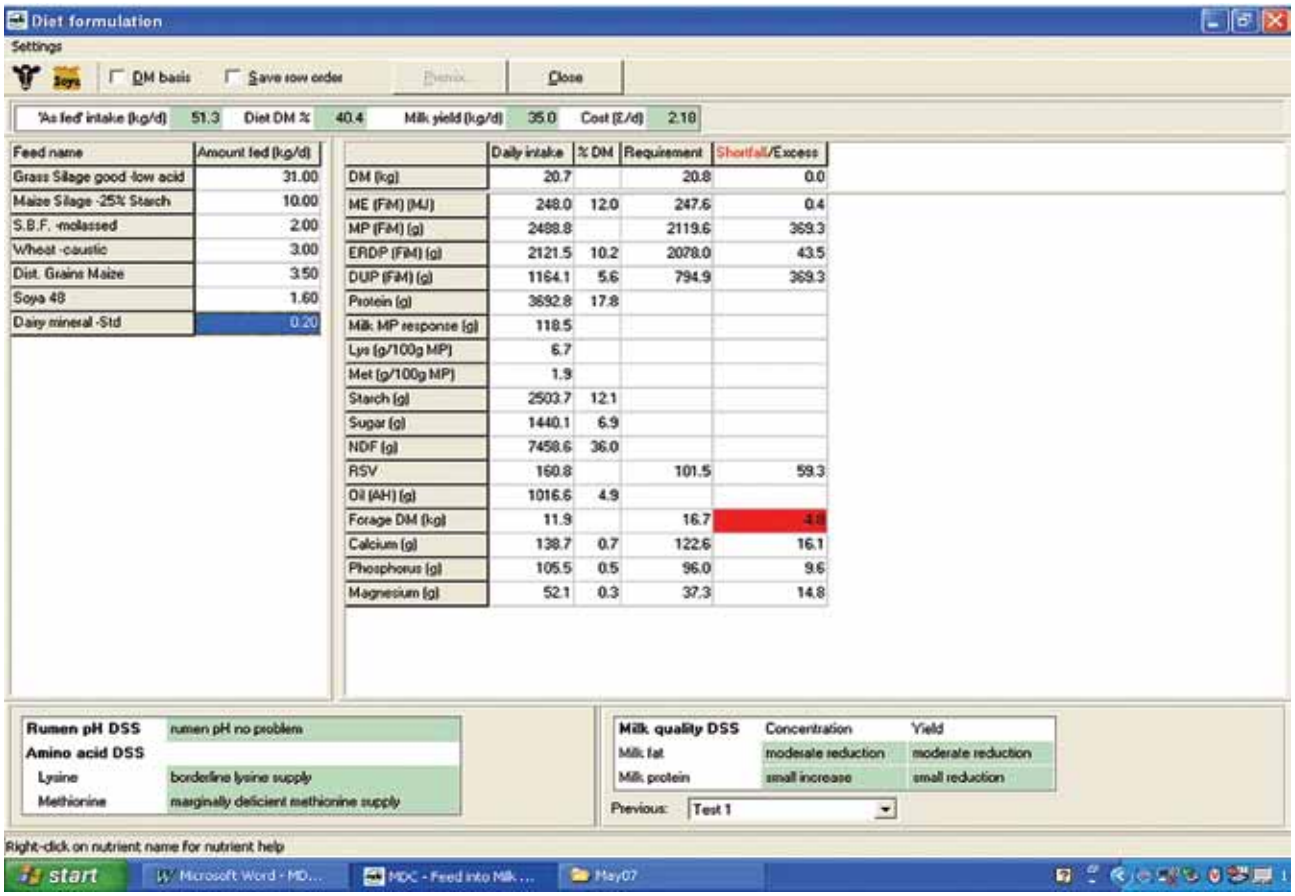


D.

The program matches these ingredients to the cow requirements to produce diets suitable for the feeding system, displaying full details of their nutrient provision and sufficiency together with 'as fed' information for making up the ration and costs **(Figure 7.4)**.

This allows any nutritional shortfalls and excesses to be minimised by ingredient adjustments, and enables diets to be formulated from different mixtures of ingredients to compare daily feeding costs.

Figure 7.4: Typical diet screen



Ensuring accurate allocation

Accurate daily allocation of the diets is as important to success as their effective formulation (Section 3).

Accuracy in diet allocation demands:

- Good calibration of all feeding equipment
- Regular checking and maintenance of all feeding equipment
- Careful weighing-out of mixed ration ingredients
- Effective mixing (if using TMR)
- Accurate identification and grouping of cows
- Good presentation of feeds to ensure adequate access to all cows
- Diligent feed hygiene to avoid compromising palatability
- Effective performance monitoring.

Water management

The critical importance of sufficient good quality water to dairy cow performance **(Section 2)** makes good management of water supplies throughout the year essential.

Cows normally drink 2-5 times per day, with the peak intake after milking.

While cows can survive for two to three days without water, milk yield is closely related to water quality, availability and intake.

Meeting water requirements

70cm of water trough space needs to be allowed per cow – a 100-cow herd requiring 7m of total trough space.

Rule of thumb

The trough space should be sufficient for 10% of the herd to drink at once.

Water should be clean and its flow rate sufficient to allow rapid refilling of the trough so water is always in front of the cows.

Cows can drink up to 14 litres/minute, so 10 cows drinking at the same time can consume 140 litres every minute.

More specific water supply requirements are set out in the quality assurance schemes of some milk buyers.

Siting water troughs

At pasture cows should not have to walk more than 250 metres to a drinking trough.

Additional water troughs should be available in the collecting yard and, if possible, on route to the grazing area.

All troughs should allow cows unrestricted access.

Water troughs are best sited on a dry area of the field to ensure good continuous access for stock, and maintained regularly to minimise leaking or overflowing problems.

Wherever possible, troughs should be protected from the wind which can surprisingly easily cause spillage and poaching in the drinking access area.

Troughs should be sited well away from gateways to minimise poaching and avoid any restriction to cow flow.

An apron is often a good investment, particularly around heavily-used water troughs, to prevent the ground becoming muddy and stony.

To allow cows to drink freely the rim of water troughs should be 75cm (30in) above ground level.

Water bowsers are an effective short-term solution to provide extra water in areas of low pressure or where new troughs have yet to be installed.

D.

The Grass+ programme provides practical advice on making the most of grass.

For detailed guidance on water at pasture see Factsheet 4.

In buildings water troughs should always be sited to maximise accessibility to all animals.

Water must always be available in collecting and dispersal areas as well as in housing and fields.

For ease of cleaning, tip-over troughs are ideal in yards.

In cubicle sheds it is important to:

- Ensure water spilled from troughs or any leakage does not run onto cubicle beds
- Prevent cows standing in cubicles reaching troughs
- Avoid the risk of troughs being filled by feeder wagons.

Cross passages are ideal sites for troughs in cubicle sheds and should be at least 3.6m wide to allow two cows to pass behind animals that are drinking.

In straw yards it is important to:

- Ensure cows cannot drink while standing on bedded areas
- Design floors to fall away from bedded areas so waste water and leaks do not make beds wet
- Site troughs where straw will not be blown into troughs during bedding down or make simple covers to use while straw blowing
- Avoid the risk of troughs being filled by feeder wagons.

Performance monitoring

As well as being essential for feed to yield concentrate allocation systems (Section 6), good regular monitoring of performance is important to ensure the diets are actually delivering the required results.

Cow performance and dietary sufficiency can be monitored through:

- Milk output
- Feed intake
- Body Condition Score
- Gut fill and dung consistency
- Metabolic profiles
- Health and fertility.

Monitoring milk output

Since it is always one of the first things to be affected by the diet – positively or negatively – milk yield is the most essential element of performance to monitor.

Bulk milk sales

Daily bulk milk sales have the benefit of being the simplest and most immediately available measure of yield.

They can be very useful as an immediate indicator of improvement or difficulty.

However, changes in herd milk production need to be interpreted with care because they can be disproportionately affected by the performance of a few animals or one particular group.

Bulk milk sales will, of course, also be affected by a number of non-feeding factors, including the weather, other management changes and large numbers of bulling cows.

Individual milk records

Individual records of milk production – either through daily measurements or official milk recording – are more valuable tools for performance monitoring.

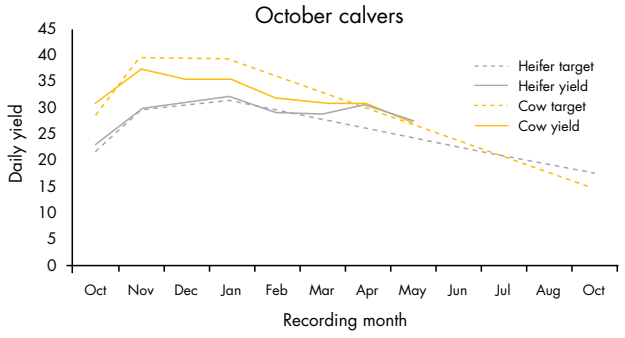
They are essential for the most accurate feeding to yield but may be considered unnecessarily costly or time-consuming for flat rate concentrate feeding or TMR systems **(Section 6)**.

By identifying performance adequacies, inadequacies or changes in individual animals or particular groups of cows, they allow dietary effects to be separated from non-feeding factors far more accurately than bulk milk records.

Lactation curves plotted for individuals or groups of animals provide a very graphic illustration of performance **(Figure 7.5)**.

Worksheet 8 provides a pro forma for farm lactation curve recording.

Figure 7.5: Typical lactation curve plots



D.

If milk yields are not as expected it is advisable to check whether:

- Feed intakes are as expected
- The diet is effectively balanced
- Feed ingredient analyses remain accurate
- Cows are grouped correctly
- The calving pattern has changed
- More or fewer than planned cows have calved in the past three months
- The milk from a number of cows is being withheld from the bulk tank.

Milk constituents

Butterfat and protein levels are valuable indicators of diet adequacy.

While butterfats can change within days of any change in diet, it is important to appreciate that milk protein changes may reflect the dietary position several weeks earlier.

Among other things, low butterfats (Section 2) may result from:

- Poor forage intakes
- Poor forage quality
- Low dietary fibre levels
- Low fibre levels in spring grass
- Clinical or sub-clinical rumen acidosis
- High yields in early lactation
- High dietary oil levels.

Among other things, low milk proteins (Section 2) may result from:

- Low dietary energy levels
- Inadequate dietary protein
- Poor nutrition during autumn grazing
- Poor body condition or excessive weight loss
- High yields in early lactation.

Milk urea nitrogen

Milk urea nitrogen (MUN) monitoring, available on a weekly basis from most milk companies can provide a useful indication of the efficiency of rumen protein utilisation.

It is important to appreciate that MUN levels can vary widely throughout the day and between cows at different stages of lactation.

Careful interpretation is also essential as levels reflect an inter-relationship between energy and protein metabolism so can mean different things under different conditions.

Rules of thumb

Milk Urea Nitrogen interpretation

Less than 0.030ppm	insufficient rumen protein or very efficient use of protein
0.030 – 0.040ppm	sufficient rumen protein in good balance with energy.
Greater than 0.04ppm	excess rumen protein due to excess supply or poor utilisation

Monitoring feed intake

Feed intake is so critical to providing the right degree of nutrition that intake monitoring can provide a good early warning of difficulties as well as a way of pinpointing particular problems identified through milk monitoring.

Intakes vary with a number of cow, food and management factors **(Section 2)**.

A continual visual check on feed consumption is always advisable, large amounts of food remaining uneaten or cows running out of food too long before the next feed being good indicators of problems.

If forage intakes are less than expected, this may be because:

- Dry matter levels are lower than analysed or assumed
- Cows are suffering from acidosis
- Feed access is insufficient
- Silage is deteriorating in the trough
- Feed trough hygiene is insufficient
- Access to clean water is inadequate
- Concentrate feeds are depressing forage appetite.

Monitoring Body Condition Score

Body Condition Scoring provides a good measure of a cow's energy balance to inform feeding and management **(Section 2)**.

Cows can be scored in any situation, preferably restrained in a race or crush, with the assessment made over the tail-head and the loins by sight and feel.

With practice, experience shows most managers can gauge Body Condition Score very well by eye supported by feel.

The Pd+ programme provides practical advice on improving herd fertility.

To make the most of Body Condition Scoring, herds should:

- Make condition scoring a routine element in herd management – alongside rumen fill scoring and assessments of dung consistency as indicators of cow health, feed intake, lameness and overall ration adequacy
- Record condition scores for all relevant animals – using record sheets that allow active utilisation and interpretation of the information
- Focus on animals deviating from the norm – excessive BCS loss in a group of stock or the whole herd rather than just a few individuals indicating action is necessary
- Assess group trends, in particular, from one scoring session to the next – to highlight critical BCS changes
- Use condition scoring records actively in fertility management
- Consider condition scoring re-training and calibration sessions.

Factsheet 4 provides practical advice on Body Condition Scoring.

Monitoring gut fill and dung consistency

Although very subjective, the degree of rumen fill and consistency of dung are useful ways of keeping an eye on digestive efficiency and health.

Gut fill

For the greatest efficiency, cows' rumens should be well-filled throughout the day.

Insufficient rumen fill among groups of cows or individuals should raise immediate questions over feed availability or animal health.

It is important to appreciate it will often take 7-10 days after calving for rumen fill to reach acceptable levels.

Gut fill should be assessed on a scale of 1 (very empty) to 5 (very full) by looking at or feeling the triangle behind the last rib below the transfer spinal processes and in front of the hips on the left side of the animal **(Figure 7.6)**.

Figure 7.6 The gut fill triangle

If the rumen is completely full the triangle will bulge out slightly, whereas if it is very empty it will be concave in appearance and easy to push the fingers under the transverse spinal processes.

Gut fill should ideally be assessed just prior to new feed being offered and again 3 hours later to identify any obvious differences.

Comparing cows with heifers is also a good way of identifying any problems with shy feeders.

Dung consistency

Continual assessment of the dung provides a very good indication of the balance of the diet as well as overall efficiency of digestion.

The dung should:

- Be soft but maintain its shape in a pat
- Sound like a slow hand clap rather than a round of applause
- Be consistent across the herd
- Contain little or no undigested fibre or grains.

Any problems with the dung suggest diets need reformulating or their presentation needs improving.

While loose dung generally indicates faster than ideal passage through the gut, it is acceptable with cows on grass only or forage crops.

Rule of thumb

Dung that is too firm and forms mounds suggests the diet may be too low in protein or high in fibre.

Dung that is too loose and thin, spreading easily, suggests an excess of protein, too little fibre, acidosis or the presence of mycotoxins.

Monitoring metabolic profiles

Analysis of blood samples from a representative group of cows for a range of energy, protein and mineral parameters can be very valuable in assessing exactly what the cows think of the diet.

Cows in negative energy balance, for instance, have high concentrations of non-esterified fatty acids (NEFAs) and beta-hydroxybutyrate (BHB) or ketone bodies in their blood.

Survey work involving 15,000 cows in one UK metabolic profiling scheme has shown that a high proportion of modern dairy cows are in energy deficit in early lactation.

It has also underlined the value of monitoring the adequacy of feeding through metabolic measures that enable dietary imbalances to be identified and corrected before they seriously impact production, fertility or health.

Metabolic profiling, with blood sampling undertaken at key times of the lactation cycle, has been found to be a valuable management tool when organised as part of a routine herd health scheme.

Blood sampling needs to be conducted with veterinary supervision and the involvement of both a vet and nutritionist is recommended in interpreting and acting upon the results.

This is especially important since recent work has suggested that slightly raised BHB and NEFA levels may not be the problem once thought.

Furthermore, some experts consider NEFA levels should be allowed to rise in late pregnancy to condition cows for early lactation **(Section 9)**.

Factsheet 9 provides further information on metabolic profiles.

Monitoring health and fertility

Given the wide impact dietary problems and imbalances can have on productivity, monitoring specific aspects of dairy health and fertility can be very valuable in feeding management.

Fertility

Even though production monitoring may suggest dairy rations are adequate in their energy supply, they can compromise fertility performance.

The time delay between lack of energy in the ration and any resulting oestrus expression or pregnancy rate problems means nutritional inadequacies often go unrecognised until it is too late to do much about them.

This is compounded by the fact that fertility has not traditionally been given sufficient prominence within rationing programmes.

Whenever a ration is being prepared it is always worth questioning:

- If the ration is necessarily adequate for good fertility just because it is appropriate for the level of milk production
- If ration formulation has actually taken into account fertility performance and potential problems
- If there are ways of monitoring the performance of the ration in terms of fertility as well as milk production
- If sufficient focus has been placed on cow condition as a measure of ration adequacy.

Calving Interval – CI (the number of days between one calving and the next) is the easiest measure of fertility, although it fails to account for cows already culled from the herd and is generally too historic to be of immediate management value.

Caving to Conception Interval – CCI (the average number of days from calving to the service at which cows get pregnant) is less readily available to all herds, although provided by most milk and fertility recording services.

CCI is of far greater use as a practical measure of fertility, especially when calculated for individuals or groups of cows (by month of calving perhaps) to avoid hiding extremes within a whole herd average.

Rules of thumb

CCIs typically range between 80 and 120 days.

The target CCI for reasonable fertility is 70-90 days.

It is important to appreciate that poor fertility tends to be caused by a number of different factors, including inadequate heat detection and healthcare as much as nutrition.

The Pd+ programme provides practical advice on improving herd fertility.

For detailed guidance on feeding for fertility see Section 7.

Metabolic health

Disorders like acidosis, ketosis, displaced abomasums and fatty liver are clear signs of dietary problems **(Section 2)** especially if they affect a number of animals rather than just the odd individual and occur regularly rather than occasionally.

More than occasional problems with milk fever and

Factsheet 1 provides practical guidance on metabolic disorders.

A high incidence of such metabolic disorders in early lactation cows often results from inadequate nutrition and management in the dry period or around calving (Section 9).

Lameness

Like fertility, lameness is recognised as being caused by a number of factors, including inadequate nutrition.

Apart from incurring significant veterinary and medicine costs, it can have a seriously depressing effect on both milk production and fertility.

A significant incidence of lameness observed in the herd or identified in cattle heath records suggests diets should be checked for excess levels of starchy energy or protein in particular.

Mobility Scoring provides a good snapshot of the current incidence and severity of lameness **(Table 7.5)**.

Compared to target levels for lameness, a 7000 litre herd with 10% of cows at Score 3, and 15% at Score 2 could be losing an average of 400 litres/cow, worth £100 at 25p/litre.

Mobility scoring can be time-consuming and is, like gut fill scoring, subjective.

However, regular scoring is an extremely valuable way of ensuring sufficient attention is paid to foot condition in herd management and lame cows are identified and treated early.

Table 7.5: Mobility scoring

Category of score	Score	Description of cow behaviour
Good mobility	0	Walks with even weight bearing and rhythm on all four feet; with a flat back. Long, fluid strides possible.
Imperfect mobility	1	Steps uneven (rhythm or weight bearing) OR strides shortened; affected limb or limbs not immediately identifiable.
Impaired mobility	2	Uneven weight bearing on a limb that is immediately identifiable AND/OR obviously shortened strides) usually with an arch to the centre of the back, that may increase as the cow begins to move).
Severely impaired mobility	3	Unable to walk as fast as a brisk human pace (cannot keep up with the healthy heard) AND signs of score 2.

Feed record keeping

Maintaining good records of feeds, diets and feed plans is becoming increasingly essential to comply with legal and farm assurance requirements.

As well as demonstrating full traceability, good feed records are invaluable in investigating nutritional links with performance revealed through production, fertility or health records.

They can also be extremely useful in tracking value-for-money in feed purchasing and comparing current volumes, values or quotations with previous supplies.

For purchased feed ingredients, records should include:

- Feed description (with analysis, if available)
- Date of supply
- Fresh weight
- Load/batch reference (if available)
- Supplier name and address
- Feeding period (dates)
- Cost.

Most of this information is typically available from feed delivery notes and invoices.

For home-grown feeds, records should include:

- Feed description (with analysis)
- Observations on preservation/physical quality
- Fresh weight (approximate)
- Reference to field sources (if required for management improvement)
- Feeding period (dates)
- Cost (estimated).

For rations, the minimum requirement is to keep a record of the quantity of feeds being fed to each group of stock.

However, supporting information (such as silage analyses or computer print-outs with nutrient breakdowns) should also be kept.

Home-mixing records should include the dates of mixing, the ingredients and the quantities mixed.

For traceability purposes feed record information should be kept for at least two years, although more historic records can be very useful for reference purposes.

Expert advice

Even those who formulate all their own diets find it useful to get a second opinion from an outside expert every now and then.

This is particularly valuable when major changes are to be made to the diet – such as in moving from one forage to another, at turnout or when performance falls below expectation.

Nutritional advice comes in various shapes and forms, with varying degrees of commercial independence.

The best advice invariably comes from professionals who:

- Are independent of any feed supplier
- Have a good practical knowledge of feeding cows
- Understand the herd's requirements, limitations and feeding resources.

For health-related problems, veterinary advice will always be helpful, although it is important to appreciate that vets may not necessarily be experienced nutritionists.

Good expert feeding advice should include:

- A review of the existing diet
- A check of feed analyses
- An examination of milk records
- An assessment of cow body condition
- An assessment of dung consistency
- A general appraisal of herd health.

The vet, herd manager and nutritionist should meet together occasionally to review progress, assess problems and agree forward plans.