10. Feeding the cows

Learning outcomes:

This chapter will help you to:

- Calculate the feed requirements of cows with targets set for milk production and body condition.
- Provide pasture for cows that will ensure a high intake.

We have set the primary aim of pasture management to increase pasture consumption. So far, we have dealt mostly with the pasture only.

In this chapter we will discuss:

- What the **cow needs** from the pasture.
- How to ensure **high cow intake of pasture**.

A cow is a ruminant: She has **four stomachs**:

- The first part is the **rumen, filled with bacteria**.
- The **bacteria digest the pasture,** breaking it down so the cow can absorb and use it.

10.1 The feed contents of pasture

Pasture consists of water and dry matter.

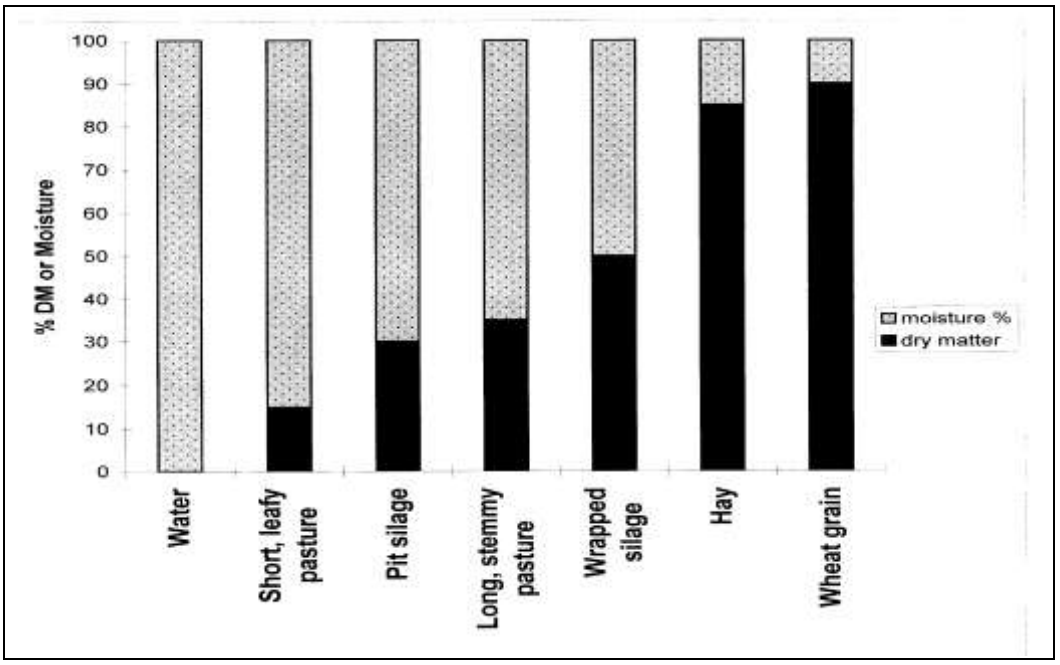
10.1.1 Dry matter

As explained in Section 8.2 feeds are best compared on the dry matter they contain.

Figure 10-1 shows the dry matter and moisture in different feeds. For example, short leafy pasture is about 15% dry matter and 85% water.

For clarity, if you refer to a weight of feed with its moisture still in it (that is, as you normally find it), you really should add the phrase “as fed”.

Figure 10-1: The approximate dry matter and moisture in different feeds



10.1.2 The contents of dry matter

The dry matter of a feed contains:

- **Energy**
  - Energy is measured as megajoules of metabolisable energy per kilogram of dry matter (MJ ME/ kg DM).
  - Energy drives all the cow's bodily processes, is stored as body fat, is made into milk fat, and helps build milk protein.
  - The energy levels of perennial ryegrass and white clover are shown in Chapter 4.
  - Cows need between 60 and 200 (or more) MJ ME per day, depending on level of milk production, pregnancy, etc.
  - To take in enough energy to produce at the higher levels, a cow needs to be provided with energy-dense feeds that contain at least 11 MJ ME/ kg DM.
- **Fibre**
  - Fibre is measured as neutral detergent fibre (NDF), expressed as a percentage of dry matter.
  - Some fibre is digestible and some is not.
  - Fibre causes the cow to chew, which produces saliva and reduces acid buildup in the rumen.
  - The digested products of fibre produce milk fat.
  - Cows need about 35% NDF.

- **Protein**
  - Protein is measured as crude protein (CP), expressed as a percentage of dry matter.
  - Protein builds all the cow's tissues and organs and is made into milk protein.
  - Cows need between 15% and 20% crude protein, with 18% being ideal.
- **Minerals** and **vitamins**
  - Cows usually get sufficient minerals and vitamins if they are eating enough green pasture.

10.2 How a cow uses food

A cow uses the feed she eats to:

- **Maintain** herself, which includes breathing, blood circulation, digestion, tissue repair, keeping warm, standing, and grazing.
- **Walk** to and from the dairy.
- Support the calf inside her, if **pregnant**.
- Produce **milk**.
- Put on **body condition** (that is, get fat).

The cow uses the feed (or partitions it) in the following order:

- She will firstly **maintain herself**.
- Then look after the **calf** inside her.
- And lastly, put on **body condition or produce milk**.
- So if she is not getting enough food, these last two are the first to suffer.
- Higher genetic merit dairy cows tend to partition food to milk before body condition.

All the following requirements of feed (kg DM) assume the feed is good quality, that is, about 11 MJ ME/ kg DM. Cows will need more dry matter if the feed is poorer quality.

10.2.1 Maintenance requirement

- **Heavier animals** have a higher maintenance requirement. (see Figure 10-2).
- Cold, windy **weather** will increase maintenance requirement only a little. The main problem of bad weather is that cows spend less time eating.
- About one third of a milking cow's feed, a significant amount, is necessary to maintain her.

Figure 10-2: Maintenance dry matter requirement for cows and yearlings of various weights

Liveweight (kg)	Maintenance requirement (kg DM)
200	3.0
350	3.5
400 (average Jersey)	4.0
550 (average Friesian)	5.0
600 (large Friesian)	6.0

All tables in this chapter assume there is 11 MJME/ kg DM, that is, good quality feed.

10.2.2 Walking to and from dairy requirement

The walking feed requirement only becomes significant if the cows are walking long distances on steep terrain, as shown in Figure 10-3.

Figure 10-3: Dry matter requirement for walking to and from the dairy

Terrain	Walking requirement (kg DM per kilometre)
Steep	0.3
Flat	0.1

All tables in this chapter assume there is 11 MJME/ kg DM, that is, good quality feed.

For example, if the cows were walking to and from a paddock 1 km from the dairy, on a steep farm, they would use 1.2 kg DM of feed (4 km x 0.3) each day doing it.

10.2.3 Pregnancy requirement

- Prior to the sixth month of pregnancy, the calf is very small and the feed requirement is insignificant.
- The calf starts to grow rapidly in the sixth month.
- The calf doubles its size in the ninth month (when the cow is usually dry) so the feed requirement for pregnancy then becomes considerable, as shown in Figure 10-4.

Figure 10-4: Dry matter requirement for pregnancy

Month of pregnancy	Pregnancy requirement (kg DM)
5	0.1
6	0.7
7	1.0
8	1.5
9	2.0

All tables in this chapter assume there is 11 MJME/ kg DM, that is, good quality feed.

10.2.4 Body condition requirement

For a **cow to gain condition** (usually in late lactation or when dry), she requires extra feed above that needed for maintenance, milk and pregnancy:

- **One condition score** (CS) varies between 32 and **44 kg of live weight,** depending on the size of the cow (see Figure 10-5).
- Therefore, to gain one CS over six weeks, a bigger cow would need to gain about 1 kg per day over the 42 days.
- To **gain that one kilogram of condition,** a cow needs to eat an **extra 4 kg** of dry matter.
- So she would require 4 kg of extra feed each day to put on one CS in 6 weeks, or a total of 168 kg DM.
- If she gained one CS more slowly, say over 12 weeks, she would need to eat only half that amount extra each day, but she would still require the same total of 168 kg DM of extra feed.

Figure 10-5: Dry matter requirement for condition score gain in lactating cows

Liveweight	LWT per CS	Feed to gain 1 score in 6 weeks	Feed to gain 1 score in 12 weeks
400 kg	32 kg	3 kg DM/ day	1.5 kg DM/ day
550 kg	44 kg	4 kg DM/ day	2 kg DM/ day

All tables in this chapter assume there is 11 MJME/ kg DM, that is, good quality feed.

It is advisable to **dry the cows off in the condition you want them to be in at calving** rather than to try to gain condition while they are dry. This is because:

- Cows **make more efficient use of feed** to put condition on **while still milking** rather than when they are dry. If dry, cows will need 25% more feed to put on the same condition.
- If attempting to put condition on cows when dry, they will still require 5 kg for maintenance, 2 to 3 kg for pregnancy, and 4 kg for condition, totalling 11 to 12 kg DM. **Dry cows will struggle to eat this amount,** especially if it is higher-fibre feed, such as hay.

When a **cow loses condition** (usually in early lactation):

- She **converts that condition into energy,** which she can then use.
- She then does not need to eat as much feed to produce the same quantity of milk.
- In early lactation, a cow typically loses one condition score in six weeks to produce more milk, at a time when her intake has not reached its peak.

- Unfortunately, **losing a kilogram of body fat provides the equivalent of only about 2.5 kg DM of feed**, even though it took 4 kg DM of feed to put it on. Some energy is lost in the conversion process. (See Figure 10-6).

Figure 10-6: Dry matter released from body condition loss

Liveweight	LWT per CS	Feed equivalent released if 1 CS lost in 6 weeks	Approx increased milk production from CS loss
400 kg	32 kg	2 kg DM/ day	4 litres / day
550 kg	44 kg	2.7 kg DM/ day	6 litres / day

All tables in this chapter assume there is 11 MJME/ kg DM, that is, good quality feed.

10.2.5 Milk production requirement

- A cow needs to eat about **0.5 kg** of good quality pasture dry matter to produce **one litre** of milk.
- Therefore, a cow producing 20 litres needs 10 kg of pasture dry matter just for the milk.
- If she is not pregnant and not changing body condition, she will need another 5 kg for maintenance, totalling 15 kg dry matter for the day.

Figure 10-7 shows how much feed is needed for milk, milkfat and milk solids.

Figure 10-7: Dry matter requirement for milk production

Milk production	Dry matter requirement
1 litre milk	0.5 kg
1 kg milkfat	11 kg
1 kg milk solids	6.5 kg

All tables in this chapter assume there is 11 MJME/ kg DM, that is, good quality feed.

Figure 10-8 shows a summary of approximate feed requirements for all the different uses of feed by the cow. Figure 10-9 shows the calculations of total feed requirement for three example cows.

Figure 10-8: Summary of approximate feed requirements for the different uses of feed by the cow

Use	Stock class/ action	Feed requirement or equivalent feed released
Maintenance	200 kg LWT 350 kg LWT 400 kg LWT (average Jersey) 550 kg LWT (average Friesian) 600 kg LWT (large Friesian)	3.0 kg DM/ head/ day 3.5 kg DM/ head/ day 4.0 kg DM/ head/ day 5.0 kg DM/ head/ day 6.0 kg DM/ head/ day
Activity	Steep terrain Flat terrain	0.3 kg DM/ km 0.1 kg DM/ km
Pregnancy	5 months pregnant 6 months pregnant 7 months pregnant 8 months pregnant 9 months pregnant	0.1 kg DM/ head/ day 0.7 kg DM/ head/ day 1 kg DM/ head/ day 1.5 kg DM/ head/ day 2 kg DM/ head/ day
Liveweight gain	To gain 1 kg LWT To gain one condition score: Jersey (1 CS = 32 kg) Friesian (1 CS = 44 kg)	4 kg DM 126 kg DM 168 kg DM
Liveweight loss	Losing 1 kg LWT	Releases: 2.5 kg DM
Milk production	To produce 1 litre milk To produce 1 kg milkfat To produce 1 kg milksolids	0.5 kg DM 11 kg DM 6.5 kg DM

Figure 10-9: Calculation of total feed requirement for some example cows

Use	Cow 1	Feed req'mt (kg DM)	Cow 2	Feed req'mt (kg DM)	Cow 3	Feed req'mt (kg DM)
Maintenance	500 kg LWT	5	400 kg LWT	4	600 kg LWT	6
Pregnancy	5 months	0.1	0 months	0	6 months	0.7
Walking to/ from dairy	1 km, flat	0.1	3 km, steep	0.9	2 km flat	0.2
Milk production	19 litres	9.5	30 litres	15	25 litres	12.5
Condition gain/ loss	Steady	0	1 CS loss over 6 weeks	-1.5	1 CS gain over 12 weeks	3
TOTALS		**14.7**		**18.4**		**22.4**

10.3 Achieving high pasture intake by cows

A cow will produce more milk if she eats more feed. The following factors affect how much a cow can eat:

- **Size of the cow**. A cow can eat between 2% and 4% of her liveweight as dry matter.
- **Level of milk production**. A cow that is producing a lot of milk is stimulated to eat more.

- **Stage of lactation**. Immediately after calving, appetite is about 75% of maximum. It is not until about week 11 that appetite rises to 100%. It then gradually declines until drying off, when it drops to about 80%.
- **Time grazing.** Cows spend only about 8 hours in 24 hours actually grazing, and they take in 80% of an allocation within 2 to 3 hours of entering that area. Cows eat about two-thirds of daily intake during the **day** and one third at **night**. The night period between milkings is usually longer, but cows do sleep. On very hot days, cows will eat less during the day and more at night. If milking takes a long time, it can impact on grazing time.
- **Quantity of feed offered**. Obviously, if not much pasture is offered, not much can be eaten.
- **Ease of harvesting** the feed, which means how easily can the cow get a mouthful. For pasture, this usually means its height and density and the amount of stem.
- **Feed quality**. A cow can eat more of a higher-quality (mostly meaning lower-fibre) feed.
- **Feed palatability**, that is, whether cows find the feed more or less acceptable to eat.

In this manual, we will concentrate on the last four factors, the ones that are pasture management issues.

10.3.1 Pasture quantity offered and intake

The pasture quantity offered to a herd of cows is a combination of:

- The **area allocated** for the day.
- The quantity of **pasture per hectare**.

Once the area and quantity have been allocated, a cow's intake will depend on her:

- **Grazing time**. Cows eat for about 8 hours each day. If very hungry, they may extend that to 10 hours but no more.
- **Bites per hour**. Cows bite about once per second. So a cow bites between 20,000 and 40,000 times a day, depending on how hungry she is.
- **Bite size**. The upper limit of each bite size is about 1 gm DM.

If you offer a lot (a big area and lots of grass per hectare), the **cows will eat a lot**, because:

- They **will get their fill** before reaching their daily limit of about 8 to 10 hours grazing.
- They will be **able to be selective**, that is, avoid the feed they are less inclined to eat.

In fact, to achieve maximum intake, about twice that quantity of pasture needs to allocated for the day. That may seem a lot to offer, but included in that double offer is a lot of feed (say 1,300 kg DM/ ha) below 3 cm, which is difficult for cows to graze, and we don't expect, or want them to graze that feed anyway.

HOWEVER, if you **offer too much pasture to achieve maximum intake** on a particular day:

- Pasture will be **wasted** on that day.
- In the **long term, less pasture will be grown and more will be wasted, and the pasture will be poorer quality and will not persist as well.**

A compromise is needed to obtain reasonable per cow production **and** reasonable pasture consumption:

- It is best to **allocate the right amount** at each grazing.
- The cows will then **graze to the post-graze point you want**.
- The **cows should be moderately fed**.
- This leaves the **paddock prepared for the next grazing**, so the same can occur again.

If 1 hectare of pasture has 2,200 kg DM/ ha and is to be grazed down to 1,300 kg DM/ ha, 900 kg DM are available to be eaten. Consider the differing milk production if the 900 kg was offered to 40, 50 or 80 cows, as shown in Figure 10-10 (for simplicity, this example assumes the cows use all the feed for milk, and do not change body condition):

- With only 40 cows, each one is offered 23 kg, but they could probably eat only 18 kg each.
- When 60 cows are put in the paddock, they are offered 15 kg each and would eat most but not all, say 14 kg each.
- The 80 cows are offered only 11 kg each, so would probably eat the lot.
- Each cow still needs 5 kg for maintenance.
- Therefore, as calculated in Figure 10-10, the 40 cows produce 26 litres each, the 60 cows produce 18 litres, and the 80 cows produce only 12 litres each.
- But, when total milk is calculated, the 60 cows produce the most.

Figure 10-10: Getting the best value from 900 kg of pasture

900 kg available to be eaten, on the hectare	Number of cows on the ha		
	40	60	80
Kg DM available/ cow	23	15	11
Kg DM eaten/ cow	18	14	11
DM for milk after maintenance req'mnt / cow (5 kg)	13	9	6
Milk production (litres/ cow)	26	18	12
Milk production (litres/ hectare)	1,040	1,080	960

Figure 10-10 shows that:

- A **low stocking rate** might get high per-cow production but will not necessarily get high total production per hectare because of **too much wasted pasture**.
- A **high stocking rate** might not waste pasture, but not necessarily get high total production per hectare because **too much feed is "wasted" on cow maintenance**.

10.3.2 Pasture ease of harvesting and intake

A cow can eat more if she can bite faster and get bigger bites:

- Bite size varies from 0.2 to 1.0 grams DM per bite, depending mostly on **the height of the pasture**. Bite size will be small on very short pasture.
- Bite rate will be faster if the pasture **rips off easier**. Leaf is easier to rip off than stem. Ryegrass and clover are easier to rip off than tougher plants, such as paspalum. You can test this yourself by ripping different species off by hand.
- Cows seem to prefer silage or hay, even if it is poorer quality than pasture. This is because it is **easier and faster to harvest**.
- Sometimes pasture is **mown before the cows graze it**. Intake may then be higher because cows can get big mouthfuls of the cut grass easily and the moisture in the grass is lower.

10.3.3 Pasture quality and intake

The main aspect of feed quality that affects dry matter intake is fibre level:

- A **low-fibre** feed is digested very quickly and the rumen is cleared quickly, **allowing the cow to eat more**.
- However, **fibre level can be too low**, causing an acid rumen, which then reduces intake.
- **Ideal fibre content is about 35%** neutral detergent fibre, and fibre content below 30% is more likely to cause rumen acidosis.

Fibre level and energy level in pasture go hand in hand:

- If the **fibre is higher, the energy level is usually lower**, and vice versa.

- The **fibre and energy level in a feed combine powerfully to affect total energy intake** and therefore milk production, as shown in Figure 10-11.

Figure 10-11: Pasture feed quality is critical for milk production

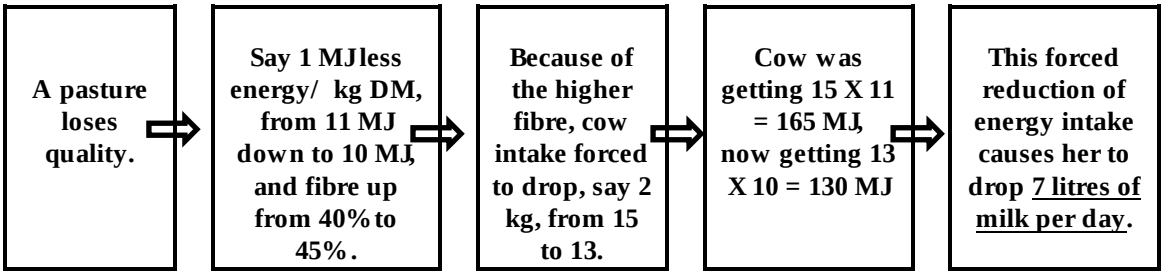


Figure 10-12 shows typical pasture qualities and intake of cows. Cows on the higher quality diets have a much higher energy intake and therefore much higher milk production.

Figure 10-12: The effect of energy and fibre levels on intake and milk production

Cow weight (kg)	Typical pasture energy (ME MJ/ kg)	Typical pasture fibre (% NDF)	Typical intake (kg DM/ day)	Milk (L/ d)
450	9.5	50	10.8	10
	11.5	40	13.5	21
550	9.5	50	13.2	15
	11.5	40	16.5	28

Observation of cows can show this quality versus intake story:

- Sometimes cows seem hungry when grazing leafy, say 12 cm high, green pasture.
- They are able eat a lot of this high quality feed, are still hungry for more, but in fact could be obtaining a lot of energy from the feed.
- Leafy green pasture is so highly digestible that there is a lot of water but not much undigested fibre in the manure. This, commonly known as "the squirts", is a sign of quality feed but may indicate a need for more fibre in the diet.
- On the other hand, hay has a high fibre content and is relatively indigestible, so it moves slowly through the digestive system, reducing intake.
- Cows eating hay to appetite are contented, appear well fed with a gut full of this feed and have very solid manure but are actually not getting much energy.

10.3.4 Pasture palatability and intake

Pasture palatability is a difficult factor to measure. Generally, **cows prefer** and therefore will increase intake of:

- Higher-**quality** pasture.
- Pasture between the **2 and 3 leaf** stage.
- **Green leaves**.
- **Clover**.
- Possibly **limed** pasture.

Cows **do not like** and will reduce intake of:

- **Dead** leaves.
- **Stems and seed heads**.
- **Stubble** left from previous grazings.
- Pasture soiled with **mud, manure or urine**.
- Pasture recently **fertilised with nitrogen**. It is best to apply nitrogen immediately after (or less than two days before) grazing and to allow the pasture to get to at least 2 leaves before grazing. Graze nitrogen-boosted paddocks consecutively so the cows become accustomed to it.

So, pasture **palatability will be high** if:

- The **previous grazing** (or topping) was down to the **desired post-graze** point so that now only new leaf is present.
- The interval between grazings is long enough to **get to at least 2 leaves** but short enough to **avoid decay in the base** of the pasture.

10.3.5 Pasture composition and intake

Of all the pasture species, ryegrass and clover are the best species to ensure high intake. When offered both ryegrass and clover, cows eat more of the clover than the ryegrass and produce more milk. This is shown in Figure 10-13.

Figure 10-13: Milk production from cows fed on clover or ryegrass

Measurement	Clover	Ryegrass	Percent difference
Intake (kg DM/ day)	17.0 kg	13.4 kg	27%
Milk (litres per cow)	17.8 L	14.4 L	24%

10.3.6 Pasture substitution and intake

Imagine a cow:

- She is being fed **only** pasture.
- She is **then offered a supplementary feed**, say grain.

- She may then eat more in total but, almost always, **will eat less** of the **pasture**.
- She **will "substitute"** grain for some of her initial intake of pasture.

Substitution is measured as the decrease in pasture intake for each 1 kg DM of supplement fed. It varies:

- **From 100%,** that is, for every 1 kg DM of supplement eaten, 1 kg DM less of pasture is eaten.
- **To 0%,** that is, even when fed some supplement, a cow does not eat less pasture.

The **level of substitution depends on**:

- The **amount of pasture** offered. The closer a cow gets to being full, the more pasture she will leave in the paddock for each kilogram of supplement eaten. This is shown in Figure 10-14.
- The **quality of pasture**:
  - If the quality of the pasture is the same or lower than the quality of the supplement, the supplement will be eaten first.
  - With high-quality supplements on high-quality abundant pasture, almost complete substitution occurs, that is, cows eat 1 kg less pasture for each 1 kg of supplement eaten.
- The **fibre level of the supplement** fed:
  - Substitution is greater when fibrous supplements (hay, silage) are fed rather than when concentrates are fed.
- The **balance of the diet**:
  - If a supplement improves the balance of energy, protein and fibre, less substitution will occur, and vice versa.

You can get an **indication of substitution** by:

- **Observing the post-graze** point closely. This practice, known as "clumpology", was discussed in Chapter 7. More clumps, higher clumps or higher pasture remaining between the clumps means more substitution is occurring.
- **Observing changes in milk production**. Theoretically, there is enough energy for about 2 litres of milk in 1 kg of supplement. If you feed an extra kilogram of supplement, the further away from the 2 litres extra milk in the vat, the more substitution is occurring or the more body condition gain on the cows.

Figure 10-14: Pasture substitution at high, medium and low pasture allowances

Pasture allowance	High	Medium	Low
Intake: Pasture only (kg/ cow/ day)	15.9	11.8	6.0
Total intake: Pasture+3.5 kg supplmt	17.2	14.4	9.5
Extra intake	1.3	2.6	3.5
Substitution (kg)	3.5 - 1.3 = 2.2	3.5 – 2.6 = 0.9	3.5 - 3.5 = 0
Percent substitution	63%	26%	0%
Effective use of supplement (%)	37%	74%	100%
Milk from pasture only (L/ day)	23.1	21.0	15.4
Milk from pasture + supplement	24.0	23.0	18.5
Response (litres/ kg of supplmt)	0.3	0.6	0.9

Source: Grainger and Matthews, 1989.

At high pasture allowance:

- Total intake increased by only 1.3 kg when 3.5 kg supplement was fed.
- 2.2 kg of pasture was substituted by supplement.
- 2.2 kg is 63% of the 3.5 kg of supplement.
- The milk response was only 0.3 litre extra for each kilogram of supplement fed.

At medium pasture allowance:

- Total intake increased by 2.6 kg when 3.5 kg supplement was fed.
- 0.9 kg of pasture was substituted by supplement.
- 0.9 kg is 26% of the 3.5 kg of supplement.
- The milk response was 0.6 litre extra for each kilogram of supplement fed.

At low pasture allowance:

- Total intake increased by the full 3.5 kg when 3.5 kg supplement was fed.
- No pasture was substituted by supplement.
- Substitution was 0%.
- The milk response was 0.9 litre extra for each kilogram of supplement fed.

Although the post-graze point tells you substitution is occurring, it is virtually impossible to "see" the amount of pasture that might be wasted in a paddock if another kilogram of supplement is fed. To illustrate:

- Imagine a 200-cow herd was being fed 400 kg of supplement for the day and 50% substitution was already occurring.
- Then another 1 kg of supplement per cow was fed (200 kg total extra).
- Assuming the 50% substitution continued, the extra amount of pasture that would then be wasted (not grazed) for the day would be 100 kg, that is, 50% of 200.
- That wasted 100 kg of pasture would be spread over say 2 hectares, which is an extra 50 kg per hectare, or about 0.5 cm higher grass.
- Not many people would be skilled enough to "see" this difference from the day before.

In summary, substitution will be reasonably high, say 50% to 70% if:

- The cows are already being **fed well** on pasture (say 12 to 15 kg DM).
- The **post-graze point is more than 5 cm** and more than one-third of the area is covered with clumps or clumps are higher than 8 to 10 cm.
- The **supplement is poor** quality.
- The supplement is causing an **unbalanced diet.**

If substitution is too high, it causes the following problems:

- **Waste of pasture** on the day.
- **High post-graze** levels, which cause poorer subsequent pasture growth, quality, utilisation and persistence.
- **Lower milk response** as shown in Figure 10-14.
- **Lower pasture consumption** over the whole year.

However, substitution is both a friend and enemy. **Substitution is useful**, in fact necessary, to:

- Prevent the post-graze level from going below your target post-graze. The post-graze level can get too low when pasture growth is not keeping up with herd requirements. Then, supplements can be fed, substituting for pasture, to ensure the best amount of pasture is left after grazing.

If you regularly watch your milk production in conjunction with the post-graze point you will discover what a pasture must look like to ensure:

- High intake.
- An appropriate level of substitution.
- High, long-term milk production.

10.4 Summary

Milking **cows need to be fed well** to meet all their needs and to achieve the target high milk production and body condition .

To ensure a high intake of pasture by cows and to prevent substitution from reducing profit, **the right quantity, height, quality, and palatability of pasture must be offered.**

11. Yearly feed planning

Learning outcomes:

This chapter will help you:

- Predict the quantity and timing of seasonal pasture feed surpluses or deficits, using herd feeding targets and pasture cover targets.
- Identify the quantity and timing of supplement requirements.
- Identify the quantity and timing of pasture surplus to conserve.

An important aspect of grazing management is feed planning. A feed plan:

- **Compares** the **feed requirements** of the whole herd over the year with the expected yearly **pasture growth**.
- Shows when pasture can or cannot supply the feed required by the herd, that is, shows **pasture surpluses and deficits**.
- Could be for the **milking area only** or may include the area that replacement heifers and other stock graze.
- Helps to make **decisions** concerning:
  - **Stocking rate**.
  - When to **calve** cows.
  - When to **dry off** cows.
  - When, and **how much**, **nitrogen** will be needed.
  - When, and **how much**, **supplement** will be needed.
  - Which **type of supplement** will be needed. If the pasture deficit is severe, protein and fibre supplements, as well as energy supplements, may be needed to balance the ration.

A **pasture deficit can be managed** by:

- Growing extra pasture by applying **nitrogen** fertiliser.
- Growing extra pasture by **better grazing** management, say better rotation length or post-graze point.
- Using **supplements,** such as hay or silage, **made in** the previous **spring**.
- **Buying in supplements,** such as hay or grain.
- Reducing the feed requirements. This could be done by:
  - **Selling cows**.
  - **Agisting dry cows** off the farm.

  - **Agisting young stock** off the farm.
  - **Drying off cows** earlier.
  - **Calving later** (obviously, this decision must be made well in advance).
- **Doing nothing** and allowing the cows to be underfed, milk production to drop, and pastures to be overgrazed, with all its future problems. However, an optimist might take this option and simply hope that growth rates will be a lot higher than the estimated rates used in the feed plan!

A **pasture surplus** (for example, in spring) **can be managed** by:

- **Reducing** or eliminating any **supplementary feed**.
- **Conserving** the surplus as silage or hay.
- **Calving earlier**, to ensure the herd requirements are peaking at the time of surplus. (Again, this decision must be made well in advance).
- **Topping the pasture,** before or after grazing.
- **Buying more cows**. Once the lactation is under way, this is usually not an option. But it may be possible to bring non-milking stock into the milking area to reduce post-graze levels.
- **Doing nothing** and allowing the pasture to become rank, lose density and produce less. However, a pessimist might take this option, worrying that growth rates will be a lot lower than the estimated rates used in the feed plan!

11.1 Seasonal feed demand of herd and target body condition and milk production

On any farm, the **feed demand is driven by**:

- The **number of cows** being grazed.
- The feed needed by each cow, which is dependent on their **milk production and body condition changes** and, to a lesser extent, requirement for pregnancy.

Both of the above can be varied, but a farmer usually has targets for the number of cows grazing, milk production, and body condition at the different points in the year. These targets drive the herd needs.

Figure 11-1 shows **typical herd needs during a year**, on an August-calving, irrigated farm:

- Starting in mid-winter, the herd needs are the lowest because all the cows are dry.
- The herd needs peak in late spring, about three months after the bulk of the herd has calved; and intake is at its highest.
- The herd needs then decline as the lactation progresses.

Figure 11-1: Pasture growth versus herd needs, August calving, on irrigation

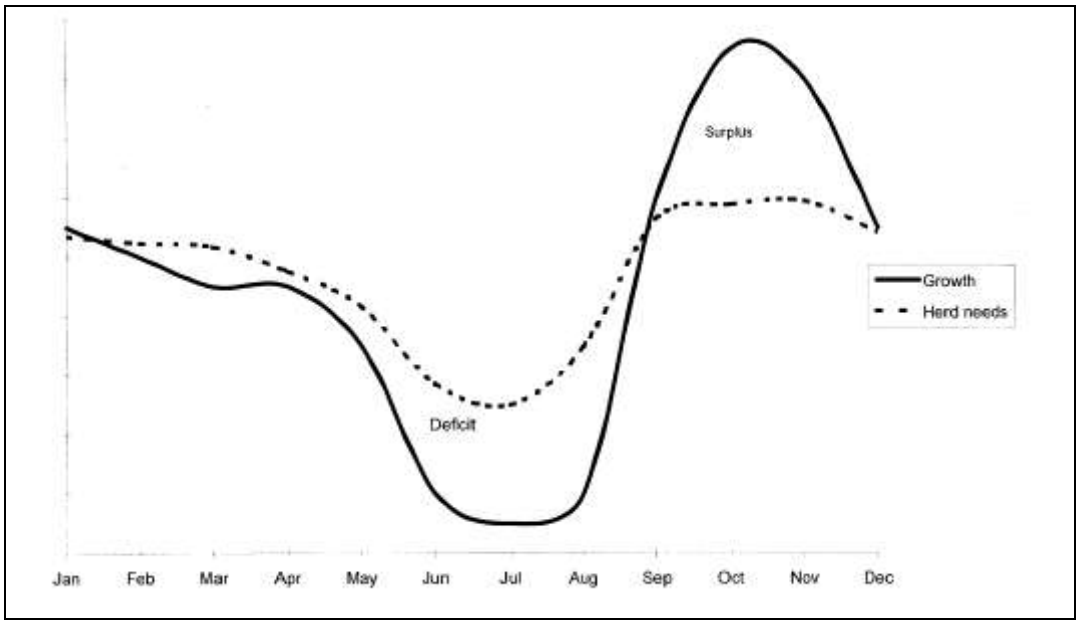
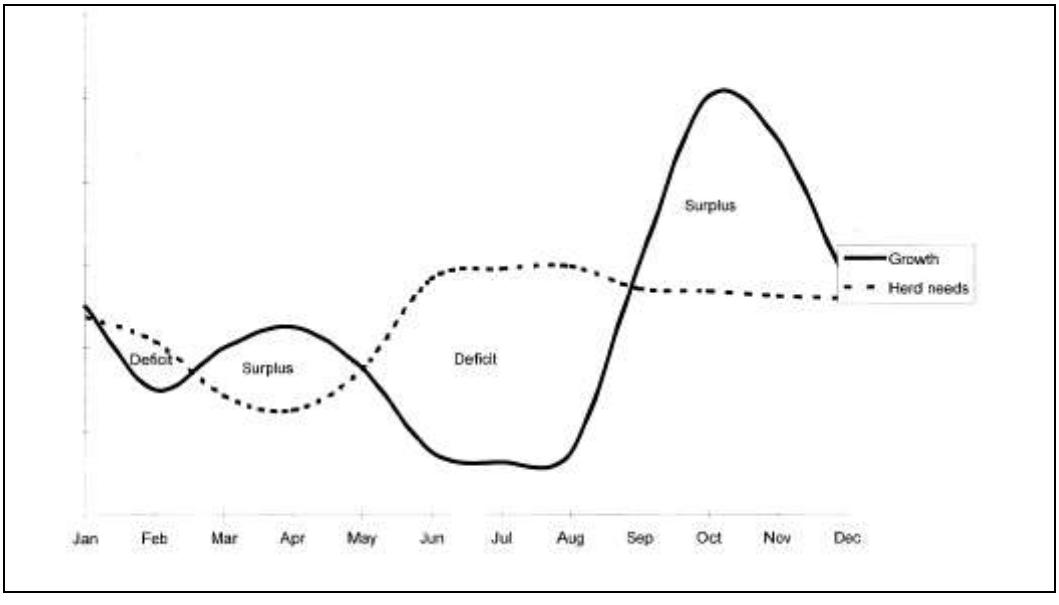


Figure 11-2 shows **typical herd needs during a year**, on a May calving, non-irrigated farm.

- Starting in April, the herd needs are the lowest because all the cows are dry.
- The herd needs are quite high in winter when most cows have calved and intake is at its highest.
- The herd needs then decline as the lactation progresses.

Figure 11-2: Pasture growth versus herd needs, May calving



11.2 Seasonal growth and target average pasture cover

Figure 11-1 shows typical pasture growth during a year on an August-calving irrigated farm:

- Starting in mid-winter, the growth is the least because of low temperature.
- The growth peaks in mid-spring when optimum growing conditions are present.
- The pasture still grows reasonably well during late summer and autumn, due to irrigation.

Figure 11-2 show typical pasture growth during a year on a May-calving non-irrigated farm:

- Starting in mid-winter, the growth is the least because of low temperature.
- Growth peaks in mid-spring when optimum growing conditions are present.
- There is a sharp decline in late summer and early autumn, due to lack of moisture.
- There is usually another smaller peak in growth following the start of the autumn rain.

When you compare the seasonal pasture growth and herd needs in Figure 11-1 and Figure:

- Both show deficits of pasture feed, generally in autumn and winter.
- Both show surpluses in spring.

Although surpluses and deficits of pasture occur during the year, there is always an ideal amount of pasture to have on the farm. This pasture could be measured as total tonnes but is more often measured as **average pasture cover (APC)**:

- Average pasture cover is the average amount of pasture on the farm.
- APC is made up from paddocks that have been recently grazed down to 5 cm (usually between about 1,300 and 1,600 kg DM per ha), paddocks about to be grazed at 2 to 3 leaves (usually between about 2,200 and 3,000 kg DM per ha), and other paddocks in between these amounts.
- **Ideal APC occurs when a farm is being grazed at the recommended target pre- and post-graze points.**

Target APC will vary during the year, and between different farms, from about 1,700 to about 1,900 kg DM/ hectare because:

- When growth rates are higher, larger leaves will be produced and there will be more kilograms of dry matter per hectare at the 3-leaf stage, so the average pasture cover will be higher across the farm.

- Or, conversely, when growth rates are lower, smaller leaves will be produced and there will be fewer kilograms of dry matter per hectare at the 3-leaf stage, so the average pasture cover will be lower across the farm.

Target APC's will be:

- Higher on farms that are capable of growing a lot of pasture, for example, if soil fertility is optimum, if using nitrogen, if soil moisture is maintained at optimum and with good pasture compsoition.
- Higher during the better growing seasons.

The average pasture cover is measured in kilograms of dry matter per hectare (kg DM/ ha). It is determined by assessing the cover on each paddock (with plate meter, probe or eye), multiplying the cover by the area of each paddock, adding all these together, and then dividing by the total area (as shown in Figure 11-3). Do not simply average all the paddocks' different covers, because that does not allow for different paddock sizes.

Figure 11-3: An example APC calculation

Paddock number	Area (ha)	Pasture cover (kg DM/ ha)	Pasture cover × area (kg DM/ ha)
1	1	2,500	2,500
2	1	2,200	2,200
3	1.5	1,900	2,850
4	3	1,700	5,100
5	1	1,400	1,400
Total	7.5		14,050
APC	**14,050 ÷ 7.5 = 1,873 kg DM/ ha**		

Walking all of a big farm to assess average pasture cover can take some time. APC can be estimated quickly by taking the average of the three paddocks with the most feed and the three paddocks with the least feed. This is usually quite close to the mark. Figure 11-4 shows an example calculation.

Figure 11-4: An example APC calculation using only three high and three low paddocks

Paddock number	Area (ha)	Pasture cover (kg DM/ ha)	Pasture cover × area (kg DM/ ha)
High			
11	1	2,500	2,500
30	3	2,300	6,900
42	1.5	2,100	3,150
Low			
3	2	1,700	3,400
43	1	1,500	1,500
9	3	1,300	3,900
Total	10.5		21,350
APC	**21,350 ÷ 10.5 = 2,030 kg DM/ ha**		

11.3 Developing a feed plan

A feed plan aims to match the target milk production and body condition feed needs of the herd while maintaining the target average pasture cover.

Figure 11-6 is an example of a feed plan. Various bits of information about your farm and various calculations need to be done in different rows:

- Row A: Insert the **days in the month**.
- Row B: Insert the **number of milkers** you anticipate milking on the grazing area for that month. This number will change as cows and heifers calve, as cows are dried off, sold or bought.
- Row C: Insert how much you would like to **feed each milker** in that month. Use the tables in Chapter 10.
- Row E: Insert the **number of dry cows** you anticipate to be grazing on the "grazing area" for that month.
- Row F: Insert how much you would like to **feed each dry cow** in that month. Use the tables in Chapter 10.
- Row G: Calculate the total feed you will need to feed the milkers and any dry cows for each day.
- Row H: Calculate the **total feed you will need** to feed the milkers and any dry cows for a month.
- Row I: Insert the **grazing area**. This is the area you normally graze the milkers on, but on which you might graze dry cows sometimes, and conserve silage or hay sometimes.

- Row J: Insert how much **pasture you expect to consume** from each hectare of the grazing area each day of each month. Use the monthly averages in Figure 11-5 as a guide. They are consumption rates, not growth rates, because only assumed "consumption" rates can be used in a feed plan.
- Row K: Calculate the monthly pasture you expect to consume.
- Row L: Calculate the monthly **pasture surplus or deficit**.
- Row M: Insert your **target APC**. This will be higher when growth is high, and lower when growth is lower, but in the range of 1,700 and 1,900 kg DM/ ha. (Ideal APC occurs when all paddocks are grazed at ideal pre- and post-graze points).
- Row N: In any month there is a pasture deficit, insert the amount of **supplement needed** to maintain the target APC on the farm.
- Row O: In any month there is a pasture surplus, insert the amount of **pasture needed to be conserved**. The pasture is conserved to maintain the target APC on the farm.
- Row P: Insert the APC on the farm at the **start** of the feed plan.
- Row P: Calculate the **end APC**. If you have provided the correct amount of supplement in row N or the correct amount of fodder conserved in row O, this end APC should be similar to the target APC.

Figure 11-5: Typical daily consumption rates by month for high, medium and low total annual consumption

Annual consumption	Average daily pasture consumption rates (kg DM/ ha / day) by month											
Rainfall	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
High (12 t consumed)	17	11	14	20	18	15	11	21	53	82	85	48
Medium (8 t consumed)	10	7	8	14	13	10	7	14	38	56	54	33
Low (6 t consumed)	4	3	5	11	10	9	6	11	28	45	43	22
Irrigation	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
High (14 t consumed)	49	49	43	24	12	10	6	24	43	73	73	55
Medium (9 t consumed)	32	32	28	16	7	6	4	16	28	47	47	35
Low (6 t consumed)	21	21	18	10	6	4	3	10	18	31	31	24

NB: These rates are typical around a range that varies, depending on different seasons.

Figure 11-6: An example feed plan

	Month	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Annual totals
A	Days in month	31	31	30	31	30	31	31	28	31	30	31	30	
B	No. milkers on grazing area	0	80	200	280	280	280	280	280	255	200	200	80	
C	Target feed/milker (kg DM/day)	0	14	15	15	15	15	15	14	14	14	13	11	
E	No. dry cows on grazing area	275	195	100	0	0	0	0	0	20	75	75	195	
F	Target feed/dry cow (kg DM/day)	8	9	9	9	9	9	9	9	8	8	8	8	
G=(B x C)+(E x F)	Total feed req'mts/day (kg DM)	2,200	2,875	3,900	4,200	4,200	4,200	4,200	3,920	3,730	3,400	3,200	2,440	
H=G x A/1000	Total req'mts /month (t DM)	68	89	117	130	126	130	130	110	116	102	99	73	1,290
I	Grazing area (ha)	110	110	110	110	110	110	110	110	110	110	110	110	
J	Daily pasture consumed (kg DM/ha)	10	18	35	60	50	45	35	20	20	25	22	15	
K=A x I x J/1000	Monthly pasture consumed (t DM)	34	61	116	205	165	153	119	62	68	83	75	50	1,191
L=K - H	Monthly pasture surplus/deficit (t DM)	**-34**	**-28**	**-1**	**75**	**39**	**23**	**-11**	**-48**	**-48**	**-19**	**-24**	**-23**	
M	**Target APC (kg DM/ha)**	**1,500**	**1,700**	**1,800**	**1,800**	**1,800**	**1,800**	**1,700**	**1,700**	**1,800**	**1,800**	**1,700**	**1,600**	
N	Supp'mnts fed (t DM)	30	40	20	0	0	0	0	40	60	25	20	10	245
O	Fodder cons'vd (t DM)	0	0	0	80	40	20	0	0	0	0	0	0	140
P	Start APC (kg DM/ha)	1,600												
P=prev APC+((L+N-O)/I x 1000)	End APC (kg DM/ha)	1,564	1,673	1,845	1,800	1,791	1,818	1,718	1,645	1,755	1,809	1,773	1,655	

11.3.1 Why use a feed plan?

The case for feed planning is the same as for financial planing:

- If you are not running close to the wind, you probably do not need to plan. But you are probably not optimising the use of your resources, be it feed or money.
- It is often claimed that plans are a waste of time because they anticipate the future and it never works out the way you plan. However, it is better to have some idea, no matter how rough, rather than none at all. You can then have contingency plans ready for problems, be ahead of the game and be proactive rather than reactive.
- And anyway, plans should never be considered to be static. They are far more useful if updated continually as changes occur. A feed plan is particularly useful if a farmer is new to dairying, taking on a new farm, or making significant changes to the current operation.
- The number crunching of a feed plan makes it an ideal application for a computer. There are spreadsheets available to do feed plans, or go to the Target 10 website at www.target10.com and use the on-line consultant.

11.4 Capturing the spring surplus

On most dairy farms there is a surplus of pasture in spring that could be conserved. Feed plans usually show this surplus. The **surplus should be conserved to**:

- **Achieve high pasture consumption** for the year. Any surplus should be removed and fed back later, rather than wasted.
- **Achieve target post-graze levels**, maintaining pasture density and growth, quality and persistence.

Fodder conservation should be firstly be seen as a pasture management tool, rather than a method to fill later deficits with your own conserved fodder:

- Only a true surplus should be conserved, and milkers should not be underfed to conserve fodder. However, **if too much area is conserved**, and pasture is in short supply and more supplement is needed to maintain milk production, in the long-term the pasture will benefit.
- **If not enough area is conserved** paddocks may go beyond the 3-leaf stage, reproductive tillers will proliferate, the pasture base will be shaded, a build up of dead material will occur, there will be fewer daughter tillers, less clover, and later more bare patches.

If you plan to conserve pasture as silage and then feed it to milkers and presumably maintain good milk production, the **silage must be high quality**, at least 10 to 11 MJ ME/ kg DM. To achieve high quality silage, it must be:

- **Made from high-quality pasture** (11 to 12 MJ ME/ kg DM), preferably cut on a sunny day in the afternoon. Do not allow the desire for high quantity to override quality by waiting too long after the previous grazing before cutting.
- **Wilted quickly**, and stacked or baled within 24 hours of mowing.
- **Compacted** well to remove air.
- Wrapped or **covered properly** and completely to exclude air, ensuring no holes develop in the plastic later.

Deciding when and what area of pasture to conserve, and ensuring it actually happens can be difficult. Having the ability (machinery and labour) to conserve the required area at just the right time by yourself or with competent contractors is critical. The weather needs to be watched carefully. Cold wet weather reduces growth rate over the whole farm, as well as delaying harvest. Delayed harvest causes paddocks to take longer to recover and get back into the grazing rotation.

One method of deciding the time and area to conserve is to:

- Observe when there are more than three paddocks ready to be grazed.
- Skip those three paddocks from the grazing rotation.
- Wait or "shut them up" for say another week or two.
- Conserve them, if growth rates remain high. (If growth rates unexpectedly fall and you need to graze them, if the "shut-up" time has not been too long, their quality will not be too bad).

The following is another method to decide how to capture the spring surplus. It helps you to identify the area of pasture required by the milkers and the area that could be locked up for silage or hay. It is also available in the on-line consultant on the Target 10 website at www.target10.com.

11.4.1 Cow requirements

First, ensure the milkers are well fed. Complete the following to work out their daily feed requirement (see Chapter 10 for values to use).

Maintenance ☐ kg

Pregnancy ☐ kg

Condition score ☐ kg

Milk ☐ kg

TOTAL (a) ☐ kg DM/cow/day (daily cow requirement)

11.4.2 Herd requirement per hectare

Now calculate the per-hectare herd requirement, using the daily cow requirement and your stocking rate.

Firstly, work out your stocking rate using the following calculation:

Stocking rate = ☐ number of milkers ÷ ☐ hectares available for grazing

= (b) ☐ cows/ha (stocking rate per hectare)

Now calculate the amount of pasture required per hectare per day by your milkers:

Daily cow requirement (a) ☐ x ☐ stocking rate per ha(b)

= (c) ☐ kg DM/ha/day(daily herd requirement per ha)

Example: 16 kgs per cow per day x 2 cows per ha = 32 kg DM/ ha/ day.

11.4.3 Hectares required by the milkers

You can now work out the daily area required by your milking herd using the herd requirement per hectare, the expected spring growth rate and the area you have available for grazing.

Figure 11-7 is a growth rate guide for grazed pastures during the spring peak. These are average figures: immediately after grazing growth will be slower, then become faster, then slow down again, as pasture reaches the stage when it should be cut.

Figure 11-7: Typical average spring growth rates

Type of pasture	Spring growth rate
High producing pastures	70 kg DM/ ha/ day
Good pastures	60 kg DM/ ha/ day
Poor pastures	50 kg DM/ ha/ day

Complete the following calculation:-

(c)daily herd reqs ☐ ÷ ☐ growth rate x ☐ ha available for grazing

=(d) ☐ hectares for the milkers

Example: 32 kgs DM/ ha daily feed requirements ÷ 60 kg DM growth/ ha/ day X 100 ha total available area = 32 ÷ 60 x 100

= 54 hectare required for milkers

NOTE: This is the area of pasture to keep in the rotation for the milking herd to meet their feed requirements. Rotate the herd on this area at an appropriate rotation (for example, 15 days) to maintain the grazing pressure and so achieve your target post-graze point.

11.4.4 Area for fodder conservation

The rest of the area of pasture is surplus to herd requirements and can be used for fodder conservation.

Complete the following calculation to work out the area of your farm that could be conserved for silage or hay:-

Total grazing hectare [ ] - [ ] hectares for the milkers(d)

= [ ] hectares available for silage or hay

Example: 100 ha - 54 ha = 46 ha

11.5 Summary

A yearly feed plan helps to:

- **Identify the pasture deficits and surpluses** that will occur as you try to feed the cows and hold ideal average pasture cover.
- **Better plan** the purchase and use of supplements, the use of nitrogen, drying off cows, and agistment, based on the timing and quantity of these deficits and surpluses.
- Decide when and how much **area of pasture needs to be conserved**. For long-term pasture benefit, any surplus of pasture is best conserved. You need to monitor post-graze levels or average pasture cover to quickly identify any surplus and conserve it.