5

Improved herd management on smallholder dairy farms

This chapter reviews the key aspects of dairy production technology influencing the persistency of milk yields during lactation, milk responses to extra feeding and breeding and replacement heifer rearing.

The main points in this chapter

- Understanding the principles of the cow's lactation cycle, particularly her peak level and persistency of milk yield, are the keys to productive and profitable dairy farming.
- When offered extra feed, milk responses follow the law of diminishing returns in that there comes a point when milk yields plateau.
- Special attention should be given to young stock as they are a key investment in future herd performance. Likewise, improved reproductive management will provide economic benefits through increasing the proportion of income generating cows in the herd.
- Generally speaking, the importance of genetics is overshadowed by feeding management.

This chapter contains several sections from *Tropical dairy farming* (Moran 2005) because these highlight the essential principles of dairy production technology that need to be understood for farmers to become more effective business managers of their smallholder operations.

These principles include:

- Farmers are in the business of generating profits from the production and sale of milk. Over a 300-day lactation, the same dairy cow can produce anything from less than 2000 kg milk to more than 5000 kg milk, depending on her feeding and herd management. The more milk she produces, the more income she will generate, which generally leads to more profit, that is total income from sale of milk and other animal products (such as calf, manure and cull cow) less total production costs (feed, herd and overhead).

- Farmers have to feed cows better to produce more milk. The milk response to an extra feed can vary from less than 0.25 kg milk to more than 1 kg milk; that is a fourfold variation.

Throughout this book milk production is quantified either in kg/d or L/d. Western dairy specialists tend to use volume as this is measured by most milking machines. In contrast, Asian dairy specialists tend to use weight as this is measured by most hand milking operators. With specific gravities in raw milk varying from 1.024–1.032, 1 L milk can weigh between 1.024 kg to 1.032 kg. Interchanging the volume and weight of milk can then introduce an error of 2–3% in milk yields.

- Before cows can produce milk, they must have a calf and this can happen when the cow (called a heifer) is as young as 24 or as old as 40 months. Obviously the older she is, the greater her rearing costs as a calf and heifer.
- To maintain a regular milk supply, the cow must regularly have a calf, and this can happen every 12, 18 or 24 months. In addition, she should keep producing milk every lactation right up until about two months before she is due to have her next calf. Lengthy calving intervals, particularly associated with short lactations, mean that the cow spends many months ‘dry’ or not producing milk
- To offset the high costs of rearing her as a replacement heifer, she should be able to remain a productive member of the milking herd for many years, certainly more than five years. She should only be sold when her ability to generate profit falls below a certain level. So cows producing six or even eight calves during their productive life will be more profitable than those which have to be culled from the dairy herd after only one or two calves.

This chapter deals with several key aspects of dairy production technology, namely:

- Exactly what is the ‘lactation cycle’?
- How cow management should be directed towards maximising persistency of milk production
- How we should understand milk responses to extra feed
- Young stock and reproductive management
- Exotic breeds and crossbreds for milk production.

There are other key aspects of herd production technology, such as animal health and environmental management, but space will not allow for these to be covered in this book.

5.1 The lactation cycle

A number of changes occur in cows as they progress through different stages of lactation. As well as variations in milk production, there are changes in feed intake and body condition, and stage of pregnancy.

Following calving, a cow may start producing 10 kg/d of milk, rise to a peak of 20 kg/d by about seven weeks into lactation then gradually fall to 5 kg/d by the end of lactation.

Although her maintenance requirements will not vary, she will need more dietary energy and protein as milk production increases, then less when production declines. However, to regain body condition in late lactation, she will require additional energy.

If a cow does not conceive, she has no need for additional energy or protein. Once she becomes pregnant she will need some extra energy and protein. However, the calf does not increase its size rapidly until the sixth month, at which time the nutrient requirement becomes significant. The calf doubles its size in the ninth month, so at that stage a considerable amount of feed is needed to sustain its growth.

Cows can usually use their own body condition for about 12 weeks after calving to provide energy in addition to that consumed. The energy released is used to produce milk, allowing them to achieve higher peak production than would be possible from their diet alone. To do this, cows must have sufficient body condition available to lose, and therefore they must have put it on late in the previous lactation or during the dry period.

This chapter introduces the lactation cycle with its varying goals for feeding strategies. Further chapters will enlarge on management to achieve these strategies.

5.1.1 From calving to peak lactation

Milk yield at the peak of lactation sets up the potential milk production for the year; one extra kg/day at the peak can produce an extra 200 kg/cow over the entire lactation. The full lactation response to extra milk at peak yield varies greatly with feeding management during mid and late lactation. There are a number of obstacles to feeding the herd well in early lactation to maximise the peak. The foremost of these is voluntary food intake.

At calving, appetite is only about 50–70% of the maximum at peak intake. This is because during the dry period, the growing calf takes up space, reducing rumen volume and the density and size of rumen papillae is reduced. After calving, it takes time for the rumen to 'stretch' and the papillae to regrow. It is not until Weeks 10–12 that appetite reaches its full potential.

If the forage is very moist, say with a dry matter content of only 12–17%, the rumen cannot hold sufficient fresh forage to meet the DM needs of the cow. Peak milk production occurs around Weeks 6–8 of lactation. So, when a cow should be gorging herself with energy, she is physically restricted in the amount she can eat. Figure 5.1 presents the interrelationships between feed intake, milk yield and live weight for a Friesian cow with a 12-month inter-calving interval, hence a 300-day lactation. Such a lactation cycle is more typical of temperate dairy systems rather than smallholder tropical ones. However, as it is possible in the tropics, it has been included in this manual as a target.

The level of feed intake is primarily determined by stage of lactation, but can be manipulated. Table 5.1 shows the feed intakes required for cows to meet their energy needs to produce target milk yields. By providing a high quality diet during early lactation (10 v 8 MJ/kg DM of ME), the physical restrictions of appetite would be reduced.

The farmer has two feeds available to give to the cows:

- mature pasture, with an energy density of 8 MJ/kg DM of ME, and
- green, leafy grass, with an energy density of 10 MJ/kg DM of ME.

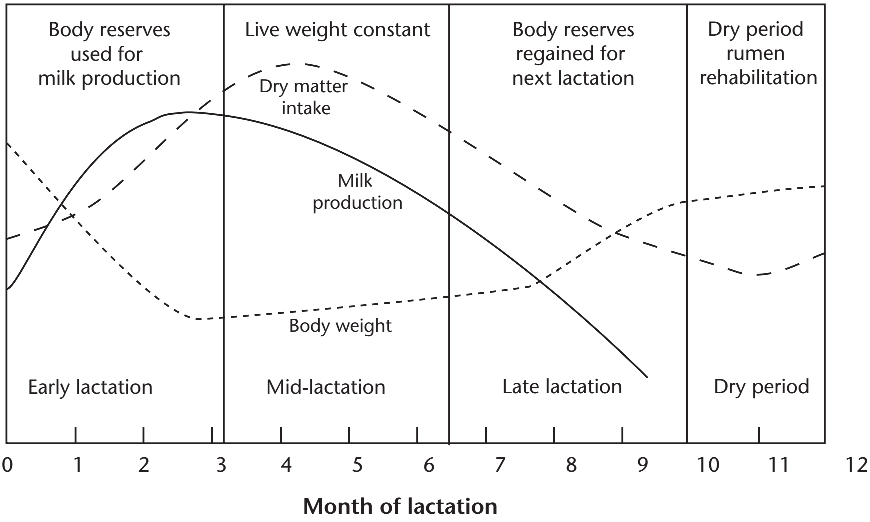

Figure 5.1 Dry matter intake, milk yield and live weight changes in a cow during her lactation cycle

To produce more milk, a cow must eat more DM. If lower quality (i.e. lower energy density) feed is provided, the cow must eat more of it. To produce 20 kg of milk on the mature pasture, a cow must eat 20 kg DM/d, a virtually impossible task.

The 20 kg/d cow could probably not even eat 20 kg DM of feed at 8 MJ/kg DM of ME at any time during lactation, let alone in early lactation when intake is restricted. During early lactation, they will produce more milk from more energy-dense feeds because they have to eat less DM to receive an equivalent intake of energy. Nutritional requirements generally exceed voluntary food intake until Week 12, so body fat reserves are drawn upon to make up the nutrient deficit.

5.1.2 The rest of lactation

Following peak lactation, cows' appetites gradually increase until they can consume all the nutrients required for production, provided the diet is of high quality. From Figure 5.1, cows tend to maintain weight during this stage of their lactation.

Although energy required for milk production is less demanding during mid and late lactation because milk production is declining, energy is still important because of

Table 5.1 Quantities of dry matter consumed by cows fed diets of different energy density and producing three levels of milk

Milk yield (kg/d)	Daily energy requirement (MJ ME/d)	Required intake (kg DM/d)	
		8 MJ/kg DM	10 MJ/kg DM
13	125	15.6	12.5
17	146	18.2	14.6
20	161	20.1	16.1

pregnancy and the need to build up body condition as an energy reserve for the next lactation.

It is generally more profitable to improve the condition of the herd in late lactation rather than in the dry period. While lactating, cows use energy more efficiently for weight gain (75% efficient compared to 59% efficient when dry).

5.1.3 The dry period

Maintaining (or increasing) body condition during the dry period is the key to ensuring cows have adequate body reserves for early lactation. Ideally, cows should calve in a condition score of at least 5, and preferably 5 to 6 (out of 8 points). If cows calve with adequate body reserves, feeding management can plan for one condition score to be lost during the first two months of the next lactation.

Australian studies have found each condition score lost (between score 3 to 6) in early lactation to be equivalent to 220 kg of milk, 10 kg of milk fat and 6.5 kg of milk protein over the entire lactation (Robins *et al.* 2003). Furthermore, each additional condition score at calving can reduce the time between calving and first heat by five to six days. The sooner the cow begins to cycle, the sooner she is likely to get into calf.

If cows calve in poor condition, milk production suffers in early lactation because body reserves are not available to contribute energy. In fact, dietary energy can be channelled towards weight gain rather being made available from the desired weight loss. For this reason, high feeding levels in early lactation cannot make up for poor body condition at calving.

5.2 Persistency of milk production throughout lactation

The two major factors determining total lactation yield are peak lactation and the rate of decline from this peak. In temperate dairy systems, total milk yield for a 300-day lactation can be estimated by multiplying peak yield by 200.

Hence a cow peaking at 20 kg/d should produce 4000 kg/lactation, while a peak of 30 kg/d equates to a 6000 kg full lactation milk yield. This is based on a rate of decline of 7–8% per month from peak yield, that is, every month the cow produces, on average, 7–8% of peak yield less than in the previous month. Actual values can vary from 3–4% per month in fully fed, lot fed cows to 12% or more per month in very poorly fed cows, for example, during a severe dry season following a good wet season in the tropics.

The higher this number the faster the rate of decline, hence the less milk produced. Persistency is calculated as follows:

$$\text{Persistency (\%)} = \frac{[(\text{Peak milk yield}) - (\text{Current milk yield})] \div [\text{Peak milk yield}]}{\text{Months after peak milk yield}} \times 100$$

For example, if cows peaked at 17 kg/d and currently produce 12 kg/d, three months after the peak,

$$\text{Persistency} = \frac{[17 - 12] \div 17}{3} = 10\%$$

If these cows still produced 14 kg/d, their persistency would be 6%, whereas if their milk yield had decreased to 10 kg/d, their persistency would be 14%.

The rate of decline from peak, or persistency, depends on:

- Peak milk yield
- Nutrient intake following peak yield
- Body condition at calving
- Other factors such as disease status and climatic stress.

Generally speaking, the higher the milk yield at peak, the lower its persistency in percentage terms. Underfeeding of cows immediately post-calving reduces peak yield but also has adverse effects on persistency and fertility. Dairy cows have been bred to utilise body reserves for additional milk production, but high rates of live weight loss will delay the onset of oestrus. Compared to temperate forages, the lower energy and protein contents and higher water and fibre contents of tropical forages reduce appetite for these forages, thus requiring higher intakes of high quality concentrates to compensate. Underfeeding of high genetic merit cows in early lactation is one of the biggest nutritionally induced problems facing many smallholder farmers in the humid tropics.

It is induced because cow quality has been overemphasised in many South and East Asian dairy industries without the necessary improvements in feeding systems to utilise this genetic potential. If imported high genetic quality cows are not well fed, milk production is compromised, but most importantly, they will not cycle until many months post-calving.

Thin cows have less body reserves, therefore cannot partition as much to milk yield, thus reducing peak yield and persistency. Unhealthy and heat stressed cows have reduced appetites, hence poorer persistency of lactation.

5.2.1 Theoretical models of lactation persistency

Table 5.2 and Figure 5.2 present data for milk yield over 300-day lactations in cows with various peak milk yields and lactation persistencies. Such data provide the basis of herd management guidelines for temperate dairy systems with 12-month calving intervals. Depending on herd fertility, hence target lactation lengths, similar guidelines could be developed for 15- or 18-month calving intervals.

Table 5.2 and Figure 5.2 only present data for cows with peak yields of 15, 20 and 25 L/d. Smallholder dairy farms in the humid tropics with good feeding and herd management should be able to achieve 15 L/d peak yield, and for those with high genetic merit cows, 20 or 25 kg/d is realistic. Lactation persistencies of less than 8% per month may be achievable in tropical dairy feedlots but more realistic persistencies are the 8–12% per month presented in the Table and Figure.

Virtually every smallholder farmer records daily milk yield of his cows, so they know peak yield and can easily determine the monthly rate of decline from peak in kilos per day, hence the percentage decline. This then provides a simple monitoring tool to assess their level of feeding management.

Unless feeding management can be improved, it may be better in the long run to import cows of lower genetic merit. For example, importers may request ‘5000 L cows’

Table 5.2 Effect of peak milk yield and persistency on 300-day lactation yields

Peak yield (L/d)	Persistency (%/month)	Monthly milk decline (L/d)	Full lact yield (L)	Average milk yield (L/d)
15	8	1.2	2980	9.9
	10	1.5	2650	8.9
	12	1.8	2330	7.8
20	8	1.6	3970	13.2
	10	2.0	3540	11.8
	12	2.4	3110	10.4
25	8	2.0	4960	16.6
	10	2.5	4420	14.8
	12	3.0	3885	13.0

(that is cows that peak at 5000 L under good feeding management, with a persistency of 8%/month). If, through poor feeding, their persistency is reduced to 12% per month, 300-day lactation yields are only 3900 L and they do not cycle for many months after calving, '4000 L cows' may be a better investment. From Table 5.2, such cows would produce similar milk yields if they could be fed to 8% per month milk persistency and they are more likely to cycle earlier.

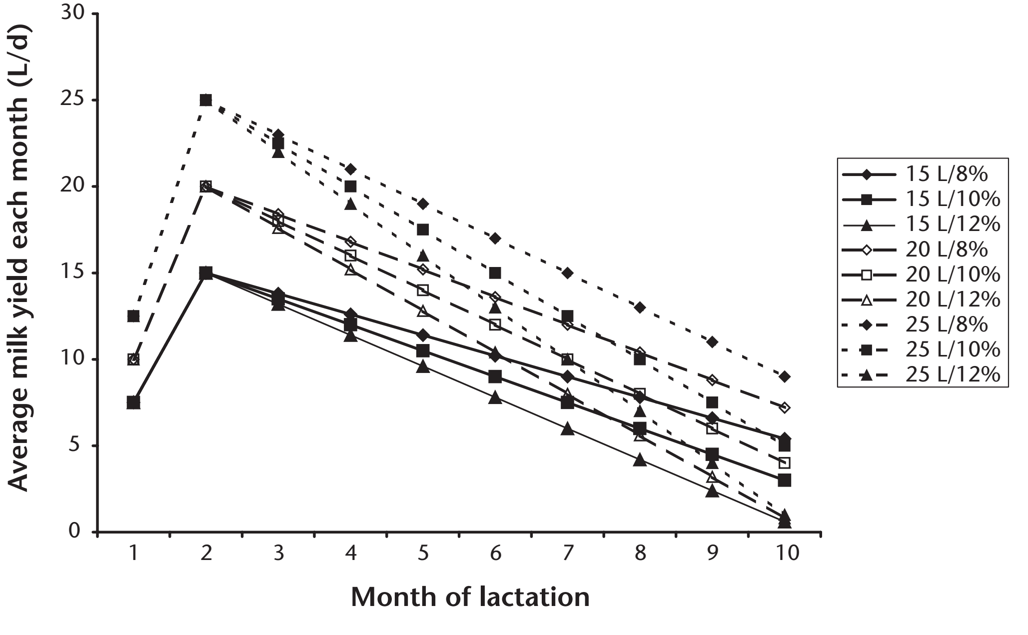

Figure 5.2 Milk yields each month for cows varying in peak yield and persistency. Legend shows peak yield (L/d) and persistency (% decline/month)

5.3 Milk responses to feeding

5.3.1 The law of diminishing returns

The response to any farm input is never linear. As an input is increased from a low level there may be an increased response up to some point, but eventually the response will plateau and then, at very high levels of the input, the response may even decrease. This is the concept of diminishing returns and it applies to all aspects of dairy farming. With forages there is a point when applying more fertiliser (either as organic cow manure or dairy shed effluent or as inorganic fertilisers such as urea or superphosphate) will grow so little extra forage that it is not worth applying.

5.3.2 Marginal milk responses to extra feeding

As the intake of feed increases above a certain point, the amount of extra milk produced from each extra unit of feed decreases. In other words, the marginal, or additional, milk response decreases as the level of supplement intake increases.

The major reason for this decreasing marginal milk response is that, with successive increments of feed energy, the cow increasingly partitions nutrients from milk production towards body tissue deposition as milk production approaches the cow's genetic potential. In addition, the stage of lactation has an influence on how much of the supplement's nutrients 'go into the bucket' and how much 'go on the back'. Cows in early lactation tend to lose weight to divert additional nutrients towards milk while those in late lactation tend to repartition nutrients to replace previously lost body reserves.

A second reason for declining marginal responses is that utilisation of one feed type can change with increasing intake of a second feed type, which is known as an associative effect. Efficient digestion of forages, particularly low quality forages, requires an adequate population of fibre-digesting microbes in the rumen. By feeding increasing amounts of high starch concentrates, the proportion of these microbes will decrease as more starch-digesting microbes propagate as a result of the higher starch intake. Consequently, the digestion of the forage can decrease with increasing intakes of such concentrates. Additional starch excretion may also occur, further reducing feed utilisation. This can be particularly important when feeding high levels of supplements rich in fermentable carbohydrates, as rumen pH can decrease dramatically reducing fibre digestion.

Supplementary feeding usually results in higher total feed intakes. Increasing intakes are the result of decreased times that consumed feed spends in the rumen where it is exposed to microbial breakdown. If less of that feed is digested and the nutrients absorbed into the bloodstream or pass down the digestive tract, less dietary energy becomes available for use by the animal. The cow partly compensates for this through decreased losses of energy via methane and urine with increasing feed intake. Although this may not be important unless total feed intakes dramatically increase through supplementation, it can contribute to declining marginal milk responses to supplements.

Another factor decreasing milk responses is the often incorrect assumption that all of the supplement is actually consumed. Rarely is there nil wastage, particularly if the supplement is a roughage. Fortunately, stall feeding minimises such wastage, compared to feeding cows while outdoors.

The major difficulty when predicting milk responses to supplementation, even if substitution rates are known, is the lack of information on the relative importance of the above factors. Without such knowledge, dairy advisers can only, probably incorrectly, assume additive effects when feeding a mixture of various feed types, which would tend to overestimate such milk responses particularly when:

a) There are marked differences between basal roughages and supplement type, and
b) Large amounts (say 5 kg DM/cow/d or more) of supplement are fed.

5.3.3 An example of marginal milk responses

Table 5.3 and Figure 5.3 present theoretical data for milk responses to feeding increasing level of formulated concentrates to Friesian crossbred cows fed a basal ration of 40 kg/d fresh of a high quality tropical forage. The data are based on actual results from studies conducted in Victoria with Friesian cows grazing temperate pastures during summer while fed a cereal based concentrate (Gibb *et al.* 2006) adjusted for the levels of milk production expected on smallholder tropical dairy farms. The average milk response is the increase in milk yield for increasing levels of concentrates divided by the total level of concentrates fed. The marginal milk response is the increase in milk yield for each increasing increment of concentrates fed.

This graph highlights several very important points which influence the decisions frequently made by farmers. The peak marginal response, 0.90 L/kg, occurred at 4 kg/d of concentrates, whereas the peak average milk response, 0.77 L/kg occurred at 5 to 6 kg/d. Most advisers would recommend farmers feed 5 or 6 kg/d of concentrates to maximise the milk responses. However the more appropriate level to feed would be 4 kg/d. Above that level, the law of diminishing returns takes effect, in that marginal milk responses decrease as more is fed. The range of possible reasons for this phenomenon has been discussed in the previous section (5.3.2).

Knowing the cost of the concentrates and the milk return allows the calculation the most economical level of concentrates to feed. So long as the value of the extra milk

Table 5.3 Milk responses to feeding increasing level of concentrates to cows fed a basal diet of quality tropical forages

Concentrate intake (kg/day)	Milk yield (L/day)	Average milk response (L/kg)	Marginal milk response (L/kg)
0.0	8.0	0.00	0.00
1.0	8.5	0.50	0.50
2.0	9.3	0.63	0.75
3.0	10.1	0.70	0.85
4.0	11.0	0.75	0.90
5.0	11.9	0.77	0.85
6.0	12.6	0.77	0.75
7.0	13.2	0.74	0.60
8.0	13.7	0.71	0.45

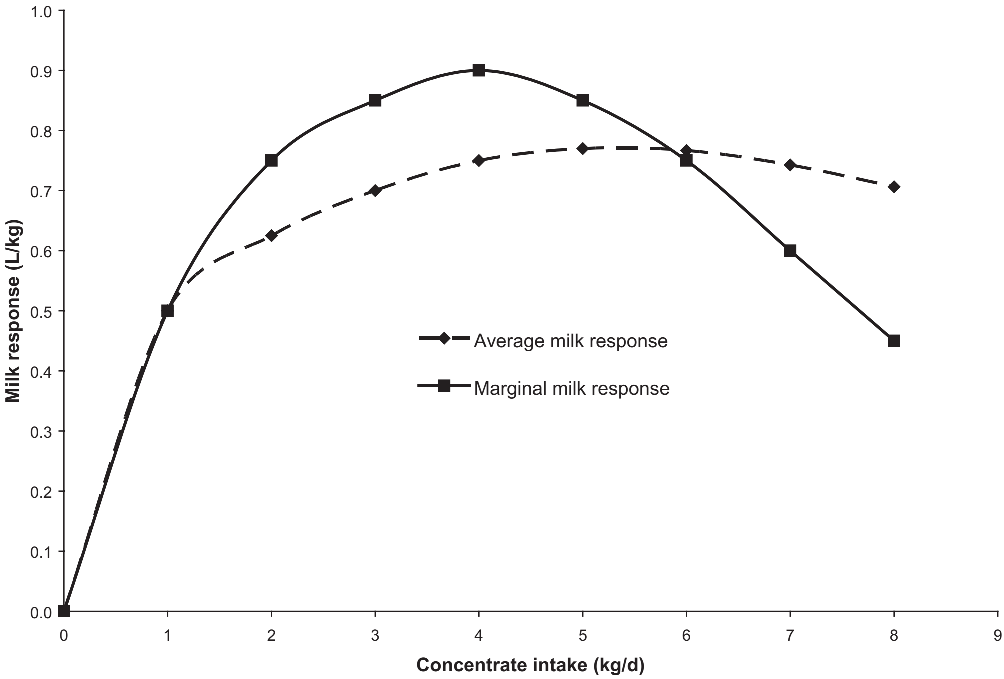

Figure 5.3 Average and marginal milk responses to feeding increasing levels of concentrates to milking cows fed a basal quality tropical forage ration

produced is greater than the cost of the additional concentrates to feed, it is more profitable to feed more up to this point. The 'break even' point would be the level of concentrate feeding when returns from the additional milk produced just cover the costs of the extra feed required.

Unfortunately, such milk response curves are very rare and are likely to differ with the quality of forages and concentrates, and other constraints such as environment (heat stress) and herd management (animal health, genetics) not to mention farmer skills. In fact, data such as the above are sadly lacking from any tropical dairy research study and until they become available, theoretical graphs (such as Figure 5.3) based on the limited temperate dairy research will have to suffice.

5.3.4 Immediate and delayed milk responses

Responses to supplementary feeding have both immediate and delayed components. Some of the supplement goes immediately to milk production and some goes to body fat, which contributes to milk production at a later stage when this condition is mobilised.

To manage the feeding of supplements effectively, it is important to know how cows respond to them. The response is variable. It depends on the circumstances in which the supplement is fed.

The response in milk yield is generally due to the extra energy in the supplement. Unless the supplement improves the use of nutrients already in the diet or stimulates

Figure 5.4 A cow's daily intake of good quality grass/clover pasture

intake of the basal forage, farmers will not get any more milk than that produced from the energy the supplement contains.

In practice, forage substitution almost always occurs, resulting in the response being less than that predicted from the amount of energy in the supplement. The response will be reduced at least by the equivalent of the energy in the forage no longer eaten. Also, some of the energy in the supplement goes to condition score rather than directly into milk. So the immediate milk response will be smaller again. Most experiments have only measured the immediate response to supplements. Because they are short term (usually only several weeks), they cannot measure the delayed milk response from body condition, hence the total milk response.

We know most about the immediate response to supplements from studies in temperate countries. Whether these will be similar to responses in tropical countries requires further research. The major differences between temperate and tropical climate zones is the poorer quality of tropical forages and the fact that many supplements are based on by-products, which vary greatly in nutritive value in tropical countries. Another difference may be the poorer quality control in feed mills, hence the greater variation in energy and protein contents of formulated concentrates in tropical countries. Therefore, it is highly likely that milk responses in South-East Asia will be lower than those in temperate countries.

Guidelines for temperate grazing dairy systems
In early lactation, the average immediate response to feeding concentrates containing 12 MJ/kg DM of ME is 0.6 L of milk per kg of supplement DM, ranging from 0.2 > 1.0 L. In mid-lactation to late lactation, the average immediate response is 0.5 L of milk per kg of supplement DM, ranging from 0.3 > 0.8 L. One generalisation sometimes made is that you get half the response now and the other half later, when the condition score energy is converted back to milk.

Improved feeding management for Asian smallholder dairy farmers has been covered in detail in various chapters in *Tropical dairy farming* (Moran 2005), namely:

- Chapter 10: Supplements for milking cows
- Chapter 11: Milk responses to supplements
- Chapter 12: Formulating a diet
- Chapter 13: Problems with unbalanced diets
- Chapter 14: Diet and milk production
- Chapter 18: Body condition scoring
- Chapter 20: Future developments in feeding management in the humid tropics.

5.4 Rearing replacement heifers

Well-grown dairy heifers are a good investment in the milking herd. To ensure they grow to become productive and efficient dairy cows, their management must be carefully planned and begin the day they are born.

A well-managed heifer rearing system aims for:

- Good animal performance with minimal disease and mortality
- Optimum growth rates to achieve target live weights
- Minimum costs of inputs, such as feed (milk, concentrates and forages), animal health needs (veterinary fees and drugs) and other operating costs (milk-feeding equipment) to achieve well-reared heifers
- Minimum labour requirements
- Maximum utilisation of existing facilities such as sheds for rearing and quality forages for feeding.

There is no single best way to milk-rear calves. All sorts of combinations of feeding, housing and husbandry can be successful in the right hands and on the right farm. Successful calf rearing is a specialist job requiring suitable facilities. It also requires a genuine concern for the welfare of young calves and quick responses to early symptoms of disease. If farmers are unable to commit the time and resources to rearing their own replacement heifers, they should seriously consider paying someone who is better placed to do a good job.

The first three months are the most expensive period in the life of any dairy cow. During that time, mortality rates are high, 10–20% in many cases. Calves need protection from the extremes of sun, wind and rain, no matter what the rearing system. Disease prevention and treatment can be costly during early life. Typically, raising heifers is the second largest expense on the dairy farm, requiring 15–20% of the total expenses.

Only feed costs for the milking herd take a greater share of farm expenses, 50–60%. Deaths of young stock should not exceed 2–4%, while the incidence of calf sickness should not exceed 10%.

All too often, farmers rear their heifer calves carefully until weaning but neglect them thereafter. Calves that are poorly managed after weaning are disadvantaged for their entire life. Even if they are well fed after mating, their ultimate mature size is restricted and if they do put on extra weight, it tends to be fat. Most of the growth in skeletal size occurs before, not after puberty.

Weaned heifers do, however, require less attention than milk-fed calves and milking cows. Dairy heifers need to be well fed between weaning and first calving. If growth rates are not maintained, heifers will not reach their target live weights for mating and first calving. Delayed calving costs money both through higher expenses and delaying the onset of lactation when farmers begin to recoup the money invested in rearing the heifer. In the US, it takes 1–1.5 lactations of milk production to reimburse the cost of rearing, and a six month delay in calving, from 24–30 months, increases this to two full lactations. So reducing heifer rearing costs is not a good investment.

Undersized heifers have more calving difficulties, produce less milk and have greater difficulty getting back into calf during their first lactation. When lactating, they compete poorly with older, bigger cows for feed. Because they are still growing, they use feed for growth rather than for producing milk. Many studies have demonstrated the benefits of well-grown heifers in terms of fertility, milk production and longevity.

Young stock management is discussed in detail in Chapter 16 of *Tropical dairy farming* (Moran 2005).

5.5 Reproductive performance

Improved reproductive performance provides many benefits to farmers such as:

- A greater proportion of milking cows are generating farm income.
- Higher average milk yields each day. Cows with poor reproductive performance will spend more of their time in late lactation, when daily milk yields are lower.
- Fewer cows that have become excessively fat because they have failed to conceive.
- Less compulsory culling of cows failing to become pregnant.
- Reduced insemination and semen costs.
- Heifers calving at a younger age.
- Increased number of calves produced each year, thus providing more animals for sale or as replacements for the milking herd.
- More efficient feed utilisation as a result of the above benefits.

A large-scale Australian study identified six factors which have large influences on herd reproductive performance in both temperate and tropical dairy production systems. Three are non-nutritional and three are nutritional. They are:

- The length of the voluntary waiting period, that is the number of days delay after calving before farmers begin inseminations. This is 50–55 days in the herds with the best fertility.

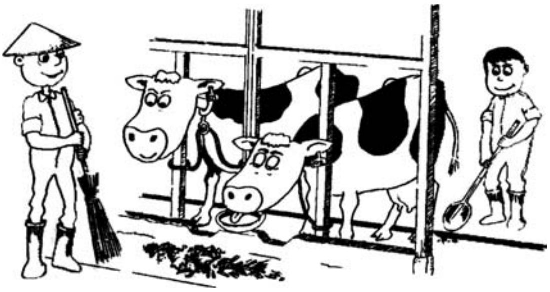

Figure 5.5 Happy cows on a well-managed smallholder farm

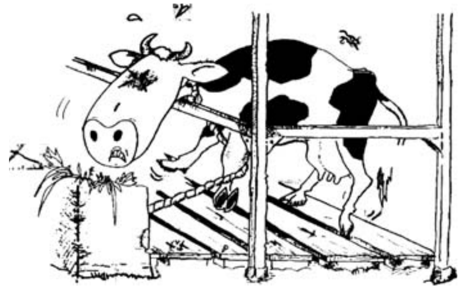

Figure 5.6 An unhappy cow on a poorly managed smallholder farm

- Heat detection. Farmers can make two types of mistakes, they can diagnose heat in cows not on heat (called a false positive) or miss a heat identification (undetected heat). Missed heats are more common. The higher the heat detection rate, the higher the submission rate. Farmers with over 80% heat detection rates had 73% 80-day submission rates.
- Artificial insemination (AI) practices. There are many skills in AI, but discussion of these is outside the scope of this manual. Good first insemination rates were 45–48%.
- Body condition. Cows calving at condition scores of 4.5 to 5.5 (where 1 = emaciated and 8 = extremely fat) had higher 100-day-in-calf rates (54%) than those calving at less than 4.5 (41%). Cows calving in very high score (6.0 or more) may lose condition more rapidly after calving and can suffer reduced fertility.
- Feed intake. Better fed cows have higher fertility. Better feeding can improve 100-day-in-calf rate from 41–57% and reduce 200-day not in-calf rate from 15% to 9%.
- Heifer live weight. The occurrence of the first oestrus in yearlings depends on live weight. So better feeding practices in early life will lead to younger age at first calving in virgin heifers. These heavier animals will also cycle earlier after calving.

Reproductive management is discussed in detail in Chapter 15 of *Tropical dairy farming* (Moran 2005).

5.6 Exotic breeds and crossbreeds for milk production

The most significant economic impact of exotic dairy breeds on the development of dairy farming in Asia has been through crossbreeding with the Friesian, and to a lesser extent Jersey, Brown Swiss and Red Dane, with local dairy cattle as well as with some Zebu dairy breeds such as Sahiwal and Red Sindi (Chantalakhana and Skunmun 2002). When properly fed and managed, Friesians in Thailand produced 5700, 6900 and 7500 kg milk (at 4% milk fat over 305 days) respectively in their first second and third lactation while their purebred daughters averaged 5300 kg milk in all three lactations. However, other data from Thailand (Himarat and Lynch 1994) showed that the cost for purebred Friesians to produce milk was higher than farm gate milk prices. Therefore,

Table 5.4 Performance of purebred Jersey v Friesian and crossbred (XB) Jersey v Friesians in the tropics, with number of animals in each mean value (Tibbo *et al.* 1994)

Trait	Jersey	Friesian	Jersey XB	Friesian XB
Milk yield (kg)	2400 (95)	3620 (35)	1903 (108)	2545 (48)
Lactation length (d)	315 (59)	309 (24)	317 (61)	328 (25)
Milk fat (%)	4.8 (30)	3.6 (11)	5.0 (21)	4.4 (13)
Age at first calving (months)	29.5 (42)	31.2 (16)	32.7 (67)	33.4 (37)
Dry period (d)	93 (16)	88 (8)	–	–
Calving interval (months)	13.9 (47)	14.1 (23)	13.7 (52)	14.0 (28)
Services per conception	2.0 (14)	1.5 (4)	2.0 (14)	2.3 (7)
Conception rate (%)	59 (10)	48 (3)	51.6 (5)	41.8 (3)

local farmers preferred to raise crossbred cattle (62–75% Friesian), because they required lower cash inputs and could still profitably produce 8 to 12 kg/d (2400–3600 kg over 305 days) under smallholder conditions of feeding, management and health care.

Worldwide tropical data (from 190 reports) of the productivity of Jerseys and Friesians, both purebred and crossbred, were reviewed by Tibbo *et al.* (1994). Their summary, presented in Table 5.4, highlights the milking superiority but the poorer reproductive performance, of the Friesian. Purebred Brown Swiss in India have produced 2700 kg while Red Dane in Thailand have produced 2300 and 2800 kg in their 1st and 2nd lactations. The Friesian is then the temperate dairy breed of first choice for upgrading tropical native cattle. Upgrading programs using Zebu dairy breeds can introduce other management problems such as poor milk letdown. Consequently, smallholder dairy farmers prefer to grade local cattle up to 75–87% temperate dairy breeds.

Extensive research in India and Pakistan has monitored breeding programs to upgrade Zebu dairy breeds (Sahiwal and Red Sindhi) with temperate dairy breeds, also finding Friesian the breed of first choice. However, the Friesians' higher milk production and lactation length has generally been at the expense of calving interval, which is up to one month longer than in Brown Swiss and Jerseys. Similar conclusions were reached on South-East Asian smallholder farms with the added advantage of a wider genetic pool to source Friesian semen compared to other temperate dairy breeds.

The question of optimum level of temperate dairy infusion in local stock seems to vary from country to country depending on farmer experiences, veterinary services, milk price and other socio economic factors. In most countries 50–75% Friesian appears optimum, although farmers with experience in dairy feeding and management may prefer 87% (or more) Friesian.

Crossbreeding programs can utilise hybrid vigour (or heterosis) but the theoretical benefits arising from this are confounded by the other management factors (feeding, heat stress, disease), when the genotype by environmental influences (GxE) come into play (Moran 2005). In addition, specially bred tropical dairy genotypes such as the

Australian Milking Zebu (based on Jersey and Red Sindhi), the Australian Friesian Sahiwal or the New Zealand Sahiwal Friesian have been introduced to many Asian countries over the last two decades. However, the general conclusion (Chantalakhana and Skunmun 2002) is that they are no more productive than local crossbreeds of similar genetic makeup.

In summary, improved genetics can be a good investment so long as the other links in the supply chain for a profitable dairy enterprise do not limit their potential, notably Links 1, 2, 3, 4, 5 and 6 in Figure 2.1. In many countries selection or culling of crossbred dairy cattle has not been practiced due to many reasons, such as lack of record keeping, which makes national average production level very low. Such internal as well as external genetic development programs are necessary to optimise progress in improving the merit of any nation's dairy gene pool.

5.7 Describing environmental stress for dairy cows

The comfort zone for milking Friesian cows is 6 to 18°C. Within this range, there are no measurable fluctuations in their physiological processes while the energy input to output shows good biological efficiency, in that all body processes will be functioning in their expected ranges. Between –5 and +5°C, appetite will be stimulated while at the upper level above 27°C, appetite is depressed and both biological and economic efficiencies decline. Above 24°C, dry matter (DM) intake decreases by about 3% for every rise of 1.2°C.

The best single descriptor of heat stress is the Temperature Humidity Index (THI), as this combines temperature and relative humidity into a single comfort index. The higher the index, the greater the discomfort, and this occurs at lower temperatures for higher levels of humidity. The THI is presented in Appendix 1 while its effect on cow performance is briefly summarised in Table 5.5.

Environmental management is discussed in detail in Chapter 19 of *Tropical dairy farming* (Moran 2005).

Table 5.5 Effects of Temperature Humidity Index (THI) on dairy cow performance

	THI	Stress	Comments
A	<72	None	–
B	72–78	Mild	Dairy cows adjust by seeking shade, increasing respiration rate and dilution of blood vessels. Cow performance is adversely affected with reproduction more so than milk yield.
C	78–89	Severe	Both saliva production and respiration rates increase. Feed intakes decrease while water intakes increase. Milk production and reproduction are both reduced.
D	89–98	Very severe	Cows will become uncomfortable due to panting, high saliva drooling and high body temperatures. Milk production and reproduction will markedly decrease.
E	>98	Danger	Potential cow deaths can occur.