



Beef production

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Foreword

Beef, meat from cattle, is produced worldwide in an enormous variety of systems; by nomads in semi desert areas, to intensive dairy farmers who sell male calves for their meat and cull cows that no longer produce enough milk, as well as ranchers whose main aim is to produce meat.

The main aim of this Agrodok is to provide information on how to increase beef production in extensive and low-input systems, utilising existing conditions, but in a different way. This is a different form of intensification of production and requires a different look at the system, and probably a little more labour and specific inputs.

Much information is available about the nutrient requirements of pregnant and nursing cows and growing animals, but here we look at animals under grazing conditions where salt and minerals are the main supplement. This booklet focuses on the physiological and management aspects that are needed to increase the number of calves born per cow, without increasing undue stress to the cows. The management of these systems and the growth of the animals are the most important issues, and we devote most attention to these. In some special cases supplementation will be considered. The care and use of grazing areas, whether communal or private, and the strategies for different seasons are also looked at.

While we write in this Agrodok about the production of beef from cattle, many aspects apply similarly to other bovines such as buffalo, Bali cattle and the like. There are differences, such as the length of pregnancy, but most aspects, especially management, are applicable to the other species.

The author has over 50 years of experience in livestock production in Africa, Asia, Europe and Central and Latin America. I am very grateful to

my peer readers Robert Baars, Hans Blauw and Johan Koeslag. The drawings were done by Barbara Oranje, who deserves special thanks.

Gijs den Hertog

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1 Introduction

1.1 Meat production

Many animal species produce meat, but humans use only a few of these types of animals for the meat that they eat. These animal species, together called livestock, also vary greatly. And so the production systems that farmers have developed also vary in their intensity, use of resources, and time required to produce the final product: meat. The types of feed, housing and management vary, as do the efficiency of production and reproduction.

Here are a few examples that illustrate this variety in meat production:

- To produce chickens for their meat, put eggs in an incubator. After 3 weeks chicks will hatch and 6 weeks later the broilers will be ready for slaughter and for eating.
- To rear sheep, goats and pigs it takes about 1 to 1.5 years between the parent animal being serviced to the offspring being ready for slaughter.
- Cattle raised under extensive conditions take about 4 years between a cow being serviced and the offspring being fattened enough for slaughter.
- In countries or regions close to the sea, fishermen will go out almost every day to catch fish and thus produce that type of fish meat.

Also, there is a big variation in the number of offspring that different types of animal produce:

- Chickens can lay up to 150 eggs for reproduction per year.
- Sheep and goats usually have between 1 and 3 offspring per birth.
- Pigs have between 1 and 2 litters a year, with anywhere between 7 and 14 piglets per litter.
- Cows produce much fewer offspring: 1 calf per year in intensive systems, and in the tropics usually about 1 calf every 2 years.

1.2 Beef production

The meat from cattle is called beef. All systems in which cattle are kept produce beef, except where this is prohibited by the religion. Sometimes cattle are reared mainly for beef production, but far more often they are kept for other purposes and the meat is a by-product. Cattle are kept in all climatic zones of the world. Production systems include:

- Intensive dairy production on a farm, where cows are culled when they no longer produce milk and male calves are reared for their meat.
- Nomadic pastoralism, where people move with their cattle, using or selling their milk and its processed products, some also consuming the blood of live animals, some selling surplus bulls or steers/oxen for meat, or slaughtering them for meat when necessary (the animals can no longer keep moving).
- Cattle kept as draught animals, then slaughtered when no longer useful.
- One or two cows kept on a smallholding, for family consumption of the dairy products, eating crop residues, until finally they are slaughtered or sold for meat.
- Cattle may also be kept as a form of bank or savings account; they are a source of wealth.

This booklet focuses on extensive systems of cattle rearing, from nomadism and dairy farming (where beef is a by-product) to ranching, where beef is the sole product of the farming.

1.3 Production systems

Livestock production systems can be classified according to how they are organised in terms of how people are involved in them (social), how they generate income (economic) and how they deal with natural resources (environment). In terms of the environment, livestock systems are found in different climatic zones, such as the humid or dry tropics, and the seasonally humid or dry tropics. The purposes for which animals are kept and reared may differ between systems, but they also overlap.

Between all different systems there will be similarities and differences. However, each system has its own dynamics and changes over time, partly because of the expertise and skills of the farmer. Classification may help understand a system better, but the main point here is to understand the following questions:

- What are the production constraints?
- What are possible solutions?
- What ways of management can be used to overcome the constraints?

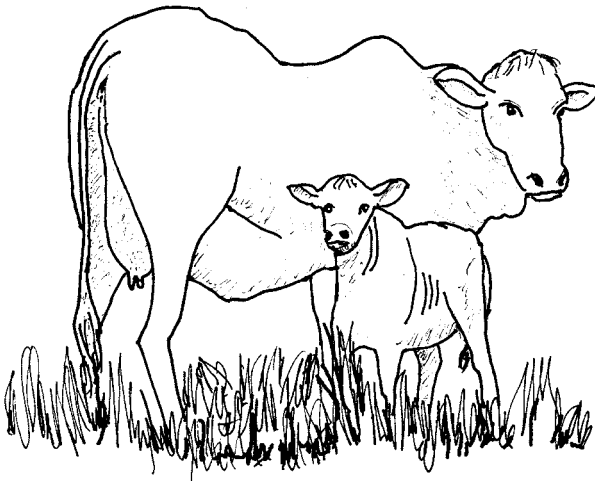


Figure 1: Typical cow-calf situation

On-farm production of beef varies from country to country and from region to region. However, much beef production throughout the world is done in low-potential areas, characterised by:

- poor soils
- long dry periods
- low levels of inputs
- infrequent outputs
- lack of infrastructure, such as roads and markets
- lack of processing opportunities

We have divided beef production systems into the following categories for this booklet:

A: ranches with breeding herds and fattening of steers kept until slaughter

B: ranches with breeding herds, selling immature or young stock to C

C: ranches with steer growing (C1) and fattening (C2), buying immature, sometimes castrated animals

D: dairy ranches

A: These are large ranches in very inaccessible areas. They produce stock that go for slaughter, mainly male animals, but also the non-productive cows. All age groups and both sexes are present, often separated into sub-herds:

- Cows with calves (200-250), with bulls present in the breeding season.
- Young stock, males and females kept separately in different locations.

B: Calf producers: these farmers produce calves that they sell to other farmers who keep them to grow (over a dry period), intending to fatten them later. They also sell young cattle soon after weaning to farmers who will fatten them. Male animals (castrated and not castrated) may be reared specifically for this purpose, or they may be the by-product of an extensive dairy production system. The ranches are often on poor soils where infrastructure, such as roads, is inadequate in some seasons.

Males are often castrated as this makes management easier, although some farmers prefer to fatten bulls. The farmer earns income from selling live-stock for fattening and then slaughter, for their beef.

C1: Growers buy calves (nearly always castrated bull calves) that they grow to a certain weight and then sell to fatteners. These ranches are also often in remote areas, although conditions are sufficient for growing extensively: animals graze and at best are given some salt and minerals. Growth of the animals is low to moderate, especially as they are bought very soon after weaning and they are often not yet ruminating fully. If grazing is of sufficient quality, the growth potential of the animals will improve. Young male stock are kept for 1 to 2 years before they are sold to fatteners.

C2: Fatteners finish growing the animals before they are sent for slaughter. The ranches are on better soils, so in the good season the young bulls or steers grow faster (gaining up to 800-900 grams per day). The ranches are usually in a more accessible area than A and B. In the lean season, these farmers may use agricultural by-products or buy concentrates to supplement the animals' diet so that they can achieve the desired body weight and/or condition. They may use the same inputs so the animals grow faster and can be slaughtered sooner. In some countries slaughter stock with a good weight will command a higher price per kg of live weight. Sometimes, however, animals may have a good weight, but with a little more time (often only a month) they would also have better body condition and carcass composition. This is important, especially where payment depends partly on carcass quality. Farmers need to be able to judge an animal's potential if they are to obtain a better income.

Economic returns on the different systems

The profit share in these different systems is very unequal. Calf producers (B) receive about 10% of the total profits earned; the growers (C1) receive about 30%; fatteners (C2) earn about 60% of the profits.

D: Dairy ranching takes place on better soils and where there is sufficient infrastructure. Cows are generally milked only once a day, giving calves enough time with their mother so they grow and develop good condition. In this system the bull calves are a by-product: they are mostly sold to C for fattening.

The systems described here are the most common types, but often farms may have characteristics of more than one system. This book focuses on extensive beef cow-calf systems, but much of the information presented also applies to intermediate systems. All information will need to be adjusted to local conditions.



Figure 2: Small local cattle market

2 Production constraints

Extensive, low-input livestock farming systems face many constraints. Here we outline the main production constraints, which are common to nearly all the different extensive livestock production systems regardless of the climatic conditions they face.

We know a lot about the nutritional requirements of calves and adult cattle, but we often do not know what quality of feed they get. At best we can make a well-informed guess and hope that the animal will do well. Here we focus on the main production constraints and what are possible and feasible solutions.

The first problem a calf faces after it has been born is weaning: the transition from suckling its mother's milk to depending entirely on eating solid feed. Weaning is the biggest stress an animal faces in its life. If the stress is too much, it can cause serious setbacks in growth and development (see 2.1). Where these setbacks are very extreme, a second constraint arises: a heifer that does not grow and develop enough. She will reach puberty at a late age and may not be able to get pregnant (see 2.2). The third constraint is that of a long calving interval between consecutive calves. All three

constraints together result in cows that produce few offspring during their productive life.

2.1 Post-weaning stress

When a calf is weaned it no longer drinks milk from its mother and it usually is removed from her as well, so its feed changes and it no longer has the security it had when it was close to its dam. Calves can be helped to feel secure by placing them with lead animals, such as yearlings or bulls past their service period. These are also groups that get good pasture.

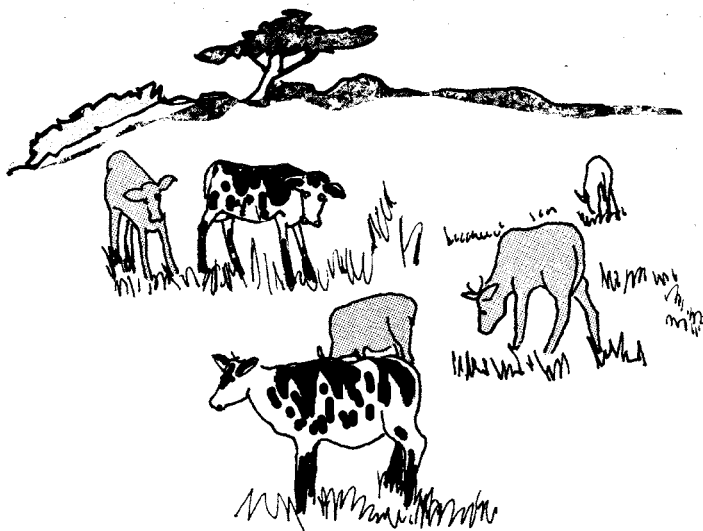


Figure 3: Group of calves with lead animal

The change from milk to pasture is stressful for calves because they have not become full ruminants yet. Cattle have four stomachs, but the relative size of these to each other changes as they grow. At birth the abomasum (the fourth and true stomach) takes up over 80% of the total capacity of the four stomachs; in a mature animal the abomasum takes up about 7% of the total capacity (see Table 1). It takes almost a year for a calf to be able to digest roughage adequately.

Table 1: The development of the rumen and abomasum

	Rumen	Abomasum
At birth	16 %	84 % (capacity 1-2 litres)
2 month	25 %	75 %
4 month	50 %	50 %
8 month	75 %	25 %
10 month	84 %	16 %
Adult	90 – 95 %	5 – 10 %

The total rumen capacity of a cow may be between 150 – 250 litres or more.

Most calves overcome post-weaning stress with some supplementation and good grazing conditions, and grow and develop into good breeding or fattening animals. This requires good care, sometimes supplementation and careful attention of the rancher or the stockmen to these young, vulnerable animals.

It is most important to understand the nutritional requirements of calves that are being weaned because they cannot fully digest grass until they are about 1 year old. In addition, weaning often takes place towards or during the dry season, which increases stress: feed is lower quality and is combined with not being able to ruminate fully. The result is that calves cannot grow and develop optimally. When the stress is very extreme, growth and development is seriously delayed or may even stop completely, causing severe stunting. Animals that are stunted look young (e.g. 8 months) but when you look more closely it becomes clear that they are older (e.g. 2 years). A farmer with a well-trained eye knows to look at the indicators for age: the teeth, the size and shape of horns and hooves, the quality of the calf's coat (it will be rough and long haired) and its general appearance and size.

Reduced growth and development is a very serious problem. Not only does it affect the external appearance of the animal, but also the vital internal organs, such as the lungs, heart, liver and kidneys. If feed is in such short

supply that the development of the organs is severely reduced or stops, the animal will never recover, even if conditions improve later. An animal with stunted internal organs will never grow to full size, but more important, it will never become productive.

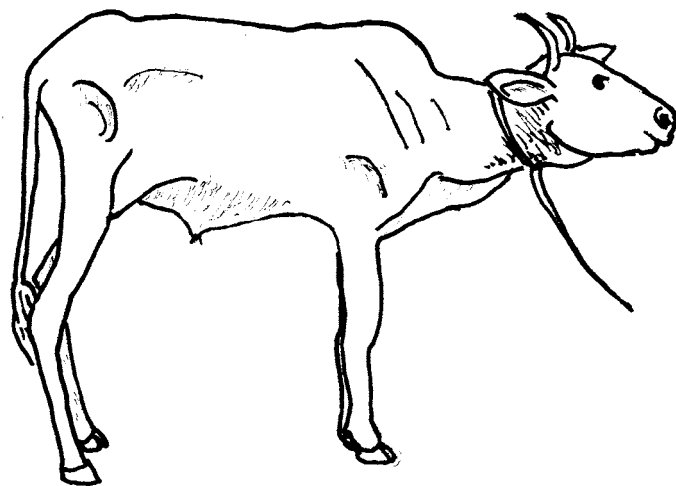


Figure 4: Stunted calf

Another stress factor is internal parasites. These cause more damage to young, vulnerable animals, making their chances of recovery smaller. They reduce the animals' ability to eat, and may affect their ability to digest feed, their rumen size, and in particular the liver and kidneys. If no effective treatment is available, it is better to cull animals affected by internal parasites, as they will not become productive.

Under normal conditions, giving calves supplementary feed can help reduce post-weaning stress. It can help to teach calves to eat a supplement in the time that their suckling is being restricted (gradually), or just before they are weaned. When conditions are particularly severe, e.g. when there is less or no rain, more serious measures are needed to avoid stunting. If possible, feeding concentrate can help, otherwise it is advisable to sell young animals before it is too late, or, as a last option, slaughter them.

Helping a calf to become a ruminant

A farmer noticed that one of his calves was not growing well, its coat had long hairs, and it was not strong and robust (farmers call this thrifty). The farmer asked his son to help him. They went to the cow barn where a well-developed cow was chewing the cud. The farmer kept the cow down, closed off her oesophagus with one hand, and asked his son to take out the cud that the cow was chewing. The farmer then gave the cud to the calf, making it swallow it. Within a fortnight the calf's condition had improved and it started growing well. It even showed 'compensatory growth'. After about 6 weeks it was impossible to tell this calf from the other calves. By giving the calf the cud from the cow, the farmer inoculated the calf's rumen with the cow's healthy stomach bacteria population. This can sometimes help calves to develop into healthy ruminants.

2.2 Late puberty onset in heifers

Under normal conditions, where post-weaning stress is not too serious, calves will catch up during the next rainy season as pastures improve. Most heifers reach puberty towards the end of the rainy season, when they are about 15 months. The age varies depending on the breed, but as most heifers are not serviced immediately, this is not a problem. Generally, heifers are not serviced until they are over 2 years old, well into the following rainy season, so they will not calve until they are at least 3 years.

A seriously stressed or stunted animal will not reach puberty until an older age – 3 years or older is common. However, a stressed or stunted heifer will not have reached the optimal size for becoming pregnant. She will still be growing slowly, and if she conceives, she may not be able to carry her calf. Sometimes the heifer's ovaries or womb (uterus) may be affected. The ovaries may not produce viable eggs (ovum); the egg may not be fertilised; or it may not be accepted by the womb. In any of these cases the heifer will not get pregnant. If a weak heifer does get pregnant, she will be at risk because she cannot eat enough or digest feed well. Her birth canal may also be too small to be able to deliver the calf normally. In some cases both

cow and calf may die. If possible, it is better to let a stunted heifer reach her mature size before allowing her to breed, as developmental growth and pregnancy compete with each other for limited nutritional resources. But this longer amount of time means spending more money on the heifer: for example, calving at 3 years costs extra concentrate feed, calving at 4 years costs extra grass.

2.3 Long calving interval

The ideal calving interval for beef cows in temperate climates is 1 year. This can be expressed as a calving percentage of 100% (see how to calculate calving percentage and calving interval below). This frequency is not often achieved in the tropics, where 2 years between calves is more common, especially for local and zebu breeds. Cows in the tropics suckle their calves, often for a long time, and do not come into heat while the calves are still suckling. By the time a calf is weaned it is often the dry season, so feed quantity and quality is reduced. Most cows will not come into heat until well into the next rainy season, hence a calving interval of 2 years.

In many extensive beef production systems the average calving percentage ranges from 45-48%, but may be lower, or, where conditions are better, (much) higher. A low level of production is not necessarily a problem, especially where little management or other inputs are required. The benefits of more calves (income from fattening or selling young) should outweigh the costs of inputs and labour. For more detail, read Chapter 4 on Cow Management.

Calving percentage and calving interval

Calving percentage and calving interval are complementary measures and can be converted into one another.

Calving percentage is calculated as $365 \div \text{number of days calving interval}$

E.g. $365 \div 456 = 80\%$

Calving interval is then $365 \div 80\% = 456 \text{ days}$

3 Production strategy

When cows are kept for beef production, the aim is for the cows to produce and wean as many good calves as possible. This requires a sound production strategy. There are many different strategies, from calving just before the wet season to waiting with calving until well into the dry season. Each has its own advantages and disadvantages. In this chapter we focus on calving just before the rainy season.

The aims of the production strategies are geared toward a few basic, but very important goals, listed below.

A: Minimise fluctuation in number of animals

Animal numbers should only fluctuate between calving and when the slaughter-ready stock is sold. During this period, which often coincides with the rainy season, there are more animals on the ranch, but at the end of the rains the stock that is ready for slaughter should be sold, so for the rest of the year the numbers of cattle will remain more or less stable.

B: Minimise fluctuation in seasonal weight gain (and loss)

The emphasis should be on maximal growth during the wet season and minimal weight loss in the dry season.

C: Maximise reproductive performance

Reproductive performance is very important for the management and economics of the farm. Table 1 shows the effect of the calving percentage on the composition and performance of the herd.

Table 2: Herd projection with 50 and 80 % calving

	LSU	50%	LSU	80%	LSU
Cows	1	100	100	79	79
Bulls	1.2	4	4.8	3	3.6
Calves 0-1 yrs	0.2	48	9.6	60	12.2
Heifers 1-2 yrs	0.5	23	11.5	29	15.5
Heifers 2-3 yrs	0.9	22	19.8	28	25.2
Steers 1-2 yrs	0.55	23	12.65	29	15.95
Steers 2-3 yrs	1	22	22	28	28
<i>Total</i>		242	180.35	256	179.45
Potential sale					
Cows 15% culling		15		12	
Steers 3 yrs		22		28	
Heifers 3 yrs		7		16	
<i>Total</i>		44		56	

LSU = Livestock Unit (conversion factor)

When the calving percentage is higher, with the same number of livestock units the farmer will have fewer cows and more animals for sale.

D: Minimise mortality

Any animal that dies is a loss.

E: Maintain or improve the grazing

Maintaining and improving the quality of the pasture will benefit the herd and its productivity.

3.1 Nutrition of the cow

If the start of the rainy season is reasonably reliable, then the best period for the cow to calve down is about 4 weeks before the rains start. This may sound as though it is cruel to the cow, but this is not the case. In the last month of the pregnancy the foetus (the calf in the womb) requires a lot of nutrients. This may be as much as the equivalent of 10 litres of milk a day or more. However, once born, a calf suckles only 3 to 5 litres of milk a day. So in fact the nutrient requirements of the cow are lower after she has calved. The cow's rumen also expands again rapidly after giving birth, in particular if the quality of feed is low, as it often is at the end of the dry season when grass is dry and fibrous. The rumen is reduced in size during the last phase of pregnancy. As soon as the cow calves, the rumen will start to increase in size, and its growth is stimulated by eating coarse high-fibre roughage. This enables the cow to eat more and produce more milk for the calf once in the rainy season. Increased rumen size and good quality pasture benefit the cow in two ways: her milk production will increase and she will start to regain lost condition.

For information on the changeover from the dry to the wet season read the section on green grass losses, Chapter 7.1.

Once the wet season starts, good quality and quantity of grass will give the cow the nutrients she needs. Her milk production will increase, which will benefit the calf: it will grow faster. The cow will continue to regain condition as a kind of compensatory growth, which will happen because she is in a positive energy balance. This growth, even if it is only a few grams per day, will enable her to come back into oestrus or heat, although this may require help from the farmer.

From a few weeks to a month of age, the calf will also benefit from the early growth of grass in the wet season, as this stimulates the rumen development and growth.

3.2 Effect of suckling and weaning

The frequent suckling of the calf induces the release of oxytocin (the milk let-down hormone), and this in turn inhibits the release of the luteinising hormone. The luteinising hormone is required for stimulating, maturing and releasing the ovum for the next pregnancy. If from the age of about 8 weeks onwards the calves are allowed to suckle only one hour per day, the oxytocin effect will decrease so much that cows whose condition is improving will come back on heat within a few weeks and can then be served. Once the cows have re-established a regular oestrus cycle, the calves can return to run with the cows full time, because the cycling will continue.

The period of restricted suckling also enables the farmer to manage the calves separately and to train them to do other things, such as eating other feed and going through the yard, dip or spray-race. Using a few yearlings as lead animals will make the work easier and help the calves. It is important that calves have access to water. The first few days the cows will be around the yard, but soon they will go and graze by themselves. The calves can be grazed in different pasture, preferably a good one, for part of the day. At the same time, minerals and salt may be introduced to the calves in the yard.

For a cow to carry her next pregnancy to term it is important that she builds up her condition before the next dry season starts. Therefore, by the end of the rains the calves should be weaned and moved to the best pasture. Some supplemental feed is advisable in this period as the calves are not yet fully ruminating, and will not do so until they are 10-12 months. For uninterrupted growth and development, some supplemental feed (depending on the quality of pasture) is important. Towards the end of the dry season the calves' growth may slow down a little, but there should be no damaging effects, as compensatory growth will occur in the next rainy season.

3.3 Late calving

When cows calve down in the rainy season they undergo more nutritional stress, as the last part of their pregnancy takes place during the changeover from the dry to the wet season. These cows are more seriously affected by

‘green grass losses’. A pregnant cow’s rumen capacity is reduced, so she cannot eat so much, but at the same time the nutrient demand of the unborn calf (foetus) increases. Then a cow cannot fully benefit from the high quality of the pasture at the start of the rains. And after calving it takes more time for the cow’s rumen to reach its maximum size, because lush grass is less fibrous. Cows that calve down before the rains regain more rumen capacity than cows that calve down during the wet season. Moreover, well into the wet season the grass is no longer of top quality and the cow, suckling her calf, will have more difficulty recovering her lost body condition and starting to grow again. This may prolong the post-partum anoestrus and therefore increase her calving interval. As long as the cow is not in a positive energy balance and does not gain weight (even a little) her reproductive cycle will not start again. This, combined with the ‘oxytocin effect’ of suckling a calf, will increase the calving interval further. Moreover, the calf also misses the best quality pasture and this may slow down its growth and rumen development a little.

3.4 Other considerations

Care should be taken to avoid parasitism, especially for the calf. If the area is (heavily) infected it is better for the calves to be born before the rain or later in the wet season. It is a good idea to consult a veterinarian about the best solution: whether to change the calving season or to treat the calves.

Some farmers prefer the cows to calve down well into the dry season. However, this does not enable the cow or the calf to benefit from the good pasture in the wet season and it requires a good feeding strategy for the cow. Good feed can be preserved roughage, hay or silage, and possibly some concentrates. Feeding will increase the cost of production, but sometimes it is done for good reasons, such as marketing, and is justified. Calves born in the dry season will have fewer problems with parasitism, but one should always be watchful.

4 Cow Management

This chapter looks at the factors affecting cows' physical condition and their fertility. The main problem in extensive and low-input systems is that the cows tend to have a long, sometimes very long, calving interval. One reason is because cows suckle their calves.

An important factor is the quantity and quality of feed available. This is closely related to the amount of rainfall: many studies have shown that more rain gives more pasture and this in turn results in higher conception and pregnancy rates. The highest conception rates occur about one to two months after the rains have started, when lots of good feed is available. Cows need to be in a positive energy balance, i.e. they need to be gaining weight after a previous pregnancy, to become pregnant. The cow's rumen capacity also plays a role, because she needs energy for maintenance, lactation and growth.

Climatic temperature also influences a cow's condition. The higher the outside temperature, the lower the animal's appetite becomes. Digestion produces heat in the body and when outside temperatures are high, it is difficult for the cow to get rid of the surplus heat. Shade may help here;

large trees can provide cool shade for cows. Animals kept in pastures with large trees perform better, both in terms of breeding and growth. Reducing excessive heat stress is more important than cutting down trees to increase the amount of grass available for feed. However, care should be taken not to let parasites build up when cattle group together under trees.

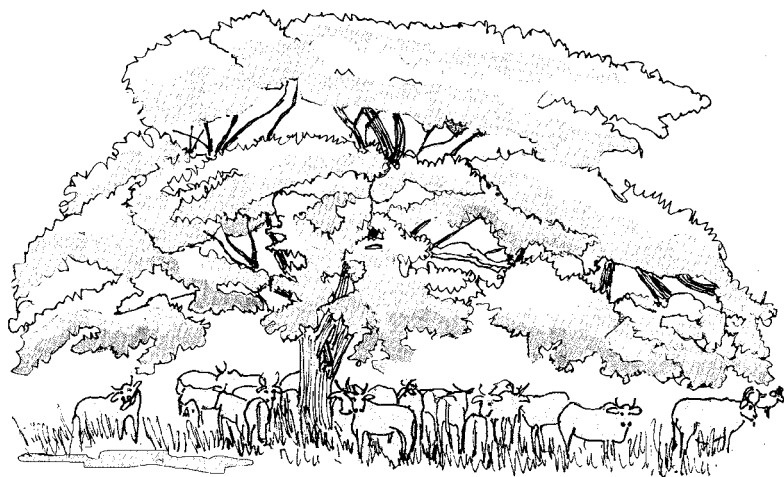


Figure 5: A large tree provides shade for cattle

The age at which a young cow enters puberty is closely related to the time of year at which it was born. Calves born early in the breeding season often grow and develop faster, reaching puberty as much as one year earlier than late-born calves. When mature, cows that were early-born calves produce more offspring than late born calves. This is a lifelong effect and worth taking into consideration when selecting heifers to replace others in a herd.

A cow's body condition also plays an important role in her fertility. A cow with poor body condition will not come into heat. Her reproductive cycle will be suppressed, so she cannot be served and will not become pregnant. Below a certain weight cows are not fertile. The actual weight varies de-

pending on the breed. Cows just above the critical weight may come into heat and be served, but this may not result in pregnancy because the uterus might reject the embryo. It is difficult to give figures per breed, but a body score below 2 is generally an indication of low, insufficient body condition.

Young cows that are not yet fully grown and developed when they bear their first calf will have more difficulty coping with lactation, growth and fertility. If they do not calve early in the season, or conditions are harder than normal, they may be excused for not conceiving, especially when they are promising animals, as it is worth waiting before letting them conceive.

When twin calves are born, and one is male and the other female, the female is almost always a 'freemartin' (also called hermaphrodite or inter-sex). This means she is not a full female and cannot reproduce because the sex organs will not develop fully and so will not be functional. These freemartins should be excluded from the breeding herd and fattened for sale. Some cows are born with 'white heifer disease': their oviducts do not develop fully and so do not function. This congenital problem was first seen in white Shorthorn heifers, hence the name, but it seems to affect other breeds too. It is thought that a small percentage of heifer infertility is due to this problem.

Certain diseases also cause fertility problems, for example venereal diseases such as *Trichomonas*, *Campylobacter* and *Brucellosis*. These diseases are easily spread among a herd through the bulls. If a cow or bull is infected and servicing takes place, the diseases are passed from one animal to another. All these diseases cause abortion in cows. *Campylobacter* causes abortion between 25 and 60 days into the pregnancy. *Brucellosis* causes late abortion, usually in the seventh month of pregnancy. The dead foetus and afterbirth are very infectious to other animals and even humans. All these and other diseases cause endometritis: an inflammation and infection of the internal lining of the uterus that leads to an accumulation of pus in the uterus. The pus that is excreted through the vagina is dirty white in colour and smells foul.

4.1 Calving

The average length of a pregnancy of a cow is around 278 days. In younger animals it is a little shorter and in older animals a little longer. However, some heavy breeds, like Charolais and Brown Swiss, have an average pregnancy of 288 days, with a little variation on either side. The length of the pregnancy of the mother of the breeding bull determines the length of the pregnancies he causes. So if the breeding bull is of a large breed, or a cross-bred with a large-breed sire, then longer pregnancies can be expected. The longer a pregnancy is, the heavier the calf is likely to be, which may cause problems at calving. The calf grows fast, up to 1 kg a day, during the last few days of a pregnancy, which is why heavier calves are born at the end of longer pregnancies. When heifers are to be serviced, it is advisable to use bulls that are known to produce shorter pregnancies and smaller calves. Herdsman should also pay close attention to heifers during their pregnancy. Female calves are usually born a few days earlier than bull calves and tend to be a little lighter.

Calving is a natural process and older cows generally calve down easily and without assistance. However, young and inexperienced heifers usually take longer to give birth to their first calf. This is partly because the animal is often agitated and nervous, so it takes longer for the birth canal to relax, which in turn makes the animal even more stressed. Herdsmen should watch this process carefully and assist if need be. This is only possible if the animals are used to having people around. So in extensive systems this is much more difficult to do.

Animals with slightly sloping pelvis, like most Zebu breeds, calve a little more easily than cows with a straight back (see figure 6). Again, this is a point to take into account in crossbreeding programmes in extensive systems where it will be difficult to provide assistance at calving.

If there are heifers in the herd that are calving for the first time, it is important to watch that older or leading cows do not ‘steal’ the newly born calf from a young and inexperienced mother. Older mothers that are close to

calving and when they start to produce colostrum may steal a calf from a younger, lower ranking cow. Once the older cow has herself calved she will reject the 'stolen' calf, which will no longer be accepted by its own dam. These calves become orphans and are likely to die.

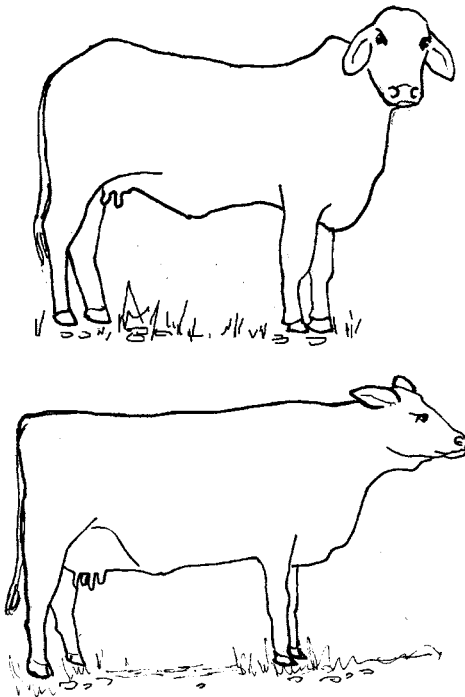


Figure 6: Cow with sloping pelvis (top picture) and cow with straight pelvis (bottom picture)

One strategy is to keep pregnant heifers separate from the main herd until they have calved down and become fully comfortable with their calves and the other cows have calved as well. This solves two problems: more attention can be given to the heifers when they calve, and the problem of calves being 'stolen' will not happen.

If a calf is born normally, it presents itself with the front legs and the head lying on top of them. This presentation generally causes very little difficulty. However the calf may be lying in a different position, and present its hind legs first. This makes delivery more difficult and the calf may die because it cannot breathe. Even more of a problem is when one leg is not presented, or no legs are presented. Then the calf has to be repositioned, which requires an experienced person so as not to cause damage to the cow. If the calf is in a very difficult position a vet may be needed to operate to get the calf out. This is called dystocia. In this case it is very important that the cow is handled as gently as possible to reduce stress.

4.2 Culling

There are many reasons for culling animals on a beef ranch. Few decisions need to be taken for bulls. The non-breeding ones can be simply fattened and sold. Breeding bulls should usually service for three years at the most, after which they can be fattened and sold too. In their third season, take care not to let the bulls serve their own daughters. Ideally bulls should be used to service a different herd.

For female cattle the considerations are different. First: is it possible to select among calves and heifers or is the reproduction rate so low that all females are needed for replacement? If this is not the case, the calves and heifers with unwanted characteristics, late born, slow growth and poor development should be directed towards fattening and sale.

Cows are culled on the basis of their productive and reproductive performance. If they fail to breed or wean good calves they should be culled. Cows with physical defects, like limping, or an undesirable character (wild or aggressive), should also be culled. There is a general belief that cows of a certain age, in many places around 10 years of age, should also be culled. But this is not necessarily the case. If the cow is fit and healthy and is one of the leaders, think carefully before culling her. At this point it is a good idea to check her teeth. If she still has all her teeth and they are strong, give her another year, as these cows are generally good calf producers.

5 Bull Management

Contrary to common belief, a bull will not serve all cows that are on heat. The belief comes from the fact that when bulls are hand mated with a cow they will always serve. This is because the bull is not generally kept with the cows, so he is eager to serve. The same is the case on dairy farms where bulls are always kept separately from the cows. Bulls that run with a herd of cows develop very specific behaviour and it is well worth paying close attention to this, so that more cows will get pregnant and produce calves. Be aware that bulls cannot be trusted: they are strong and can be aggressive, especially if they are not handled frequently. There is an old farmers' saying: 'You cannot trust a bull (or a stallion) until you've got his skin/hide on the wheelbarrow.'

5.1 Selection of bulls

As bulls contribute 50% of the genetic potential to their offspring, it is worthwhile selecting bulls that will pass on qualities such as good meat production to their offspring. Points to consider when selecting are:

- a strong and vigorous animal, but not too heavy for heifers
- a masculine appearance, typical of his breed

- a good body conformation, with attention to beef production characteristics
- well-developed, round hindquarters
- well-developed reproductive organs, testicles and penis
- good libido
- the absence of a prolapsed prepuce, no pendulous sheath (hanging down too loosely) or scrotum
- scrotum circumference

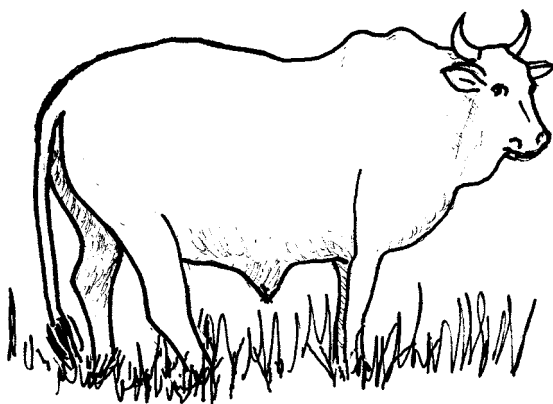


Figure 7: Example of a well-shaped bull

Most of the points above are self-explanatory, but we add a few notes here.

It is advisable to select a bull that produces smaller calves if he is to serve heifers. That means he should have been carried by his dam for less than 283 days during her pregnancy.

Prepuce prolapse, which is mainly found in Zebu breeds, is a serious problem. It is also found in other breeds, especially in polled or hornless breeds, and seems to be genetically related to the hornless characteristic of these breeds. The inner lining of the prepuce is turned outwards and hangs down

outside the sheath. of the penis This increases the risk of infection through spiky seeds and other foreign objects and dirt, particularly in rough grazing areas. This problem results in a lower pregnancy rate and reduced fertility in cows. Because the prepuce is infected, the penis itself becomes infected, which in turn infects the cow during service. If a bull has a serious prepuce prolapse infection, he will not be willing or able to serve the cows. This problem should be given serious attention when selecting a breeding bull.

Bigger scrotum circumference is often associated with higher fertility, as it seems that bulls with a bigger scrotum produce more semen. The other factor associated with this, which is less well known, is that these bulls produce offspring that mature earlier, so these heifers will reach puberty sooner. However, this is only likely to happen when production conditions are good. This may be a point to consider when selecting a bull, but care should be taken when examining testicles, as not all bulls like their testicles being handled, particularly if they are not accustomed to being handled frequently. Check carefully that a bull has two equal-sized testicles and that both testicles are in the scrotum. If one or both testicles are not in the scrotum it is called cryptorchidism. Although the bull's libido will be good (high), he will produce little or no viable sperm, so he will be sterile.

It is important that the bull has a sound and well-developed penis. Many kinds of abnormalities and deformation occur, both genetic and also due to physical damage, e.g. during servicing. If a bull has an infection, from other cows or through prepuce prolapse, he may refrain from mating because it is painful, but if he does mate he will pass on the infection to the cows he services. Some infections may be venereal disease (passed on through sexual contact), such as *Trichomonas* or *Brucellosis*. These infections are passed on to the cows, as a result of which the cows will abort the foetus and become infertile. These kinds of infections can spread rapidly throughout an entire herd.

High temperatures decrease the production of viable sperm cells in the testicles. Generally the temperature inside the scrotum is a few degrees

lower than the body temperature. Bulls of non-adapted breeds, e.g. for crossbreeding, may be affected by high environmental temperatures. If the skin of the scrotum is dark or black this may be even worse. When they lie down, bulls of adapted breeds often place the upper hind leg above the scrotum so it is shaded from the sun; non-adapted breeds are not always that smart. It is known that (high) quality non-adapted bulls can lose their fertility completely due to too high scrotal temperatures. See Chapter 6 for information on adapted and non-adapted breeds.

If a bull is often kicked aside or disturbed during mating by other bulls because he is too young, not sufficiently developed, or shy, he may eventually refrain from servicing at all. The same applies if the older and leading cows do not accept him and keep him on the edge of the herd. So, after introducing a bull or bulls to the cows, the herd's behaviour should be observed for a few days to see how the animals act towards one another.

When bulls are kept separately from the cows for a longer period, especially during a long dry season, the bulls' hormone levels go down and their sperm production almost stops. Moreover, the semen in the testicles ages and loses its ability to fertilise a cow's ovum. To get bulls back into sexual action they need to be kept near or alongside the cows, just before the breeding season. Some ranchers do this by introducing a group of well-developed heifers to the bulls, so that they will service them. The first services probably will not lead to pregnancies, but the bulls' hormone levels and sperm production will be activated, and after a short period they will be able to run with the cows and get them pregnant. This is called 'warming-up' and is a good practice.

If a bull has been seriously ill with a high fever, it will take at least 2½ months to fully restore his fertility. Fever has a disastrous effect on sperm development in the testicles, which reduces fertility or stops it altogether. Many farmers say that any male animal used for reproduction should not be used for 3 months after being seriously ill.

5.2 Courtship behaviour

A bull depends mainly on his eyesight to identify a cow on heat, especially when they are in large fields in a hilly area. Cows that are about to come on heat often seek out other cows that have recently been served, or others that are also coming on heat. They form 'sexually active groups'. Once the bull has identified a sexually active group, he will easily find the cow 'most on heat'. He will then start up and build courtship behaviour with this cow, which will last for several hours or up to half a day if only a few cows are to be served. At the peak of the 'courtship' the bull will serve the cow only once. Immediately afterwards both the bull and the cow will lie down and start to ruminate for a while, and then eventually go their own way. Services where adequate courtship has taken place are often very successful in resulting in pregnancy.

5.3 Shy breeders

Most Zebu breeds are what we call 'shy breeders'. This means that the bull will not serve a cow when a person is nearby. Bulls have been known to stop their courtship behaviour and move away when a person comes too close. So here, distance is the key factor to not interfering in the process of servicing. This may also explain the common belief that most cows are served at night-time. In very hot weather, the cow may only show her heat during the cooler hours of the day. Bulls can be trained to serve in the presence of humans, e.g. for artificial insemination. The main message is: be watchful, but keep your distance.

5.4 Single sire system

Where there is one bull for a herd of cows and heifers, the number of cows he can serve will depend on the length of the breeding season. If it is short, one bull will be able to serve about 20 females. When the breeding season is longer, the number of females may go up to a maximum of 30, and the number may be even higher if the season is very long.

Any bull in a 'single sire system' will disregard about 15% of the cows, regardless of whether they are very much in heat or cows present themselves

for service. It is not known why this happens, but both field observation and research have shown this to be the case. In order to get the ignored cows served, the bull should be changed about every 14-17 days to another herd. The next bull will have its own preferences, and the previously ignored cows will be readily served. It is also important to have one bull (or a few bulls, depending on the number of herds) in reserve, in case the main bull becomes less fertile, starts limping, has recently been ill with a high fever, or is overworked.

5.5 Multiple sire system

On large ranches it is very convenient to have herds of 200-250 animals altogether for easy management. Here, the 'multiple sire system' is best, where 4-10% of the herd is made up of bulls (depending on the terrain), which will serve the cows. In this system the cows disregarded by one bull will be served by another, so it is not necessary to change bulls frequently. Here, the age of bulls plays a very important role. It is often believed that older bulls are more effective than the younger ones, but this is not the case. Another point is that bulls that are too young, and do not yet have good body development, may be rejected and chased out of the herd by the old and leading cows.

The number of bulls per 100 cows depends on the terrain conditions on the farm or ranch. If the land is more or less flat, then 4-5 bulls will be sufficient. If the terrain is very hilly or has a lot of trees and bushes, then as many as 10 bulls will be needed.

It is generally best not to use bulls younger than 3 years. By the time they have reached 3 years they should be of adequate size and development to be accepted by the herd. By this age a bull's reproductive ability will be good and he will be able to run with the herd. Bulls aged between 3 and 5 are generally very effective, as they have not developed specific behaviour and will serve the cows without too much fighting or competence problems.

Bulls over the age of 5, however, develop what we call 'harem behaviour', which means that a bull tries to keep as big a herd of cows as possible together. This causes a lot of unrest in the herd as the bull tries to fight off the other bulls and other bulls try to get in. There is also no time for the bull and cow to develop the courtship behaviour that leads to good service. When the bulls are this age, even if there are only a few, there are continuous disturbances and fighting, and this affects the whole herd. Most services in large herds are quick copulations because of the constant risk of disturbance, and the result is a low rate of pregnancy per service. This is well demonstrated in many films about the animals in game parks and reserves. By the time bulls are 6 or 7 they cause more unrest and trouble than pregnancies.

Bulls over the age of 8 develop 'territorial behaviour', which means that they fight, conquer and defend a territory for themselves. They sometimes run with the herd, but rarely serve, and most of the time they do not run with the herd and are busy defending their territory. They will only serve the cows that stay in or pass through their territory, but then the other (harem) bulls will interfere and fight. This again causes unrest and disturbance, so bulls and cows do not have a chance to develop their courtship behaviour, which further reduces the cows' pregnancy rate. In some cases a calving percentage of 30% has been observed in a herd with older bulls, whereas the average on the ranch was 45-48%. The solution is to remove bulls that are over 5 years old from the herd.

The best age for bulls to stay with the herd is when they are between 3 and 5, as then they are strong, vigorous and able to serve a good number of cows. In addition, if they are removed after 3 years of being with the herd, inbreeding can be avoided, as the bulls will not be able to serve their own daughters when the heifers are older than 2 years. If heifers are already served when they are 2, the bulls should be removed earlier and put to service in other herds. After his third breeding season, the bull should be given some time for his condition to improve and can then be sold for slaughter.

In addition to all these instructions, it also pays to observe the animals closely, particularly the bulls, during the breeding season, as there may be many other reasons why a bull does not perform optimally. For example, a limping bull will not readily serve cows, and the same applies to a bull with an infected prepuce (prolapse, see 5.1). Many other factors may prevent a bull from servicing readily, but a bull failing to do his job may cost you as many as 20 calves or more. On the other hand, if a cow fails to carry a pregnancy, it only costs one calf.

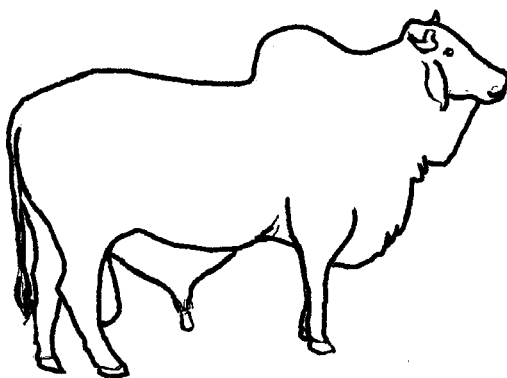


Figure 8: Prepuce prolapse

The management and care of bulls in the non-breeding season is also very important. Bulls can be kept together as one herd during this season, giving them good pasture so they can recover their condition and prepare for the dry season and the next breeding season. It is also important that they have sufficient salt and minerals (see chapter 7). Bulls aged 3-5 will not fight or create disturbances when they are together in a herd and away from the cows. They can also be run with the weaned calves. When separation takes place, the cows should not be kept too close by, as some may come back into heat, which will create unrest and fighting. Later on in the season, the bulls will be much quieter, as their libido is lower and cows hardly show any signs of being on heat. The same applies here: attention always pays.

6 Breeding and selection

The genetic potential of a particular animal, or a breed, is almost never a limiting factor for production. External factors such as climate, nutrition and management weigh far more heavily. For this reason we do not deal extensively with cattle breeds or combinations of breeds here. Instead, this chapter is about breeding and selection because these two factors can either help or limit production. In most circumstances, the local breeds are best adapted to the local conditions, even though they may not be the highest producers. Zebu breeds do well in the tropics, and quite a few of them also have very good beef production characteristics. It is only worth considering introducing improved non-Zebu breeds where there are improved conditions.

Many people think that bigger breeds are better, but bigger animals need more feed for maintenance. If the farmer cannot meet the demand for more or better quality feed, these animals will do worse than the local or traditional breeds. Moreover, larger breeds generally mature later and so they take longer to reach the optimal body condition for slaughter. In some cases this requires an extra year of grazing, which reduces the number of breeding cows on the farm or ranch. The animal may eventually fetch a higher

price, but the numbers are less, so it is important to make careful economic calculations.

Many good traditional breeds are efficient beef producers. However, many people would have us believe that the modern (European) breeds are better producers. This is sometimes true, but only under very good environmental conditions and with good management. There are also the artificial breeds, often crosses between European and local or Zebu breeds. Here the same applies: they may do well, but only under optimal conditions. Some of these breeds become very stressed in hot and humid climates; for example Santa Gertrudis bulls show very little libido and do not search actively for cows in heat.

Another point to consider is the shape of the cow's udder and in particular the teats. If the udder is very large, which often occurs due to inflammation at the time of giving birth, then the newborn calf may have difficulty suckling the first colostrum. Some cows have such big 'bottle shaped' teats that the newborn calf is not able to suckle at all.

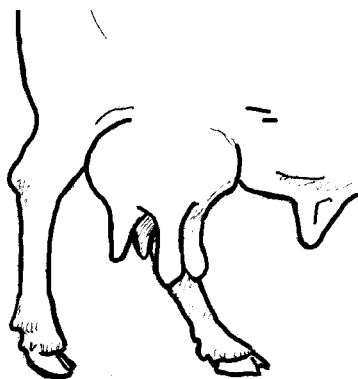


Figure 9: 'Bottle shaped' teats

This shape of teat is found particularly in Sahiwals (a Zebu breed) and their crosses, which are excellent tropical dual-purpose breeds. Some other

breeds have similar characteristics, and although not as pronounced, these must be taken into consideration when selecting breeding animals. It is very hard to select for udder and teat shape in heifers, but once they are in production this should be looked at. The type of grazing should also be considered when choosing a breed. If there are many (thorn) bushes and shrubs, animals should not have low hanging body parts. This applies to udders in cows and the prepuce in bulls.

6.1 Selection

It is more important to search for the right male and female animal than spending time on complicated genetics. We already mentioned some characteristics in Chapters 4 and 5, and here we list some more:

- adaptability: choose an animal that is adapted to local conditions
- tolerance of disease: e.g. tolerance of Trypanosomiasis in some West African breeds
- mothering ability: how well do the cows care for their calves?
- hardiness: do animals cope with e.g. very hot dry weather?
- resistance: to both diseases and parasites
- easy calving, without assistance
- easy to handle, for collection, dipping, etc.
- good grazers, even under difficult conditions
- size versus resources: what size is more suitable for the local circumstances?
- early or late maturing
- high dressing percentage
- good carcass composition
- pigmented skin and a light coloured coat

Pigmented skin is less susceptible to sunburn. Animals with less pigment, such as Friesian cows and their crosses, have little protection against strong sunlight. This is even more serious if they have an infected liver, for example by liver fluke. If at all possible, select animals with a coloured patch of skin around the eyes, as these animals are less likely to develop eye cancer or pink eye.

All of the characteristics listed can be influenced, first by the breed you choose and then by selecting an individual within a breed. It is important to understand that however good you are at choosing, it is impossible to choose for all the characteristics at once, but it will help a lot if you keep these aspects in mind when you select the next generation of bulls and heifers.

Using artificial insemination is hardly ever worthwhile. First, most beef animals are not used to being handled; they have to be tied up for insemination, and the inseminator is an intrusion into their body. The stress hormones that are released will suppress the reproductive hormones and the chance of conception taking place will be low. Second, you need to think about the value of using semen from a very high quality bull where conditions in the field, and quality of feed and management are not very good. The only circumstances in which it might be worth considering artificial insemination on a small scale would be if you want to produce crossbred bulls for service with cows that are used to being handled frequently.

Most of the so-called ‘artificial breeds’, such as Santa Gertrudis, Droughtmaster or Brangus, are stabilised crosses between two or more genetically different breeds. They often do well under favourable conditions and management. Many commercial farmers or ranchers may find it just as convenient to produce the final cross on the farm or ranch.

Crossing two or more different breeds gives the offspring so-called ‘hybrid vigour’. This is the ability to grow faster and produce better than either of the parent breeds. This kind of crossbreeding is easy to do in almost all circumstances. Most male offspring are for slaughter, and the females have the potential to become the next generation of breeding cows, if they perform well. In some cases, females are produced purposely for fattening and sale. In this case, replacement heifers should be produced in a specialized herd.

6.2 Crossbreeding

Crossbreeding is the process of crossing two or more unrelated breeds. Often the male is brought in from outside and crossed with the cows on the farm. The male may be of a different breed, or even exotic (a product of artificial insemination). These crosses usually result in hybrid vigour in the offspring. There are different reasons and purposes for doing crossbreeding. We describe a few different systems here.

Two-way cross-breeding system

Exotic can be any breed that is not related to the breed of the cows on the farm. Usually it is the male that is the exotic.

E (Exotic)	X	L (Local)	
E	X	50% E50%L	
	L	X	75%E25%L
	E	X	37.5%E62.5%L
			68.75%E31.25%L etc.

In this system Exotic and Local males are alternated in each generation. A good rule of thumb to apply is: when a cow looks like an exotic cross it with a local bull; when the cow looks like a local animal cross it with an exotic bull.

Three-way cross breeding system

This is also called criss-cross breeding. Here three very different breeds are used in a continuous breeding system. This requires good identification of animals and accurate administration so that the right males and females are crossed. This system ensures that a certain level of hybrid vigour continues.

breed A	X	breed B	
breed C	X	50%A50%B	
	breed A	X	25%A25%B50%C
	breed B	X	62.5%A12.5%B25%C etc.

Upgrading

If a farmer wants to replace the breed of his or her herd with a different breed, then it is possible to do a replacement-breeding programme, also called upgrading. For this, bulls of an exotic or other desired breed are used continuously, and after four or five generations these animals will have replaced the original breed.

E (Exotic)	X	L (Local)
E	X	50%E50%L
E	X	75%E25%L
E	X	87.5%E12.5%L
E	X	93,75%E6.25%L (called grade)
E	X	96,875%E3,125%L (called pure)

Once this state has been reached, farmers can use their own bulls and cows for breeding, because what started as exotic in the replacement plan is now regarded as pure breed.

The figure below shows the effects of feed, disease and environmental temperature (heat) on different breeds. The information comes from a large field trial done in Australia, in which four different breeds and crosses of young steers were compared: a Hereford x Shorthorn cross (HS), an Africaner x HS cross (AX), a Brahman x HS cross (BX) and pure Brahman. (Frisch and Vercoe).

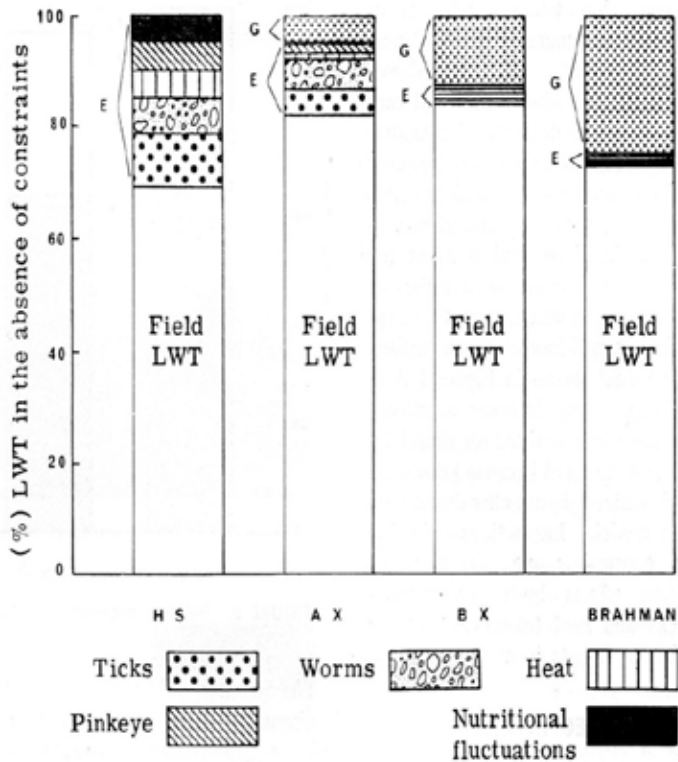


Figure 10: Model of reasons for difference in growth in various breeds. G = difference in liveweight caused by genetic differences in appetite; E = difference in liveweight caused by genetic differences in resistance to environmental constraints: ticks, worms, heat, pink-eye, nutritional fluctuations; Field LWT = liveweight at 15 months under field conditions.

7 Nutrition and grazing

Basically there are two types of ranchers: one is the so-called ‘grass manager’ and the other the ‘animal manager’. Ideally the two are combined into the one person who is responsible, but this is not always the case. The ‘grassland’ person has to look after the animals and the ‘animal’ person has to look after the grassland and its production. The productivity of the animals depends upon the grasslands and how productive they are, and the way the various fields are allocated to the different groups of animals across the different seasons.

Farmers usually want or need to improve pasture as a way of increasing the productivity of their animals. Pasture improvement is easier on small-scale units than on larger ranches. On larger ranches, particularly in drier regions, pasture improvement is a risky enterprise. Overstocking, or a worse than average drought, may offset all the earlier effort. The easiest may be to over-sow a field with adapted legumes, but even this is risky. If it is successful, however, it will increase the protein content of the animals’ diet and thus increase production. A careful analysis, including economic calculations, has to be made before starting to do something.

Another way to increase the protein content of the animals' diet is to provide a urea-molasses mixture in the field. Animals can lick this mixture and so consume urea, which is used by the micro-organisms in the rumen as a protein source. Care should be taken to avoid over-consumption and to prevent rainwater from entering the urea-molasses, as this will separate the mixture. When water comes in contact with urea, the urea dissolves in the water and may reach toxic levels. Concentrates may offer a solution, if they are affordable.

In most extensive systems the main nutritional strategy is based on a grazing strategy and the question is: how can we best divide the different groups of animals over the different pastures available? To do this we have to decide what groups we have, in the different seasons. This varies according to the type of production system. For convenience we distinguish the following systems: a) ranch with breeding stock; b) ranch with breeding, store and fattening stock; c) ranch with growing young and fattening stock.



Figure 11: Natural grazing

One of the strategies should be to ensure that developmental growth can continue, even if it is little and/or at the cost of body condition. Condition will improve easily again during the next rainy season, e.g. through compensatory growth. Another strategy is to try and avoid, or reduce, the 'green grass losses'. With reduced growth in the dry season, there will be compensatory growth anyway during the next rainy season. A lot can be gained by applying these two strategies, probably a whole season, so in the end the animals will reach their productive age sooner.

If the animals receive supplementation during the drought, they may maintain their body weight or condition, but in the next rainy season these animals will show little or no compensatory growth. So by the middle of the rainy season, both herds of animals will have more or less the same weight – it will have made little difference to feed animals extra.

7.1 Green grass loss

Green grass loss is the name given to the set of problems ruminants face when there is rapid transition from the dry to the wet season. In the course of the dry season the quality of pasture declines, making the animals' feed more fibrous (often very fibrous), and the bacteria (and other micro-organisms) in the animals' rumen adapt themselves to this type and quality of feed. Depending on the length and the severity of the dry season, the animals' weight gain will slow down and eventually stop, and they may even lose weight. Gut fill and the body's water content play a role in this.

In severe conditions, the animals may actually not just lose weight; they will also lose condition, as the body tissues deplete. These animals are hardest hit by the changeover from dry to the wet season. At the start of the rains, the new shoots of grass contain little fibre and are highly nutritious. However, the bacteria in the digestive tract cannot yet digest this high quality feed, which can cause the animal to have diarrhoea (scouring). The animal will lose weight; it may eat a lot but cannot utilise the energy and nutrients from the grass.

In a well-illustrated example, Payne showed that young animals lost weight during a long and severe dry season. However, the weight loss at the start of the rains was more serious. In the dry season they lost 40 % (20 kg) and at the start of the rains they lost 60 % (30 kg) of the total weight loss. In a more modest dry season the animal may stop gaining weight but not lose much either, but at the transition from the dry to the wet season they will lose more weight. This changeover period is a very serious threat to body condition, and weak animals or those with health problems may not survive this period.

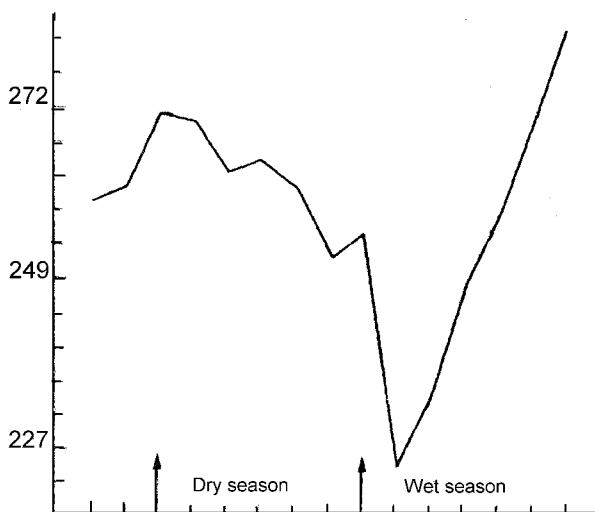


Figure 12: Weight development over the seasons, note severe loss at changeover to wet season

It takes about two weeks for the rumen bacteria to adapt to the new situation and good quality feed. In fact, the whole bacteria population has to change. There is a saying: ‘don’t feed the cow, feed the bacteria in the rumen’.

There are solutions to this process of ‘green grass loss’, but they require considerable input. The most convenient is to reduce the grazing time, once the shoots are edible, to about 4 hours per day, by enclosing the animals or just letting them graze a small pasture. It helps if the animals get some coarse roughage, for example from standing hay, or maize or sorghum stover, or some straw from barley, oats or wheat. They should be made to eat this first in the morning before the short grazing. A total of about 25 kg of coarse roughage per animal will suffice in the course of these two weeks.

The grazing hours may be gradually increased after the third day over a period of at least a fortnight. This will allow the micro-organisms in the rumen to adapt themselves and enable the animals to benefit fully from the good quality pasture. It is better for the animals to go hungry than to have heavy scouring and weight loss. It does require roughage and labour, but saves a lot of weight loss, and after a period like this the ‘compensatory growth’ will still happen. On larger ranches it may be more difficult to carry out this strategy, but the animals will definitely benefit from having the amount of time they graze restricted, or from being put in a small, not completely grazed pasture.

With the start of the rains and a new season of abundance, another problem may arise in fields that have a mixed grass-legume sward. The sudden lush feed available can cause bloat in the animals. Bloat is excessive gas production in the rumen, often in the form of froth, which the animal cannot get rid of, and it may lead to the death of the animal. Again, dry coarse feed or standing hay may prevent the problem. First graze or feed the dry feed and later, for example after the morning dew has evaporated, allow the animals to graze the fresh grass, gradually increasing the number of hours. When bloat occurs, force-feed the animals some edible oil.

7.2 Compensatory growth

In the dry season, if it is not too long and severe, most ruminants will stop growing, but not lose much body condition. This is not necessarily a

bad thing, as in the next wet season the animal will show ‘compensatory growth’. First, body weight will increase because of gut fill and more water retention, and once the bacteria in the rumen have adapted themselves to the good quality feed the animals will grow fast. Part of the compensatory growth consists of the depleted tissues being replenished, and another part is the laying down of new tissues in the body. Compensatory growth leads to an increase in body weight, which may be as much as 1kg increase in carcass weight per day. This fast growth takes place because superior feed is being converted into tissue after a period of deprivation. This phenomenon is very convenient for farmers with animals that are nearly ready for sale and slaughter. Increased body condition and weight mean a higher price and better carcass quality. However, care should be taken that such animals are sold before the end of the rains, so as to reserve sufficient pasture for the remaining animals.

Compensatory growth affects animals in different ways. Young animals that have lost a lot of weight during a previous drought or due to parasite infection may show partial compensatory growth. Animals that have been subjected to very severe stress may have permanent damage to their internal organs. They will only show a very small amount of compensatory growth. Animals that are really badly stunted will hardly benefit at all from compensatory growth. It is best to sell these animals because keeping them will not lead to any gain or profit.

This compensatory growth strategy is also often used in intensive feedlot finishing of beef cattle. Farmers buy mature or nearly mature lean animals, which they then feed intensively for a period of two to three months. The animals are fed good roughage and concentrates, or locally available by-products from food processing. Such animals may show a weight gain of about 1 kg per day and the amount of harvestable meat on the carcass can double in this amount of time. A good quality carcass will fetch a higher price, depending on both its weight and composition. The possibilities for local intensive feedlot finishing depend on the economic factors involved, such as prices of animals, labour, feed and the final sales value.

7.3 Young animals

On a ranch that has only store animals or growing young stock, the nutrition strategy is relatively simple. The largest group of bulls and steers can be sold to a fattening rancher before the farmer's feed resources deteriorate or become depleted. If there are heifers for fattening on the farm, they can best be handled as a separate group, one reason being to avoid unwanted pregnancies. The animals that can just make it should get the best pastures, while the bigger, more robust ones should get lower quality pastures, as they will survive anyway. When working out a strategy the rancher should take into account the following: the local market; when are animals sold and bought; and whether it is the dry or wet season. A farmer should aim to have the animals in the best body development and condition before they reach the market. The animals that have too much fat can be directly sold onto the meat market. Animals with a good body conformation and condition have potential for further growth and fattening, e.g. for feedlot fattening.

7.4 Fattening stock

When young bulls from various herds are grouped together, there may be a bit of unrest at the beginning. It is important to watch closely to make sure that one animal is not pushed into a submissive position and ridden frequently. Mostly the herd will settle, and if handled as one herd they will stay quiet. Later reshuffling of animals, and mixing them with animals from other herds, will cause a lot of unrest and attempts to mount one another.

Put the herd that you want to go to the market first onto the best pasture to get them into optimal condition for selling. Do not go for the minimal weight when selling, but for good body condition (see figure 13). You often see very lean animals offered for sale and slaughter, but with a few weeks' extra grazing they will gain a lot of weight and condition, and the rancher will make more money. Make sure that there is enough pasture, both in terms of quality and quantity, left for the remaining herd or herds during the dry season.

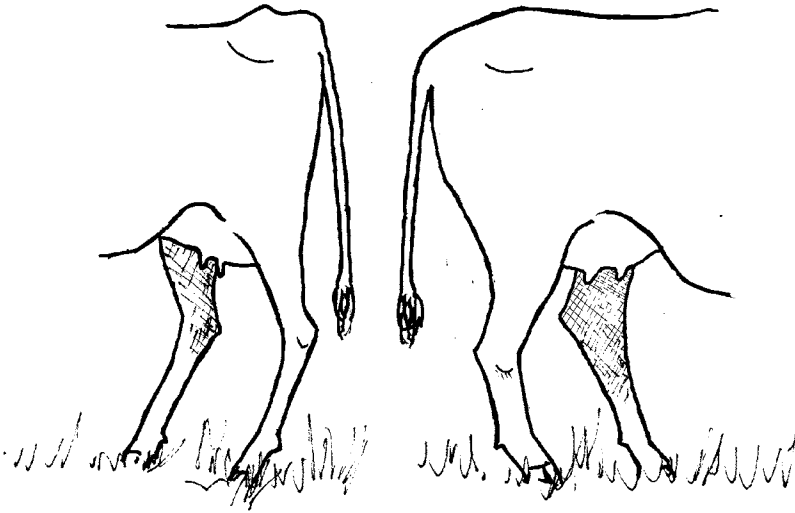


Figure 13: Do not go for minimal weight (left) when selling, but for good body condition (right)

7.5 Breeding stock

A ranch with only breeding stock is easy, because in the wet season there are one or several herds of cows with calves and breeding bulls. And there are the young females (the breeding stock), who need good care and nutrition so they can calve down at around three years of age. The breeding stock have high priority and should be given the best or at least a good pasture. The other herds can easily be divided over the various other pastures. If cows that are calving for the first time (heifers) are managed as a separate unit, then they should be given the best pasture. This is because these animals not only need to suckle their calves, but they also have to continue their own developmental growth and preferably get pregnant again. If conditions are hard, the animals in this group are the only ones excused if they don't get pregnant. So there may be competition between heifers and first calving cows and the rancher has to make a wise decision on this.

In the dry season there might be only cows, bulls and replacement stock. If so, then bulls, after an intensive service period, should be given the best pasture. If calves are sold at a later stage, they can be grazed together with

the bulls until then. In this period the heifers, either separated into age groups or together with the cows, will have to make do with the second best pasture.

7.6 A full ranch

On a ranch with breeding animals, and young growing and fattening stock, the different pastures should be allotted to the different categories. In the dry season there will be the following herds: cows (some with calves), bulls, calves, young stock (both male and female). In the rainy season there are: cows with calves and bulls, fattening stock and growers.

In the wet season the best pasture should be used for the fattening stock, so they grow fast and can be sold early and these pastures can then be used for other herds. The second best pastures should be used for the young growing animals, preferably letting males and females graze separately. Thus the remaining pastures are for the cows with calves and bulls.

In the dry season the best pastures should be grazed by the calves. This can be done once the calves are weaned and, if need be, the calves' diet can be supplemented. A 'creep gate', which a calf can get through but not bigger animals, can be used to allow calves access to better pasture while still suckling. In many cases, the bulls that have just finished their breeding duties are grazed together with the calves. This means the calves have 'lead' animals around and they can continue their development, and bulls have an opportunity to restore their condition. The second best pasture is for the young and growing animals. The farmer needs to choose whether to give priority to the males or females, based on experience and market strategy.

A further differentiation can be made within this group, between 1-2 year-olds and 2-3 year-old growers, and pasture can be divided according to preference. The remaining pastures are for the cows, often without calves. Preferably they should be able to build up some condition for the end of the dry season, their pregnancy and early calving.

Any choice may raise questions about how applicable and how practical those choices are, but the choices are usually straightforward. The bulls, whether altogether or not, combined with the calves, make up a relatively small part of the whole operation. They will therefore manage on a relatively small field of good pasture, while the other groups/herds are bigger and have much greater feed demands. You have to weigh up one against the other, but the choices should be clear.

The following examples of different ways of going about cattle management are taken from real situations.

A good practice

On a large ranch in a region with low rainfall (an average of about 275 mm per 3 months), the rancher weaned 88 calves from 100 cows that had been serviced by the bull. He tried to get the cows to calve down about one month before the rains, so that both the cows and the calves would be able to benefit from the good pasture that would become available in the rainy season. He created small fields to try to reduce the green grass losses, and when the calves reached about 8 weeks he changed them from permanent to restricted suckling. About 2.5 to 3 weeks later the cows started cycling again, and once the bulls were 'warmed-up' the cows started getting pregnant again. As soon as nearly all cows were cycling, he gave the calves full access to suckling again. Nearly all cows conceived at the first or second service. The calves' diet was supplemented during their restricted suckling period, with some legume hay and when necessary with concentrates. The calves were weaned at the end of the rainy season, so the cows' condition could improve before the good pasture was finished. During the long dry period that followed, the cows did have a large tract of land available, mostly with 'standing hay' (hay left standing in the pasture for cattle to graze) and they maintained weight and condition reasonably well. Minerals and salt (separate) were always available, as was drinking water. The farmer used a few very good quality pastures for the calves and supplemented their

diet too until the next rainy season. His results can be described as excellent. But there is also another side to this very strictly planned and managed system. On one occasion the rains failed altogether and another time there was very little rain. When this happened the farmer went out into the field and shot all the calves. It sounds awful, but he explained why it was necessary in his opinion: "The cows are my means of production and the calves are the products. I would rather lose the calves than the cows, and next season I will try again, and the cows will produce new calves."

A common practice

On a moderately large ranch, the herd was split up into 10 units of a good number of cows each, which were more or less managed as separate units. The ranch was located in a mountainous area with fairly poor soil, where there was moderate rainfall and a dry period of about three months. There were bulls constantly available in each herd, so calves were born all through the year in all herds. The calving percentage was around 65 %, with a little variation between herds. This kind of set-up is very difficult to manage efficiently. The farmer had to identify calves each month during the second dipping of that month, and older calves were castrated and branded. Moreover, he had no more or less homogeneous groups of animals for sale. The labour demand on this ranch was very high. So a changeover was proposed: group together all the cows that calve down in one month and manage these herds as units with a restricted breeding period. This reduced the whole labour requirement considerably, and more or less homogenous groups of calves could be efficiently managed for all purposes: weaning, branding, dehorning, castration or fattening. Restricted suckling to stimulate the cows to restart cycling became effective, and as a result the calving and weaning percentages increased considerably without any other inputs. Weaned calves could be managed better, resulting in more weight gain. Moreover, the work was much easier and the

rancher was able to pay more attention to detailed management of the staff, the herd and the ranch. This led to increased income and more pleasure in their work for the whole staff.

These two examples give a very different picture, but both show that a well-planned and well-managed system produces very good results and often at little or no cost. Once the farmer had a clear picture of what he wanted, it was not difficult to pursue a strategy. People very often stick to old routines, while there are better and more efficient systems available. The changeover in the second example was relatively simple: easy to execute and very effective. The rancher said he ‘had never thought about it before’, but after that he played around with other inputs to try to increase his production. If you can’t come up with a solution, consult extension staff or a successful colleague or neighbour.

7.7 Minerals

Care should be taken to supply salt and minerals to the animals, especially during the growing season. Minerals and salt can best be supplied separately in different containers or troughs, with a simple roof to prevent rainwater from entering. When salt and minerals are mixed, which is often the case with ready-mixed licks sold by suppliers, animals are forced to eat what is available. If an animal likes salt, it is forced to also consume minerals and if the animal wants minerals, it has to take salt as well. So consumption goes up, but this does not necessarily benefit the animal, although it certainly benefits the suppliers who sell these mixtures.

While the mineral need of various categories of animals is well known, the amount of minerals supplied by pasture is usually not known, nor are the amounts that are absorbed by the body known. The most common minerals, besides salt, are calcium and phosphorus, and there is also a whole range of minerals that the body requires in very, very small quantities: trace elements. They all are essential for proper functioning of the life processes. When an animal faces a shortage of minerals it will first deplete its body

reserves. A lack of minerals will lead to decreasing appetite, reduced fertility, a dull coat and poor growth. When minerals are introduced for the first time, care should be taken to avoid overeating, so introduce them gradually.

Table 3: Characteristics of a 'good' free choice cattle mineral supplement

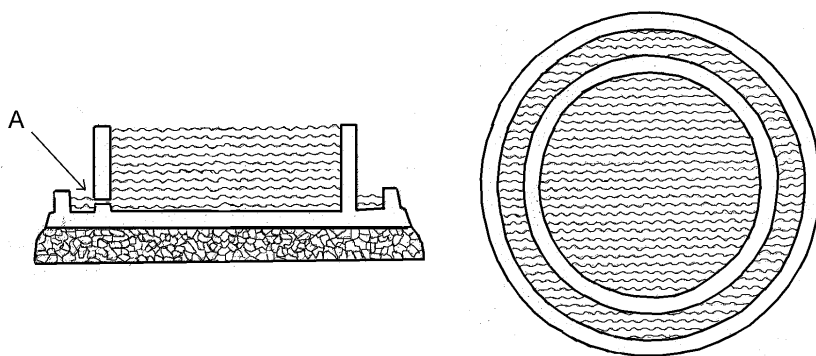
An acceptable cattle mineral supplement should be as follows:

1. Final mixture containing a minimum of 6-8% total P. In areas where the P content of forage is consistently lower than 0.20%, it is advisable to give the animals mineral supplements with 8-10% P.
2. Calcium to phosphorus (Ca:P) ratio, not substantially bigger than 2:1
3. Provide a significant proportion (e.g. 50%) of the trace mineral requirements for cobalt (Co), copper (Cu), iodine (I), manganese (Mn) and zinc (Zn). In regions where trace minerals are known to be deficient, 100% of specific trace minerals should be provided.
4. Composed of high quality mineral salts that provide the biologically available forms of each mineral element. Avoid mineral salts containing toxic elements (e.g. phosphates containing high fluoride (F) concentrations).
5. Formulated to be sufficiently palatable, so that animals consume adequate amounts in relation to requirement.
6. Backed by a reputable manufacturer with quality control guarantees, such as accurate labelling.
7. An acceptable particle size, so that adequate mixing can take place, otherwise the smaller particles settle to the bottom and the animals do not get the right balance of minerals. (Source: McDowell et al.)

The mineral content of the pasture depends very much on the type of soil and its mineral content. Moreover, the variety of plants also makes a big difference; grass has a different mineral content compared to legumes and there are variations within their respective varieties. Minerals based on the known local conditions are the most suitable to be used. Do not put the mineral containers close to the watering point, as this may encourage over consumption, particularly if the pasture is poor. Mineral containers can also be a useful element in a kind of rotational grazing.

7.8 Water

Animals must always have a supply of drinking water available, so they can drink whenever they like. However, there are a few points to consider. If you make the water tank or trough deep, say dug half to one metre into the ground, the water will be cooler. A roof or shade above the trough will also keep the water cool. Cooler water alleviates heat stress under very hot conditions; drinking water cools down the rumen and the animal loses some heat when it urinates.



*Figure 14: Example of a good watering trough: cross-section (left) and top view.
(A = water inlet with mechanical float system)*

Care should be taken to avoid a muddy pool developing around the trough, because this is a good breeding ground for parasites and liver flukes. The same may happen with a natural water supply from a stream or dam. Wherever animals drink, they trample, and create mud and all the problems associated with this. Therefore it is preferable to construct a concrete slab around the trough and/or a good draining system to take away the spilled water, or make a sloping bank of stones along a stream.

Another point is the capacity of the trough. Cows can drink up to a hundred litres of water a day (or more), depending on temperature and the moisture of the feed. A trough should be big enough for all animals to be able to drink at once and in a relatively short time. If the capacity is not big

enough, then the younger and lower status animals will drink after the others. If the herd starts to move again, these animals may not get enough to drink, as they are likely to move on with the herd. Watering points should not be more than 5 km apart.

In large fields with only one watering point, in the first zone of about 1 km around it the soil is bare, the second zone is heavily overgrazed and is infested with weeds, zone 3 is overgrazed and has weeds and some grass, zone 4 is grazed and zone 5, more than 4-5 km from the watering point, is hardly grazed at all. Zone 5 may be regarded as a reserve for the dry season, but then animals have to walk large distances to drink. In such cases it helps to create more watering points to maintain the pasture and prevent heavy weed infestation. Such watering points can also be used for a kind of rotational grazing, by opening or closing one or more of the watering points.

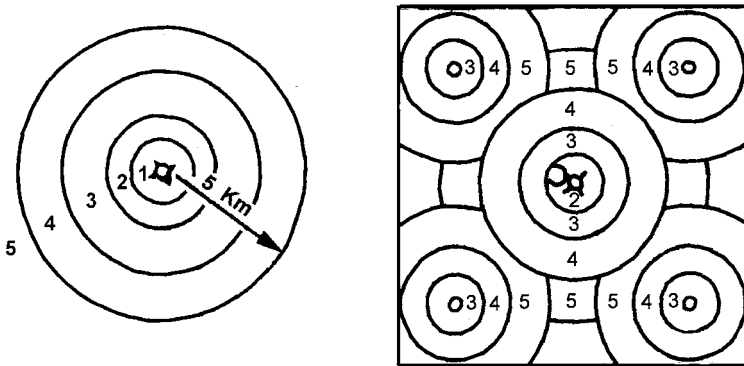


Figure 15: Grazing zones where there are one or more watering points

8 Grassland and grazing

Most of the grassland areas in the tropics that are used for beef production are found on poor or low quality soils. They also tend to be in areas with strong seasonal variations in climate, which are often unpredictable. Under natural conditions the soil is not fully covered with grass, and bare patches can often be seen, particularly when the land is overgrazed. Most of the plant species found under these conditions are only palatable and nutritious for a short period during the wet season. Soon after they dry out and are left as low quality ‘standing hay’, which only supplies minimal nutrients for maintenance.

Large-scale improvement to grassland is often not economic. In certain areas good results have been obtained by oversowing with adaptable legumes. In other areas the legume seed is fed to the cows; they then distribute this via their manure, which gives the seed a good start for germination. The inclusion of legumes improves the nutritive value of the available feed, specifically in terms of protein and minerals in the dry season. Moreover, legumes root much deeper so stay green longer and grow for longer too; they also take up more minerals from the deeper soil.

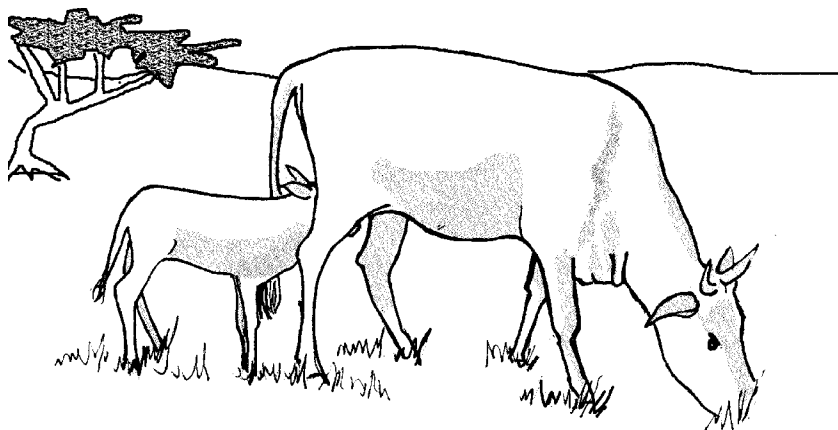


Figure 16: Grazing cow with calf

8.1 Management practices

Management of extensive pastures has the following aims:

- To provide, as far as possible, a uniform and year-round supply of herbage for a maximum number of stock.
- To utilise the herbage at a stage where nutrient quality is good and yield is high.
- To maintain the pasture in its most productive condition by encouraging its best species and by promoting as full a ground cover as possible. This will protect the soil from insolation and the beating action of rainfall, thus preventing run-off and erosion.

When evolving management methods to achieve these aims, consider the following factors:

- the influence of seasonal growth and grazing on the maintenance of the sward
- the variation in composition and feeding value of the herbage according to the stage of growth
- the value of certain trees and shrubs as browse plants
- the need to control growth of bush vegetation

The long-term productivity of grassland is important. If grazing is too early, too heavy or too frequent it can lead to a reduction in yield and vigour of the pasture, and death of some of the plants, resulting in bare patches and invasion by weeds. This is because, after being grazed or burned, plants cannot build up sufficient reserves in their root system to facilitate vigorous growth. The best is to not graze all fields in the same year, but to allow one or several fields to rest and flower, so they can also spread their seed.

There is the permanent threat of bush encroachment, which will reduce the carrying capacity of the land. This requires permanent attention and a lot of labour. Under some conditions, it may be worth considering planting fodder trees, e.g. along fences. Such trees can provide valuable nutritious leaves, especially in the dry season. But it might not be easy to get these trees established. Species like *Gliricidia*, *Leucaena*, *Acacia*, *Sesbania* and *Erythrina*, once established, provide shade and high protein feed, which makes the total ration more digestible.

Early field observation and research has shown that cattle (and goats and, to a lesser extent, sheep) eat many local species of trees and shrubs. It is well known that, in Africa, herdsman lop off branches of trees to use as feed for their animals. In certain parts about one hundred species have been identified as being eaten by goats, and cattle eat 75 of these. Similar experiences have been reported in Asia and Central and Latin America. Local experience and consultation with research and extension agencies may give valuable answers.

8.2 Burning

In some regions pasture is burned for bush and weed control, as well as to reduce the old and dry grass vegetation. Burning can also reduce the external parasite load considerably. However, burning requires experience and careful planning to avoid unwanted damage, to other fields, fences, etc. If grasses are to be burned, wait until they have shed their seed, for, after burning and during the next rains, this will help improve the pasture. Another point to consider is the timing in relation to the rain. If pastures

are burned early then the grass will put out new shoots of grass. Nomadic herdsman are well aware of this, as it helps them through the dry season. However, when plants are burned too early and start pushing out shoots again, the energy and nitrogen reserves in the root system become depleted, so when the rain comes these species have little or no reserves to start vigorous growth. This is a serious threat to the quality of the pasture, as the poorer species will gain and the better ones lose out. Burning also causes more bare patches, which increases the impact of rain and may lead to erosion, first sheet erosion and later on gully erosion. The biggest challenge remains to maintain a reasonable level of organic material in the soil, and frequent burning will reduce this as well. While burning is and will remain a useful management tool, it should be used carefully and at the right time, and be done by experienced people.

The best way to burn a field is when there is a good stand of old and dry grass. This is often the case when the pasture has been grazed until the middle of the rain season and after that is left to grow, set and shed seed. This kind of pasture can be burned just before the rain comes, preferably against the wind direction, so that the fire burns slower and hotter, that way killing shrubs and weeds. One way to control the fire is to then, towards the end of the burn, start a fire that goes with the wind direction, so the two fires meet and kill each other. This is a good management tool, but has disadvantages and risks.

8.3 Permanent or rotational grazing

Both rotational and permanent grazing have advantages and disadvantages. It all depends on the location, the size and type of the ranch, its infrastructure in terms of tracks and fences, and the management strategy. If the ranch gets partly flooded every year, as happens for example in the Orinoco delta and the Amazon region, then a kind of natural 'rotational' grazing system will develop. In regions that are heavily infested with ticks, rotational grazing is recommended. On the other hand, in (very) dry areas, where large tracts of land are available per animal, permanent grazing is

possible and suitable. So there is no one strategy that works for all or most systems.

Where there is stratified herd management and good fencing, rotational grazing is very advisable, especially if the needs of the various age groups and sub-herds can be managed adequately. In a very extensive system, where the animals are mustered or rounded-up only once or twice a year, permanent grazing of the fields is the most effective strategy. But regardless of the system, care should be taken to avoid overgrazing and causing bare soil, e.g. by placing salt and mineral licks at strategic locations and changing these regularly. The health and strength of the system depends on the grass cover and the way animals use this.

Where fields are very large it is possible to apply a kind of rotational grazing by using minimal fences. A watering point is located in a position where there is access from all sides. A fence with gates is constructed in a circle at a distance from the watering point. From this surrounding fence, four other fences are constructed to form a kind of cross, each extending about 1.5 km (about 1 mile) in each direction. This creates four blocks, only one of which gives access to the watering point at any time.

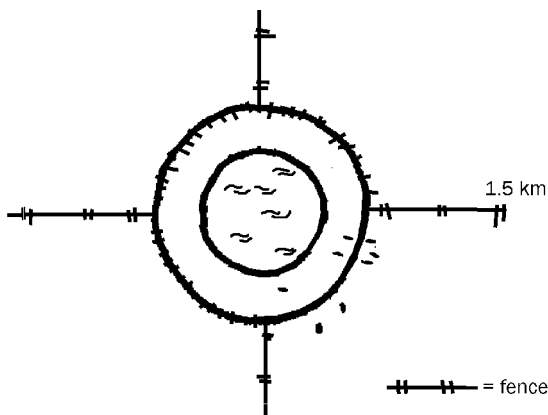


Figure 17: Rotational grazing by using fences

If the mineral and salt troughs are strategically placed, almost all animals will remain in the one block. If you want them to move to another block, close the access to the water and move the herd and let them follow the mineral troughs. Make sure that the gate to the water is open at the new block. The older and leading cows very quickly catch on to how this works, and effective rotation can be managed without much investment or labour.

8.4 Drought management

When a serious drought, which is longer and more severe than a normal dry period, occurs, it is of vital importance to take early and adequate decisions on possible relief measures and their priority. The success of a drought control programme depends upon the standard of the ranch and the management of the herd both before and during the drought. The following measures may be important:

- weaning of calves from the cows
- reduction of number of animals
- herd segregation to enable adequate treatment for the different risk categories
- utilisation of the available feed in the field(s)
- attention to water supply
- parasites and health control
- predator control
- deciding on breeding programme
- supplementary feeding

During a serious drought, the calves can be weaned very early from their dams so as to increase the survival chances of the cows. Calves weaned early or very early require special attention and special feed. If this is not available or is too much trouble, they are sometimes slaughtered.

The carrying capacity of the farm during the drought has to be estimated, and how many animals can survive on the available feed. The other animals should either be sold, or grazed on contract on other ranches that are not

affected by drought. The earlier this is done the better the survival chances of the remaining breeding animals.

The list below is of groups of animals in decreasing order of susceptibility to drought conditions:

- early weaned calves younger than 5 months
- cows in advanced pregnancy or newly calved. Aged cows and first-calf cows are especially vulnerable during the 3 months prior to and after calving
- weaners 6-12 months old
- non-lactating pregnant cows
- bulls
- yearlings aged 12-18 months
- non-pregnant cows and heifers
- steers over 18 months and bullocks

Basically the breeding cows and bulls are the means of production and all other animals, except the replacement stock, are the products. These 'products', including early culled animals, can be sold to reduce the pressure on feed and give the remaining animals a better chance of survival. The breeding animals form the farmer's basis for starting again after the drought, from which to rebuild the herd and get back to a normal production cycle. There are all kinds of reasons for deviating from the main rule, but decisions have to be taken for the continuation of the ranch.

While artificial milk replacer might be available for young calves, cheap concentrates for specific classes for stock, or hay or agricultural by-products as a supplement, it is more important to make strategic decisions concerning the long-term prospects of the farm.

Herd segregation requires a lot of internal fences, to keep the sub-herds apart and provide allotted pastures. Cows and young stock often respect these fences, but bulls may damage or destroy them, so the fences should be sturdy and firm. Once the fences are in place, the herd can be divided into

sub-herds, each of which can be given special, suitable treatment. Heavily pregnant cows and heifers can be given what they need, as can young (early weaned) calves. Strategically placing mineral sources in the fields can help create more efficient grazing and better use of scarce resources. Do not place a salt-lick too close to the watering points, as some animals may become salt junkies; they will continue to lick salt and drink and graze (very) little.

Care should be taken to supply sufficient water to the animals, especially if the natural sources dry up. If they do dry up, close them down, so as to avoid a muddy mess and animals getting stuck. Where there is an underground water supply, the salt and mineral content of the water should be watched carefully, as the concentrations may increase due to the drought. Remember that animals may go a few days without feed, but can die after a day without water, especially if temperatures are high.

During a drought the animals are weaker than normal and may fall victim to local predator animals or wild or stray dogs. If there are predators nearby, well-planted bait should be set out or traps set, and the rancher must be watchful.

The normal breeding programme should be considered carefully, and also that it may need to be totally cancelled for the season. The survival of the breeding stock is vital to the future of the ranch. If breeding is cancelled, a whole year's calf crop will be foregone, but hopefully the 'means of production' will survive.

8.5 Supplementary feeding

Supplementary feeding is often one of the first things we think about, but other factors should also be considered and weighed up against whether to do supplementary feeding. These include the long-term weather forecast, early weaning, early culling and sale. We can also think about the supply of urea-molasses mixture, extra purchased roughage and concentrates. A cost-benefit analysis should be made for all of these options. Moreover, the

labour consequences should also be considered: can we manage to carry out these plans and how?

One of the options, for selected groups of animals, may be the supply of urea-molasses. This 'protein' source can help animals to better utilise the low-quality feed that is available.



Figure 18: Urea-molasses lick

When animals receive roughage as a supplement, it is better to feed this to them twice a week. This will encourage the animals to search for feed themselves on the other days. Make sure that supplementation starts in time, for once the animals get weak they will have already lost much weight, and supplementation will only help a little. When animals are still strong they will benefit more from (even a little) supplementation and will be more aggressive in searching for other feed.

In many places there are trees and shrubs that cattle find palatable. Animals are often not used to this form of feed, but leaves and pods may be valuable in such periods. Chopping some down or lopping off branches may help them to look for themselves and to browse these shrubs and trees, which can certainly relieve some of the feed shortage. Most shrubs have a higher protein content in their leaves and sometimes in their seedpods, and this may help to digest the other sources of roughage better.

After a period of drought, special care should be taken to avoid 'green grass losses' (see Chapter 7.1). The animals are weak and too much consumption of nutritious young sprouts of grass may cause heavy diarrhoea in already weak animals. This may cause more casualties, so it is highly recommended to continue feeding, or introduce supplements like hay or straw, for at least the first two weeks into the rains or as the grass starts to regrow. At any rate, try to avoid sudden changes in the feed or the diet of the animals.

8.6 Feed trial

A trial carried out near Darwin, in tropical northern Australia, investigated the level of feed at which cattle would survive. When given feed daily, the animals survived when fed close to 90 % of the maintenance requirement. When fed every 2 days, the ration could be reduced to just below 80 %. When fed the total ration once every 3 days, it could almost be reduced to nearly 70 %. In such cases the animals looked very ugly and poor, but they survived. On the feeding day the animals were active: eating, drinking, ruminating and roaming around. On the second day they did ruminate and drink, but lay down most of the time. On the third day the animals hardly showed any activity, except for drinking. This trial was carried out with animals in a yard, so not applicable to large herds in the field, but it shows that feeding at regular intervals may help them to survive. Once these animals were put back to graze, initially very gradually, they all recovered, resumed regular cycling and became pregnant. In mature animals this strategy can work, but in young and growing stock this will cause permanent damage to the internal organs and is not a solution.

In some cases, ranchers may have the opportunity to move part of or their entire herd to other regions where there is still pasture available. The rancher will have to pay a fee for the use of these grazing 'rights', on top of the cost of transport. So here economic considerations have to be made: does it pay to, for example, buy hay or other supplements, sell early and immature animals, graze elsewhere or carry out whatever other options there are to keep the animals alive and survive the drought? Careful consideration of all the options will give the best solution.

In some countries, such as Australia, when a severe drought is expected, as happens when El Niño or La Niña occur, the ranchers can sell their surplus animals prematurely for slaughter. The beef is then deep frozen and stored for later consumption, thus avoiding great losses for the producers. This requires special investments: for paying the ranchers and building the infrastructure. Many countries do not have these kinds of facilities and may not have the resources to develop them.

9 Health

The health situation of animals varies enormously according to the ecological zone they are in, so it is impossible to describe a general approach in this small booklet. Here we point out a few important health aspects, particularly in relation to how animals are managed. One of the most important factors is to maintain the animal's immunity and so management should be geared to strengthening this immunity. Avoiding or reducing stress and ensuring adequate feed will greatly help to maintain an animal's immunity.

How health care is managed also depends on the size of the holding and herd or herds. Animals kept in small units are often handled frequently, so farmers can observe them closely and care is easy. In medium or large operations the animals are not handled frequently and observation is often done from a distance, e.g. from horseback or motorbike. In these situations, handling a sick animal is more difficult, so the emphasis will be more on adopting a good herd health approach, rather than focusing on an individual animal.

In an area where tsetse flies are prevalent, e.g. western Africa, the emphasis is on animals' tolerance to Trypanosomiasis (sleeping sickness, the disease that the flies carry) and taking specific measures at specific times. If animals are kept in a tick infested area, then the question is: what kinds of ticks are there? Based on the answer, a suitable dipping or spraying regime can be applied.

The same approach can be used for internal parasites, where different strategies can be used for the various age groups. For example, fencing off swampy areas will reduce liver-fluke infection, but still it might be necessary to treat young animals as well, to avoid internal damage.

Individual treatment of sick or injured animals can only be done on small and medium-scale holdings, and the farmer or a trained herdsman should be in the position to handle such cases. To be able to do so, handling facilities (see chapter 10) are often required. In all animal health activities, the farmer should take care that any residual elements from the treatment, e.g. medicine, anti-helminthics and/or acaracides, are not present in the final product, the meat of the animal. It is very important that the people who consume the meat do not consume any medicine or chemicals used to treat the animal. The farmer must ensure that enough time elapses between application of any medicine or chemical and slaughter.

The best approach is to develop a strategic animal health plan in consultation with a local, well-informed veterinary officer. The plan should include the general approach for the herd at large, with details for specific age groups on vaccination, parasite control and other related aspects (like castration), and the management approach.

10 Handling

On small-scale farms with few animals, there is no need for extensive handling facilities. The animals are often used to being handled frequently so they are easy to deal with when they need to be sprayed by hand, vaccinated or other treatment. A few firmly planted poles or a small crush will suffice.

On larger units a complete yard with all the necessary facilities is very convenient for handling the animals. These animals are not used to frequent contact with humans and might be difficult to handle. On very large ranches, animals are really wild and often scared of people. The facilities must be sturdy and well constructed to contain the animals, and the staff must be experienced in handling cattle to avoid damage or injury to both humans and animals. The height of the fences depends on the behaviour of the animals, but generally 1.8 m is advisable. Scared animals have been known to jump out of gangways even with fences as high as this, so the handlers should be aware and alert.

A yard should consist of: a collecting yard, a funnel or forcing yard, a gangway that does not allow the animals to turn, preferably with a partly raised

catwalk, a veterinary crush, a yoke to hold one animal, a dip or spray-race, a weighbridge, a loading ramp and another holding yard. The last holding yard should have a floor, preferably made of concrete, so the dip run-off can be drained back to the dip or spray-race. It is convenient to have several holding yards on larger ranches so as to enable smooth and efficient work.

The main reasons for handling animals are:

- spraying
- branding
- earmarking
- dehorning
- castration of male calves
- vaccination
- spaying of female animals
- weaning
- weighing

Ranchers almost everywhere in the world are obliged to brand their animals for ownership identification. Branding can also be used for recording. The location of the brand is important if the hide is to be used or sold after slaughter, but not so convenient for noting the brand. Good places for branding are: the lower part of the hindquarters, the front legs, the hump (if any) or the lower jaw.

Earmarking or ear notching can be used to identify an individual animal, but it is not easy to read marks or notches on animals that are not frequently handled; in such cases branding is more convenient.

Dehorning, or disbudding, is still controversial. Some people are in favour of it; others are not. There are arguments for and against dehorning future breeding animals. Some people say you take away the (defensive) weapons of the future cows. Others say dehorned animals do not cause injury or bruises. There are several ways to dehorn young animals: with a hot iron, caustic paste or by cutting them right off. Local experience and the age

of the animals are a good guide here. Care should be taken with using the caustic paste on young calves. They can rub it off against the belly skin or the udder of the dam and cause burning wounds. Sometimes the cows will lick it off and burn their tongue.

Castration is done to take away the reproductive function of male animals. Also here, local experience and preference are important. In some places bulls are preferred for slaughter and in other places steers are preferred. Bulls tend to grow faster, but the carcass contains less fat and the meat is what they call 'a littler hairier'. Beef from a steer contains more fat and is juicier, more like that of a female. It is also important to consider whether it will be possible to manage a herd of young bulls on a ranch where there are also breeding cows.

There are several ways of castrating a bull. Surgical castration involves removing the testicles completely. Care should be taken to avoid infection from insects, particularly screwworms, which can cause heavy infections. When surgically castrating bulls, particularly older animals, care should be taken to prevent the wound from bleeding, which may also happen later. A 'Burdizzo' is preferred when the risk of bleeding is high, and for many other reasons too. This is a 'bloodless' operation and, if done correctly, is safe and permanent. An elastrator is used to place an elastic band around the top of the scrotum above the testicles, which is easy and convenient to do with young calves. The testicles then wither.

In some regions ranchers spay their surplus heifers to avoid unwanted pregnancy in this group, and so they can be handled and grazed together with bulls or steers. If bulls are preferred on the market, and there are only a few surplus heifers, then spaying can be a practical solution.

Spaying is a surgical operation to remove the ovaries of a female. It sounds cruel, but experienced personnel can do it quickly, efficiently and with little trouble to the animal. In Australia a special tool has been developed,

with which an experienced person can spay up to or more than 30 animals per hour.

Cattle should be vaccinated against any currently prevalent diseases and diseases for which vaccination is obligatory. Vaccination should be carried out when appropriate, according to age and season. It is best to administer only one vaccination at a time, but for management reasons it is often easier to give several vaccinations or a cocktail at once.

Care should be taken that the vaccine is properly handled (e.g. kept cool), the equipment clean and sterile, and that the stockmen are experienced in vaccinating. A subcutaneous vaccine is often given under the skin behind the shoulder, while an intramuscular vaccine is given on the rump. To avoid injury to staff when vaccinating, it is important to be aware that the animal may react unexpectedly.

Weaning calves can either be done at a moment selected by the rancher, or the cows will wean the calves by themselves because of pregnancy or feed problems. The age at which to wean and the post-weaning management of the calves are strategic choices that the rancher needs to make. If there is special, good quality pasture available for the calves, train them to go through the yards, and introduce minerals and some supplement. The younger the calves are the more important this supplementation is, to maintain their growth and development. Remember, calves are not fully ruminant and ruminating until they are at least 10-12 months old.

In most areas weaning is done earlier or later depending on the conditions of a season. During a good season weaning will be done later, when rainfall is poor it will be done earlier. Weaning should be done at a time that allows the cows to still build up some body condition, so that they can face the coming dry season and stay pregnant. The best way to wean is to put the calves in the yard and keep the cows out, making sure the calves cannot poke their head through the fence to suckle from their dam when she is standing alongside. The cows will stay close for some time, but after

a while they will start to graze and after a few days their milk will dry up and then they will not return to the yard. In the meantime, the calves should be fed hay and supplement, and be trained and got used to lots of different types of experiences in and around the yard. It is wise to put a few yearlings with the calves as lead animals; they know the routine and the calves follow and feel more at ease. If necessary, this period is also a convenient time to give the calves anthelmintic drugs to fight gastro-intestinal parasites. Other interventions can also be made, such as vaccination, but take care to not overload the animal with different vaccines and/or stress.

A last word about handling is the avoidance of stress just before slaughter. Animals should be rested after transport. Drinking water should always be available in the yards at a slaughterhouse and, depending on the time the animals have to wait, some feed too, preferably hay. The gangway between the yard and the killing box should be such that the animal cannot turn around, and preferably cannot see what is coming next. In some slaughterhouses they used 'Judases', oxen that lead the animals toward the killing box, as this gives a better quality of meat.

A field observation

On an experimental farm there were about a thousand head of dairy and beef animals, more or less half/half. Every fortnight all these animals had to be dipped, which meant putting them through the spray-race. This normally took two days of very hard work for all the staff, and each had 2 or 3 horses available for this purpose. The dairy animals did not like it, but were reasonably easy to handle.

The beef animals, all 2-4 year-old steers, were very difficult to handle, as they were scared of men and at times dangerous. It was impossible to get down from your horse without a second person nearby. Rounding these animals up and driving them toward the yards was an enormous, troublesome and tiring job. By sheer accident we discovered that these animals would follow a lead animal, so an old and well-trained plough-ox was used as a lead animal and to move

these animals. Suddenly the work became much easier, required fewer staff and horses, and much reduced stress. The plough-ox, obeying verbal commands from a man on horseback, was moved into the herd. The ox was sent on his way and all the animals in that herd moved quietly behind him, right along the path and into the yard. It was still not easy to get the steers through the spray-race, but the rounding-up was relatively easy. Now the whole operation could be handled in one day and neither animals nor staff were exhausted at the end of the day. This semi-retired plough-ox proved his worth: the beef animals had less stress and a better growth-rate.

11 Record keeping

Recording important information helps to understand the ongoing activities and to plan for the future. On smallholdings it is easy to keep individual records on simple cow cards, writing down data on breeding, service, vaccination, etc. This can help when deciding which animals to keep and breed, and which to sell.

On medium and larger holdings it is difficult to keep individual cow records. Even if animals are seen daily, it is almost impossible to know which is which, and whether a cow has been served. So here group records of the whole herd can be kept for vaccination, calf crop, replacement, bull(s) used, etc. This is a more general approach to gathering and keeping information on the herd. During handling or rounding-up of the herd, individual animals can be checked and information noted, for example whether a cow is wet and nursing a calf, whether she has still got a good set of teeth, etc. This is somewhat easier to do for bulls, because they are fewer in number, but on larger and extensive holdings it is still difficult.

If at all possible the following records should be kept:

- health records, including vaccination and dipping

- heat and service books
- cow cards
- bull cards
- weaner book
- grazing records
- sales: for slaughter, breeding, growing, hides
- a farm diary, to note down ongoing activities and special happenings
- last but not least: economic records

While keeping records can be quite difficult, they do provide a lot of information and will help to improve the farmer's care of the animals and the management of the farm/ranch. Much can be learned from the information collected, but if it is not used, for whatever reason, don't keep records: it's a waste of time and effort. Without records, however, little or nothing is learned from previous experiences, and there is no base for future planning.

All efforts made by a farmer, regardless of whether on a small farm or a large-scale ranch, are geared toward making an income. So economic analysis, based on all the farm/ranch information and the records, should reveal the potential income and profit. On the basis of this, a farmer can decide what part of this income should go towards the household and what part should be used for further investment in the farm, for maintaining and improving the production facilities.

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Useful addresses

DIO, Veterinary Medicine in Development Co-operation

DIO is a non-profit organisation whose objectives include giving support and advice in the field of animal health and production to individuals and organisations in developing countries: healthy animals, healthy people. A participant in the Vétérinaires sans Frontières-Europa-network, DIO specialises in answering questions in the field of veterinary medicine, through the Veterinary Information Service. DIO foundation, Yalelaan 1, 3584 CL Utrecht, The Netherlands
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FAO, Food and Agricultural Organization

Via delle Terme di Caracalla. 00153 Rome, Italy. W: www.fao.org

ILRI, International Livestock and Research Institute

ILRI works at the crossroads of livestock and poverty, bringing high-quality science and capacity building to bear on poverty reduction and sustainable development for poor livestock keepers and their communities. ILRI works in the tropical developing regions of Africa, Asia and Latin America and the Caribbean. Addresses of offices can be found on the website: www.ilri.cgiar.org

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Practical Action

Practical Action (the former Intermediate Technology Development Group, ITDG) helps people to use technology in the fight against poverty. Keywords are: practical answers to poverty, sustainable solutions

and people focused. Addresses of offices can be found on the website:
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PTC+

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Glossary

Abomasum	Fourth stomach of a ruminant, which receives feed from the omasum and passes it to the small intestine
Abortion	Premature expulsion of foetus from 40 days after conception onwards
Acaricide	Chemical product used for tick control
Ad libitum (ad lib)	'Free access to', often used in relation to drinking water, roughage and minerals
Anoestrus	A period during which an animal is not fertile, does not come into oestrus
Anti-helminthic	Anti-parasitic drug that expels parasitic worms (helminths) and other internal parasites from the body by either stunning or killing them and without causing significant damage to the host animal
Artificial breeds	Recently developed stabilised crossbred animals
Bacteria	Microscopic one-celled organisms capable of causing diseases
Bloat	Excessive gas production in the rumen; may cause death
Body composition	The relative proportion of bone, muscle, fat and organs in an animal. This will vary according to age, stage of production and season.
Browse	Eating from trees and shrubs
Brucellosis	Infectious disease causing abortion two months before expected calving
Calf crop	Number or percentage of calves produced within a herd in a given year relative to the number of cows and heifers in the breeding herd
Calve	Cow giving birth to a calf
Calving interval	The number of days between two successive calvings
Calving percentage	Calculates the percentage of full-term calves relative to the number of exposed females. Formula: (Number of Calves Born) ÷ (Number of Exposed Females) * 100

Carcass composition	Relative proportion of meat, fat and bones of a slaughtered animal
Castration	The removal of a bull's testicles to prevent breeding
Colostrum	A form of milk produced by the mammary glands of cows just before calving and for the first 2-3 days after birth. Colostrum contains antibodies to protect the new-born calf against disease.
Compensatory growth	Rapid growth after a period of reduced growth and/or feed
Contagious disease	Infectious disease that can spread easily to other animals
Conception	Becoming pregnant
Creep gate	A gate that allows only calves to get through
Crossbreeding	Mating animals of different breeds
Cryptorchidism	Condition in which one or both testicles of a bull remain in the belly cavity
Cud	Partly digested feed returned from the first stomach of ruminants to the mouth for further chewing
Culling	The removal of unwanted animals for sale
Dam	Mother of calf or calves; cow
Dormant	A very low level of activity, half asleep
Draught	Animals used for pulling heavy loads, e.g. ploughs or carts
Dressing percentage	The percentage of live weight that can be sold after slaughter
Dystocia	Difficult birth usually because foetus is in wrong position, requiring surgery by veterinarian for the calf to be born
Embryo	Unborn calf in the womb, foetus
Endometritis	Infection of the uterus
Feed intake	Amount of feed eaten by animal
Foetus	Calf growing in the womb
Forage/roughage	Bulky green or dried/conserved plant materials, e.g. grasses, hay, legumes, leaves and crop residues

Freemartin	Male and female sexual characteristics in one animal, hermaphrodite
Gestation	Pregnancy
Green grass losses	Weight loss due to the rapid changeover from old dry feed to fresh sprouts
Gut fill	Content of entire digestive system
Heat	The period during which the female cow is fertile
Heifer	Female animal up to birth of first calf, or in lactation, following first calving. After her second calving a heifer is called a cow.
Hermaphrodite	Having both male and female sexual characteristics
Hybrid vigour	Increased genetic potential due to crossbreeding
Intersex	Male and female sexual characteristics in one animal, hermaphrodite or freemartin
Legume	Plant, shrub or tree that fixes nitrogen in the soil
Luteinising hormone	Hormone that stimulates ovum development and release
Morbidity	Arrested growth due to being diseased or underfeeding
Mortality	Unwanted death of an animal
Oesophagus	The part of the digestive tract (alimentary canal) which connects the throat to the stomach
Oestrus	Heat, cow is receptive to the bull for service
Omasum	The muscular third stomach of a ruminant animal, between the reticulum and the abomasum
Ovary	Female reproductive organ that produces eggs and hormones
Ovum	Egg from the ovary, ready for fertilisation
Ovulation	Production of ovum during heat period
Ox	Adult castrated male, plural oxen
Oxytocin	Milk let-down hormone
Polled	Animals that are genetically hornless
Prepuce	Hairless moist skin that connects the sheath to the penis of a bull

Prolapse	Condition where the inner lining, e.g. of a prepuce or vagina, hangs outside
Puberty	Period during which young animals reach sexual maturity and become capable of reproduction
Regurgitate	To bring already swallowed feed up again to the mouth
Reticulum	The second stomach of a ruminant, with a honeycomb-like structure, receiving feed from the rumen and passing it to the omasum
Rumen	The first and largest of the four stomachs of a ruminant where digestion and fermentation of fibrous feed (roughage) by micro-organisms takes place
Rumination	Chewing the cud after regurgitating feed from the rumen
Scouring	Diarrhoea, watery and foul-smelling dung
Scrotum	Pouch of skin containing the testicles
Semen	The fluid produced by the male containing the male reproductive cells (sperm)
Service	When a male animal mates with a female animal
Service period	Period between first detected heat and conception
Sheath	Outer pouch that contains and supports the penis, covered with hair
Sire	Father; bull
Spay	The removal of the ovaries of young females
Spray-race	A kind of shower to treat animals against ticks
Standing hay	Grass and other herbaceous plants that dry out and are left standing in a pasture
Standing heat	Period that the female is ready to accept mating by the bull
Sterile	An animal that is unable to reproduce
Steer	Male castrated before sexual maturity
Stock	General word for farm animals, such as cattle, kept for meat or milk; livestock
Store animals	Young animals, kept over a dry period, and needing further growth

Stover	Leaves and stalks of maize, sorghum or legumes after the harvest
Stunted	Arrested growth due to disease or under feeding
Sward	Expanse of short grass
Urea-molasses	A mixture that supplies nitrogen, a protein source, and energy
Uterus	Organ in the female in which the unborn foetus develops, also called the womb
Vagina	Part of the female reproductive tract
Warming-up	Prepare the bull for active service, after a long period of non service
Weaning	End of the period of suckling or feeding milk to the calf
White heifer disease	Name of disease describing female with defective oviducts
Womb	Uterus

The Agrodok series

The AGRODOK-SERIES is a series of low-priced, practical manuals on small-scale and sustainable agriculture in the tropics. AGRODOK booklets are available in English (E), French (F), Portuguese (P), Kiswahili (K) and Spanish (S). Agrodok publications can be ordered from AGROMISA or CTA.

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