CHAPTER 7

# Management of reproduction

## Introduction

Reproduction is one of the main factors which determine the overall productivity of the goat enterprise. It is important that goat keepers are able to manage the reproduction of their goats according to their own objectives, the availability of feed, and the demands of the market. Reproduction dictates not only the rate of expansion of the flock and the number of excess stock for sale, but also the availability of milk for home consumption and sale. It should be possible for goat farmers to exert enough control to determine when their goats start breeding, how often they breed and, if required, what season they give birth.

In order to manage reproduction successfully, it is important to understand the basic physiological processes underlying it.

## 7.1 Reproduction in the goat

### 7.1.1 Female reproduction

The reproductive organs of the female goat are shown in Figure 7.1. The female's eggs (ova) are produced in the ovaries and transported into the oviducts, where fertilisation occurs. The development of the ova, and timing of their release for fertilisation, are controlled by hormones.

The ovaries are the two essential organs of reproduction in the female. The ovaries produce the ova, as well as the hormones oestrogen and progesterone. The oviducts, also known as Fallopian tubes, pass from the horns of the uterus to the ovaries, where they end in a funnel-shaped structure. These tubes carry one or more ova from the ovary down to the uterus. The uterus is lined with a mucous membrane. Once an ovum has been fertilised, the doe supplies oxygen and nutrients through this membrane to nourish the developing foetus. The vagina extends from the neck (cervix) of the uterus to the vulva, which is the external part of the reproductive tract.

Puberty is the period when the reproductive organs of a young animal become functional. In females this is the age at which

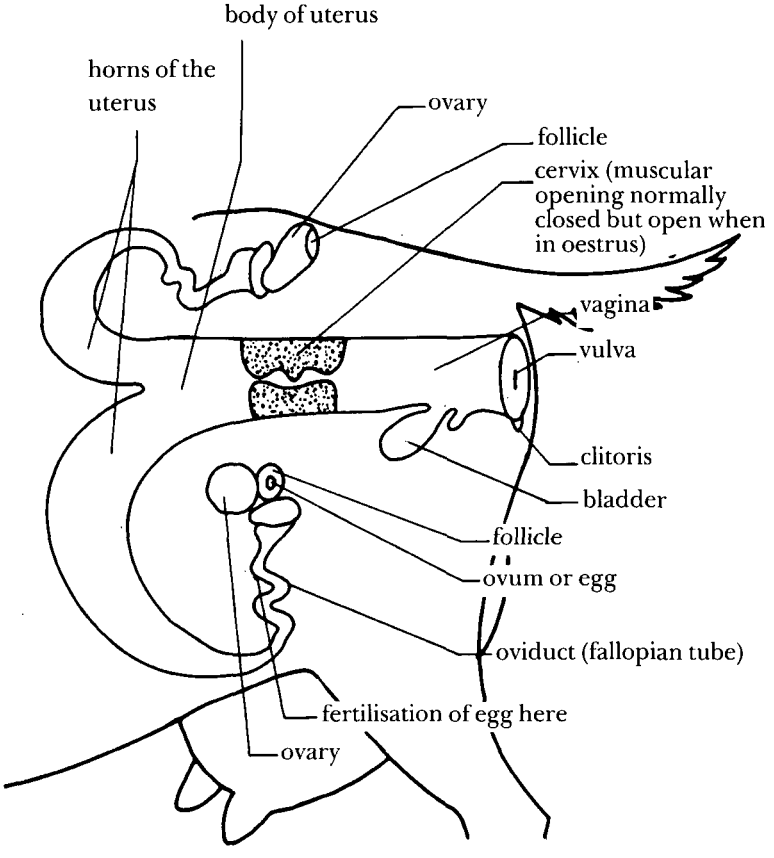



*Figure 7.1 Female reproductive organs*

oestrus is first shown and the young female will allow a male to mount and mate her. In goats this occurs at about 7 months, but may vary from 3 to 12 months. The age at which puberty occurs will vary according to breed (smaller breeds are earlier, larger breeds are later); nutrition (poor nutrition will delay it); health; and the presence/absence of a sexually mature male (the sight, sound, and smell of a male will encourage sexual maturity).

From puberty onwards, females experience repeated sexual cycles, called oestrus cycles. This cycle will normally continue, unless interrupted by pregnancy, or suppressed during the early stages of lactation (lactational anoestrus) or if the goat is poorly fed and experiences nutritional stress (nutritional anoestrus).

Oestrus cycles are regulated by hormones. In goats the cycle takes about 19 days to complete, but this may vary between 17 and 21 days. The site of the developing egg (Graafian follicle) releases oestrogen, which induces the doe to come into oestrus.

The main signs of oestrus are bleating, wagging the tail, seeking out a male (if present), standing to be mated, swelling of the vagina, and discharge of mucus from the vagina.

The oestrus cycle culminates in ovulation, when a mature egg (ovum) is released into one of the oviducts. The collapsed Graafian follicle is then known as the corpus luteum, which in the event of fertilisation and pregnancy will secrete the hormone progesterone to maintain pregnancy. The ovum remains viable in the oviduct for 10–12 hours. If the ovum is unfertilised, it will degenerate and die, passing out of the oviduct into the uterus, where it may be reabsorbed, or lost through the vagina.

In temperate areas of the northern and southern hemispheres, oestrus occurs only when the day-length decreases after the summer months. This is a natural way of ensuring that goats are mated in the autumn and give birth in the early summer, when pastures are at their best. This restricts goat farmers in temperate countries to one breeding season per year. On commercial farms, farmers have developed ways of artificially breeding outside this natural season.

In the tropics and sub-tropics, where day-length varies little, theoretically oestrus can occur throughout the year. However, in practice most farmers do encounter a period of anoestrus, triggered by nutritional stress, for example in the dry season.

In tropical breeds of goats, there is a relatively high incidence of multiple births: twins, triplets, and occasionally quadruplets. This is due to the release of more than one ovum at ovulation. Ovulation rate, the number of eggs released at ovulation, is determined by the number of follicles developing in the ovary. This, in turn, is determined partly by genetic factors, the breed of the goat, but also by the body condition and age of the doe. A well-fed mature doe is more likely to produce twins than a poorly fed doe. This has led to the practice of 'steaming up': feeding does particularly well for one to two months before mating. In this way there is a higher chance of multiple births.

### 7.1.2 Male reproduction

The reproductive organs of the male goat are shown in Figure 7.2. They consist of two testes, suspended by the spermatic cord in the scrotum. The sperm and the male hormone testosterone are both produced in the testes, which hang outside the body inside the scrotum. The location of the testes, outside the body, maintains their temperature 4–7°C lower than the rest of the body. This is important for normal sperm production. The penis is the male organ of copulation. The end of the penis (prepuce) protrudes outside the body. In order to provide extra length during copulation, the penis of the goat has an S-shaped curve behind the scrotum, enabling considerable lengthening of the penis during copulation.

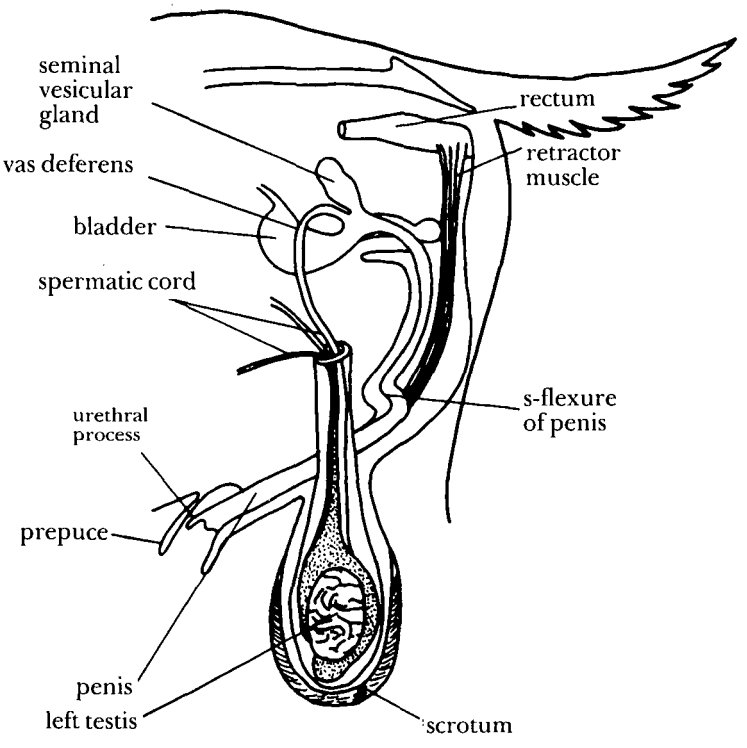



*Figure 7.2 Male reproductive organs*

Puberty is reached in male goats at about seven months of age, but successful matings have been reported from bucks as young as three months. Male kids may even show sexual behaviour, such as mounting each other, within a few days of birth.

### 7.1.3 Mating and fertilisation

The buck responds to the signs of oestrus shown by the doe. Apart from behavioural signs, odours (pheromones) are released by the doe, stimulating the buck to sexual excitement. The main signs of male sexual excitement are pursuing the doe, pawing her with the front legs, curling back of the upper lip, and usually a loud snorting sound. The doe is ready to be mated when she stands for the buck to mount her. Once oestrus has been detected, copulation takes place. At ejaculation, sperm are deposited into the vagina, from where they are transported through the uterus and into the oviducts by the muscular contractions of these organs. Sperm may be able to fertilise an ovum for 24–36 hours after ejaculation, although there is some ageing of the sperm during this period, which reduces fertility.

### 7.1.4 Age at first mating

The age at which female goats should first be mated will vary according to breed and feeding. It is important that the young female is well grown before she is expected to become pregnant and rear a kid. If she is mated too young, she herself will be stunted and it is unlikely that she will ever reach a good mature body-weight which will give her the capacity for a long and productive life. Young breeders are very likely to abort and may be unable to produce enough milk for the kid; this will lead to nutritional stress and a high probability that the kid will die. However, feeding and looking after an unproductive female is a burden for farmers.

A doe should never be mated before one year old. Ideally she would have one pair of permanent incisors, i.e. be aged about 14–17 months, before first mating. Exceptions to these rules would occur only in intensive systems, where goats have been well fed and are able to develop early.

It is best if bucks are not used for mating before one year.

### 7.1.5 Intersex goats

Occasionally intersex (or pseudo-hermaphrodite) goats are born with a mixture of male and female sexual organs. In goats the dominant gene for polledness (having no horns) is linked to the gene for intersex. If polled males mate with polled females, there will be a high chance of some of the offspring being intersex. Affected goats are genetically females, but they may show great variation in external sexual organs, from virtually male to virtually female reproductive organs. All intersexes are infertile. They may be kept for fattening, but are of no breeding value, and should be culled if feed is scarce.

## 7.2 Mating management

### 7.2.1 Detecting oestrus

If fertile males are kept continuously with fertile females, the males will detect the occurrence of oestrus and will mate repeatedly with females in oestrus. The natural detection of oestrus, and natural mating, is by far the most effective method of ensuring successful mating. It is usually when people interfere that problems arise!

If the farmer does not own or cannot borrow a breeding male and so is not able to keep one continuously with the breeding females, there are several important steps which must be taken to ensure a successful mating. Firstly, the signs of oestrus must be observed. In situations where goats are kept close to the farmer's

family, perhaps even share the owner's house, or are in a nearby house, it should be possible to notice any changes in behaviour. If the female starts bleating, wagging her tail, and perhaps riding other goats, these are sure signs of oestrus. Oestrus often starts late at night, so signs might be observed early the following morning. Once oestrus is noticed, the farmer must make arrangements for the doe to be taken to the buck, or *vice versa*. The farmer is unlikely to know the exact time at which oestrus started and so is not able to predict the time of ovulation, the optimum time for mating. Once shed, the ovum will be viable for only 10–12 hours; the sperm has a longer period of viability: 12–24 hours. To ensure a good chance of fertilisation, the sperm must overlap with the ovum when both are viable. Because the sperm has a longer period of viability than the ovum, it should be in place in the reproductive tract before ovulation takes place, so it is ready for the descending egg. The best time for mating is shown in Figure 7.3.

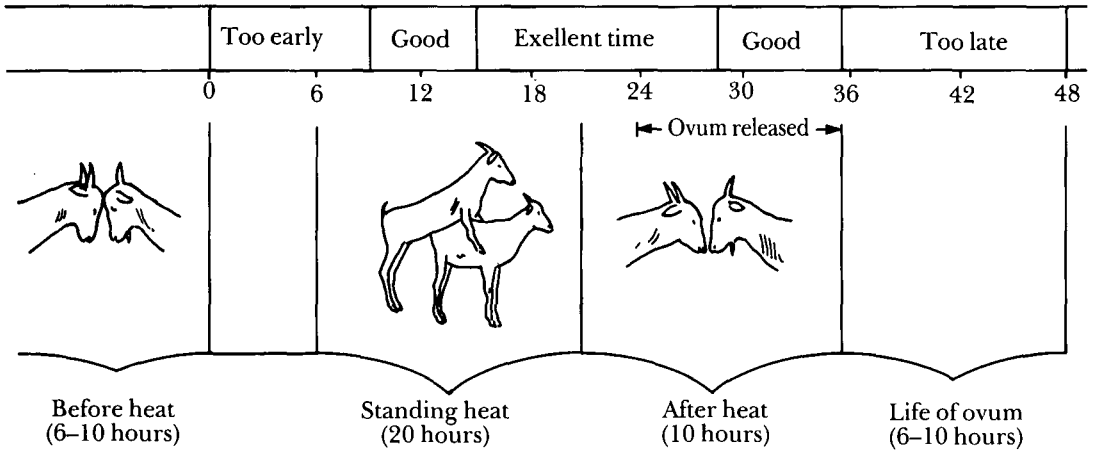



*Figure 7.3 When to mate?*

In large flocks it may be desirable that a selected buck mates with some particular does: in a breed-improvement programme, for example. It may not be easy for farmers to spot each doe in oestrus. In these circumstances, it may be useful to have what is known as a 'teaser buck'. The teaser buck is run with the flock continuously and used to detect the occurrence of oestrus. However, he is not allowed to mate. Mating may be prevented by the use of an apron, or by performing a vasectomy. A vasectomy is a surgical operation to sever the spermatic cords; it does not affect the sexual desire of the buck, but does render him infertile. In very large flocks that are not supervised when grazing, the teaser buck may be fitted with a raddle harness with a coloured block that leaves a mark on the doe during mating. This raddle

harness can also be used if fertile bucks are introduced into a flock, to show when, and by which buck, a doe is mated.

## 7.2.2 Manipulation of breeding

For various reasons, goat-keepers may want to control the time of mating. This may be in order for kids to be born at a favourable time of year when feed is plentiful, or it may be to ensure that milk is available at a certain time of year. For example, in many pastoral societies goats provide milk to their owners at the end of the dry season, when cows have dried up, but goats are able to make use of the first flush of browse growth. In more intensive systems, farmers may want to breed their goats to take advantage of seasonal changes in the price of goats, or goat products.

There are several methods to control mating and the season at which kids are born.

- **Separation of males from females**: this requires the year-round separate management of males and females, introducing males into the flock at the time desired for mating. For most farmers in the tropics, this method of breeding control is suitable only for goats that are housed for most of the year; otherwise there would be a large labour demand to look after two grazing flocks.
- **Buck apron**: the buck wears an apron made of leather, canvas, or other suitable material when it is not required for mating (Figure 7.4). This apron is either removed, or twisted round during the time of mating.
- **Buck penis string**: a string is looped at one end around the testicles and at the other around the prepuce of the buck, so that, if the buck extends his penis, it is forced to deviate to the

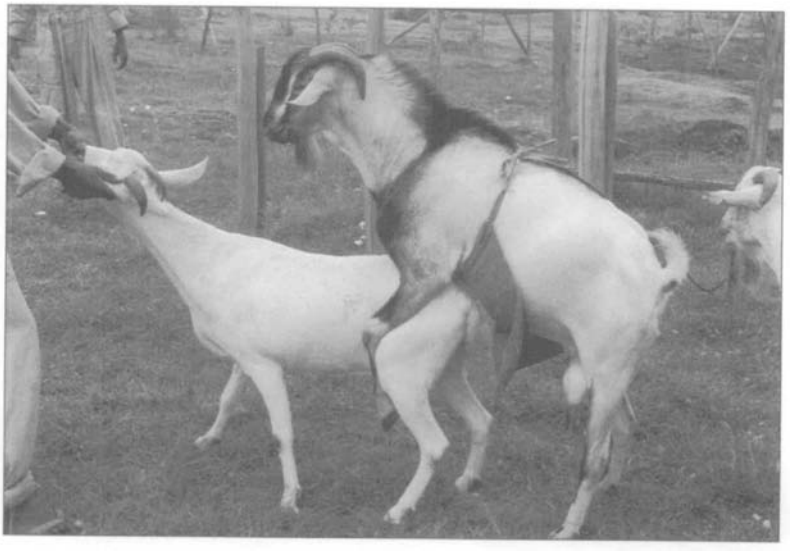


*Figure 7.4 Use of a buck apron to prevent conception*
CHRISTIE PEACOCK

*Figure 7.5*
*Top: Castration using a Burdizzo castrator*
*Bottom: A Burdizzo castrator*
CHRISTIE PEACOCK

right or left, making copulation impossible. The string must be removed for successful mating.

- **Castration**: unwanted breeding males may be made infertile by crushing their spermatic cords, using a rubber ring or a special metal pincer known as a Burdizzo castrator (Figure 7.5). Rubber rings should be used only on very young kids. The surgical removal of testicles should be carried out only by skilled people in clean conditions. There are usually traditional methods of castration, involving two pieces of wood and a hammer or stone. Because they often only partially castrate the buck, the Burdizzo castrator is the recommended method.

Castration is one method of ensuring that poor-quality males do not breed. In some countries it is also used to reduce the odour of the meat from males; it will also increase both the fat content of the final carcass and the goat's growth rates, by reducing the energy spent on sexual activity and fighting.

### 7.2.3 Planning breeding seasons

It is important to consider carefully the implications of adopting a seasonal breeding policy, and the reasons for doing so. If the reason for seasonal breeding is to take advantage of a season of good grazing for dams and kids, then you need to consider whether that season is reliable. In marginal areas, where rainfall is unreliable, aiming for the majority of kids to be born during a particular season can be risky.

In large flocks, a kidding season can place heavy demands on available labour. If many kids are born within a short time period, much labour will be needed to look after the kids at, and after, birth. This labour may not be available, because of competition with other farm work.

### 7.2.4 Artificial insemination

Artificial insemination (AI) is a procedure whereby the sperm from a male goat is collected and used to inseminate a female goat artificially. The sperm may be used fresh or can be frozen and stored for long periods. Semen may be inserted through the cervix using a speculum, or inserted into one horn of the uterus using a surgical procedure.

*Breeding control in Maasai goats*

The Maasai in Kenya try to control the season at which their sheep and goats give birth by using a leather apron. There are two rainy seasons and most flock owners try to arrange for the majority of births to occur during, or just after, the short rains in November. The owners remove the aprons at the beginning of the dry season, in June, when the goats' body condition is at its best. When a doe is observed standing to be mated, the owner holds her, slips the buck's apron round, and holds the doe while she is mated. After mating the apron is replaced. In practice, there are births all the year round, but as many as 60 per cent of births may take place in November.

The Maasai believe that, if kids are born during the short rains, their dams will have good feed and so produce ample milk for their kids. The kids are then reared during a short dry season and are naturally weaned during the long wet season, March/April. In theory this strategy makes sense and will ensure good survival rates of the kids. However, in the arid environment in which the Maasai live, the rains are notoriously unreliable. If the short rains do not occur, then the majority of the kids are born at the end of a very long dry season and their chances of survival are very poor. High mortality rates can be expected. Seasonal breeding control appears to be quite risky in semi-arid and arid environments.

The main theoretical reasons for using AI are listed below.

- It provides an opportunity for the rapid improvement of breeds by using semen from high-quality bucks which farmers could not afford to buy for themselves.
- It is one method of importing new genes, even breeds, into a country, while reducing the risk of importing diseases, and without the problems associated with handling live goats.
- It allows the use of outstanding bucks after their death.

While there are many good theoretical reasons for using AI, running a successful AI programme is not easy and requires many resources for its success. A supply of semen, skilled staff, technical equipment, and good transport and communications, as well as highly motivated farmers, are needed for a successful AI programme. If semen is to be collected 'in country', a well-equipped laboratory will be needed, together with highly trained laboratory staff. AI programmes should not be considered unless these conditions exist, or the resources are available to make these conditions exist. It may be possible to run a goat AI programme alongside a cattle AI programme, making use of the same laboratory and technicians.

### 7.2.5 Embryo transfer

The embryo transfer (ET) technique is a method of surgically introducing a fertilised embryo from a superior buck and dam into a goat of poorer genotype. The recipient goat becomes a stand-in or 'surrogate' mother to the developing embryo, eventually giving birth to the fully-developed foetus in the normal manner. ET requires highly skilled staff and sophisticated equipment. It might be successfully used under research-station conditions, but should otherwise not be considered.

### 7.2.6 Oestrus stimulation and synchronisation

In order to inseminate a batch of goats at one time, either naturally or artificially, it is possible to artificially induce oestrus to take place simultaneously in a group of does. Small sponges, impregnated with a synthetic progesterone hormone, are inserted into the vagina. They are removed 16–18 days later. The does will show signs of oestrus two–three days after the removal of the sponges. This approach may be used on research stations or large commercial farms when using AI.

Oestrus can also be stimulated by using the so-called 'buck effect'. Females which have been kept apart from bucks, out of the sight or smell of a buck, can be stimulated to come into oestrus by introducing a buck. This technique can synchronise oestrus in a batch of female goats with a fair degree of success.

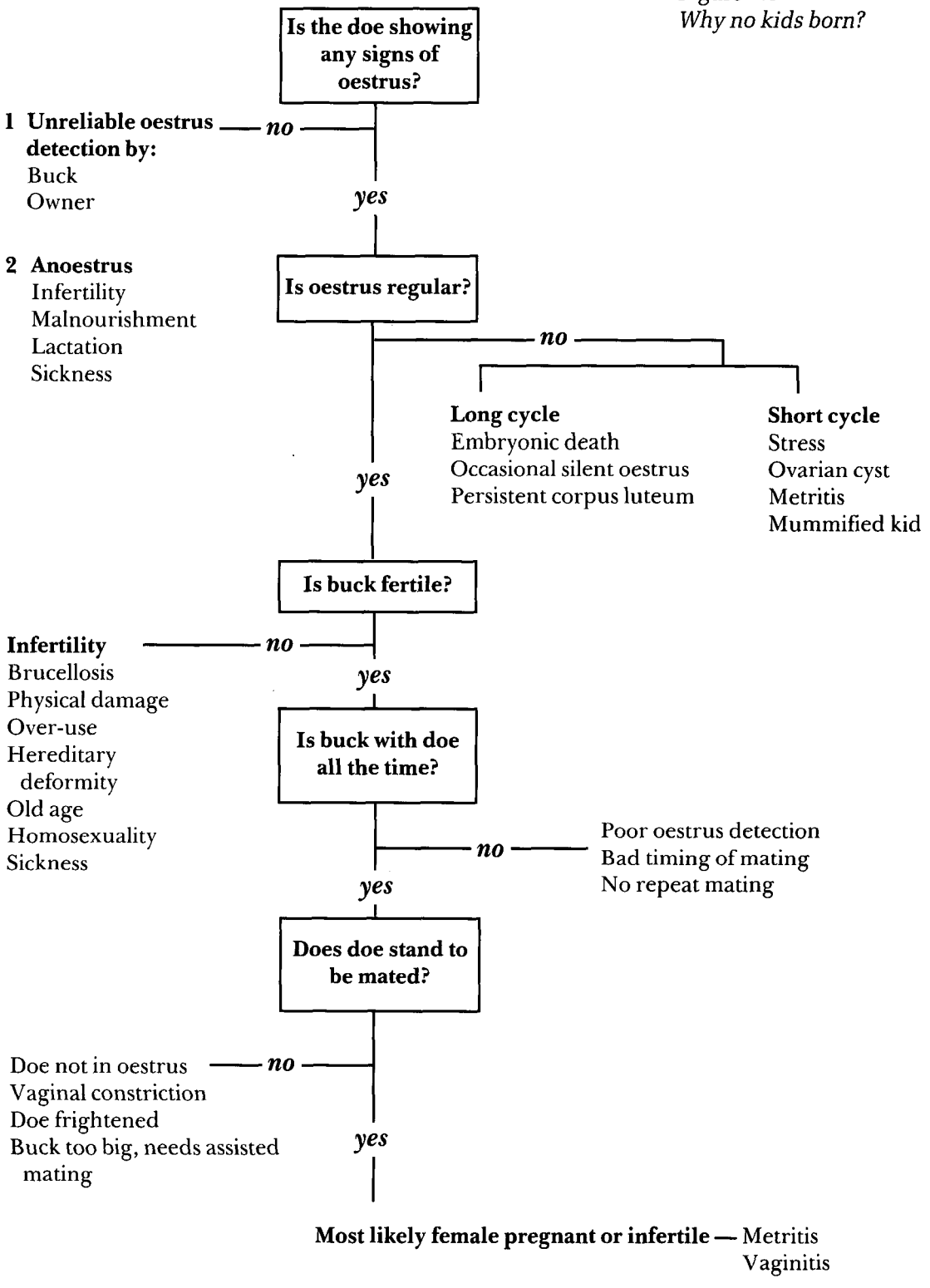
## 7.3 Reproductive problems

Reproductive problems are often difficult for a farmer or extension agent to investigate. However, it is usually possible to identify whether the problem is one of management or whether it has a physiological cause. Problems of reproduction management can be identified and normally overcome. However, if deeper physiological problems are suspected, for example difficulties of a hormonal nature, access to an appropriate laboratory, able to do hormonal assays, will be required, in order to make a definitive diagnosis. Such a facility is unlikely to be available.

Figure 7.6 sets out a series of questions that might be asked when investigating the reasons why a doe is not kidding, or why the reproductive rate of a flock is poor.

The first question to ask is: *Is the doe showing signs of oestrus?* It is important to check whether oestrus is being detected properly. In flocks where males are not run continuously with females, oestrus detection can be a problem, unless the owner is very alert.

*Figure 7.6*
*Why no kids born?*



Those most closely involved with the goats, possibly women and children, should know when the doe is in oestrus, but this should not be automatically assumed. It is necessary to check this, and also to check that the buck responds normally to females. Homosexual bucks may not do so (see below).

Females may be experiencing normal cycles, but may not show overt signs of oestrus. Any of the following factors may cause **anoestrus**.

- **Poor condition:** poor nutrition over long periods, resulting in severe weight loss (10–20 per cent of body weight), can cause the doe to stop showing sings of oestrus; this is known as 'nutritional anoestrus'.
- **Lactation**: in the early stages of lactation, does may not show signs of oestrus. This is known as 'lactational anoestrus'.
- **Sickness**: if the doe is very ill, she may not show signs of oestrus.

Alternatively the doe may not be cycling at all, owing to some infertility problems, and so is not able to show any signs of oestrus.

If the doe is showing signs of oestrus, the next question to ask is *Is oestrus regular?* Try to record when oestrus occurs. Sometimes oestrus cycles are very short (6–10 days) or very long. Long cycles may be caused by any of the following factors.

- **Embryonic death**: the death of the embryo in the uterus.
- **Anoestrus**: occasional anoestrus, possibly due to malnutrition or disease.
- **Hormonal disturbance**: a hormonal disturbance resulting in a persistent corpus luteum.

Causes of short cycles are listed below.

- **Stress**: when the doe is stressed, for example during transportation, the corpus luteum may prematurely regress, causing a short oestrus cycle, perhaps as short as seven days.
- **Ovarian cyst**: cysts on the ovary produce oestrogen, which may shorten the oestrus cycle to 3–7 days.
- **Metritis**: infection of the uterus after kidding may result in short oestrus cycles.
- **Mummified kid**: if a kid becomes mummified in the uterus, it can serve to stimulate repeated short oestrus cycles.

If oestrus is being regularly shown, but there are still problems, the next question to ask is *Is the buck proven to be fertile?* Males may be infertile for a number of reasons.

- **Brucellosis:** infection with brucellosis in males can result in orchitis (swollen testicles), which can make the buck temporarily infertile, or permanently sterile.

- **Physical damage**: any physical damage to the penis or testicles can render the buck sterile. Also lameness or other physical problems can make the buck unable to mount a female.
- **Over-use**: bucks should not be expected to serve successfully more than one or two females per day. If a buck is run with a batch of females that come into oestrus close together, he may attempt to serve them, but the sperm quality will fall with each doe served. By the third or fourth doe of the day, the buck may be effectively infertile.
- **Hereditary condition:** occasionally a buck is born with deformed reproductive organs, causing him to be sterile.
- **Age**: when bucks grow weak through age, they may no longer be able to mount and mate a doe successfully.
- **Homosexuality:** males reared exclusively with other males in the absence of females can develop homosexual behaviour patterns, and will not respond to females in oestrus.

In some systems of production the buck and doe may both be fertile, but the buck may not be kept with the doe all the time, and may even have to be borrowed from a distant neighbour. The next question to ask is *Is the buck with the doe all the time?* If the answer is no, then there may be problems either in detecting oestrus, or in mating at the correct time in relation to ovulation. If the doe has to be taken to be mated to a distant buck, it may not be possible for her to be mated twice at the recommended interval of 12 hours.

Does the doe stand to be mated? Standing to be mated is the true sign of oestrus; however, even if the doe is in oestrus (check this), she may be too small to support the weight of the buck. It is common in cross-breeding programmes for the doe and buck to need assistance at mating. The doe may have to be supported while the buck mounts, in order to achieve successful copulation.

If the answer to all the previous questions is yes, but the doe is still not breeding properly, then it is time to consider the possibility that the doe is infertile.

Females may be effectively infertile, either not showing signs of oestrus, or simply not ovulating at all, for one of the following reasons.

- **Pregnancy:** if the reproductive problem reported is a recent one, consider the possibility that the doe is currently pregnant.
- **Previous metritis:** metritis, infection of the uterus, may occur after kidding and can leave the doe infertile.
- **Hereditary condition**: hereditary deformities do occur, but are rare.
- **Age**: eventually females become too old to breed.

## 7.4 Pregnancy

### 7.4.1 Normal pregnancy

If a doe that has been mated does not show signs of oestrus (does not return to service) 17–21 days after mating, she is most probably pregnant. This is not an infallible method of diagnosing pregnancy, because the doe may experience anoestrus, or may have an unusually long oestrus cycle, for some reason. However, non-return to service is, in most cases, the only practical method of pregnancy diagnosis. In the last six weeks of gestation, the foetus can sometimes be observed moving and may be felt by firm pressure deep into the lower part of the abdomen.

The more sophisticated methods of pregnancy diagnosis, such as ultra-sonic scanning or testing milk for progesterone, have little real value to farmers in the tropics.

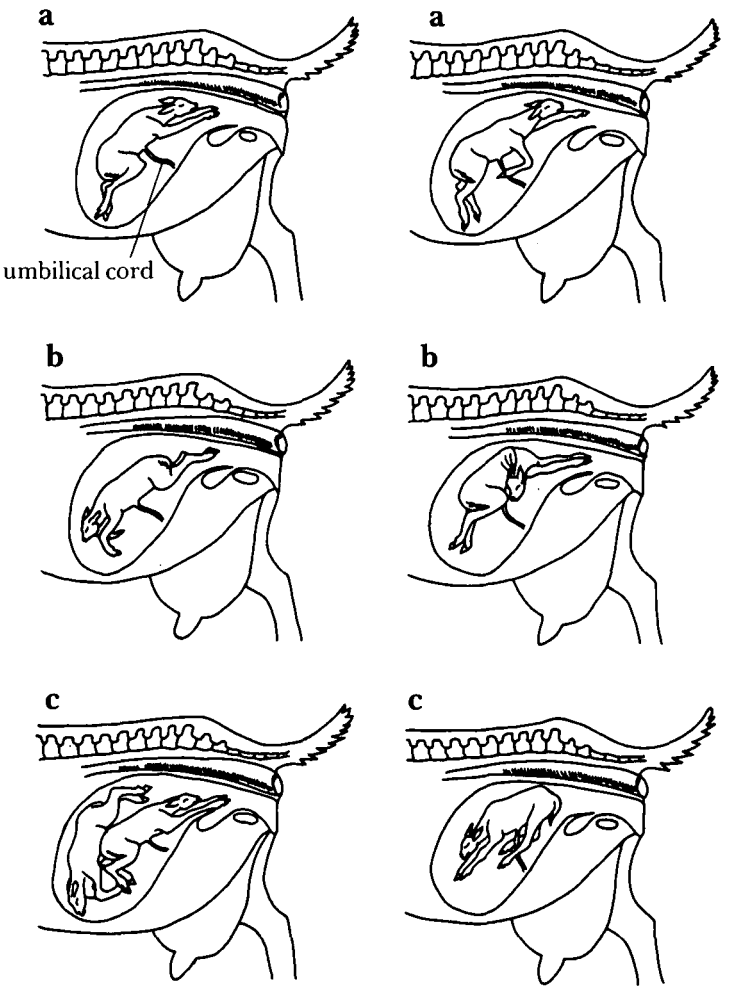
Gestation lasts about 150 days, but may be more or less than this by a few days. Once the doe is known to be pregnant, small adjustments to routine management can help to ensure that there is a successful pregnancy. Ideally the level of feed should increase during pregnancy, and the quality of the feed should be increased, as described in 5.6.1. Pregnant does should not be stressed in any way. Stress, often due to transportation or rough handling while dipping, can lead to spontaneous abortion.

### 7.4.2 Causes of abortion

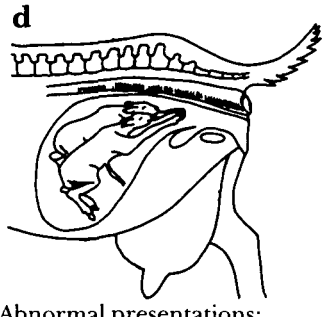
Spontaneous abortion is probably slightly more common in goats than in other domestic livestock. The most common stage of gestation for abortion to take place is at 90–115 days. Goats are more susceptible to spontaneous abortion than other domestic animals, because the foetus is dependent on the corpus luteum for the hormonal control of its development. If this is disturbed in any way, the foetus will be aborted. The main causes of abortion in goats were described in 6.3.9.

### 7.4.3 Kidding

Kidding is triggered at the end of gestation by a series of hormonal controls. Contractions of the uterus push the foetus through the relaxing cervix. The membranes around the kid remain attached to the foetus while it is being born. If kidding is prolonged for any reason, the kid can still obtain oxygen through the umbilical cord. The first signs of imminent kidding are an enlarged vulva and restless behaviour; the udder may become slightly enlarged. The vast majority of kiddings proceed normally and do not require assistance. Often they occur while the doe is out grazing. She will normally seek a quiet place, away from other




Normal presentations:
a Anterior
b Posterior
c Twins




Abnormal presentations:
a Foreleg back
b Head back
c Breech
d Twins jammed at pelvis

*Figure 7.7 Normal and abnormal presentations*

goats, lie down, and give birth. The water bag, preceding the foetus, will protrude from the vulva and burst; the kid(s) will follow soon afterwards. The herder must be alert to goats that may kid while out grazing. The new-born kid will not be able to keep up with the rest of the flock and will need to be carried home.

### 7.4.4 Difficult kidding (dystocia)

Occasionally a doe will experience difficulties while giving birth and may become so weak in the process that she needs assistance. The correct procedure is first, if possible, to wash your hands in soap and water. Ensure that the doe is lying on her side. Try to identify the parts of the kid showing at the vulva. How many feet are there? Can you feel a head or a tail? If you suspect that there may be more than one kid, be very careful. It is easy to get the kids' legs muddled up and pull a leg from one foetus with the leg of another. Feel to the top of the leg, if possible, and make sure that the legs are coming from the same body. Make sure you know which bit of which kid's anatomy you are holding before pulling. If necessary, push the kid back into the uterus and try to encourage a better position. When you do pull, pull at same time as one of the doe's contractions; work together, pulling downwards, in the same-shaped curve as the doe's back. Figure 7.7 shows the normal and abnormal ways in which kids may be presented. Always be very careful not to tear the vagina, which will result in the death of the goat.

An experienced veterinarian may be able to perform a Caesarian section, and remove the kids by surgery.

### 7.4.5 After kidding

Immediately after kidding, the doe will naturally start to lick the new-born kid clean. The stimulation of the licking is very important to revive the kid after its birth sufficiently for it to stagger to its feet and suckle. The sucking of the first milk, colostrum, is vitally important for the kid's future health. It is from its mother's colostrum that it acquires antibodies to protect it during the early period of its life. Make sure that the kid sucks milk within six hours of birth.

After checking that the kid is breathing normally, and has drunk some colostrum, it is very important that the doe and kid are left quietly together after birth, particularly for first-time kidders. It is during this period immediately after birth that the doe and kid bond together.

If the kid was born very weak, it may need some assistance to revive it. Clear the mouth and nostrils of any mucus. Swinging the

kid by its hind legs to stimulate breathing helps, and also vigorously rubbing its body and pumping the chest. Even if a kid shows few signs of life, keep trying to revive it for several minutes. Do not give up too quickly.

### 7.4.6 Problems after kidding

**Prolapse of the uterus** may occur if the doe has to strain very hard during kidding and pushes out the uterus during or after the birth. Unless there is an experienced veterinarian immediately available to sew the uterus back in place, there is nothing that can be done and the goat should be killed.

After a normal birth the placenta falls out of the vulva within three hours. However, occasionally the doe may have a **retained placenta** after kidding. Unless speedy action is taken, the cervix will close, trapping the placenta inside the uterus, where it is likely to cause a severe infection which may lead to the death of the goat. A course of antibiotics should be given.

Normally after kidding there is a reddish discharge from the vulva for up to 14 days. However, if the discharge is dark red and sticky, there may be an infection of the uterus known as **metritis**. A course of antibiotics normally results in full recovery; however, if chronic metritis develops, the doe may be rendered infertile.

## 7.5 Measures of reproductive efficiency

Reproduction is the engine of the flock, ensuring that goats are able to generate enough replacements for themselves, expand the flock, and supply excess stock for sale. The reproductive rate of both individual goats and the flock as a whole is an important determinant of the overall success of the flock. Chapter 3 described methods for gathering information about farmers' goats, including information on reproductive performance. Some data can be collected from one visit to the flock, but most aspects of reproduction need long-term monitoring studies. However, it is important that reproductive problems are spotted as early as possible and action taken to remedy the situation.

Some measurements used to assess individual reproductive performance are given below.

- The frequency with which individual does produce kids (**parturition interval**).
- The number of kids born per doe (**litter size**).
- The number of kid deaths up to weaning (**pre-weaning mortality rate**).
- The number of kid deaths after weaning (**post-weaning mortality rate**).

In addition, consideration must be given to the question of whether there are any females that are *not* reproducing.

Some measures of reproductive performance of a whole flock may express the number of kids born either from the breeding females that were actually mated or from the potential breeding females, i.e. including infertile females. These indicators may include the number of kids born per number of breeding females per year (**kidding rate**).

An index that includes an estimate of pre-weaning mortality is:

- Number of kids weaned per number of breeding females per year (**weaning rate**).

## Further reading

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CHAPTER 8

# Breeds and breed improvement

## Introduction

The aim of goat farmers is to improve the productivity of their goats in order to achieve better the purposes for which they are kept. Productivity can be improved by two approaches:

- Improving the **management** of goats, so that their genetic potential can be expressed as fully as possible. This is achieved through technical improvements such as improving the quality and quantity of feed given, reducing the incidence of disease, improving the rate at which goats breed, or any of the other technical options described in this book.
- Improving the **genetic potential** of goats by selecting the best goats for future mating (**selection within the breed**), or by introducing new genetic material (**cross-breeding with another breed**).

Although professional animal breeders may be needed to design detailed breeding plans, there are many simple improvements that extension staff can suggest, with or without the advice of animal breeders.

## 8.1 Principles of breed improvement

It is important for extension staff to understand the basic principles of how genetic changes occur within livestock populations, so that they can understand the characteristics of the tropical breeds with which they work, and help farmers to improve the genetic characteristics of their goats, when appropriate.

The genetic make-up, or genotype, of any goat is determined by the genes passed on to it by its parents, which in turn received their genes from their parents, and so on, back to the original ancestors of the goat. Genetic changes, both good and bad, within any population such as a flock, village, or district can be brought about through the mating of individuals which may occur randomly, or

through human intervention. Positive change, or breed improvement, may occur through goat-breeders' selection of superior individuals for mating. These two steps of selection and mating are the basic tools of breed improvement.

## 8.1.1 Variation

Most characteristics of production, such as milk production or growth rate, known as traits, are determined by a combination of genetic and environmental factors. A characteristic, such as the weaning weight of a kid, is determined by a combination of factors: the dam's milk production, whether the kid was born as a single or twin, and the kid's original birth weight. Each of these individual factors, in turn, is also determined by genetic factors and by environmental factors, such as feeding and disease incidence.

For any particular trait within a population there will be some variation, because goats are genetically unique, and each goat lives in its own unique environment. This variation is the raw material of breed improvement; an example is shown in Figure 8.1. The main tool that goat keepers, extension staff, and professional animal breeders use to make changes to this variation is selection. The objective of any breeding programme, whether at the level of the flock, village, or national population, is to improve the mean performance of a trait, or a number of traits, and reduce the degree of variation.

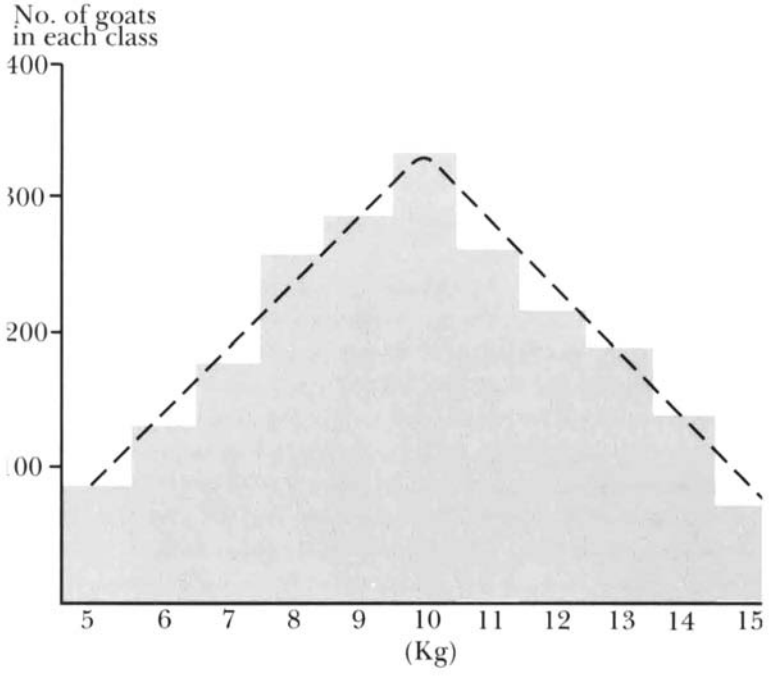



*Figure 8.1 Histogram showing variations in weaning weights*

## 8.1.2 Selection

Natural selection by the environment and selection by human goat-keepers have occurred for generations in goats. During breed improvement, the owner selects superior individuals to be the parents of the next generation, and does not select others. Individuals not selected may be removed from the population through culling; or males may simply be castrated.

## 8.1.3 Genetic progress

There are three factors which control the genetic progress made in a trait through selection.

1 **Heritability** describes the likelihood of passing on a characteristic from the parents to the offspring. If a trait has a heritability of 50 per cent, it means that it is highly heritable; and, if the parents have this trait, there is a good chance that it will be passed on to their offspring. Coat colour is a simple trait with a high heritability. Growth rate is a more complex trait than coat colour, but is quite heritable; so if parents with superior growth rates mate, there is a good chance that this superior growth will be passed on to their offspring. If heritability is low, say 10 per cent, then little parental superiority will be passed on.

*Table 8.1 Heritabilities of some characteristics in goats*

| Trait | Heritability (%) |
|---|---|
| Weaning weight | 30-50 (high) |
| Milk yield per lactation | 20-30 (medium) |
| Multiple births | 15-25 (low) |

2 **The selection differential** expresses the degree of superiority of the selected parents over the rest of their generation. If there is a great deal of variation, it is possible to select only the very best individuals for mating, and, provided that the heritability of the trait is high, the offspring will be considerably better than the average of the previous generation (Figure 8.2).
3 **The generation interval** is the time interval between generations. It affects the rate at which genetic progress can be made. Genetic progress can be made more quickly the shorter the generation interval, because selection pressure can be put on a population more often than in species with longer intervals. So faster genetic progress can be made in goats than cattle.

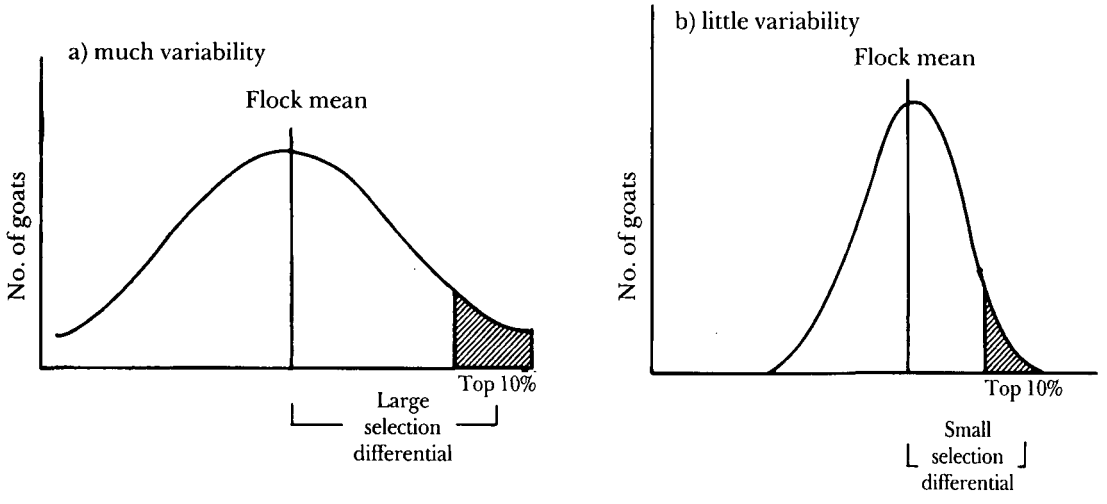



*Figure 8.2 Selection differential*

It is clear that quite rapid genetic progress, through selection, can be made in a trait with high heritability, if larger selection differentials can be applied to a population with a short generation interval.

### 8.1.4 Relationships between traits

Many traits in goats can be improved. If one trait is improved, another is often also improved; in this case the traits have a positive correlation. An example of a positive correlation is that which is found between weaning weight and weight at 12 months. Sometimes there is a negative correlation, when an improvement in one trait of production will result in a loss in another. An example of these relationships between traits might be that an increase in birth weight, increasing the kid's chances of survival after birth (positive correlation), might decrease the ease with which the kid is born, resulting in a higher incidence of dystocia and lower survival at the time of birth (negative correlation).

It is important to be aware of correlations known to occur between traits, because they can be used by breeders to plan better breeding programmes.

### 8.1.5 Identification of superior stock for selection

It is obviously important to be able to identify accurately which goats are superior for the characteristic(s) being improved. Selection by eye for body size, udder size, body shape, or other physical characteristic has been used for generations, but this method is not necessarily accurate when judging the economic traits of milk production or growth. The recording of performance is the most accurate basis for selection, but this can

often be hard to organise in the tropics. Often more than one trait is of interest, and they may be correlated in some way, so an index is constructed, incorporating all the traits of interest. Goats are then chosen according to this selection index, rather than on the basis of a single trait. For accurate selection, accurate recording of the performance of relevant goats is vital. However, the performance of goats does not depend only on genotype. There are environmental factors to consider. Factors such as management standards, season of birth and weaning, and the difference between years can all affect performance. This must be accounted for in any selection programme.

Selection of individual goats for mating can be made on the basis of the following factors.

- **Performance testing**: individuals are selected on the basis of their own performance. This is useful if the trait is highly heritable and can be measured in both sexes (growth rate, for example). Performance testing is probably the most practical approach to selection for goats in the tropics.
- **Progeny testing**: goats are selected on the basis of the performance of their own offspring. This is useful when the heritability of the trait is low, or where the trait can be measured only in one sex (milk production, for instance) or can be measured only after slaughter (carcass characteristics). To carry out a successful progeny-testing scheme, the use of Artificial Insemination (AI) (see 7.2.4) is required, in order to have a large enough number of offspring from which to record. The need for AI means that progeny testing has limited value for the improvement of goat production in most countries in the tropics.
- **Pedigree selection**: goats are selected on the basis of the performance of their parents and grandparents. This method might be used if there is no information on the performance of the goats themselves, perhaps because the trait is related to the sex of the goat or can be observed only at a later age (milk production, for example). Pedigree selection requires accurate information on the performance of the ancestors of the goats in question. This information is unlikely to exist for goats in most countries in the tropics.
- **Collateral selection**: goats are selected on the basis of the performance of their close relatives. If there are several relatives, their performance is measured, to provide information which can be a guide to indicate the performance of the individual in question. Goats are quite prolific, so the performance of all close relatives should be scrutinised, whenever possible, before selection is made.

### 8.1.6 Mating plans

After selecting the goats to be mated, the second tool of breed improvement is to decide how to mate them. There are two methods: mating within the breed (**pure-breeding**), and mating outside the breed (**cross-breeding**).

Mating goats of the same breed will not improve that breed unless one or more of the parents selected is superior, and is mated to pass on a reasonably heritable trait. The performance of goats must be accurately recorded and rigorous selection procedures followed.

Mating individuals of one breed with those of another breed possessing some desired characteristics is known as 'cross-breeding'. Cross-breeding brings new genetic variation into the goat flock and can dramatically improve the performance of goats.

### 8.1.7 Cross-breeding

Cross-breeding is one method of quite quickly improving the performance of goats in one or more traits, while retaining many of the advantages of the local breed. There are many situations in the tropics where a better goat is an intermediate type that is still adapted to the tropical environment but has the improved breed's potential for higher production. Cross-breeding should be undertaken only in situations where the levels of management have been improved sufficiently to take advantage of the cross-bred's potential. The necessity of a link between the cross-breeding programme and an extension programme to improve management is discussed in 8.4.2, where practical methods of breed improvement are described.

Genetic gains from cross-breeding come from two sources:

- A combination of the superior adaptation of the tropical breed with the better productivity of the improver breed. This effect is purely additive, adding some of the characteristics of one breed to the other.
- If the goats mated are genetically distant from each other, a phenomenon known as **heterosis** may be observed. Heterosis can be positive and negative. Positive heterosis is when the offspring, known as the $F_1$ generation, is better than the mean of its parents; this is known as **hybrid vigour**. The offspring may be known as a hybrid, or cross-bred, and can be greatly superior to the worst parent. This characteristic of heterosis can be very beneficial in animal breeding, but it can be hard to maintain, because when the offspring themselves go on to

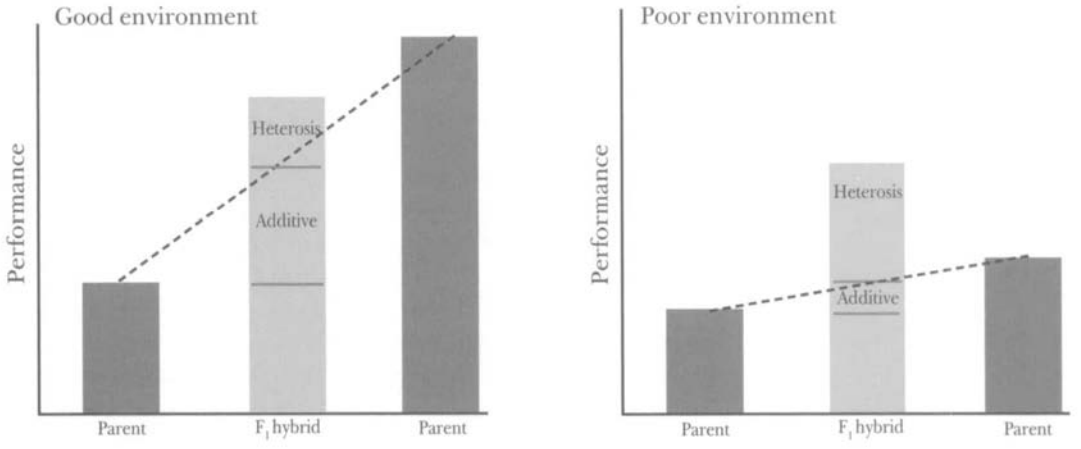



*Figure 8.3 Heterosis in good and bad environments*

mate, the genetic difference will not be so great, and some of the hybrid vigour will be lost in the next generation ($F_2$).

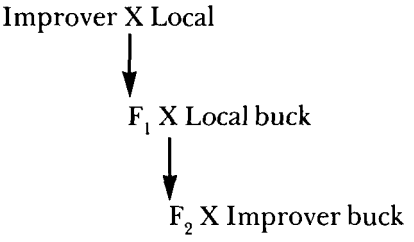
The effect of heterosis can be greater in a harsher environment than in a more favourable environment. This is because the improver breed may not perform very well in a difficult environment, indeed may be little better (or even worse!) than the local breed. However, the cross-bred often shows remarkable performance, even under stress, and may surpass both parents. This is as a result of heterosis. In a better environment, the improver breed will be able to perform closer to its potential and will be far superior to the local breed, and to the cross-bred. The cross-bred may perform little better than the mean of the two parents, indicating that heterosis is making little contribution to overall improvement, but that the additive effect is.

In any cross-breeding programme, the problem always arises of what to do after the first cross? There are two main approaches: to try to maintain high levels of heterosis, or to upgrade the local breed through repeatedly mating it with the superior breed.

High levels of heterosis can be maintained by:

- the continuous production of $F_1$ stock, known as **terminal crossing** (a very expensive and inefficient method of improving production);
- alternately mating tropical and improved breeds, known as **criss-cross mating**. The local breed is first mated with an improver breed and then mated with its own breed. At equilibrium, two thirds of the heterosis of the $F_1$ is maintained. This system is flexible, but requires access to two breeds of goats and their appropriate use.

*Figure 8.4: Criss-cross mating*




- Production of a synthetic breed. Synthetic breeds may be made through the reciprocal crossing of several breeds and the rigorous selection of the offspring. This is a complicated approach to breed improvement, which requires good management over a long period of time. Few countries in the tropics would have the resources to undertake the development of a synthetic breed and could do so only with high levels of external support.

*The Kenya Dual Purpose Goat (KDPG) Breed*

Individual farms in western Kenya are becoming too small to support a dairy cow, so a dual-purpose goat breed was proposed, to supply milk and meat to households on these small farms. The USAID-funded Small Ruminant Research Project, begun in Kenya in 1980, believed that the local Small East African breed of goat had limited potential for improvement through selection, while pure temperate breeds of goats would not survive on these farms. It was felt that a structured cross-breeding programme was not feasible for smallholder goat farmers in Kenya, so the development of a new synthetic breed of goat was proposed.

Four breeds — two temperate (Toggenburg and Anglo-Nubian) and two tropical (Small East African and Somali) — were chosen to make up the new breed. Each temperate breed was mated with each tropical breed to produce four types of $F_1$ cross-breds. Each cross-bred was then mated with each of the three other cross-breds, to produce a $F_2$ generation, having 25 per cent of their genes from each of the four breeds. These four-way crosses were then mated together to produce large numbers of this synthetic breed. Rigorous selection procedures were then applied to these four-way crosses, to produce a stable and superior breed, known as the Kenya Dual Purpose Goat (KDPG).

The development of the KDPG breed has taken over 14 years to reach the stage of producing a small number of superior KDPGs for distribution to farmers. This is a long time for farmers to wait. All breeding has been carried out on a large breeding station, and has required a high level of professional skills, as well as good flock-management. This has been very expensive to supply.

### 8.1.8 Grading up

Probably the most practical approach to cross-breeding in the tropics is to place less emphasis on maintaining levels of heterosis and to base improvements on the additive effects of one breed on another. 'Grading up' is the gradual improvement of a breed through repeated matings of the local breed with an improver sire. It is accepted that after four matings the local breed is a member of the pure improver breed. However, grading up local breeds to virtually 100 per cent improver is rarely desirable, and it is usually more appropriate to stop at some point in the up-grading process and stabilise at a suitable blood-level. This might be at 50 per cent or 75 per cent improver blood-level. Sires of the desired blood-level are used from then on. This system is simple to implement, and management can be graded up in step with the genetic improvements.

### 8.1.9 In-breeding

There are many fears associated with in-breeding, no doubt mainly because of cultural taboos in human societies against marriage between close relatives. In-breeding can become a problem in a population for two reasons: firstly, because it can throw up occasional physical deformities in offspring (an example in goats is the occurrence of an undershot jaw), and secondly (and more seriously) because 'in-breeding depression' may result in a reduction in the size, fertility, and possibly survival of each succeeding generation.

Farmers can take simple steps to prevent the build-up of in-breeding in their flock and any depression in performance from in-breeding. These are suggested in 8.3.2.

### 8.1.10 The application of bio-technology in goat breeding

Rapid developments in bio-technology in recent years have considerably expanded the range of tools available to breeders to improve livestock breeds more efficiently. It is now possible to study the individual genes of goats, describe them, and identify which parts control which characteristics. Breeders are close to being able to incorporate specific characteristics, such as disease resistance, or milk-fat content, into individual animals. This genetic engineering is still in its infancy but is, potentially, a very powerful tool.

The genetic analysis of goats can also identify the genetic distance between individuals, types, and breeds. This can help in classifying indigenous goats into breeds, or types, and can also be used to predict the degree of heterosis between two parental strains of goats.

## 8.2 Tropical goat breeds

### 8.2.1 The development of tropical goat breeds

The basic principles of genetic change and breed improvement have been described, and it is now possible to relate these principles to the tropical breeds of goats which are found in the field. A consideration of how these forces of change have acted on goat populations will help to improve our understanding of their characteristics.

The breeds of goats found in the tropics have been reared there for hundreds or thousands of years. The breeds that now exist are the result of hundreds of years of pressure by the tropical environment, through natural selection, combined with some selective breeding by owners. As a result, tropical goats are well adapted to surviving in tropical environments with high temperatures, poor-quality feeds, limited water, and a high disease challenge. The environment does not allow these goats to perform at a high level of production, and they rarely have the potential to do so. Rather, their important characteristic is the ability to survive under rigorous conditions, with sufficient production to reward the efforts of their owners.

There are several hundred different breeds of goat in the world, which all originated from the basic goat stocks domesticated in the Middle East and Central Asia over 10,000 years ago. Over the years, as goats developed, physical changes in colour, size, and shape differentiated goats into distinct breeds. Most of these breeds have developed in relative geographical isolation. New blood may have entered goat populations when human populations moved during trade, wars, and ethnic migrations, when it is likely that some cross-breeding occurred. Looking at the breeds that now exist, we can see that there are locations containing populations of goats of relative uniformity; these might be called breeds. However, the mixing of stock around the boundaries of these areas, through trade or movement, has led to many intermediate, less distinguishable, goats, which are often referred to as 'types' or 'sub-types'. Many goats are referred to as a 'non-descript type', simply because nobody has made the effort to describe and name them. In most countries in the tropics, little effort has been put into the systematic description, classification, and evaluation of goats, so the potential of most tropical goat breeds and types remains only poorly known.

Most goats in the tropics serve multi-purpose functions for their owners. There have been few breed-improvement programmes to develop them for more specialised economic functions, such as for producing milk or meat.

Although the environment has probably played the major role in developing the breeds of goat we know today, the societies that

have kept goats have their own preferences and have exerted some influence of their own. This influence can be both positive and negative. Positive selection has been reported among the Somali pastoralists who have selected for single births and against twins.

*Somali goat-breeding in East Africa*

The Somali pastoralists of East Africa, who keep large flocks of very distinctive white goats, report that they do not like their goats to twin. They select against twinning in their own flocks. When purchasing new breeding females, the first question they ask is whether it has ever had a twin birth; they will not buy it if it has. The reasoning behind this is that the Somalis live in a very harsh environment and rely on milk from their goats. If the lactating doe is trying to rear twins, there will be little milk left over for her owners, and two kids may be put at risk. If she has to look after only one kid, there is more milk for the owner and a good chance for the kid to survive. As a result of this selection policy, practised for generations, the Somali goat breed rarely gives birth to twins.

Negative selection for growth is believed to take place in flocks where males are sold or culled young — for example, among the Afar pastoralists of Ethiopia and Eritrea.

*Afar goat-breeding in Ethiopia and Eritrea*

The Afar are pastoralists who live in one of the harshest environments in the world. They keep large flocks of goats for milk, grazing the arid borders of the Danakil desert. Grazing is so scarce that they cannot afford to keep any unproductive goats. They kill most male kids, not required for breeding, within one week of birth. Breeding males, therefore, are selected when very young, when there can be no objective reason for making the selection, except on the basis of the performance of their ancestors. It is therefore likely that the best males are not always kept for breeding, and in reality some negative selection pressure may be exerted in Afar flocks.

Other pastoralists, in less harsh environments, may keep males for longer periods, but are likely to sell the fastest-growing males earlier, before they can breed and pass on their fast growth to future generations. The slower-growing males remain in the flock for longer, and therefore have a greater chance of passing on their genes.

It is clear that all past selection by goat-keepers has been at the level of the flock. There have been no cases reported of villages, or other groups, cooperating to improve the genotype of their goats.

However, in virtually all societies where goats are kept, new goats may enter the flock through purchase, loans, gifts, or even theft; thus superior individuals may have been introduced into the flock, and in the process improved it.

In very small flocks of goats (1–10), there is very little opportunity for farmers to apply any selection pressure within their own flocks. All they are able to do is to reduce the negative effects of in-breeding by the regular introduction of new stock.

It is clear that the forces of natural selection, together with the intervention of keepers who select and cross-breed their goats, have acted on goats in the past to produce the breeds which we have today. Extension staff have to start with the local breed kept by farmers in the area in which they are working. They must first understand the particular characteristics of the breed kept by the farmers with whom they work, before considering any course of breed improvement.

### 8.2.2 The characteristics of tropical breeds

Thousands of years of development, in so many different environments by different ethnic groups, have resulted in goat breeds with a wide range of characteristics.

- **Size**: goats may range from the tall, leggy, desert goats such as the Jamnapuri and Sudan desert breeds to the small West Africa Dwarf and Black Bengal goats. Size is partly related to nutrition, but genotype also plays a part.
- **Colour**: colours may range from the pure white Somali goat, through patchy coat colours, to the pure black of the Black Bengal.
- **Coat type**: most tropical goats have a short thin coat, adapted to reflecting radiation and keeping the goat cool. However, in some colder environments hairy coats have developed, as in the Kashmiri (Pashmina) goat, found in northern India, Tibet, and Mongolia.
- **Growth**: growth is generally slow, partly reflecting the poor nutrition of most goats in the tropics, but also their genotype. Nutritional studies in the tropics show a generally poor response to improved nutrition by tropical breeds of goats.
- **Milk production**: some selection by owners has taken place for milk production. Milk yields per day are generally rather low at 200–1,000 ml per day, and lactation length is short at 3–5 months. This partly reflects the environment in which the goats are reared for milking, as well as their own inherent capability.
- **Prolificity**: most tropical breeds of goat regularly give birth to twins, and triplets are not uncommon.

- **Disease resistance**: most goats manage to build up their own resistance to the common diseases of the area in which they are kept. There is great variability, both within and between breeds, in resistance to disease. Breeders are starting to look at the possibility of breeding resistance to certain diseases into future generations.
- **Water use**: tropical breeds of goat have adapted to using water efficiently in their physiological processes.
- **Survival**: survival rates are generally quite good, although survival from birth to weaning can be poor in the harsher environments.

These characteristics create both advantages and disadvantages among tropical goat breeds (see Table 8.2).

The best-known tropical breeds of goat are listed in Table 8.3, together with their locations and the main features of the breed. Extension staff are most likely to be confronted with a breed of goat that is not in this list, and perhaps has only a local name, often associated with the area in which the goat is found, or the ethnic group keeping them. The characteristics of these 'non-descript' types should first be investigated before any consideration is given to their genetic improvement.

*Table 8.2*
*The advantages and disadvantages of tropical goat breeds*

| Advantages |
|---|
| Ability to survive with little care |
| Some disease resistance |
| **Disadvantages** |
| Low milk yields |
| Slow growth rates |
| Limited response to improved management |

## 8.2.3 Conservation of goat genetic resources

Recently there has been interest in conserving the variety of breeds of domestic livestock. In developed countries, the genetic base of domestic livestock has become very narrow, with very few breeds farmed, and few sires used. Much genetic variability, the raw material of breed improvement, has been lost. In the tropics there is concern that the indiscriminate cross-breeding of indigenous breeds with imported breeds will result in the replacement of the indigenous breed altogether, or at the least some diluting of it. There is often talk of 'genetic pollution', and the debate can become quite heated. Often it becomes an issue of national pride, rather than one for rational consideration. Developing countries, striving to improve the welfare of their population, must make use of all appropriate technology, including new breeds, where suitable.

There is no doubt that preserving genetic diversity, for either immediate or future use, is important. We can never know when we may need to incorporate new genetic material into existing stocks for some productive use. The conservation of what we have is necessary for future generations. However, for developing countries the questions arise of who should be responsible for this preservation, and how it should be done?

The Food and Agriculture Organisation of the United Nations (FAO) is coordinating the global conservation of domestic

*Table 8.3 The major goat breeds of the tropics*

| Name | Location | Characteristics | Uses |
|---|---|---|---|
| **Africa** | | | |
| Nubian | East Africa | Tall, long ears, convex nose | Good milk production |
| Somali | East Africa | White, short coat, no twins | Milk, meat in harsh conditions |
| Afar | Ethiopia, Eritrea | Leggy, curved horns | Milk, meat in harsh conditions |
| Small-East Africa | East Africa | Small, multi-coloured | Meat |
| Sudan Desert | Sudan | Long legs | Meat |
| Red Sokoto | Nigeria | Dark red, medium size | Skins, meat |
| West African Dwarf | West and Central Africa | Very small, prolific, adapted to humid tropics | Meat |
| West African Longlegged | West Africa | Tall, fine hair, many colours | Meat, milk, skins |
| Bantu | Southern Africa | Small, multi-coloured | Meat |
| Boer | South Africa | White, stocky, long ears | Meat, milk |
| **Middle East** | | | |
| Angora | Turkey | Long thick hair | Mohair |
| Black Beduin | Syria | Black, long hair, long ears | Milk, meat |
| Damascus | Cyprus, Syria | Red/brown, hairy | Milk |
| **South America** | | | |
| Criollo | Central America, Caribbean | Black, brown, thin coat, short ears | Meat, milk |
| Moxoto | NE Brazil | White/cream, black face, belly stripes | Meat, skins |
| **South-East Asia and Pacific** | | | |
| Katjang | Malaysia, Indonesia | Black, brown, small | Meat |
| Ettawah | Indonesia | Large, long ears | Milk |
| Fiji | Fiji | Small, short hair | Meat |
| **South Asia** | | | |
| Barbari | India, W Pakistan | White, red spots | Milk |
| Beetal | India, W Pakistan | Red/tan, white spots, long ears | Milk |
| Black Bengal | India, Bangladesh | Small, black | Meat, skin |
| Cheghu | Kashmir, Tibet | White, long thick hair | Milk, fibre, meat, transport |
| Gaddi | N India, Pakistan | Large, white thick hair | Hair, meat, draught power |
| Jamnapuri | India | Large, long ears, convex nose | Milk, meat |
| Kamori | Pakistan | Black, hairy | Meat, hair |
| Kashmiri | N India, Tibet | Large, thick hair, white or black | Pashmina fibre |
| Malabar | India | Many colours | Milk |
| Sirohi | India | Small, many colours, short hair | Meat, milk |

Source: adapted from Devendra and McLeroy (1982)

livestock breeds. It is encouraging the establishment of herds and flocks of different pure breeds. Genetic material can be preserved for 10–15 years as frozen semen, and embryos can be frozen and stored. The establishment of breed societies in developing countries should be encouraged, so that they can be charged with the task of conservation.

Goats lag far behind other species in their identification, description, and classification, which are all prerequisites for conservation. We need more knowledge about the characteristics of indigenous breeds of goats, so that they may be preserved for use by future generations. As yet there is little 'threat' to indigenous breeds of goats from cross-breeding and there is no reason to deny farmers the chance of improving their lives through cross-breeding where appropriate. It should be the responsibility of concerned authorities to undertake genetic conservation, but not at the expense of individual farmers.

## 8.3 Practical methods of breed improvement for individual farmers

Breed improvement can take place at different levels in a goat population, from an individual's or village's flock to the goats of a district or nation. Individual owners should always try to improve their flock, whatever size it is.

### 8.3.1 Improvement of individual flocks

What can an individual owner do to improve the genetic potential of his or her flock of goats? If the flock is large, more than 100 goats, an owner would be able to make genetic improvements through selection within the flock, together with careful selection of new stock to counteract the negative effects of in-breeding. In smaller flocks there is little scope for selection, so the approach should be to try to counteract the negative effects of in-breeding, or up-grading through cross-breeding.

The farmer or pastoralist embarking on a programme of selection must be clear about his or her objectives. It is necessary to be able to measure the characteristic in question, in order to select goats for mating, and cull those not performing well. The farmer must also be able to measure progress in the trait. It would be possible for individual pastoralists, with large flocks of more than 100 goats, to select within their own flocks, and it has been pointed out that some selection does already take place. It may also be possible for farmers to purchase improved bucks for mating.

For farmers with smaller flocks, clear guidelines for breeding and culling within a flock are needed, to ensure that in-breeding is not building up and depressing production.

### 8.3.2 Guidelines on breeding and culling

Wherever possible, the best bucks in the flock should be selected and used for service. Farmers are likely to have their own criteria for judging how good a buck is and his likely effect on his offspring. Good bucks should be retained in the flock for one–three years, provided that their mating is controlled, to avoid high levels of in-breeding. In order to reduce in-breeding, a buck should never be allowed to mate with his full sisters (same father, same mother); his daughter; or his grand-daughter.

If new bucks cannot be bought, so the flock is 'closed', one buck should be selected each year to be the breeding buck for the year. He should serve for one year and then he should either be culled or some breeding-control device, such as an apron or string, should be applied to him.

A superior buck can be used for longer than one year if the owner separates the flock into groups, using the buck for one year before moving him to another group, and so on. However, this separation may be difficult for the owner to manage.

Another option is for an owner to cooperate with others and exchange bucks every one or two years, or rotate them regularly among a small group.

## 8.4 Practical methods of breed improvement for groups and governments

Before embarking on large-scale breed-improvement programmes, first consider the environment in which the improved goats are to be kept. It is a waste of resources to improve the genetic worth of livestock, if the environment in which they are kept remains unchanged. Any up-grading of the genetic worth of goats must be preceded, and accompanied, by the up-grading of management. Only consider breed improvement after efforts have been made to improve management.

However, once management levels have been raised, they should not outpace the genetic value of the goats managed. There is a limit to which the performance of tropical breeds of all livestock can be improved, solely through improved management. Tropical breeds do reach a production ceiling, above which they cannot rise through improved management alone.

Much greater genetic gains can be made if owners group together in some way, either to exert some selection pressure on their larger, combined flock, or to make use of a superior breed by sharing the cost of an improved buck among many members.

Government and NGOs have a role in assisting goat-keepers to organise breed improvement for themselves, or developing

improved stock on some sort of breeding station. A government or an NGO might run a programme to improve the goats of, say, a district. At a national level, government organisations should always be striving to improve the genetic potential of the national population, while also taking responsibility for preserving the nation's genetic diversity for future use.

It is very important that the objectives of the breed-improvement programme are clearly defined, and are in agreement with the objectives of the target farmers. Clearly define the traits to be improved, and define what constitutes an improvement. Remember that traits can be both positively and negatively correlated, so one owner's improvement may be a disadvantage to another owner. Increasing body size inadvertently, by improving milk production (positive correlation), may not be attractive to goat-keepers with limited access to feed.

Figure 8.5 outlines the questions to consider when deciding on the approach to breed improvement. Work through these questions carefully before deciding on any course of action.

### 8.4.1 Selection within a breed

There have been very few organised selection programmes for goats in the tropics. This reflects the general neglect of goats in these countries, rather than any lack of potential. There is much unrealised potential in tropical goat breeds that could be released by a relatively simple selection programme.

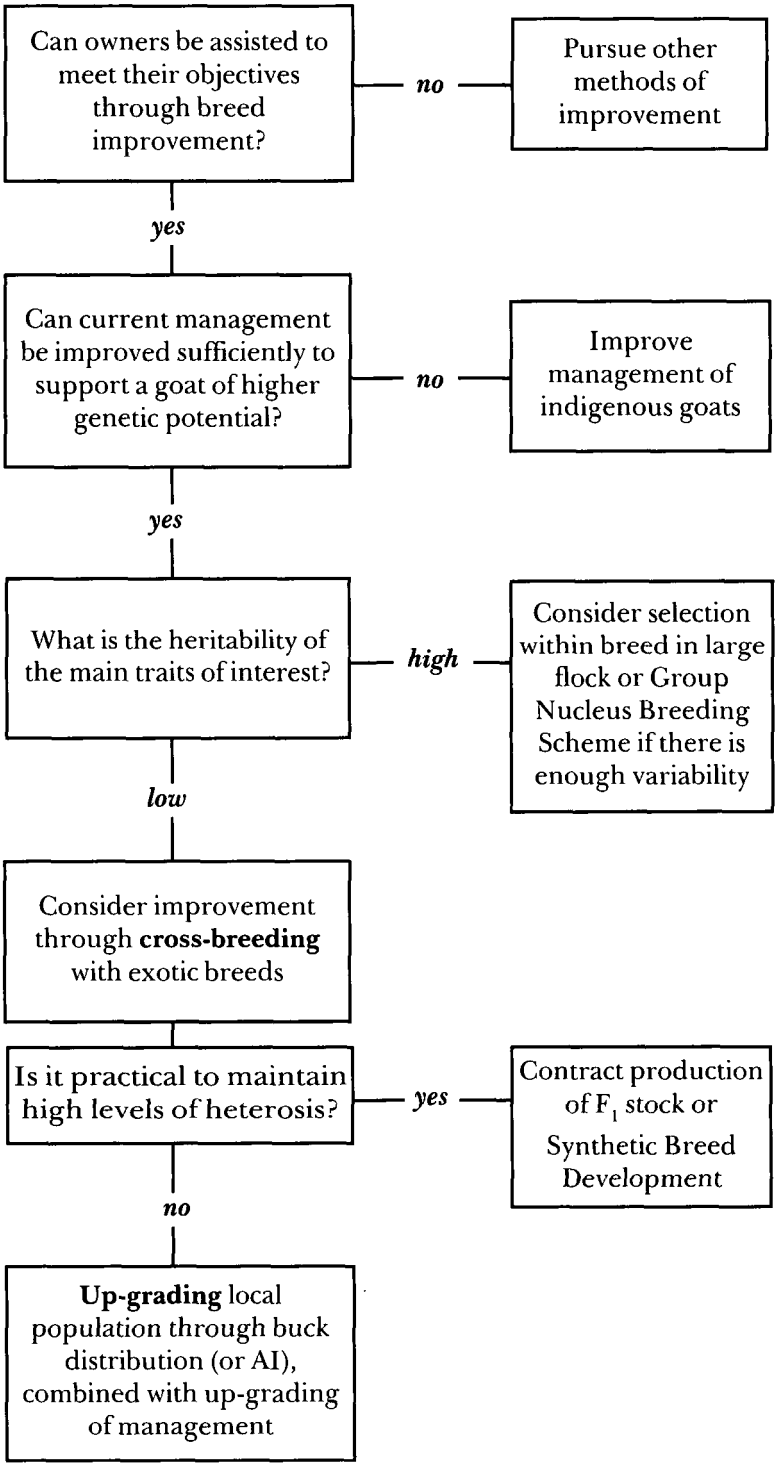
Selection programmes should be considered if:

- the trait to be improved is highly heritable, such as growth rate;
- there is a large population with great variability from which to select;
- a long-term commitment can be made by those involved;
- accurate records can be kept;
- the environment is harsh.

Because it is possible to apply more selection pressure in a large population with greater variability than in a small one, the larger the flock, the greater the progress that is likely to be made. There are few large flocks of goats in the tropics, except those kept by pastoralists or at government institutions. However, larger flocks can be created if owners with small flocks get together and collaborate in a group selection programme.

Selection programmes do not make large or quick improvements in production. They require a long-term commitment from those involved, whether donors, government agencies, or owners. Accurate records of the performance of goats in the target population are needed for a successful selection programme. If this cannot be organised, real progress is unlikely, and selection should not be considered.

*Figure 8.5 How to decide the method of breed development*



Selection is an appropriate strategy for goats kept in harsh environments where management can be improved only a little, and cross-bred goats are unlikely to perform well. In this case, strong emphasis must be placed on selection for both performance characteristics and characteristics of survival which indicate good adaptation.

### *Selection in group breeding schemes*

The principles of group, or cooperative, breeding schemes are very simple. Members agree to cooperate to set up a nucleus flock of their best goats to produce their replacement breeding males. Interest in group breeding schemes has increased recently and they are now widely used for sheep in Australia and New Zealand, and for goats in some Scandinavian countries and also in India.

These are the basic steps to setting up a group nucleus breeding scheme.

**1** Members meet and agree the objectives of the breeding scheme, its structure and organisation. Each owner must make a long-term commitment, for a minimum of ten years, to the programme and must fully understand that slow, steady improvements are to be expected.

**2** Terms of membership of the scheme are clearly set out. A useful guide is that, if a member contributes four does to the nucleus flock, he or she receives one buck in return. The location and management of the flock must be determined. It is best if the flock is located close to the members' farms and in a similar environment to that to which they are expected to return. Selection must take place under the conditions in which the selected goats are expected to perform. This will ensure that the adaptation characteristics of the tropical breed, particularly disease resistance, are not lost. The management of the nucleus flock should closely match the general management of all cooperating members. The physical location of the flock, how it will be supported, whether external funds are required, the advice that may be needed, and day-to-day management must all be considered.

**3** The group members contribute the foundation stock for the nucleus flock. Ideally they would record the performance of their goats in their own flocks, so they had enough information about the traits of concern to enable them to select the very best females for the group flock. Otherwise, judgement will have to be by eye, which is not satisfactory. This selection of the foundation stock, known as 'screening', is a very important step. It determines the starting point of the central, or nucleus, flock to which selection pressure is applied. If the very best goats are contributed, the flock will have a good start; if the goats offered

are of poor quality, then the starting point for selection will be low, and the nucleus flock may even be worse than the average of the contributing flocks!

Genetic gains are maximised when the number of nucleus does is at least 5–10 per cent of the total number of does involved in the scheme. However, the situation is more complicated if the flocks owned by members are very small. If a member is able to contribute only one or two females to the nucleus flock, he or she will be entitled to receive an improved buck only every fourth or second year. When small flocks are involved, the nucleus flock should represent a much higher proportion of the total target flock, say 10–20 per cent. Alternatively, numbers could be gradually built up over one–five years.

The critical parameters to consider are the number of bucks produced per year and how long they will serve in the members' flocks, i.e. how often they need to be replaced on-farm.

4 Once the members of the group have contributed their best does to the nucleus flock, rigorous selection procedures, on the traits of interest, are applied to this central flock. In return for contributing their best females, members will receive back superior bucks for mating within their own flocks. Quite rapid improvement in the average performance of the nucleus flock can be made in the first one–four years. Whether this improvement makes any impact on the flocks of the members will depend on the rigour of the initial screening which determined the initial quality of the nucleus flock.

Every year some does will die, or become old, and will have to be replaced. The very best buck and does should be kept in the nucleus flock. The next-best bucks can be distributed to members, and the worst bucks and does should be culled. These culls can provide a valuable source of income to help support the costs of running the nucleus flock.

It must be decided if the nucleus flock will remain 'open' and take in good females every year, or be maintained as a 'closed' flock, selection being applied only to the females which pass the original screening. Provided that the recording of on-farm performance remains accurate, the best gains are made if the nucleus flock is open. Half the nucleus doe replacements come from the flock itself, while the other half come from the flocks of group members, who must continue to give their very best does.

The beauty of group breeding schemes is that they are very flexible and can vary in size, objectives, and organisation. They could operate at the level of a village, district, or nation. In tropical countries it is probably best if group breeding schemes are designed to operate close to the members of the group, so that

*Effect of flock size on size of nucleus flock: two examples*

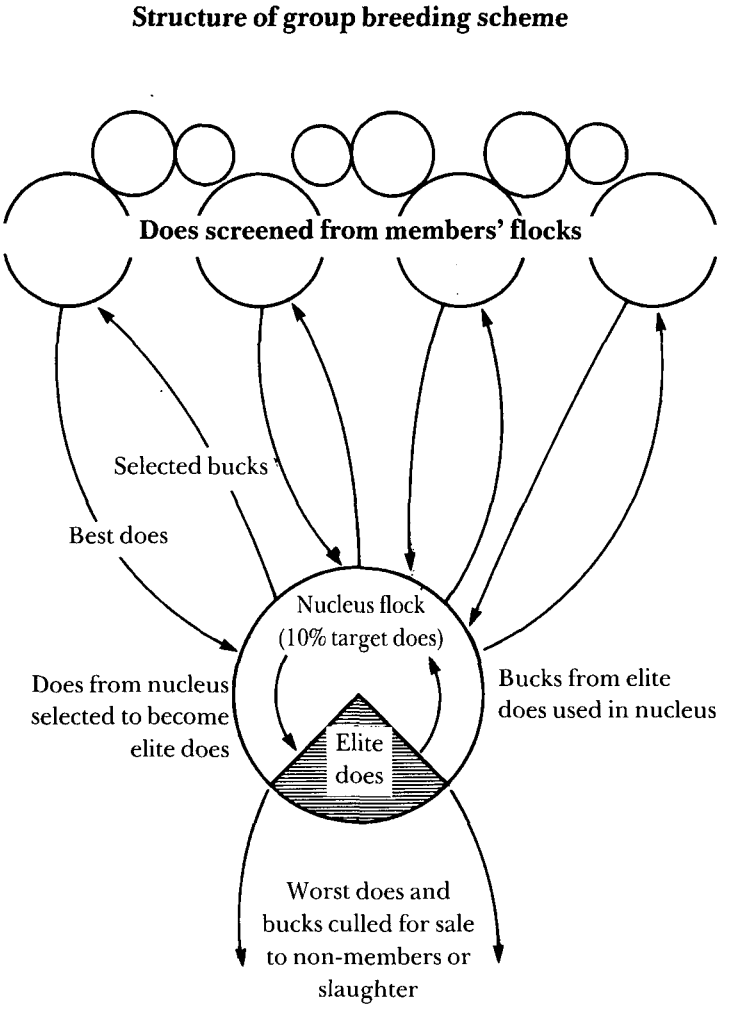
1 A group of 30 pastoralists decide to get together and set up a nucleus breeding flock. The average flock size owned by the members is 60, making a target population of 1,800 goats. The nucleus flock should be 90–180 goats, so each member must contribute 3–6 of their best females. In return, each member will be able to receive a selected buck every year. If the flock is only 90 goats, and the members want a buck every year, little selection pressure will have been applied, the bucks will not be superior, and they will make little impact on the target flocks. If the flock either is larger, say 180 (10 per cent of the target flock), or members receive a buck only every second year, greater selection pressure can be applied, because more poor-quality bucks can be culled from the nucleus flock, and the bucks selected and distributed will be better, making a bigger impact on the target flocks. The length of service of the buck in the members' flock, together with the male:female ratio, will determine the members' need for bucks.

2 A group of 50 farmers make a decision to collaborate in a group breeding scheme, but their flocks are very small. The average size is only 6, making a target population of 300. The nucleus flock theoretically should be 15–30, but little selection pressure could be placed on such a flock and the members would receive a buck only every 4–7 years. This is unlikely to be attractive to them. A bigger nucleus flock is obviously needed, but how can it be created without the members having to give an unacceptably large proportion of their small flocks to the nucleus? In this situation, the nucleus flock would have to be built up slowly over 3–5 years, until it was large enough for reasonable selection pressure to be applied to it, and for the members to derive real benefits from it.

they feel involved in the screening, selection, and redistribution of improved bucks. Owners are naturally reluctant to part with their best stock and may be persuaded to do so only if they participate thoroughly in the management of the breeding unit. Returns from breed improvement through selection are notoriously slow to be realised, and members may become impatient if they have given up their best females to the nucleus but see no benefit for a long time. However, if they are involved in the programme from the start, they will understand the procedures better.

Group breeding schemes can also form a focus for encouraging matching technical improvements. The group might serve as a

*Figure 8.6 Cooperative breeding scheme*




cooperative, assisting members to purchase drugs and equipment, and perhaps to market their goats and products.

It is best if group breeding schemes have an income-generating component, for example through selling culled stock, or supplying drugs, to make them sustainable in the long term. Genetic gains are relatively slow through selection programmes, perhaps of the order of an average of 3–4 per cent per year, depending on the trait. Major improvements will be realised after 10–20 years. This demands a long-term commitment to the programme by all those involved. This may not be possible to achieve through donor-funded projects, which are normally of only 5–8 years' duration. If the group can generate sufficient income to support the flock, and increase the incomes of the members, the breeding objectives of the programme are more likely to be fulfilled.

### *Selection on government breeding stations*

Selection can be made in a large goat flock at a government farm. Selected bucks could be sold to goat-keepers. However, not surprisingly, government staff usually find it difficult to purchase the best goats from farmers and pastoralists. They are naturally reluctant to sell their best stock, even for a premium price. As the initial screening of stock is so important in determining the genetic quality of the flock, government organisations should not consider this approach to breed improvement unless they are confident of obtaining really good breeding stock.

## 8.4.2 Cross-breeding methods

Cross-breeding can quite rapidly improve the performance of goats, provided that the management of the cross-breds is of a high level. Cross-breeding has been the most common method of improving milk production in dairy cattle in tropical countries. However, in some countries, the crossing of local and temperate cattle, when management has not been improved, has led to many cross-breeding schemes performing below expectation. Some disappointing results in certain countries have led to a reaction against cross-breeding, which has fallen into disrepute among some people. Many academics now advocate selection as the only method of breed improvement for developing countries. This is unfortunate. Under the right conditions, cross-breeding has a lot to offer farmers in developing countries, and it is not fair to goat-keepers who have improved their management to deny them access to superior stock.

Cross-breeding should be considered if:

- the trait to be improved has a low heritability, such as milk production;
- the current management of local goats is good, or there is an effective extension programme that is improving management;
- the environment has the potential to allow real improvements in management;
- quick results are needed.

Cross-breeding should be considered only if the cross-breds are going to live in an environment that allows them to express their improved potential and perform well. Otherwise it is a waste of resources. To get real benefits from cross-breeding, the environment should have the potential for improvement.

One major advantage of cross-breeding which is rarely considered is the effect it can have on an extension programme. The cross-bred goat is a new animal, it may look different, it can certainly perform differently, and so it quite quickly captures the interest and enthusiasm of goat keepers. This can be a vital boost to extension programmes and, in the process of breed

improvement, it can motivate owners to adopt the improved management strategies simultaneously being promoted. The two forces of change — improved management and breed improvement — can stimulate each other. The new cross-bred goat needs good management in order to perform well, and owners must provide it through adopting better feeding strategies, such as forage development, and better health care. Once the cross-bred is performing well under good management, it can be further up-graded in blood-level or breed, and management should be up-graded again. This step-wise improvement in management and then breed should be a continuous process, until a combination is reached that suits the owner, family, and flock (Figure 8.7).

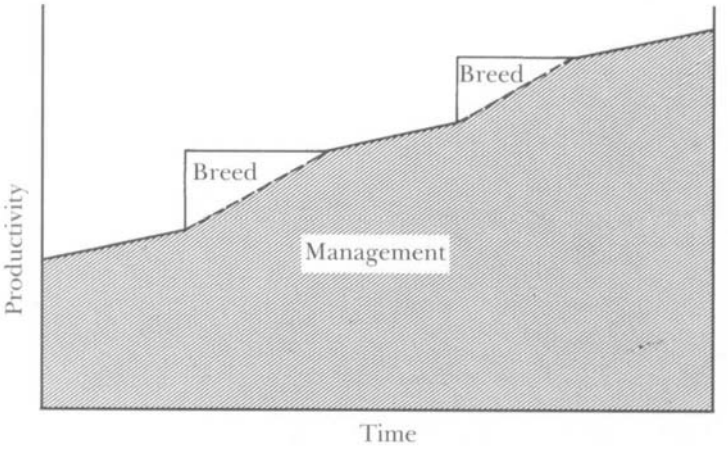



*Figure 8.7 Breed and management improvement*

The principles of cross-breeding were described in 8.1.7. The mating plans made must take into account the practical reality of the situation to be improved, and the practical means of introducing new genes into the target population. The main issues to consider are:

- the blood-level suitable for the environment;
- the level of heterosis it is possible to create and retain;
- the method of introducing new genes into the target population;
- the costs of production and delivery of new genes.

### *Mating plans for cross-breeding*

The level of sophistication of the breeding plan will depend on the circumstances under which it will have to be carried out in the field situation. A criss-cross mating plan requires a high level of

understanding among the owners involved, and a quite complex recording system. It is probably better to compromise some heritability for simplicity and to take an approach of up-grading local goats to a blood-level that functions well in the target environment. After grading-up to a suitable blood-level, mating between goats of that blood-level will be simple for farmers and pastoralists to continue by themselves. Some selection can be undertaken at that blood-level to improve performance. For an up-grading programme, all that is needed is a steady supply of bucks or semen. Once large numbers of grade goats are within the target population, they can be used to maintain the population, and trading in grade goats among owners can help to avoid in-breeding.

### *Choice of improver breed for cross-breeding*

In selecting the improver breed to use in a cross-breeding programme, consider the following factors:

- environment
- desired production characteristics
- desired adaptation characteristics
- past experience
- ease of access to new breed
- cost of new breed.

What are the characteristics of the local breed that need to be improved, and how can they be improved without losing the survival characteristics of the breed? Has there ever been any past experience of using new breeds in your country? Was the experience good or bad? In most cases, the practical considerations of access to the breeding stock and cost will over-ride other considerations. Simply because Europe, the USA, and Australia have well-organised livestock-export companies and regular flights to tropical countries, most goats used for cross-breeding are temperate breeds.

The characteristics of breeds of goats that might be used for genetic improvement are described below. Improver breeds may be divided into improved tropical breeds and temperate breeds (Table 8.4).

### *Improved tropical breeds*

**Jamnapuri:** also known as the Ettahwah, this is the largest breed of goat in India. It is mainly brown or black, with long ears and a convex face. Adult weights of 65–75 kg are common. Twinning rates are quite high, at 1.2–1.4. The Jamnapuri can be considered a dual-purpose breed, but is usually used to improve milk production. Average daily yields of 1–3 litres are possible. It has been used to grade-up goats in South-East Asia, particularly Indonesia, where its influence on the Katjang goat may be widely observed.

*Table 8.4*
*Some goat improver breeds*

| Tropical | Temperate |
|---|---|
| Jamnapuri | Anglo-Nubian |
| Boer | Toggenburg |
| Damascus | Saanen |
| Beetal | Alpine |

**Boer**: the improved Boer goat has been developed through selection programmes in the local Boer type in South Africa. It is a very stocky, well-muscled goat, which has been used to improve the meat characteristics of local goat breeds. The Boer is mainly white, often with a red/brown head and neck. It is quite short, with long ears and a convex face, and has a short neck and thick bones. It is a prolific breed, with a kidding rate of 1.5. The Boer goat has been exported from South Africa to Europe, the USA, and Australia, from where it can be obtained.

**Damascus**: the Damascus goat is undoubtedly related to the Nubian family of north-east Africa. It is found in Cyprus, Syria, and Lebanon. The Damascus goat is normally red/brown in colour, and is sometimes known as the Red Damascus. It is predominantly a dairy breed and can produce up to 4 litres of milk per day under intensive management. It is quite prolific, producing 1.4–1.8 kids per kidding. The potential of the Damascus goat as an improver breed in the tropics has not been investigated, but it is probably worth doing so.

**Beetal**: the Beetal goat is an important milk producer in India, Pakistan, and Bangladesh. It is similar to the Jamnapuri, but slightly shorter. It has long ears and a convex face. It is normally red/brown in colour with white spots. It is thought to be hardier than the Jamnapuri. It is valued for its milk production, producing 1–2 litres per day. It is more prolific than the Jamnapuri, with 1.0–1.8 kids per kidding. The Beetal breed is worth considering as an improver breed in harsher environments.

### *Improved temperate breeds*

**Anglo-Nubian**: the Anglo-Nubian breed was developed in Britain about 100 years ago. Two tropical breeds — the Zairiby from southern Egypt and the Jamnapuri from India — were taken to Britain and crossed with the local British goat. After selection, the breed stabilised into the form now seen. It is a tall goat, with long ears and a markedly convex nose. The colours are very variable, including brown, black, black and white patches, fawn, and grey. Mature body weights can be high: 50–70 kg in females and 60–80 kg in males.

The Anglo-Nubian's tropical ancestry has given it some residual tropical adaptation which has made it very successful in breed improvement in the tropics. It is a useful breed to improve both milk production and growth rates. Although milk yields are not as high as the dairy breeds originating in Switzerland, its hardiness and good adaptation to tropical environments make it an ideal breed with which to start any breed-improvement programme. The Anglo-Nubian has a relatively high milk-fat content (4.5 per cent), making its milk highly valued for butter and cheese-making.

**Toggenburg**: the Toggenburg breed originated in Switzerland and is now quite widespread in Europe and the USA; it has been used for breed improvement in some parts of the tropics. Toggenburgs are normally brown or fawn, usually with white stripes on either side of the face, and a white muzzle. The lower part of the legs and the rear of its rump are a paler colour than the rest of the body. The breed originally had long hair, mainly on the rear of the body, but this is being selected against and short hair is now more common. Mature body weights of 45–55 kg in females and 55–65 kg in males are common.

The Toggenburg has been bred for milk, but cross-breeding it with tropical breeds will undoubtedly improve growth rates as well. The breed has been able to adapt to tropical climates, and has been introduced into Kenya, Tanzania, the Caribbean, Venezuela, and South Africa.

**Saanen**: the Saanen is perhaps the best known of the dairy breeds of goat. It originated in Switzerland but, like the Toggenburg, has since spread throughout Europe, the USA, Australia, and New Zealand. In most countries there has been some separate development of the breed, making one country's Saanens slightly different from another's. Saanen goats are large and normally white, occasionally light fawn. They often have black spots on the skin, which can be seen on the udder or nose, but rarely show on the hair, which is short. They are mostly polled and, as a result, intersex goats are quite common. This feature is reducing in incidence through more careful breeding, and now horned Saanen goats are increasing in number. The face is straight, and occasionally concave. Well-bred Saanens have very good dairy conformation, with big well-hung udders and a pronounced wedge shape. Mature body weights of 60–70 kg in females and 70–80 kg in males are typical.

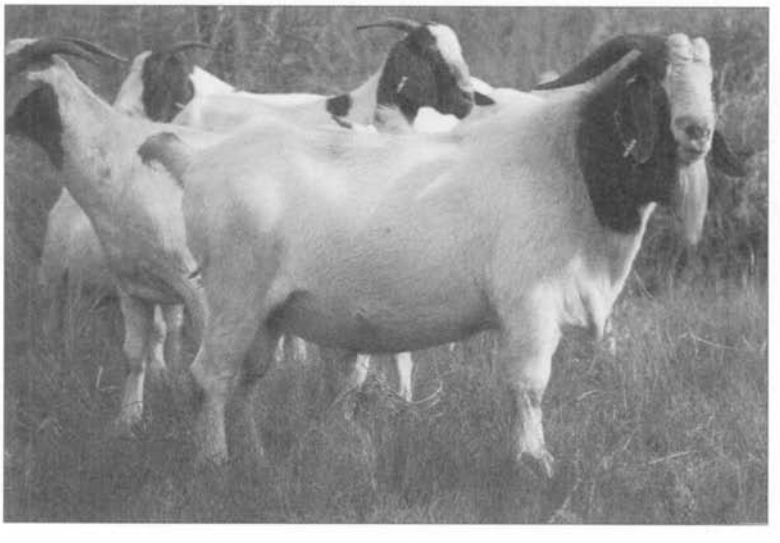
The Saanen breed has mainly been developed for milk production and is the highest-yielding goat in the world. Yields ranging from 825 to 3,850 litres per lactation have been reported. At its best, a Saanen milking doe can match a mediocre dairy cow. The Saanen responds well to good management, but is perhaps less able to withstand the rigours of the tropics. Its light skin colour makes it susceptible to strong sunlight and so it has performed well in the tropics only when housed. Nevertheless, it has been imported into many countries in the tropics including India, Malaysia, the Caribbean, Nigeria, Venezuela, and South Africa. The Saanen breed should be considered as an improver breed only when management is at a very high level; otherwise its huge potential for improvement will be wasted.

**Alpine**: the Alpine breed, like the Saanen, has been developed in separate populations in each country in which it has been imported. There are now French, Swiss, German, and British Alpine lines of

*Figure 8.8 Goat breeds*

*Anglo-Nubian*
JENNY MATTHEWS/OXFAM

*Toggenburg*
CHRISTIE PEACOCK



*Boer*
TREVOR WILSON

this breed, each with slightly different characteristics. The coat of the British Alpine is short, and coloured dark brown to black, with light stripes either side of the face. The mature body weight is 50–60 kg in females and 55–65 kg in males.

The Alpine has been bred for milk production, but will also improve growth rates. It is relatively hardy and has been found to be a useful improver breed in the tropics. It has been introduced to India, the Caribbean, Burundi, and South Africa.

**Angora**: the Angora goat is an outstanding breed for mohair production. The breed is thought to have originated in Central Asia, but was found in its present state in Turkey in the sixteenth century. Angora goats have thick wavy coats. The hair grows 12–15 cm long. The value of mohair has resulted in the breed being imported into many countries in Europe, the USA, Eastern Europe, India, Australia, and South Africa. There are now two million Angora goats in South Africa, where selection has produced Angoras with the highest fibre-yields in the world.

Angora goats have been used to up-grade the fibre production of goats in Australia, India, and Pakistan. Their main weakness is a very high incidence of abortions.

### *Importation of goats for cross-breeding*

Importing goats from a foreign country is not easy. It needs careful planning at all stages, from identifying the source of the goats, arranging transport, receiving the animals, looking after them on arrival, and making the best use of them in a well-planned breeding programme. Importing goats is expensive, and great care is needed to make the best use of these valuable stock.

Goats in the temperate regions of the northern and southern hemispheres are seasonal breeders. In the northern hemisphere they kid in January–April. Most male kids are not wanted and so are destroyed at birth. It is important to reserve males well ahead of the kidding season, so that sufficient numbers can be reared for export. Transport costs usually double the purchase price of the goats. It is cheapest to transport them in an airliner livestock-container, if available. This is cheaper per head than constructing a special crate, and makes handling on arrival much easier.

Each importing country will have its own regulations concerning the health of the goats to be imported. Careful inquiries should be made to determine the exact procedures that should be followed in the recipient country. Most countries require a veterinary officer to inspect the goats immediately before departure; some also demand that extensive tests are carried out to prove that the goats are free of major diseases, such as contagious agalactia (never recorded in the UK) and caprine arthritis encephalitis (CAE)/maedi visna, brucellosis, scrapie, and infectious reproductive diseases. Tests can be very expensive and can add considerably to the final cost of the goats. The original health certificate travels with the goats and must

be handed over to the importer, together with the original airway bill. The importer must sign a document, stating that the goats have been received in good order. Once this has been signed, insurers are no longer liable for any claims made against them. The exporter should also supply certificates describing the pedigree of each goat. This is vital in planning any breeding programme.

Once goats have been ordered, careful preparations should be made to receive and quarantine them. In most countries there is a lot of paperwork to complete before the goats can be released. A suitable truck should be available and the necessary permits obtained to allow it to enter the tarmac area and get close enough to the aeroplane to off-load the goats easily. There should be grass, hay, or sand in the back to make it comfortable and safe for them to travel. They will be very tired on arrival and will need to lie down on some comfortable material. The side should be high enough to keep them secure. It is better if they can be kept in quarantine for at least their first night, somewhere not too far from the airport, so they can rest before travelling on to a more distant place. The stress from travelling can be a predisposing cause of many diseases, particularly respiratory problems.

Most countries have their own quarantine regulations, which should be strictly followed. If there are no regulations, follow proper procedures anyway. Make sure that the goats are isolated and their health monitored for the first six weeks. These procedures should be clearly seen to be followed by the relevant authorities. In this way there can be no recriminations against the importer, should anything unusual occur after importation.

Some loss of weight after arrival is inevitable, with a change in diet and climate. Every effort should be made to find feeds that are liked, so that the goats are eased into consuming new feeds. Lack of appetite and weight loss in the presence of appetising feeds indicate a disease problem which must be identified. The health of the goats should be monitored for any changes, and speedy remedial action taken.

### *Organisation of cross-breeding*

There are several methods of organising cross-breeding to introduce new genes. It can take place on special breeding farms or in villages through bucks or artificial insemination.

### *Breeding farms*

If high levels of heterosis are considered important, goats can be cross-bred on a government-owned or privately owned farm or station. A large number of breeding females can be kept on the farm, with a few bucks of the chosen improver breed, for the production of $F_1$ cross-breds with high levels of hybrid vigour. $F_1$ males and females can be produced in this way for sale to farmers, for cash or on credit. The $F_1$ females may be distributed either

'open' (not pregnant) or 'in kid' with a kid of another blood-level. If they are released open, they can leave the breeding station at a younger age than if they are retained for mating. This can considerably increase the rate of production of the farm.

A small flock of the pure improver breed can be kept on the breeding station to breed replacement stock for the farm, so that repeated importations are not needed.

Farmers with good management skills can breed cross-breds on contract, making a profitable enterprise for them.

Breeding stations have been used by governments all over the developing world for selection or cross-breeding. They have generally performed rather badly and have been notoriously difficult to manage efficiently. This makes the cost of each $F_1$ very high, and their production has normally had to be subsidised in some way. Furthermore, breeding stations never truly represent the management environment in which the cross-breds are expected to perform. Stations often have management levels, including health care, much higher than the recipient farms. If this is the case, goats may be bred without the immunity necessary to survive on farms after distribution. Alternatively, the station management is so poor that the breeding flock performs so badly that few cross-breds are produced per year, making them very expensive and the station very inefficient.

The use of breeding stations to produce $F_1$ females has traditionally been the main method of introducing new genes. However, this use of females is a very expensive and slow method of disseminating new genetic material. It is much quicker and more efficient if the prolific breeding of improver males can be exploited more widely through the use of bucks or, possibly, through AI.

### *Buck stations*

It is important to make the best use of the prolific mating ability of expensive improver bucks. Bucks can be used for breeding at the village level. They may either be sold for cash or on credit to individuals, or sold or loaned to groups of owners, who may combine to obtain the buck. It might be justifiable for an individual with a large flock (more than 30) to purchase a buck for his or her exclusive use; otherwise it is better if goat-keepers can cooperate in the use of the buck and so spread the costs.

Cross-breeding in the environment in which the cross-bred will live has the added advantage of producing hybrids with naturally acquired immunity to the common diseases of the area. This is of great value.

If the buck is to be shared among several owners in a group, there are a few key principles to follow:

- The conditions under which the buck is received by the group must be clear. It is best if any one buck stays in one site for no

*Organisation of buck stations in Ethiopia*

Anglo-Nubian bucks were loaned freely by an NGO project to groups of women farmers in Ethiopia. The buck was looked after by one family, elected to do so by all members of the group. Members brought their does to be mated to the home of the buck-keeper. Each group agreed its own terms to pay the buck-keeper for looking after the buck. In some groups, the members take turns cutting feed for the buck. In other groups, the members provided labour to help the buck-handler during busy times such as weeding or harvesting. Another alternative is a cash fee, which perhaps provides a greater incentive to the buck-keeper to promote the use of the buck.

Many buck-keepers found that feeding a buck was a great burden and could do it for only a few months before passing him on to another family. Others took great pride in the condition of their buck, and villages rivalled each other to give the best care to their buck.

more than 12–18 months, to avoid in-breeding. If the buck is loaned to a group by a project, it must be clear that the project is able to recover the buck and exchange him for another after some agreed period. An annual membership fee, which guarantees a buck to the group, is a useful arrangement. If the buck is sick, or has served for a long period, he can be removed and replaced.

- The buck should be looked after by one family, who are responsible for ensuring that he receives enough feed, and are responsible for his health and alerting relevant people if he becomes sick.
- All members of the group should have equal access to the buck. If houses are very dispersed, this may mean moving the buck occasionally, so that all have easy access.
- The buck should not be expected to serve more than two–three does per day. Any more than this will exhaust him, and fertility rates will drop. If he is sick, he should not serve at all.
- The buck should be kept in a good house, and receive good feed and attention. There should be enough space for mating in the buck pen, and assistance should be given in mating whenever necessary. Ideally females should stay for 12 hours, or return after 12 hours to receive the second, recommended mating.

Once farmers have gained some experience of keeping cross-breds, some of the most successful may move on to produce a

*Cross-breeding for milk production in Burundi*

Farmers in the densely populated highlands of Burundi keep small flocks of 2–6 goats. The intensity of land cultivation means that most goats are kept at home and food is cut and carried to them. 'Projet Caprin Ngozi', funded by the German government, started in the Ngozi district of Burundi in 1980. The objective of the project was to intensify production and improve the milk production of local goats, so that farmers would have excess milk to sell. A small milk-processing and cheese-making factory was built, and an efficient milk-collection system established.

The project decided to improve milk production through crossing local goats with Alpine goats imported from France and Germany. At first the project set up a goat-breeding station for the production of $F_1$ stock for distribution to farmers. However, they quickly realised that the capacity of the station was not sufficient to meet the huge demand for cross-breds. Instead the station became a farm for breeding pure Alpine goats for distribution to farmer-managed buck stations. Pure Alpine bucks were placed in a network of buck stations managed by groups of farmers. Farmers brought their does for service, and very quickly large numbers of cross-breds were bred in the villages of Ngozi. At its peak, 8,000 cross-breds were produced per year from 52 buck stations.

Farmers were impressed with the performance of the cross-bred and wanted to up-grade their goats further. They back-crossed their $F_1$ stock to the Alpine breed to produce a $F_2$ of 75 per cent Alpine blood. Farmers realised that under their management it was best to stop up-grading at 75 per cent. They now maintain blood-levels at 75 per cent, while at the same time keeping some pure local goats as an insurance, in case the cross-breds have any problems.

pure line of the improver breed, for their own use and for sale. This will ensure the long-term, local supply of pure-bred stock.

### *The use of artificial insemination (AI) in cross-breeding programmes*

Artificial insemination of goats has in the past been used only on research stations, government breeding stations, or large-scale commercial goat farms. There has never been a successful goat AI programme for smallholder farmers or pastoralists in the tropics. Although there are many good theoretical reasons for using AI, the practical problems associated with its use appear insurmountable in most countries. The running of a sustainable AI programme seems difficult. Using AI in a small area, with a few

trained and highly motivated farmers and AI technicians, probably has the best chance of success. This might be part of the early stages of a grading-up process and, if managed well, could quickly introduce many genotypes into a population, giving farmers a wide range of genetic material with which to breed in the future.

AI programmes could also exploit the facilities of AI programmes for cattle. For this to be successful, there must be a strong demand from goat farmers for the service, and AI technicians must be well trained in both techniques.

## Further reading

**Dalton, D. C.** (1981) *An Introduction to Practical Animal Breeding*, London: Granada

**Devendra, C. and G. B. McLeroy** (1982) *Goat and Sheep Production in the Tropics*, London: Longman

**Mason, I. L. and V. Buvanendran** (1982) *Breeding Plans for Livestock in the Tropics*, Rome: FAO

CHAPTER 9

# Management of large goat farms

## 9.1 Introduction

This book is concerned mainly with smallholder and pastoral production of goats. However there are circumstances in which a larger number of goats than are normally kept by smallholders or pastoralists might be managed in a more intensive manner. Large goat farms might include government, or NGO, goat farms for breeding, teaching, and research; and commercial goat farms.

Organisations might start large goat farms to supply breeding stock to farmers. The goats distributed from the farm might be cross-breds, or stock improved through a selection programme. A goat flock might be kept at an agricultural college farm for teaching purposes, enabling students to have practice in the handling and management of goats. Finally, research institutions, with a goat-research programme, might maintain a large flock of goats to breed goats for experimental purposes.

Sometimes large goat farms are used to demonstrate 'modern' goat farming. However, the value of a large goat farm for demonstration purposes is very limited. There is no value in showing smallholder or pastoral goat-keepers a large goat farm with expensive housing, infrastructure, and equipment, and a large staff. There is little they can learn from such a farm and it will only create aspirations which cannot be met.

It is inevitable that large goat farms will be managed differently from flocks kept by neighbouring farmers. This has important implications. If goats bred on large farms for distribution are managed better than those on surrounding farms, they will not develop the immunity to disease which they need after distribution and may not survive. Selection programmes must select stock in the environment in which they will eventually be kept. However, often the reverse is true: large government-run goat farms are rather badly managed, and goats are distributed from a poor environment into a more favourable one.

In addition to the institutional functions of large farms, more commercially minded farmers in the tropics are increasingly keen to keep larger numbers of goats, more intensively, in order to make a profit from the sale of milk, and/or stock for slaughter or

breeding. Often they do not have experience of the management of larger farms, and usually underestimate the management requirements.

There may be many different objectives for keeping larger numbers of goats, but their management, for whatever purpose, presents particular problems. Experience has shown that goats require special care when large numbers are housed, fed, and managed together. There are several disease complexes, such as respiratory and parasitic problems, associated with the intensive management of goats, and special precautions have to be taken.

This chapter offers brief guidelines on setting up a goat farm, the annual planning of the farm, and its daily management. Readers should refer to the appropriate chapters of the book for technical details.

## 9.2 Setting up a goat farm

### 9.2.1 Definition of objectives

It is important to define the objectives of the farm very clearly at the start, as this will to some extent dictate the management strategy of the farm (Table 9.1). Setting up a purely commercial farm, under tight financial control, is slightly different from starting a government farm with a grant or allocation from the government budget.

*Table 9.1 Influence of farm objective on management system*

| Type of objective | Emphasis in management system |
|---|---|
| Breeding | High-quality foundation stock<br>Batch breeding<br>Detailed breeding plan<br>Good recording systems |
| Teaching | Variety of breeds<br>Range of equipment<br>Range of management systems |
| Research | Specialist buildings and pens<br>Good recording systems |
| Profit-making | Low-cost infrastructure<br>Simple management system<br>Few staff to reduce labour costs<br>Good financial management |

Establishing an institutional farm for breeding, teaching, or research will usually be done with a lump-sum grant, either directly through the government budget, or, more likely, with a grant from an external donor. A realistic budget must be prepared to allow for the construction of sound infrastructure. Government goat farms usually receive an annual budget for their management and this subsidises, to some extent, the products of the farms. These products might include breeding stock for sale to farmers, research outputs, and access by students to learn about goats. Non-profit making objectives should not be an excuse for inefficient management, but they often are.

### 9.2.2 Assessment of resources

Consider the resources available for developing the farm, and design a management system that makes the most efficient use of them. Table 9.2 considers some of the essential resources, and the influence they can have on the management system.

*Table 9.2 Effect of available resources on management system*

| **Resources** |
|---|
| **Land**<br>Flock size will be affected by size and type of land, including current fodder production<br>Is any land irrigable for forage?<br>Are the rights to land long-term or short-term? |
| **Climate**<br>Rainfall, temperature, and humidity will affect house design |
| **Goats**<br>Availability of foundation stock |
| **Finance**<br>Funds available for farm development and recurrent costs<br>Timing of finance |
| **Access to inputs**<br>Feed supplements, drugs, equipment, forage seed, fertiliser, irrigation equipment, building materials, fencing |
| **Personnel**<br>Goat-management skills and experience of available staff<br>Skills and availability of veterinary personnel |

### 9.2.3 Flock-management system

The flock-management system of the farm will be determined by its objectives and resources. This will dictate the groups in which the goats are managed: breeding females, breeding males, suckling kids, weaners, fatteners, or experimental groups; how the goats are fed: grazing (which requires a shepherd or fencing), seasonal grazing/seasonal housing, cut and carry feeding; the level of health care; the type of housing and the breeding systems followed: seasonal, continuous, or in batches.

### 9.2.4 Farm layout and infrastructure

It is important to make a plan of the land available for the farm, in order to plan its overall layout. Consider what infrastructure is required and how best to arrange it for easy management of the flock. Is all the infrastructure needed immediately, or can it be developed over time?

The infrastructure on a large goat farm might include the following features.

- Buildings:
  housing for breeding males
  kidding pens
  kid boxes
  milking parlour and milk-handling area
  isolation pen for sick goats
  post-mortem/slaughter room
  office/recording room, with lockable drug cupboard
  feed and equipment store
  hay barn
- Experimental pens, including feeding-trial pens
- Water troughs
- Dip bath/spraying area
- Handling pens
- Weighing equipment and pens
- Burial pit
- Manure pit
- Exercise yards
- Fencing

### 9.2.5 Housing

It is important to consider the function of the house to be constructed. With the management system adopted, what sort of housing do the goats require? Will they be housed all the time and will feed be cut and carried to them? If so, they will need more space, an exercise yard, good feed racks, and water. If the

goats will be housed only at night, the house design can be more simple, and they can be housed in the groups in which they are herded for grazing during the day. When building a house for goats, consider the purpose of the house, the site, materials, and labour available (see Table 9.3).

*Table 9.3 Factors affecting goat-house design*

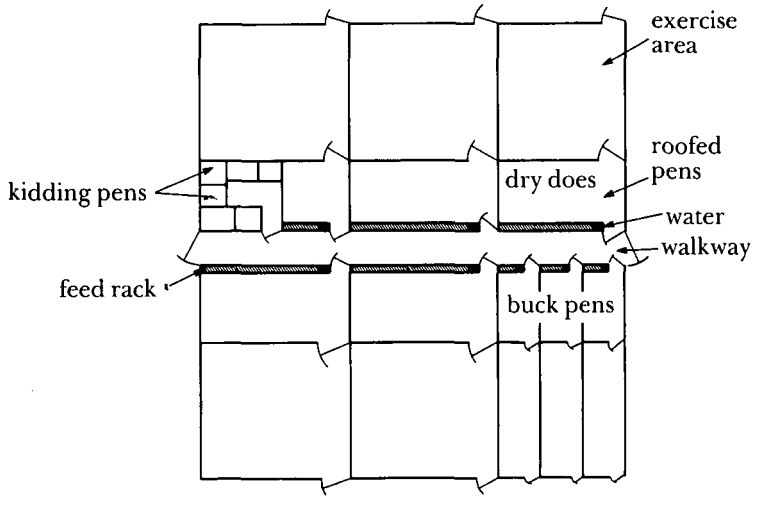
| Consider | Effect on house |
|---|---|
| **Purpose:** | |
| Permanent housing | Pen (1.5m²/goat)+ exercise yard, feed racks, water |
| Night housing | Pen (1.0–1.5m²/goat) |
| Permanent buck pens | 3m²/buck + exercise yard |
| Kidding pens | 3m²/doe |
| **Site:** | |
| Land ownership | If ownership is permanent, build a more permanent structure. If site is on a short-term lease, build cheaper structure. |
| Aspect | If hot climate, site house away from sun to reduce day-time temperatures.<br>If cool climate, house should face the sun to dry inside during day. |
| Prevailing wind direction | If wind is cool, site house sheltered from it. |
| Drainage | Build on well-drained site; or raise floor of house. |
| Rainfall | Heavy rainfall requires good roof. |
| Temperature | High temperature requires good ventilation, achieved through roof design and low walls. |
| Humidity | High humidity requires good ventilation. |
| **Materials:** | |
| Availability | Locally available materials are usually cheapest; future repairs will be easier. |
| Cost | Projected length of service. |
| Durability | If long life required, use more durable materials. |
| **Labour:** | |
| Skilled, locally available craftsmen | A more sophisticated construction |

### *Main house*

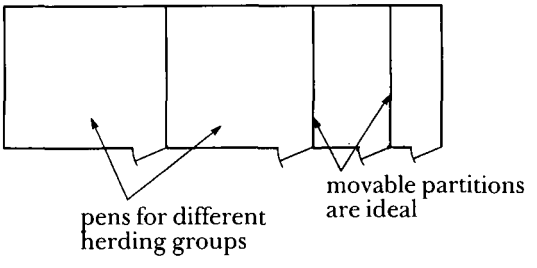
Decide whether the goats will be housed throughout the day, in which case they will need more space inside the house, as well as an exercise yard with easy access from the main house. They will also need feed racks and access to water. If the goats will go out grazing during the day, returning to the house at night only for protection

*Figure 9.1 Goat -house layouts*

a) permanently housed




b) housed at night only




and not to feed, then they will need slightly less space, and a simple design will suffice. Two suggested house layouts are shown in Figure 9.1.

### *Ventilation*

Goats are very susceptible to respiratory diseases and must therefore have good ventilation. In order to maintain fresh air in the house, and to eliminate contaminated air, the house must be designed to allow air to circulate. This is achieved when hot air rises and escapes from the house, ideally through the roof, which in turn draws fresh air into the house through side openings. This ensures the regular change of air that is needed to avoid respiratory problems (Figure 9.2).

It is very important to design a house with good ventilation from the start. Once it is built, it is hard to modify a house to improve its ventilation. In the belief that goats are desert animals, there is a tendency to over-protect them, building structures with high walls and no air vents in the roof. This must be resisted. The

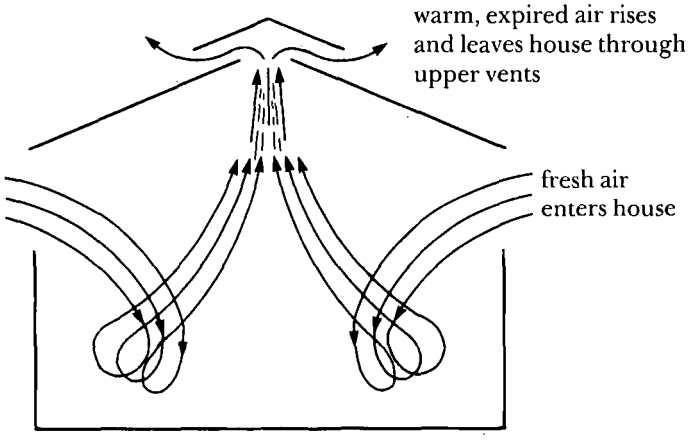



*Figure 9.2 Principles of good ventilation*

air must smell fresh and clean at all times. Any smell of ammonia indicates poor ventilation and an unhealthy environment.

In most conditions in the tropics, goats will not need any walls; or, if they do, they require only a low wall at the sides of the house. The roof should be waterproof and designed to allow the release of contaminated air. It should either slope, or have air vents, or have ventilation in the centre of the roof.

### *Floor*

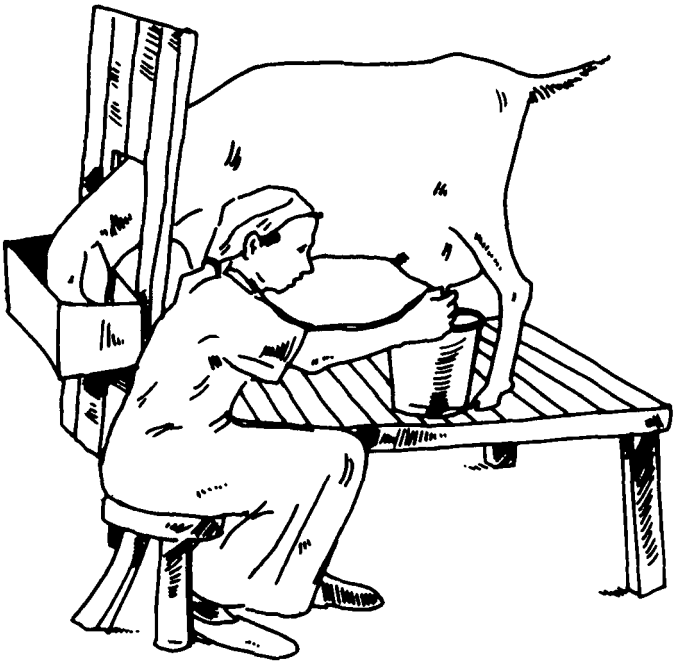
The main types of floor to consider are earth, concrete, or wooden slats. They each have advantages and disadvantages. The floor of the house should be designed so that it is easy to keep it clean and dry. A concrete floor is easy to clean, but, without bedding, is a cold, hard surface and therefore not always desirable. An earth floor is often adequate, provided it is well drained. Sand, or light sandy soil, is often adequate; it can be swept clean every day and more sand put down at regular intervals.

A raised, slatted, wooden floor is ideal, but can be very expensive. If the floor is slatted, the urine and manure will fall through and can be collected below, keeping the floor clean and dry. The spaces between slats must be wide enough to allow manure to fall through, but not wide enough for a goat's legs to be trapped. A gap of 1.5–2.0 cm, about the width of a matchbox, is about right. Wooden slats will need to be regularly replaced, as the urine will rot the wood and cause gaps to develop. The floor should be raised high enough to allow staff easy access to collect the waste underneath.

### *Milking shed*

The milking shed should be a quiet, calm, easily cleaned environment, where it is easy to milk. When goats are milked by

*Figure 9.3 Milking platform*



hand, it is easiest if they are raised on a platform with a small feed-rack. Simple wooden platforms are quite adequate (Figure 9.3).

### *Isolation pens*

It is very good practice to have an isolation pen where sick goats can be kept apart from the rest of the flock to avoid cross-infection. Ideally the pen would be quite separate from the main goat house and grazing areas, to avoid any chance of air-borne infections. It should be made from materials that are easy to clean and disinfect after the death, or recovery, of the sick goat.

### *Post-mortem/slaughter room*

A simple post-mortem/slaughter room is useful; it should be constructed next to the isolation pens. Ideally it would have a concrete floor, side bench for post-mortem examinations, drainage system and soakaway, water, and a central hook to lift carcasses for butchering.

### *Burial pit*

A deep pit should be dug, far away from the goat flock, where infected carcasses can be disposed. Carcasses should either be burned, or deeply buried and covered with soil. Wild animals must be prevented from gaining access to the carcass and spreading infected material.

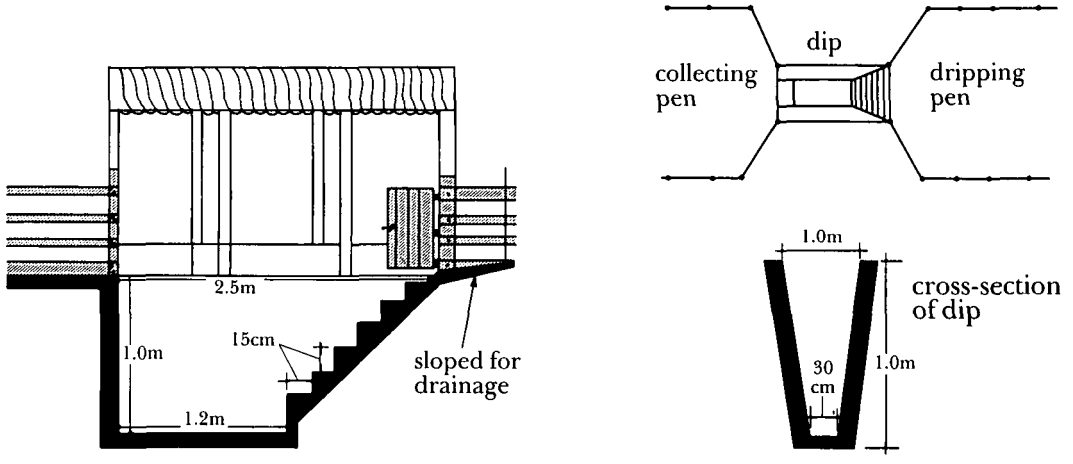



*Figure 9.4 Dip-bath design*

### *Dip bath*

In situations where large numbers of goats need to be regularly dipped to control external parasites, a cement dip bath should be constructed (Figure 9.4). The dip should be built away from the rest of the farm and should have a soak-away drain or septic tank to dispose of the waste dip-wash, without contaminating adjacent pasture and water sources. Ideally it would be constructed close enough to a source of water to allow the easy filling of the trough. However, if the water-source is a well, be careful not to contaminate the well water itself with waste dip-wash.

### *Handling pens*

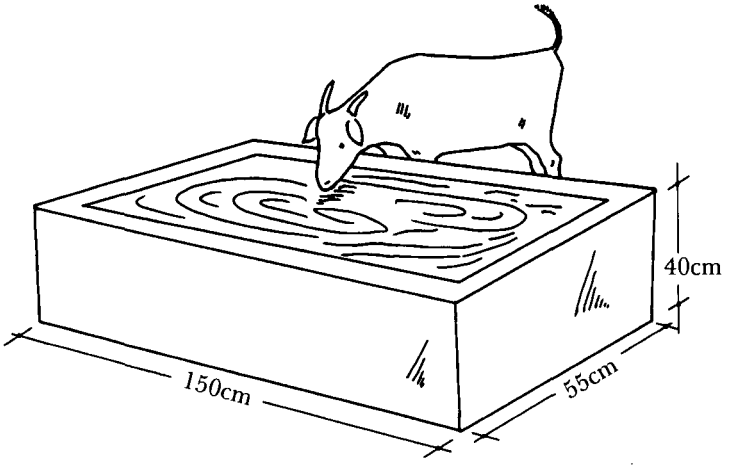
Goats may need to be handled regularly and it is much easier for staff to handle and sort them and carry out a job if the animals can be confined in suitable pens. Handling pens are useful for sorting goats for mating/culling/sale/distribution; handling before weighing; and handling before dipping/vaccination/foot trimming.

### *Office and stores*

A simple office, close to the goat house, makes record-keeping easier. The office can serve as a focal point of the farm, where records, reference books, and valuable equipment are kept. It is handy to have a store near the office, where bulky supplies and equipment such as feed and tools can be stored securely. It is an important management practice to keep good records of the stocks of materials in the store, so they can be replenished in good time, and to devise an effective method of controlling their use.

It is good to have a few simple visual displays about the farm in the office, such as number of stock by age/sex/breed, etc., for staff, students, and visitors. Lists of does due to kid can also be displayed, so that they can be checked regularly.

*Figure 9.5 Water-trough dimensions*




## 9.2.6 Equipment

### *Feed racks*

Goat-farmers have tried for years to design the perfect goat-feeding rack. Everyone has a particular design and different materials available. The principles outlined in 5.5.3 should be followed. Allow enough space for all the goats: a width of about 30 cm per animal is adequate. If there is not enough space, the weaker goats will be squeezed out of the rack by their stronger fellows, and will not eat properly.

### *Feed troughs*

Simple wooden boxes, raised off the ground, are adequate to feed dry supplements, such as rice bran, grain, or oil cakes. If feed is offered wet, a waterproof container (such as an old oil drum, neatly cut in half, a plastic bucket, or specially constructed metal trough) must be used. Allow about 30 cm per goat. If there is not sufficient trough space, feed goats in batches, to ensure that all have an equal chance to feed.

### *Water containers*

Ideally, water troughs would be made from cement-covered bricks or hollow blocks, with a drainage plug to assist cleaning. They should not be so high that the goats have to perch on the top to drink, or so low that kids get in and foul the water (Figure 9.5). Match the trough with the size of your goats. A trough with piped water and float valve, to allow self-filling, saves a lot of work.

### *Kid boxes*

Kids do not have a functioning rumen and so do not generate much heat to keep themselves warm. Young kids are very

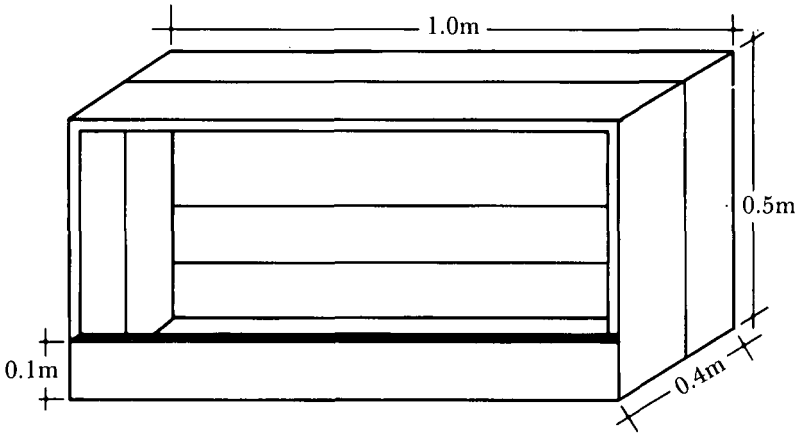



*Figure 9.6 Kid-box design*

susceptible to draughts and cold and must be kept warm, but also well ventilated, at all times. In many parts of the tropics, temperatures can fall considerably at night and kids will need help to keep warm. If they are kept with their mothers at night, each family in a separate pen, the mother will keep her kid(s) warm enough. If they are kept with other kids and their mothers, they may not necessarily be warm enough, and if they are cold they have a tendency to lie on top of one another, and may even be trampled on or suffocated by older goats. To avoid these problems, and keep kids warm, dry and safe, it is best to construct a kid box of some sort. A design for a kid box is given in Figure 9.6. The box should be constructed from a warm material, such as wood or bamboo. Ideally it would have some suitable bedding, such as straw or dry grass. Other traditional methods can be used, such as a large up-turned basket.

*Figure 9.7 Weighing crate*

### *Weighing crate*

Farms that need to weigh several hundred goats regularly will need a weighing crate with suitable handling pens, to save staff time and grazing time. A swing gate at the end of the pen can help in sorting goats on the basis of weight. This might be useful in selection programmes or on fattening farms that sell when a target weight has been reached.

### 9.2.7 Purchase of foundation stock

When setting up a goat farm, all the goats will have to be purchased. The quality of the foundation stock will, to a great extent, determine the overall performance of the farm in the years to come. For this reason, care should be taken to obtain the best breeding goats possible. This is not always easy. It is particularly difficult to obtain high-quality breeding females, because owners are naturally reluctant to sell them. Female goats sent to market are usually infertile, repeat aborters, or poor mothers. It is only in extreme circumstances that farmers or pastoralists will sell good females. For this reason, it is difficult to buy females through normal channels, and special arrangements should be made. If the farm is intended to benefit members of the surrounding community through production of cross-breds, for example, community leaders should be involved in setting up the farm so that they can approach owners to sell their stock. A premium price should reward goat-keepers for selling their very best stock.

Commercial farmers will probably have to build up their stock numbers gradually, by purchasing from large, busy markets where there is a good choice and they are able to select the best goats on offer.

New goats may bring diseases, or disease vectors, to the existing flock. For this reason, all new stock should be drenched for internal parasites, dipped if necessary, vaccinated, and given a thorough health check. Ideally they would be isolated from other stock for two–three weeks for observation of their health, but this may not be possible to arrange. New stock should be tagged and a record opened for them, in which all known information about them is recorded for future reference.

Some females will probably be pregnant when purchased. In the original plan you should allow time to assess the status of breeding females and, if necessary, time to deliver their kids before they enter any planned breeding programme.

### 9.2.8 Staff recruitment

The successful care of livestock demands constant attention to detail and a high level of commitment from all staff. Goats require attention at weekends and often need tending at night. Carelessness means that sick goats are not noticed, drugs are not administered properly, kids are not fed properly, and events are mis-recorded. The levels of husbandry skills of staff attending goats and their thoroughness will be some of the main factors affecting the performance of the farm. It is important to recruit staff with the attitude, skills, and dedication required to look after goats well.

Sometimes management of institutional farms is assigned to a committee of experts. This is unsatisfactory. Management by committee leads to delays in decision-making which can be disastrous. Sharing responsibility among several people means that no one is ultimately responsible, and husbandry standards will tend to slip. There must be one person acting as manager/supervisor who is responsible for the overall management of the farm. The manager may take advice from different specialists, but must ultimately be responsible for the whole farm. The manager should, ideally, have some experience of goat husbandry; but, if this is not the case, should at least have experience of the successful management of large numbers of some other species. The manager should be responsible for preparing the annual plan for the farm, with outside assistance, if necessary, and for supervising the day-to-day activities on the farm, assigning responsibilities and checking that they are carried out properly. In addition the manager should be responsible for ensuring that all necessary inputs, drugs, feed, etc., are ordered and in stock, and that records are properly maintained. The manager is ultimately responsible for the performance of the flock. This task is made considerably easier if the staff reporting to the manager can be trusted to carry out their work in a competent and reliable manner.

The farm workers should have experience of some aspect of livestock husbandry. Although they will be assigned to different responsibilities (kid management, milking, buck management, etc.), they should be able to cover for each other when necessary. Certain tasks require more skill and patience than others (attendance at kiddings, care of young kids, etc.), and staff with suitable skills should be recruited and assigned to these more skilful jobs. It is sometimes helpful to build a financial incentive into the wages paid, to encourage high standards. Staff can be paid individually for what they have achieved, such as paying the kid rearer for the number of kids successfully weaned, or the number of does conceiving. Alternatively a bonus can be paid to all the staff at the end of the financial year, according to the overall performance of the farm. If it is hard to pay staff in cash, they may be rewarded with culled stock, or manure, or perhaps an option to buy good-quality stock at a subsidised price.

It is important that the farm is regularly attended by a competent veterinarian, or veterinary assistant, who is on-call to the farm. Very large farms may even justify the full-time employment of veterinary staff. They should be able to treat sick goats, advise on preventative health measures, and undertake simple diagnostic procedures. Ideally these staff would be based fairly close to the farm, so that they can be called out at night or at weekends.

All staff working on the farm should be trained in simple goat health-care; the curriculum suggested in 6.7.1 might be used for this training.

### 9.2.9 Records and record-keeping

Records can be kept for many purposes. It depends on the objectives of the farm. Do not keep unnecessary records. Use simple formats that record the performance of the farm sufficiently to monitor flock productivity and inputs, in order to improve flock performance. Consider what information is needed, and how it can be obtained without disrupting the work-routine excessively. Assign competent staff to keep the records, and up-date them regularly. Be clear who will collate and analyse the records, how it will be done, and how often they should be analysed. Records might be kept of some or all of the following:

- mating
- feeding
- health, including disease incidence, treatment, outcome
- drug use
- vaccination
- daily labour attendance
- temperature/rainfall
- weight records (weekly, bi-weekly)
- milk yields
- kidding.

Records kept in the goat house itself should be transferred every day to more permanent records in the office. In the office there should be an individual record for each goat on the farm. This record might be kept on a card, sorted numerically by tag number, or in a large hard-covered book or file. Computers are becoming more widespread and there are now specially designed software programmes to record information from large herds or flocks. An example of a livestock database management programme is the Livestock Information Management System (LIMS) from the International Livestock Research Institute (ILRI in Addis Ababa). Other database programmes are coming on to the market all the time.

There is no real need for a computer on a farm. Computers are useful for processing large quantities of data very quickly, but for day-to-day management they are unnecessary. Do not consider a computerised data-management system unless you have a large number of goats, and have staff able to manage the computer and learn its operation efficiently. Otherwise a great deal of effort can be put into learning computer programmes, wasting valuable staff time and leaving other tasks neglected. Always keep a hard copy of all records. Computers break down and are mis-managed, and diskettes can get lost or damaged. Valuable records should always be kept in duplicate.

## 9.3 Annual planning

In order to run a goat farm efficiently, it is important to make an annual plan, indicating the timing and frequency of different activities. This will help the manager to procure equipment, drugs, vaccines, and additional staff in good time, without delaying important farm operations. It is likely that any annual plan will be modified from time to time as circumstances change, but it is helpful to have a plan as a starting point.

It is useful to have a calendar of activities laid out on a large sheet of card that can be attached to the office wall for all to see (Table 9.4).

Consider how all the different classes of stock will be fed through the year. Make a flock projection for the year and calculate how much feed is required to support the projected flock at different times of year. Is there enough feed of the right quality? Will feed have to be conserved, or bought into the farm? What feed supplements are available locally?

### *Health*

What prophylactic health measures will have to taken and at what seasons? What vaccinations should be given and when? Are there enough drugs and vaccines available, or will they have to be purchased? Where can they be bought?

### *Breeding*

Decide on your mating policy and make mating plans for the year. Will goats be bred in certain seasons, or continuously mated as they become ready? Consider the option of batch mating versus continuous mating. Which suits the farm and staff best?

How will oestrus be detected? Will staff have to observe it, or will a raddled or vasectomised buck be used? Does mating have to be assisted? Who will record matings?

How many goats will be culled? On what basis will they be culled?

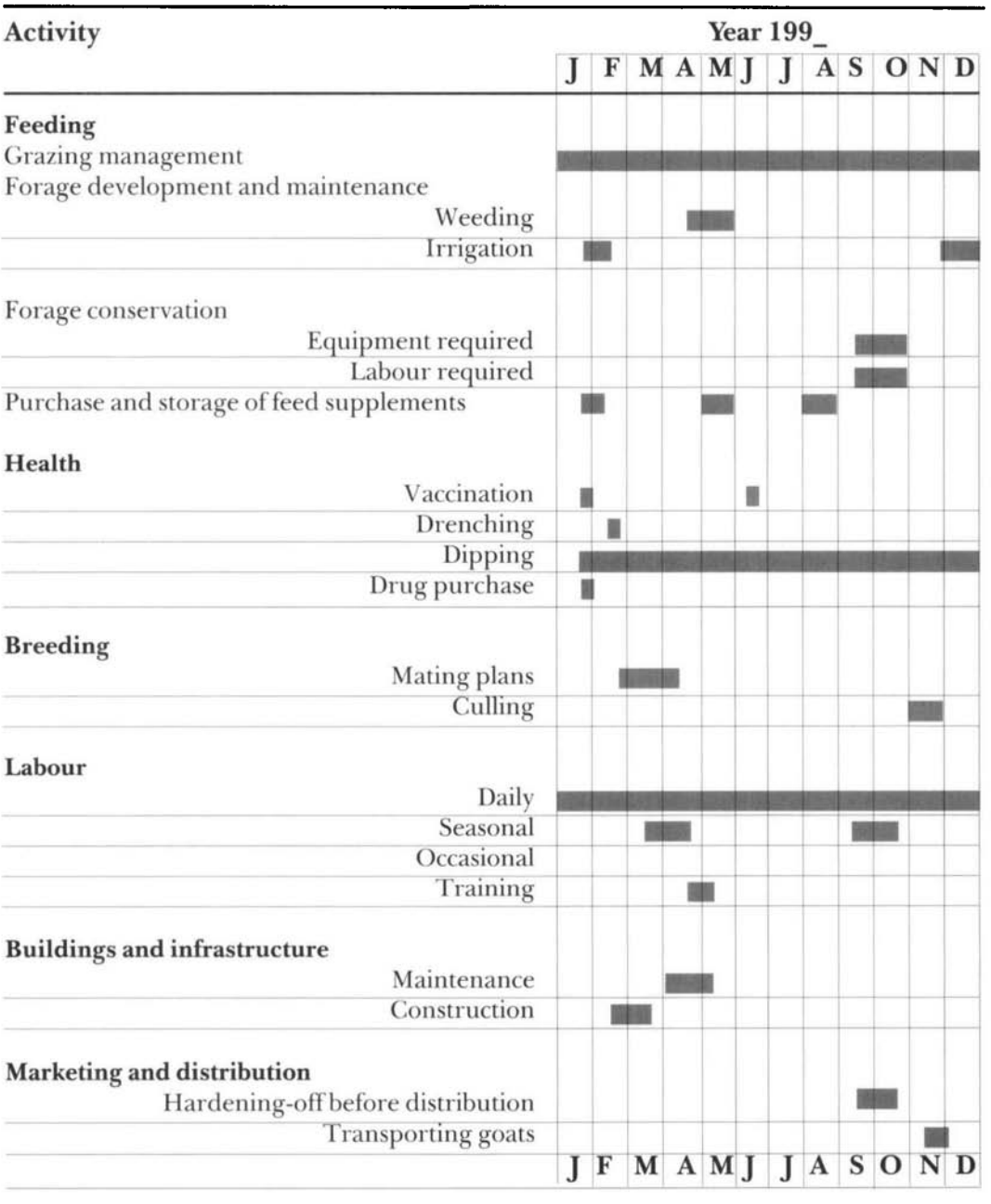
### *Labour*

The quality of the staff recruited to work on a goat farm is perhaps the single biggest determinant of the overall performance of the flock.

### *Daily tasks*

Consider the separate batches of goats maintained on the farm and the labour required to look after them on a daily basis. Allocate responsibilities clearly.

*Table 9.4 Example of a calendar of goat-farm activities*




### *Seasonal tasks*

There are likely to be seasonal jobs such as forage harvesting and building maintenance, when labour may have to be employed in addition to the regular labour force.

### *Occasional tasks*

In addition to the daily labour requirement, there will be tasks such as dipping, drenching, and weighing, for which there will be a high demand for labour. Can this demand be met from the daily labour force by rearranging their normal work pattern, or are additional staff required?

### *Training*

All staff should receive good supervision and regular training as a matter of routine. Training may take the form of specialised courses in particular aspects of goat production or regular weekly or monthly training sessions. On recruitment of staff, assess their existing skills and consider what additional knowledge and skills they need in order to work more efficiently. Training is also one method of motivating staff.

### *Buildings and infrastructure*

Buildings require regular maintenance; time, money, and labour should be allocated for this purpose. Building and infrastructure maintenance can be done during slack periods when labour is free from other jobs.

### *Marketing and distribution*

When and where will goats be sold or distributed? Is there a target market time and/or place? Should goats for sale be fattened before market? If goats are for distribution, do they need particular vaccinations before distribution?

### *Transporting goats*

How will goats get to market or to their point of distribution? Will they be trucked or trekked? Most tropical breeds of goats will need about 0.3 $m^2$ of lorry space each. Always try to give transported goats bedding for the journey, because they normally lie down and can be damaged when bumping on rough roads. If it is a long trip, they should be allowed stops every six hours for feed and water. Always make sure that goats are driven carefully, particularly if they are being transported in large numbers. Sudden braking can push goats on top of each other, crushing those in the front. Bad driving can cause high mortality rates.

If valuable goats have to be transported long distances, they can be given an injection of long-acting antibiotics (such as Terramycin LA) to prevent stress-induced diseases.

### *Budgeting*

One of the most useful economic tools to help a farm manager to plan a farm is to prepare a cash-flow budget. This is worth doing, on both commercial and institutional farms. The cash-flow budget is prepared simply by subtracting the money spent from the

money received. This can be calculated for a one-year period or for longer periods. It is perhaps more useful if each year is broken up into quarterly or monthly periods. Cash-flow budgets can be helpful in planning the running of a farm, or projecting the cash flow over a short-term or medium-term period of farm development. They can assist the farm manager's planning when repaying borrowed money.

Table 9.5 sets out the arrangement of a simple cash-flow budget of a dairy-goat farm. At the end of a period, the manager can compare the actual receipts and expenditure with the estimates made in the plan. If there are any differences, action can be taken to improve the situation before any harm is done. Action can be taken quickly if the budget for the planned cash flow and the analysis of the actual cash flow are made regularly for short periods, such as quarters.

*Table 9.5 Example of a cash-flow budget for a farm of 100 milking does*

| Item | Year 199_ 1st quarter ($) | 2nd quarter ($) | 3rd quarter ($) | 4th quarter ($) | Total ($) |
|---|---|---|---|---|---|
| **Receipts** | | | | | |
| milk sales | 3,000 | 3,600 | 4,000 | 3,800 | 14,400 |
| sale of fattened males | — | — | — | 2,000 | 2,000 |
| sale of culls | — | — | 500 | — | 500 |
| **Total receipts** | **3,000** | **3,600** | **4,500** | **5,800** | **16,900** |
| **Payments** | | | | | |
| feeds costs | 200 | 200 | 300 | 200 | 900 |
| mineral licks | 10 | 10 | 15 | 10 | 45 |
| drug costs | 20 | 20 | 30 | 20 | 90 |
| equipment | 150 | — | — | — | 150 |
| housing repairs | — | — | 100 | — | 100 |
| labour | 600 | 600 | 600 | 600 | 2,400 |
| marketing costs | — | — | 50 | 150 | 200 |
| new capital investment | — | 2,000 | — | — | 2,000 |
| interest | 150 | 150 | 150 | 150 | 600 |
| **Total payments** | **1,130** | **2,980** | **1,245** | **1,130** | **6,485** |
| **Net cash flow** | **1,870** | **620** | **3,255** | **4,670** | **10,415** |
| Loan repayment | 1,500 | 1,500 | 1,500 | 1,500 | 6,000 |
| **Balance** | **370** | **-880** | **1,755** | **3,170** | **4,415** |

## 9.4 Daily management

The daily routine management of the goat farm should be simple and clear to all staff. It is most important that each member of staff is clearly allocated his or her responsibilities and is competent to carry out those duties efficiently.

### *Routine checks*

First thing in the morning when entering the goat house, or pen, goats should be observed for signs of sickness; signs of oestrus and/or mating; and signs of labour or recent kidding.

Allocating the responsibility for these routine checks is important, but all staff must be trained to identify and report any of these events, and take any immediate action that might be necessary. If the health check is not made by a member of the veterinary staff, the veterinary personnel responsible should be alerted when a goat is thought to be sick. If there is a night guard on duty, he should give a report on the events of the previous night.

During the day all staff should get into the habit of observing goats for sickness, oestrus, mating, labour, and kidding, and observe the land for broken fences and the state of the pasture and the water supply. Constant vigilance by all staff should be encouraged and rewarded.

### *House cleaning, feeding, and watering*

Goat houses and pens should be cleaned regularly and disinfected when appropriate.

Decide where each group will graze and for how long. Will they be out all day, or return in the middle of the day? Will any supplement be fed? How much and how often? Ideally, goats should have constant access to water both in the house and while out grazing. In practice, this is not always easy to arrange for a large number of goats, so they may have to be watered once, or twice, a day — on their way to and from grazing perhaps.

### *Regular jobs*

It is likely that every day there will be at least one routine husbandry task to do, such as drenching, dipping, weighing, vaccination, hoof-trimming, or ear-tagging. Develop a simple and efficient method of tackling the job that disturbs the goats the least and does not take up valuable staff time. Continually analyse the method used and try to improve it.

Constant attention to detail by competent motivated staff is the key to success. Keeping large numbers of goats healthy and productive is not easy and requires considerable dedication from all those involved.

## Further reading

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