Conservation tillage II
Handling and care of draught animals under Tanzanian conditions

Lars-Ove Jonsson

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Preface

Tilling the land during the dry season is only possible using oxen in good condition due to the high draught power requirement, and with appropriate implements. However, the conservation tillage technique is an easy option for most small-scale farmers with oxen if they follow simple guidelines on how to till hard soils with the right implements.

Animal drawn conservation tillage is a non-starter if the implements are not available or are in poor condition, and if the draught animals are not properly trained and/or are in poor condition. The common practices for training and using plough oxen are inadequate to achieve the proficiency required for conservation tillage. Usually, the plough oxen and their operators need additional training to be able to apply this technique properly. Conservation tillage II: Handling and care of draught animals under Tanzanian conditions covers the basic training principles for farmers and extension workers to be able to train draught cattle properly for conservation tillage. The main aim of the chapter on draught cattle training is to develop the confidence and skill of both extension staff and lead farmers to pursue application and widespread utilisation of the conservation tillage technique.

When developing this book it was evident that extension workers and farmers had poor knowledge of draught animal husbandry and they requested more training in this subject. The plough oxen hardly manage ploughing with traditional management practices, which are inadequate for oxen used in conservation tillage. Furthermore, there were additional demands for basic training on regular health checks and treatment as farmers lost too many oxen from conditions that could be easily treated/handled by the farmers. Extensions workers requested a good resource book on how to keep oxen being used for conservation tillage healthy and strong for several years to enable them assist farmers with appropriate advice under the prevailing conditions of inadequate veterinary services.
Introduction

Why animal drawn conservation tillage?

Cereal crop (maize, sorghum and millet) yields in sub-Saharan Africa have decreased due to land degradation and climate changes. One of the main causes of soil degradation and the subsequent decline in crop yield is conventional tillage using hoes or mouldboard and disc ploughs. Conventional tillage and removal of crop residues leave the soil exposed to climatic factors like wind and rain, thus encouraging runoff and soil erosion. Conservation tillage is one way of converting degraded soils into productive soils, thereby improving crop yields and reducing land degradation.

Conservation tillage is here defined as abandoning soil inversion (using the conventional mouldboard plough) in favour of alternative tillage systems that improve water infiltration and soil fertility. Conservation tillage systems solve water and soil nutrient constraints by: 1) securing maximum infiltration of rainfall where it falls; and 2) enabling efficient soil fertility management by spot application of soil nutrients.

There are many documented examples of successful conservation tillage in eastern and Southern Africa. Despite these successes, adoption among small-scale farmers in the region is low. However, commercial farmers in Zimbabwe and Tanzania have seen the potential of conservation tillage as a way to increase land productivity and reduce labour needs and production costs, especially in semi-arid areas prone to land degradation (Oldrieve, 1993).

This book is Volume 2 of the RELMA publication on animal drawn conservation tillage techniques. The importance of using conservation tillage in semi-arid areas to improve crop yields, mitigate against the effects of drought and minimise risks of crop water loss is outlined in Volume 1. The methods used to conserve soil are also highlighted in the first volume. In addition, the rationale behind smallholder farmers using conservation tillage is also given.

People who live in farming systems located in areas that are highly susceptible to drought do not practise specialised production. These people have learnt that security increases with more production activities and alternative modes of production. These minimum risk strategies are deeply rooted in the minds of farmers.
and livestock keepers and any change in their traditional practices must reduce risk and increase food security if they are to be acceptable. Therefore, when discussing improved techniques with farmers it is essential to remember that any new intervention must reduce the risks for crop water shortage. Conservation tillage is an efficient way to minimise risks of crop water stress by assuring maximum infiltration and progressively increased water-holding capacity of the soil.

The objective of the two volumes is to assist in building capacity among extension officers, farmers and other professionals to promote animal drawn conservation tillage among smallholder farmers and thus minimise risk. The reports provide a practical guide on how to introduce an appropriate animal draught power technique for conservation tillage in semi-arid areas.

A basic component of the conservation tillage described in the reports is the use of draught animals. Using draught animals is not a new concept in sub-Saharan Africa. However, the type of training needed for an animal to perform traditional farming practices is inadequate for conservation tillage. Well-trained, healthy animals are essential for successful conservation tillage. The main aim of Volume 2 is to provide guidelines on training, selection and care of draught animals. It also outlines how to perform the recommended health checks and treatments for the animals.

**Training draught animals for conservation tillage**

In eastern and Southern Africa the most commonly used practice for directing oxen is by using voice commands reinforced by whipping. Most oxen are used for tillage during the short ploughing season. They have to be retrained each year and are often weak and have a poor nutritional status at the beginning of the rains. This delays ploughing until the soil is soft and the animals have regained their strength. Although most farmers traditionally harness their animals for draught work, the type of harness used is too short to allow the animals to perform the turns required for conservation tillage.

For animal drawn conservation tillage to be successful the animals must be healthy and well trained. In contrast to traditional practice the animals are directed using commands, physical assistance using reins to move the head, routine/repetitions and rewards. Training aids are also used to achieve correct behaviour more quickly. The setting of the ox-drawn implements, their quality and condition, and how the equipment is maintained are also important for conservation tillage.

The chapter on training highlights the principles and methodology of harnessing draught animals and training them to accomplish different tasks, with specific reference to conservation tillage. The training methods described are designed especially for people not used to cattle and oxen.

The training is divided into five steps: domestication; rieming and walking; walking and yoking; pulling loads; and pulling implements. Each step includes a small number of commands and behaviours taught to the animals through repetition. The trainer moves to the next step only when the animal has fully mastered the previous one. Training should follow a strict schedule until all the animals become accustomed to a routine. Rewarding animals when they accomplish a task encourages them to repeat the good behaviour.

**Selection and care of draught animals**

Ideally, larger animals should be used for draught as they can perform more work since about 10% of their weight can be transferred to draught power. Males are therefore the preferred choice as they are generally larger than female animals. Cows are not as strong as oxen and need good care to maintain reproductive efficiency but their main advantage is that they can produce milk and calves as well as draught power. However, most farmers do not own specialised work animals. Larger animals cost more than smaller ones, need more feed and are usually crossbreds of temperate breeds, which may not be as well adapted to prevailing conditions as the smaller local breeds are. Furthermore, draught animals often have multiple socio-economic
functions therefore many smaller animals are more useful to smallholder farmers in terms of economic flexibility. Changing the tradition of owning many smaller animals needs to be handled with care. The size of animals is often closely related to the environment. Animals of the same local breed raised on a research station are generally larger. This suggests that much can be done to improve size by improving village management, a better option than changing the type of animals kept. Other factors that are important when selecting draught animals are conformation (shape of an animal’s body), temperament, and age/weight ratio. Bulls generally become more aggressive as they age so castration is recommended for draught animals.

Working animals are valuable assets for farmers and therefore need to be taken care of. Proper management and careful husbandry reduce health problems. Simple attention to animal condition, feeding and provision of adequate water is basic to maintaining healthy animals that can work well. When animals are sick or wounded and both the extension officer and the farmer cannot deal with the situation, the animals are slaughtered.

Farmers should keep a regular routine for grooming, health checks, watering, feeding and grazing. There should be a close relationship between working animal and farmer, cultivated by the farmer talking to and grooming the animals. It is during the daily grooming that the animal should be checked for general fitness. Watching the animals as they feed and rest can also give an indication of their state of health. Draught work should be carried out during the early morning or in the late afternoon when it is cooler and farmers should allow at least 6 hours of grazing each day. Since animals respond well to good treatment, working animals should be kept in a simple shed that opens into a paddock where they can exercise. The shed should be well ventilated and clean.

A working animal requires enough food for maintenance, production and growth. The feed needed to provide these requirements is usually available locally and farmers should provide adequate feed to their animals to achieve the best results. Extension workers should assist farmers prepare adequate rations for the working animals using the existing fodder base. Since grazing time may not be enough, additional feed and supplementation in the form of crop residues and by-products, conserved products, specially grown fodder etc. may be used. For successful introduction of animal drawn conservation tillage, a feeding strategy that facilitates production of the required power is important. Both extension workers and farmers need to be instructed on how to adequately utilise the existing feed base.

**Health checks for working animals**

The main health problems that require treatment in working animals are specific illnesses, parasites, poisoning and wounds. These problems vary from place to place and the local veterinary services should give advice on recommended routine treatments such as deworming, vaccination and tick control. Local stockowners can also recommend management practices or traditional remedies that may help maintain the health of working cattle. Farmers who can recognise ill health and abnormal behaviour in animals can often prevent minor problems becoming major ones.

A working animal that is ill must be rested and given food and plenty of water. It should be kept away from other animals and a veterinarian should be called if there is no improvement in condition. Draught animals are more susceptible to disease stress than non-draught animals. A combination of traditional livestock knowledge and selected animal husbandry and veterinary practices can form the basis of a strategy to minimise threats of diseases at both farm and village levels.

Animals that are docile and easier to handle are more suitable for draught work. This can be achieved by castration and dehorning. Care must be taken not to castrate an animal too early as this stunts muscular growth in the animal. Dehorning should be carried out on very young animals when it is less painful and stressful. By using this report, extension workers and farmers will learn about general wound care, disease control at farm/village level and castration, dehorning and hoof care.
1 Training draught cattle for conservation tillage

This chapter is based on field experience from Tanzania, Zimbabwe and Zambia and has been modified to suit conservation tillage systems in Tanzania. The techniques have been tried under LAMP/SCAPA conditions for four seasons and found to work well. The chapter will highlight the principles and methodology of harnessing one or a team of draught animal and training them to accomplish different tasks, with specific reference to conservation tillage.

1.1 Harnessing the draught cattle

1.1.1 Introduction

Harnessing draught cattle for work requires a yoke, a rope around the horns and/or a head collar with reins. If an implement is to be pulled a trek chain is attached as the link between the yoke and the implement. The head collar and reins reinforce the controlling commands from the operator to the head of the animals. The neck yoke is commonly used by zebu draught cattle in eastern and Southern Africa. It is a simple piece of timber, which can be used for all field operations including conservation tillage. Usually, one encounters two types of yokes. Head yokes are for attaching to the horns of the animal, while neck yokes are placed on the neck of the animals. In Tanzania, the neck yoke is the more commonly used, and this report will refer to this type throughout.

A yoke can be for one animal (single neck yoke), or a pair of animals (double neck yoke). The use of a double neck yoke is a more common practice.

This section aims to accomplish three tasks, namely:

1. Provide a description of facilities used for harnessing draught animals, with specific reference to the neck yoke.
2. Describe the field application of different yokes for conservation tillage operations.
3. Describe the basic traction system for conservation tillage.

1.1.2 The yoke and trek chain

The main purpose of the yoke is to pair the animals at a specified distance apart for a particular job. Figure 10.1 shows a typical double yoke, complete with a trek chain. The trek chain links the yoke to the implement to be pulled. It is normally 290 cm long, when used for ploughing. This length is sufficient to allow free movements of the hind legs without hitting the implement when turning on the headlands or working across the land. However, this length is too short for deeper penetration of implements like the ripper. Such implements require a longer chain to work deep enough. Therefore, the ripper is equipped with an extra piece of chain of 1 m to ensure correct chain length. Another option is to use one-and-a-half trek chains.

The trek chain can be substituted with locally made twined sisal ropes or leather straps. These can be made sufficiently strong and long lasting for a fraction of the cost of a chain. There is no need for clamps when using a rope.

Yokes are measured in terms of the distance between the centres of the necks of the paired oxen. This distance is often referred to as Dyoke and it defines the type of yoke and the operation that can be carried out. The normal standard yokes have the following Dyoke specifications:

- Ploughing yoke \(D_p\) = 75-90 cm
- Ripping/ridging/planting/weeding yoke \(D_r\) = 150 cm
- Cart yoke \(D_c\) = wheel width.
1.1.3 The Skies

Skies are pieces of wood, ranging in length between 50 cm and 60 cm, and shaped to fit into slots in the yoke pole. Figure 10.1 shows skies placed at each end of a double yoke to fit on to the necks of the draught cattle. The skies keep the animals at the required distance from each other and stop the yoke from moving forward. They have notches on the outer side to hold the looped ends of the straps which tie the yoke to the neck. Skies are designed with stoppers at the end, which prevents them from falling through the holes in the yoke. The thickness of the long thin part should not be less than 1.8 cm to withstand rough handling. The holes in the yoke pole should be slightly bigger than the thickness of the skies.

1.1.4 Contact surface of the yoke

An untrained ox has a thin and soft skin on the neck. This thin neck skin is sensitive to abrasion and easily forms wounds from the yoke. A simple blister can take weeks to heal and will prevent the ox from working for a longer period. This situation is also common with plough oxen, since they are used for shorter working periods. When the animals get used to work the neck skin gets thicker, stronger and less sensitive. Every draught animal needs a hardening period, not only to train its muscles for heavy duties, but also to toughen the neck skin.

The area on the yoke in contact with the neck can be shaped appropriately to increase the contact surface on the neck. Usually, it is the pain caused by pressure on the neck that determines the maximum pulling force. The smaller the contact surface, the quicker the pain limit is reached. A smooth curved and enlarged contact area makes the yoke more comfortable, reduces the risk of wounds and raises the maximum pulling force. The increase in contact surface is particularly important with heavy work like ripping, sub-soiling and split ridging. Draught animals used throughout the year are often fit for heavy work providing they are well fed and groomed.

1.1.5 Description of the common yokes

The single neck yoke

These are yokes for use by a single animal, usually for such tasks as light transport and weeding. Figure 10.2 is a simple drawing of this type of yoke. They need two treck chains and a single tree attached to the implement being pulled. It is possible to have two animals in line, one in front of the other (Figure 10.2). This is particularly useful for late weeding of tall crops.
Figure 1.2 A single yoke and the power train (showing standard measurements in cm).

The double neck yoke
Figure 1.3 shows the design and standard measurements of a typical double yoke, complete with skies. The diameter of the yoke shaft depends on the length of the pole and the draught power required. The recommended diameter for a ripper yoke working at 75 cm row width is 8 cm. The diameter can be slightly less for a shorter ploughing yoke and slightly more for a long weeding yoke.

Figure 1.3 Standard design and measurements of a double yoke with skies (cm).

The major determining factor of the length of a yoke is the distance between the centres of the necks of the draught animal ($D_{yoke}$). Another important factor is the row width, which is known as $D_{row}$. The minimum distance of $D_{yoke}$ should be determined by a minimum distance of 25 cm between the bellies of the draught cattle when ploughing. If less the trek chain will rub continuously on their belly skin and cause injuries. With animals with small bellies, $D_{yoke}$ can go down to 75 cm but usually, 90 cm is recommended for larger oxen as the standard $D_{yoke}$ for ploughing. When ripping, the chain will be straight in the middle between the oxen and therefore it might be possible to use 75 cm as $D_{yoke}$ even with larger animals. In addition to $D_{yoke}$, one has to add 30 cm on each side to get the full length of the yoke pole. The length ($L$) of the pole of a double yoke should not be shorter than 135 cm.

The cart yoke
Most farmers have only a ploughing yoke. This yoke restricts the ability of oxen to turn a cart easily, as the pulling beam will rub against their sides. A longer yoke increases the manoeuvring ability. An old recommendation is to use a yoke with a $D_c$ equal to the wheel width (Figure 1.4), as this reduces the risk of the cart being stuck in holes or on stones, stumps and trees. Generally, a yoke with $D_c = 150$ cm fits most ox carts well.
1.1.6 Making a double neck yoke

The poles chosen for making the yoke should be light, strong, straight and free from too many knots. The following trees are suitable for making yokes:

- *Cordia africana* (mringaringa)
- *Senna seamea* (mjohoro, mwekundu)
- *Comberutum* spp. (mlama, kimaroro)
- Mriorio or msingilimo
- *Grevilia robusta* (mierezi)
- *Eucalyptus* spp. (mikaratusi)
- *Acacia* spp. (migunga)
- Mguaguasa.

The piece of timber selected should be 8 to 10 cm in diameter. The pole length required must be 60 cm longer than the \( D_{\text{yoke}} \) (hence a weeding yoke of 150 cm, for example, will require a pole of about 210 cm). Four additional pieces of 60 cm will also be needed for the pegs (skies).

Poles should normally be dried before making the yoke. However, an undried timber may be used after being treated in one of two ways:

1. The bark is removed and the pole trimmed. Oil is then applied to the end parts to prevent uneven drying and splitting.
2. The wet timber may be dried on fire, by placing it lightly above a flame. The bark is then removed after the burning process.

The bark may be removed (separated from the wood) by hammering along the length of the pole. Peel off the bark and trim the pole with an axe, removing any knots and reducing the diameter to between 7.5 and 8 cm.

Draw a centre line along the length of the yoke pole and mark the middle point. From the centre mark, measure \( D_{\text{yoke}} \) cm to either side. These two marks, known as the neck marks, will be exactly over the animals’ shoulders. The distance between them is \( D_{\text{yoke}} \).

Depending on the thickness of the draught animals’ necks, measure and mark a length of between 10 and 11 cm on either side of the neck marks. These marks must be on the centre line of the pole. Add another 7.5 cm. Then add 1 cm on each side of the centre line and mark a square of 2 cm x 7.5 cm for the skies. There should be four square markings of this size on each yoke.
Use a timber auger with a diameter of 2 cm or less to drill one hole through one of the marked peg slots. Secure the position of the yoke by placing a metal rod through the hole and hammering it into the ground so that the pole cannot rotate. Drill three straight holes per slot, all parallel to the first hole. Then use a mallet and chisel to remove the remaining wood (care is needed to make a good well fitting yoke). Smooth off the edges of the peg holes with a file and sandpaper.

Shape the four skies according to Figure 1.3. It is essential that they fit well into the slots and that they can be moved freely.

1.1.7 Yokes used in tillage operations

This section gives a brief description of the field application of different yokes and their use in different ox-drawn conservation tillage implements. The commonly used practice of directing the oxen by voice commands, reinforced by whipping, dominates in eastern and Southern Africa. Most oxen are used for tillage during the short ploughing season only. Such oxen are referred to as plough oxen in this report. These animals have to be retrained every year. Usually, the oxen are weak and have a poor nutritional status at the onset of the rain. This tends to delay ploughing until the soil is moist and soft and the oxen have regained strength.

Conservation tillage requires a professional attitude towards training both the farmers and draught animals in the use of improved implements. This can easily be achieved within the means of most farmers, as they require just a small amount of time and a better approach to preparing the draught animals in appropriate tillage operations.

**Plough yoke used for ploughing**

Figure 1.5 shows a pair of oxen pulling a plough. Almost all ploughs do not have the depth/width adjustment. The operator has to direct the plough using his own muscular power, with the help of the plough wheel. One ox walks in the furrow while the other walks on the headland. There may be hesitation when attempts are made to change the oxen positions.

![Figure 1.5 Plough yoke used for ploughing.](image)

The operator is often assisted by one or two people who direct and whip the oxen as they work. The need for these extra people is dependent on the skill of the operator and how well the oxen are trained. As long as the soil is turned there is no need to improve the system according to most farmers.

Figure 1.5 also illustrates a typical root formation of old crops or weeds in ploughed land. The shape of the roots gives a simple, fast and accurate demonstration of the presence and degree of a sub-surface hardpan, such as those formed by continuous ploughing to a certain depth. The occurrence of ploughpans can easily be detected by examining the shape and length of plant roots.
**Plough yoke used for ripping**
The ploughing yoke can also be used for close ripping. Like in ploughing, one ox walks in the furrow while the other one moves in the headland. This works satisfactorily if the field is worked as when ploughing. The distance between the ripping lines should be 45 cm (Figure 1.6).

![Figure 1.6 Ripping with a short plough yoke.](image1)

The fields will have low ridges as a result of ripping. The speed of ripping is double that of ox ploughing, with a cutting width of 20–25 cm. For more effective weed control one can split a ridge after the first ripping and then continue from this furrow over the field to get a more thorough coverage. An alternative is ripping cross-wise where land is flat.

The ploughing yoke can also be used for planting with a ripper with a row width of 45 cm for crops like beans, green gram, groundnuts etc. Seeds are dropped in the ripper furrow. If the animals (oxen or donkeys) are well trained, it is possible to weed at this row space with a ripper with short wings and a rudder. Care should be taken to avoid damaging the crop roots.

**Ploughing yoke used for split ridging and deep ripping with ripper/ridger**
A ploughing yoke can also be used for split ridging (Figure 1.7). This means splitting an old ridge and building a new one between the old ridges. This is an old technique used for covering crop residue/weeds between rows. This split ridging technique can also be used for harvesting different root crops, such as potatoes and groundnuts. The oxen are made to walk on each side of the old ridge. If done before the weeds grow too big, this operation is a fast and effective system of primary tillage. With row spacing of 75 cm this operation is three times faster than ploughing. This is an important factor when early planting on ridges is desired.

The plough yoke can also be used for deepening a ripper furrow. The oxen walk on each side of the old ripper line enabling the ripper to work in the same line. In this way it is possible for even small animals to do deep ripping.

The ripper/ridger can be equipped with a rudder to ensure that this operation stays in the middle of the old ridge.

![Figure 1.7 Split ridging with ripper/ridger with extended wings.](image2)
The ripper/ridger/planting/weeding yoke
The principles for ripping, planting and ridging are shown in Figure 10.8. The standard yoke has a $D_y$ of 150 cm, giving a row width of 75 cm. This yoke is a key component in the conservation tillage system, as it opens up the possibility for doing ripping, ridging, planting and weeding with oxen. It is a simple piece of wood but it requires a more skilled approach in terms of directing the draught animals and using the implements. There are three features of this yoke, namely:

1. The yoke is longer and most oxen that are used to the shorter ploughing yoke get confused as they become more separated from their pairing partner. There are also differences in the techniques for pulling. The long yoke requires an even pull (whereas this is less important with the short ploughing yoke). An uneven pull makes the oxen move sideways, thus making fieldwork difficult.

2. The oxen must be able to shift on command without hesitation from working in the furrow to working on the headland and vice versa.

3. Working along contours, ridging, planting and weeding require full control in directing the oxen. Any deviation from the desired course may affect the flow of water along the field. Further, a pair of oxen, which cannot follow the rows, may rip off the crops. The common practice of commanding plough oxen by voice only limits the scope for other operations.

With conservation tillage the operator must be able to direct and control the draught animals as he wants. The easiest way to direct a pair of oxen is training them to follow a leader. This can be a child holding a rope tied to the head/horns of the oxen. Another system is using steering reins tied to halters. A confusing factor is that most plough oxen in Tanzania are trained to stop when somebody is in front. It will take some effort to retrain them to follow the leader in front instead of stopping.

The listed factors are simple to practise. However, they pose serious obstacles in getting plough oxen to pull tillage implements in a desired way if neglected.

**Ripping, planting and ridging operations**
When ripping or planting, one ox follows the previous row. This means that there will be 75 cm between the rows. Rows will be parallel if the previous row was straight or if operations followed the contour. On turning at the other end of the field, the oxen change position and the other ox follows the previous row. In this way a system for precision tillage is easily applied. When planting according to this system there will be parallel crop rows, which is an important requirement in ox-mechanised weeding. Seeds can either be dropped by hand behind the ripper or by a planter unit attached to the ripper. It is important to ensure that seeds are properly covered.

![Figure 1.8 Ripping, planting, ridging, and weeding using a ripper and a ripper yoke.](image-url)
The basic ripper may be equipped with extended wings for purposes of building new or larger ridges. The same principles are applied to ripping and planting. Early ripping, down to a depth of 25 cm, is recommended before the rains, as maximum macro-pores are formed in dry soils, thus ensuring good infiltration and deep roots. This can be a difficult job for starving oxen. Therefore, it is advisable to feed the oxen properly during the dry season, and to use two pairs of oxen for this operation if possible. This can easily be arranged if two farmers (each having a pair of oxen) share animals and combine operations. Another alternative is several turns in the same rip line.

The ridger can work in fields covered with crop residue. However, if the residue is thick, it can be arranged in rows with sticks to enable the ripper to work in between. Further, in areas with short rainy periods, it is recommended to plant directly with a ripper before or at the onset of the rain without prior tillage. When the seeds have germinated it is essential to start weeding with a ripper/ridger between the rows as soon as possible. This is generally the only tillage operation required to establish and weed the crop.

A shorter yoke of \( D_{\text{yoke}} = 120 \) cm is suitable for beans. \( D_{\text{yoke}} = 180 \) cm is used when a row width of 90 cm is desired.

The effect of breaking the hardpan by ripping is illustrated in Figure 10.8. Roots will grow deep through the cracked pans. There are reports in Tanzania that maize roots in good soils can grow to a depth of 3.5 m (Acland, 1971). However, a higher depth for maize roots of 2 m can be achieved under good farming conditions. Such a deep root penetration enables the crop to tap a large volume of water and nutrients.

A drawback with planting on ridges is the often-observed reduced moisture on the raised ridge. This makes the cropping system more susceptible to drought, leading to poor emergence and crop establishment. However, this problem can be overcome by splitting the top of the ridge with the ripper fitted with the short wings (see Figure 1.7). In this way the farmer gets a furrow on top of the ridge, which effectively catches water during the drought-sensitive early stage until the new crop roots develop.

It must be recognised that this fine splitting of the ridge is also a weeding operation. Another advantage is the possibility to place both fertilisers and farmyard manure just around the plant. When the new plant has emerged and is about 10–20 cm high, the ridge is hilled up and the furrow closed. A ploughing yoke (preferably a \( D_{\text{yoke}} \) of 75 cm) is recommended for this operation.

**Weeding**

Figure 10.8 also shows a weeding operation, using the ripper/ridger. It is easy to train the oxen to walk between parallel crop rows. In principle the system is the same as with ripping. When weeding with a ripper/ridger one gradually builds up ridges. During this process the young weed plants are damaged and covered by soil. The chisel point goes deep, ensuring good infiltration in the furrow bottom. Some hand weeding might be required to clean the weeds growing close to the crop row. In addition to good rainwater infiltration, ridge formation gives good protection against erosion, provided such ridges are formed along the contours. However, if ridges do not follow the contour, then these operations can, themselves, be a source of both large water loss and serious erosion.

**Rebuilding old ridges**

No-till tied ridging is a conservation tillage system developed in Zimbabwe for semi-arid areas short of crop residue (Elwell, 1998; Nyagumbu, 1998). This system has a potential in Tanzania too. It is based on maintaining the same ridges over several seasons. The only tillage required is hilling up the old ridges every year, as they had been lowered during harvest and post-harvest grazing.

Tied ridging is practised for maximum rainwater infiltration and to avoid runoff, particularly close to depressions in the fields between contours. An apparent weakness with the Zimbabwe system is that the ridges are formed using the ox plough. The system of reforming ridges is the same as with weeding in Figure 1.8.
Sub-soiling
A row space of 75 cm is sufficient for ox-drawn sub-soiling. This means that the system described in Figure 10.8 fits well also with sub-soiling. This implement described previously in Figure 10.2 can go down to a depth of 30 cm. The effect will be best under dry conditions. It is recommended to use two pairs of oxen for this operation.

Other operations
It is possible to do split ridging with a longer yoke. In this case, the yoke has to be three times longer than the row width (3 x $D_R$). A heavy pull with an exceptionally long yoke is more difficult than with a ploughing yoke (Figure 10.7). A long yoke can also be used for weeding in more narrowly spaced crops then the length has to be 4 x $D_R$ (Figure 1.9).

![Figure 1.9 Examples of extra-long yokes.](image)

1.1.8 Other accessories used in harnessing and controlling draught animals

The clamp
There are many ways to attach a treck chain, a rope or a draw bar to a yoke. The main principle should be to avoid the use of welding, threads and nuts as these complicate things for village manufacture and repair people. Figure 1.3 gives an example of a simple but strong system for fixing a clamp to the yoke. As we are dealing with precision tillage, it is essential that the clamp be fitted to the centre of the yoke and that it has the right angle for pulling. The right angle will avoid the skies turning upwards when being pulled, which will disturb the animals.

Take a rope and turn it around the pole in the middle of the yoke and measure the circumferences. Mark that distance on the rope. Fold the distance rope in four equally long parts and mark the quarter distance on both sides of the centre line. Add 2.5 cm above this mark on one side and 2.5 cm below on the other side. Measure the distance of 5 cm to either side of the new marks in the middle of the yoke. Drill from the higher marks through the centre of the pole through to the lower marks. This means that the clamp will have a pulling angle of 35° and the skies will remain in the correct position during work.

Figure 1.3 also shows a simple clamp from a U-bolt (diameter 12 mm) with the ends bent to hooks. This system is well suited for precision tillage work, as the chain must be hooked to the middle of any yoke. The clamp is made from an iron bar with a diameter of 12 mm x 44 cm length. Mark the middle of the bar and bend it around the yoke pole. Fit the ends through the lower clamp hole and hammer it into position. Then bend the ends outwards through hammering according to the drawing.

When making a standard clamp for an ox-cart, the hole is drilled in the same direction as the skies. Usually the U-clamp is fitted at the bottom part. However, there are a number of rather complicated methods to attach the draw bar of a scotch-cart to a yoke. Ropes or leather straps are simple and sufficiently strong if properly tied. Usually it is enough to make a groove around the draw bar so the rope or leather straps cannot slip out of place when tied.
Draught animals do not always pull with equal force all the time. Naturally, one animal can be stronger than the other. However, the force of pull can be balanced by varying the hitch point. If the trek chain is attached in the centre, a pair of oxen will equally share the strain of pulling a load. When the trek chain is moved to one side, the load is increased on that side. Thus a stronger animal can be given a bigger share of the load if necessary. This is no problem while ploughing but for precision work, offsetting the hitch is a complicating factor. Therefore, there has to be more care in selecting the right size of oxen and in training them to pull evenly.

The head collar
The head collar can easily be made from leather straps derived from raw hides (these are called riems). Figure 1.10 describes the different steps for making a collar. Proceed as follows (see Figure 1.10):

1. Cut a rein of approximately 2 m.
2. Make an eye at one end of the riem. Make two short cuts at the end of the riem. Slip this end of the riem through the second cut (a) and then pull the riem through the fist cut (b and c).
3. Measure the circumference of the nose of your cattle. Make the centre put of the riem and fit it around the animal's nose. Hold where the riems meet under the chin. Remove the loop and slit the riem at appropriate places as shown in the illustration (Figure 1.10).
4. Complete the nose loop. Twist the ends of the riem around the nose loop and pass them through the side slits. Tie a simple knot of the riem ends on the outer side of the neck to hold the head collar in position. Make sure that you have a left and a right collar. For the comfort of the animal the loop around the nose must be one hand's width above the nostrils and it should be possible to fit three fingers underneath. This will prevent the animal from eating grass/crops when fitted with the halter.

![Figure 1.10 Steps for making a head collar of leather straps.](image)

The coupling
The coupling is a 4 m piece of 3–8 mm thick rope or leather strap, which connects the head collars of the draught animals under the same yoke. The coupling is looped through the nose loop of the head collars and knotted in the centre. It must be long enough, when tied, to allow the animals to look straight ahead. This will ensure that the heads will move in a parallel direction when a command is given. Figure 1.11 shows in steps the procedure for tying the coupling. The remaining loose ends may be tied lightly to the yoke shaft. If needed, they can be used for leading the animals.

Steering reins
The steering rein is a rope, or a thin leather strap riem of

![Figure 1.11 The two steps for tying a knot for the coupling.](image)
about 8–10 mm thick and a standard length of 15 m. It is used for ripping. It forms a loop behind the pair of draught animals with the ends tied to the outside of each halter passing through holes on the end of the yoke pole (Figure 1.12). The reins are attached with slipknots. The holes should be enlarged at the ends and be well greased to reduce wear.

The farmer walks behind the animals holding the rein with an extra loop drawn over his shoulder. To be able to use both the rein and to control the implement, the operator (farmer) adjusts the length so that the rein rests behind the back. Under normal circumstances, there is no need to have somebody leading the oxen when reins are used. This is only the case during the initial training period or when oxen are poorly trained.

### 1.1.9 Directing the draught animals

Animals tend to follow their heads when moving. Subsequently, control of their heads will result in control over their body direction. If one connects a head collar with steering reins, it is possible to direct a draught animal from behind with good precision. By pulling on the left rein it will turn left and by pulling on the right rein it will turn to the right. By pulling both reins it will slow down or stop depending on the force exerted in the pull. When there is no pulling in the head collar, the animal will move straight forward.

The same system can be used with a pair of oxen. Instead of having four reins, a link (coupling) is placed in between the head collars, as shown in Figure 1.13. When pulled to the left rein, the animal on the left will move his head towards left. The coupling will then move the head of the animal on the right hand side also to the left. In this way both animals are commanded or controlled to move to the left. The same procedure can be applied to turning to the right. When pulling both reins the coupling will be stretched as the heads move in opposite directions and this will instruct the animals to slow down or stop.

![Head collar with steering rein](image1)

With a combination of words and use of reins, one operator can exercise full control over a pair of draught cattle in a manner that is superior to the traditional system involving 2 of 3 people. Thus, three people with a pair of oxen each, using steering reins, can work an area of at least 3 to 4 times bigger than in a system of one pair with three people.

Steering reins can be made out of leather straps or ropes. They go from the operator, behind the implement, through the yoke to the head collars of the draught cattle.
1.2 Basic principles of training

1.2.1 Introduction

The training messages in this chapter are directed to village extension workers. These workers then become the main trainers and promoters of the animal drawn conservation tillage technique in their villages and other jurisdictions. Quite often these village extension workers are inadequately trained in the subject of training draught animals for precision tillage. Plough oxen are only semi-trained for precision work like ripping, planting and weeding. It is essential to develop their knowledge and skill in disseminating appropriate techniques. The objective of this report is to serve as a source of information and a guide for successful draught animal training.

Usually only experienced ox trainers can deal with semi-wild animals using traditional training methods. Extension workers with little draught animal experience will naturally shy away from giving practical advice in this field. Most likely they will come up with all kind of reasons or excuses why they should not deal with draught animals. This is a weakness in their previous agricultural training and is understandable. The training methods described in this report are designed particularly for people, both men and women, not used to cattle and oxen.

Any extension worker must be capable of performing the recommended steps of training. They must be able to demonstrate these steps properly to ox trainers/farmers/craftsmen. A teacher, instructor or extension worker will definitely fail to promote a new or improved technique if he/she cannot demonstrate it in a convincing manner. Very few extension workers/ox trainers/farmers/craftsmen will follow advice from a person who cannot do what he/she tells others to do.

The steps described are also meant for the training of the trainers at different levels. Experienced ox trainers might modify the procedures a bit but this is not important at this stage as we will concentrate on the basic principles starting with semi-wild steers.

When the farmer has completed the selection process, he has a number of cattle that he judges to have the potential for draught work. Training is the next stage necessary to develop that potential so the draught animal can perform the desired operations efficiently and obediently. The behaviour of cattle will change following training. Well-trained animals carry out field operations accurately. They are easy to control and can pull heavy loads for long periods. They are well balanced, strong and consistent in their movements. They co-operate well with both the operator and the other animals in the span.

To successfully train draught cattle, the extension workers, ox trainers, farmers and craftsmen should follow some basic principles. These principles, developed in this report, are based on the LAMP/SCAPA experience. They differ substantially from the common practices of training plough oxen. The LAMP/SCAPA system covers more operations and produces more obedient and versatile draught animals. The key features of the training procedure described here are:

- The programme is built up systematically and divided into steps
- The draught animals are given enough time to fully adapt to each step
- The draught cattle are not used for fieldwork until they have learned all the draught work training steps properly and are under full control of the trainer/operator

Initially, most draught animal training for conservation tillage is the simple upgrading of the skills of the existing plough oxen. This means that the animals already have some training on how to pull a plough. In this way it is possible to go through some of the training procedures more quickly than with untrained young steers. However, to avoid confusion, the training procedure is based on semi-wild young steers, and inexperienced district extension workers as potential trainers in animal drawn conservation tillage techniques.
The village extension worker should be able to arrange and implement training of the different steps of improved draught animal training for conservation tillage. He/she should also make sure that the traditional methods are improved along the recommended principles. The basic approach should be to train the farmers how to train the oxen. The number of operations the oxen are used for will give a good indication of how well the village extension worker has managed to introduce the improved ox-training technique. The number of female farmers using oxen is also an important factor when determining progress. Furthermore, the area weeded by oxen is a top priority question when determining the success of ox training.

There are six basic principles of training that aim at reducing fear and uncertainty in the cattle when strange people, new behaviour, noise and implements confront them. These principles are also important guidelines for people who are not used to cattle and oxen:

1. The trainer’s approach must be calm, firm, patient and consistent.
2. Routines and repetition of training steps must be strictly followed when training the animals in new behaviour.
3. Rewards reinforce correct behaviour. Any positive effort made by the cattle during training must be rewarded in some way, such as praise words (animal’s name…very good!), a short break or an offer of food. Incorrect behaviour is not rewarded but should be corrected immediately. In this way correct behaviour will become more desirable to the animal.
4. Completion of a step in the training programme must be achieved before progressing to the next step.
5. Training aids should be used to achieve a training objective and then they should be discarded.
6. Spoken commands should be few, simple, logical and in one language.

Before going further it is useful to discuss the existing methods of training draught animals in your area and compare them with the principles above. What is your opinion on tying an untrained animal together with a trained ox and letting the trained cattle teach the untrained? Who trains oxen and how long should it take to train a pair?

### 1.2.2 Trainer’s approach

The trainer’s approach to the draught animals is the most important factor in the success of a training programme. Some people have a natural gift to approach and handle animals correctly. Those who do not have the ability can in most cases learn how to deal with cattle professionally. The main principles are:

1. You must appear calm and unhurried. Sudden movements and unnecessary noise will startle them. Prevent excitement in the animals so they do not run away or attack. Mind your voice.
2. You must be patient. Training must not be rushed. The cattle need sufficient time to learn new behaviour and only when they have adopted the new routine can they go on to the next exercise.
3. You must be firm. The trainer must exert authority over the cattle in order to control them. But recognise that firmness does not mean bullying, beating and harsh words.
4. You must be consistent. Each series of exercises must be carried out in the same way every day because any break or changes in the repetition of routines will confuse the animal and interrupt the learning process.

The same procedures must be applied when using the draught animals for fieldwork. Both the ox trainer and the operator, if they are different, must stick to the same principles. There are numerous examples where well-trained animals stop working because the operator is dealing with them in a manner quite different from the way they (animals) were trained. Many often consider beating the best method to make the animals obedient again. In most cases it has an opposite effect.

### 1.2.3 Routines and repetitions

Animals can only learn through repetition and routine. For instance, if we want an animal to respond to the command “move” by starting to walk, we initially have to force it physically to start walking, while we say the command at the same time. The physical assistance accompanying the verbal command may include pulling
a rope around the horns, tapping on the hind legs with a stick or tying a previously trained animal to a young one. This physical assistance will be reduced as the animal progresses. Soon we may only have to give a slight push from behind or flick the reins against the belly. Ultimately, the animal will move when merely hearing the command. This principle of repeating tirelessly a certain activity is used throughout the training programme.

1.2.4 Rewarding the animal

By rewarding an animal when it performs well, the trainer encourages it to repeat the good behaviour. As mentioned earlier, a reward can a simple soothing word, patting, short breaks during work or an offer of food/water. Reward any positive effort of your animals. By doing so you will rarely have to punish them because they will know they are doing something wrong if there is no reward. If, however, the animal does wrong, the misbehaviour has to be corrected immediately.

An animal taught to react to rewards will often behave negatively if forced by beating and other unpleasant ways of making it work. You will in this way develop an animal that is ready to get revenge when the opportunity occurs.

What is the common practice in your area concerning reward/punishment of the oxen?

1.2.5 Completion of training steps

The training programme is divided into five logical steps. Each step includes a small number of commands and behaviours which the trainer should be able to train the animal to do in a few days. This is done by repeating the procedure over and over again during the training period. The training steps follow each other in a given order. Only when the animals have fully mastered one step does the trainer move to the next one. Also the trainer must be fully conversant with the technique before going further. Wrong order, interruptions, or too many new situations will confuse the animals.

The five training steps are:

1. Domestication.
2. Rieming and walking.
3. Walking and yoking.
4. Pulling loads.
5. Pulling implements.

To train the cattle effectively, the trainer/farmer/operator should follow a strict schedule. This will enable the cattle to become accustomed to a routine. Recognise that special ox trainers are temporary positions. The job they do should be taken over by the farmers as soon as possible. Every farmer, with some few exceptions, should be able to train his/her oxen in conservation tillage without outside assistance. Table 1.1 shows the place of training, hours needed per day and normal duration of each training step. The objective is to produce a pair of draught animals to be controlled by one person to a point where the animal will be able to do all major field and farm operations, including ripping, ridging, weeding, planting and transporting. The starting point in Table 1.1 is semi-wild steers and inexperienced trainers.
Table 1.1 Duration and place of the steps of training draught animals

<table>
<thead>
<tr>
<th>Training steps</th>
<th>Training place</th>
<th>Hours/day</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Domestication</td>
<td>Kraal/stock</td>
<td>3–4 hours/day in the cooler early morning hours</td>
<td>1–3 days</td>
</tr>
<tr>
<td>2. Rieming and walking</td>
<td>Start in kraal/stock, then move into fenced paddock or confined open area</td>
<td>1–3 days</td>
<td></td>
</tr>
<tr>
<td>3. Walking and yoking</td>
<td></td>
<td>3–6 days</td>
<td></td>
</tr>
<tr>
<td>4. Pulling loads</td>
<td>Open fields</td>
<td>7–14 days</td>
<td></td>
</tr>
<tr>
<td>5. Pulling implements</td>
<td>Open fields (uncultivated/cultivated) and roads</td>
<td>4–7 days</td>
<td></td>
</tr>
</tbody>
</table>

In many areas there is a belief among many people that an ox is trained when he can pull a log or a plough and be directed roughly by 2–3 people with sticks. Such oxen can only be described as being in a breaking-in phase and the real training has not yet started. It should be the result wanted which should determine training duration and methods.

Many people might argue that the scheduled given in Table 1.1 allots too much time on training. However, if one considers an average working life of 5 to 7 years for an ox, the days proposed in Table 1.1 are only a fraction of the total service time that is given by an ox to a farmer. The extra cost will be repaid several times in only 1 year. Moreover, this extra cost and time spent in training might mean the difference between 5 acres (about 2 ha) of poorly weeded maize and 5 acres of well-weeded maize. It might mean the difference between poor and good crop yields.

In areas where traditional ox training methods are used some of the proposed methods might be considered unnecessary. That might be true if the intention is not to go beyond rough ox ploughing. As it is the policy of the Government of Tanzania to ox-mechanise all major field operations and road transport, the Agricultural Extension Service must start considering how to improve the traditional methods to meet the demands of proper application of conservation tillage. It is true that some of the traditional ox trainers can perform well with untamed animals in a short time, but it is wrong to base a large ox training programme on conservation tillage on a few master ox trainers. Instead, it should be geared towards village extension workers with little experience with cattle and oxen and the common farmers.

A more gentle and positive training method, based on rewards, is important for the inclusion of women in ox training and the use of draught animals. The old common tough systems used exclude women in most cases.

### 1.2.6 Training aids

In certain circumstances during training it might be necessary to use a training aid to help the trainer or farmer achieve correct behaviour in the cattle as quickly as possible. Training aids are used to achieve the objectives of a particular training step. These aids are not intended as essential items for permanent use. The following aids and their use should be familiar to a trainer/farmer using the improved training methods recommended by the District Agricultural Extension Service.

**Riem**

Figure 1.14 shows a riem that is used by the trainer to catch the cattle and to establish man–animal contact. This riem is 4 m long and is formed into a loop by putting one end through an eye in the other end.
Figure 1.14  Riem on a stick.
The loop is passed over the animal’s head and tightened around the base of the horns or neck by pulling the end of the riem. The free end can also be used as a soft whip. A 3 m long light stick is used to support the loop of the riem if the trainer cannot go close enough to the animal to slip the loop over its horn or head by hand. With this system it is possible to catch an animal in the middle of a herd.

The riem should be wound around the stick and leave a loop big enough to go over the animal’s head. Hold the stick and the free end of the riem firmly in your hands and guide the loop around the horn or over the animal’s head. This can be done easily when the animal is moving along the side of the kraal. Keep calling the animal’s name while putting the riem on its horn or neck. When it is in position, pull the loop tight, remove the stick and put it outside the kraal.

**V-shaped single neck yoke**
Sometimes it takes longer than 2 or 3 days for an animal to accept the weight of the traditional pair yoke. In such instances, a V-shaped single neck yoke (Figure 1.15) can be used. It is fitted on to the animal’s neck and fastened with a strap which passes under the neck and fits into notches made on the sides of the yoke (Figure 1.15). Once fitted, the yoke is left on the animal during grazing or overnight until it learns to accept a proper yoke. Some people prefer to start the training with a single yoke which is left on the animal for a couple of days. They claim this reduces the risks of injuries to both animal and trainer. This system is particularly important when training women.

Figure 1.15  V-shaped single neck yoke.

**Fast yoke**
This yoke is used when yoking a young, untrained animal with an older trained ox. It is basically a plough yoke with the inner ski on the young animal’s side removed, and a riem fastened to the outer ski, passing through the free ski slot (Figure 1.16). This technique can also be used to replace (temporarily) a broken ski.
The kraal

A kraal (Figure 1.17) is used to confine new draught cattle together. It allows animals that are strangers to get used to each other. It is also useful in the first training steps, when the trainer wants the animals in a small area so they can be approached for rieming and yoking. The kraal should be strong and safe for animals. Kraals built of thorny or sharp materials are not suitable for draught animal training due to the risks of injuries of both beast and man. The ideal design involves the use of heavy poles with four rails made out of straight round timber. It is important that the rails are on the inside. Branches should be trimmed off and no sharp obstacles, such as nails or sharp timber edges, should stick out.

Not every small farm can build a proper kraal for a pair of oxen. A village can make a communal kraal and the initial training can be held there. As soon as the oxen get used to the training sessions (when they no longer run away from the trainer) the rest of the training should then transfer to the farmer’s place. Long-term training oxen and farmers away from their farms in ox-training centres is both ineffective and expensive, and it creates dependency on outside assistance.

Stock

The stock (Figure 1.18) is a simple but useful enclosure, often measuring 2 m x 2 m x 1.2 m high, which also used to get the animal used to the trainer. The animals should be taken into the stock, where they are tied, fed, patted, talked to and yoked regularly. As many young cattle have had minimum contact with human beings they are suspicious or afraid of them. In the stock the animals and the operator get used to each other at a very close range. The stock can be a separated structure or a part of the kraal.
The stock has been very popular in the LAMP ox-training programme. When a kraal proves too costly for farmers, it is always possible to use a simple stock instead. This means that the potential draught animals will have to be caught in the night *boma*, or when the cattle leave it in the morning. When training plough oxen that are already used to man, it is normally enough to use a stock. Never use harsh methods in a stock, as the animal will become frightened and may fight back. It is amazing to see how quickly big and wild steers can be tamed in a stock.

If a stock cannot be constructed, it is also possible to tie the animal to be trained with a very short riem to a pole over a day. The young steer or heifer should feel that it is trapped. First the animal will resist but it soon surrenders if the people around are nice to it. It sounds crude, but this is a very effective and soft method to break down resistance and to develop acceptance and even dependency on the human. However, the course participants in the LAMP ox-training programme preferred the stock to the pole system.

**A leader**

It might be necessary to have an extra person, besides the trainer, leading an animal to help control the cattle being trained. Such a leader walks in front of the team (Figure 1.19). In the first stage a riem should be tied around the horns or necks of the animals. The use of riems is changed to coupling as the animals become more docile. It must be recognised that the leader is considered a temporary person. The draught animal should not be taught to follow a person, but to take instruction from the operator following from behind. However, in countries like Zambia and Zimbabwe it is common practice to have a leader permanently in front of the oxen leading them.
Older trained oxen paired with young untrained oxen

It is common to use older trained animals with untrained ones. The older animals could be present in the kraal from the beginning since they have a soothing effect on the younger ones. Usually, as they are bigger, they will be the natural leaders and the younger animals will follow them. They are particularly useful during the yoking and walking steps (Figure 1.20). When an older, trained animal is paired with a younger one the younger animal soon learns to follow the older one. This is also a good system to connect voice commands with action. A pair of older animals can also be hitched in front of an inexperienced pair as leaders to prevent overworking and to set the working pace.

![Figure 1.20](image1.jpg)

Figure 1.20 An older trained ox paired with an untrained steer.

Fence

A fence is a useful training aid. It can be used to control the direction in which cattle move when they practice walking (Figure 1.21). Sometimes a line of trees, poles or a hedge can perform the same function; ditches along a road can also have the same function. The main principle is that there should be a natural obstruction to walking sideways.

![Figure 1.21](image2.jpg)

Figure 1.21 Oxen following a fence.

Logs

Logs are used as the first training aids when teaching the animal to pull a load. The logs should range from 15 to 50 kg in weight and should be attached to the yoke with a treck chain or rope (Figure 1.22). Using logs of specified weight allows for gradual systematic development of the animal’s draught power, like muscles and hardness of the neck. One can connect several logs at a time if need be. A sledge which can be loaded is a good alternative to logs.
**Lines of pegs**

Pegs hammered into the ground in parallel lines can be used to represent a row crop at different spacing to guide the pair under training (Figure 1.23). The pegged line is a distinct feature understood in a similar manner to a row. The pegs should be at least 1 m long to be seen properly. If animals belonging to different people are grouped together during training it is worthwhile to have a more permanent set-up of pegged lines.

**Spoken commands**

Before the training starts, the trainer/farmer should be conversant with the training aids described in Section 1.2.6 and know how to use them properly. It is important to combine their use with proper commands. Spoken commands are important during training and all through future work with the animal. By repeating a command in combination with certain signals on the steering reins or a training aid the trainer will teach the draught animal to recognise the words of the command and respond correctly to the spoken directives.

Commands are one or two short words that differ sufficiently from each other to be easily distinguished. Use a common language to make it possible to exchange animals. It will cause a lot of confusion if two animals put together are taught different commands.

The number of commands should be kept to a minimum but be enough to carry out the field operations required. Animals cannot remember a large number of phrases.

When giving commands to a particular animal, the trainer must start with the name and then the command. For example, if the animal’s name is Bibo, and the wish of the trainer/operator is for Bibo to go into the furrow, a simple command would be “Bibo, Furrow!” However, the animal name must be dropped when commanding a pair or a span.

Below is a list of examples of possible basic commands in English, which could be translated to the local vernacular if wanted. The words mentioned are just examples. The trainer can choose any he/she finds...
appropriate providing they are clearly distinctive and logical. Whistling and click sounds can also be used. If there is a tradition to use any specific type of commands there is hardly any need to impose a change. The intensity of the spoken word will also indicate the strength of the command.

Table 1.2 Suitable commands for draught animals

<table>
<thead>
<tr>
<th>Command</th>
<th>Meaning</th>
<th>Local vernacular</th>
</tr>
</thead>
<tbody>
<tr>
<td>Here</td>
<td>Come here!</td>
<td></td>
</tr>
<tr>
<td>Kraal</td>
<td>Go into the kraal!</td>
<td></td>
</tr>
<tr>
<td>Stock</td>
<td>Go into the stock!</td>
<td></td>
</tr>
<tr>
<td>Yoke</td>
<td>Come for the yoke!</td>
<td></td>
</tr>
<tr>
<td>Move (click sound)</td>
<td>Move forward!</td>
<td></td>
</tr>
<tr>
<td>Stop (whoa)</td>
<td>Stop!</td>
<td></td>
</tr>
<tr>
<td>Back</td>
<td>Reverse!</td>
<td></td>
</tr>
<tr>
<td>Straight</td>
<td>Go straight!</td>
<td></td>
</tr>
<tr>
<td>Come right</td>
<td>Turn right!</td>
<td></td>
</tr>
<tr>
<td>Come left</td>
<td>Turn left!</td>
<td></td>
</tr>
<tr>
<td>Close up</td>
<td>Close up!</td>
<td></td>
</tr>
<tr>
<td>Furrow</td>
<td>Go in the furrow!</td>
<td></td>
</tr>
<tr>
<td>Ridge</td>
<td>Follow the ridge</td>
<td></td>
</tr>
<tr>
<td>Foot</td>
<td>Lift your leg!</td>
<td></td>
</tr>
<tr>
<td>Trot</td>
<td>Trot!</td>
<td></td>
</tr>
</tbody>
</table>

Do not include unnecessary commands. Stick to the basic numbers. The trotting command is mostly used when checking if an animal is lame as limping becomes more apparent when the animal trots.

1.3 Domestication, rieming and walking

1.3.1 Introduction

The first and most important part of draught animal training is to develop contact and mutual understanding and trust between the trainer and the animal. Without this initial step the rest of the training will give poor results. An untrained animal is suspicious of man and does not perceive any immediate benefit from the unusual close attention it suddenly receives at the beginning of the training. The untrained steer does not understand the meaning of the occasion (and indeed, the word used). It is natural that the steer wants to get as far away as possible from the trainer who must exercise patience and understanding during this initial, confidence-building phase of training.

The purpose of this section is to explain how to rid the animal of fear and how to bring it closer to the trainer. A key issue is how to develop the skill among the trainers/farmers to do that. This aim is achieved when an animal:

- Accepts a riem being put around its horns or neck
- Accepts to move into a stock and/or being lead into a stock outside the kraal/boma
- Allows a trainer to be so close that he can pat it, groom it, lift a leg and remove the riem from the horns or neck
- Accepts a head collar to be fitted and to be paired with a coupling in a stock.

1.3.2 Steps of achievements

To achieve the objectives of developing confidence between the trainer and the animal, the trainer must repeat the described exercises at least 4 times in a day for 2–4 days preferably in the kraal or in a safe confined open area with a stock.

- The trainer can approach the untrained animal and put a looped riem by hand around the horns or neck and then tighten it
• The trainer can make the untrained animal agree to be led into a stock with ease
• The trainer can approach the untrained animal and pat it, groom it, lift a leg, and remove the riem without struggling
• The trainer can fit the head of collar and pair the untrained animal with a coupling in the stock. Here it is important to reward the animal freely when something is done correctly. This is the initial phase of developing a strong desire in the animal for getting rewards. This should turn into a passion to make things right to get praises.

1.3.3 Training exercises

The prescribed exercises must be carried out in sequence. The degree of prior domestication will determine the procedure and the need for aids. Whether a steer is accustomed to close human contact every day, or it is semi-wild, makes a big difference. A general rule is to place cattle intended for draught work in close contact with man as soon as possible. As calves they should become accustomed to head collars, should accept being caught easily and to be led. After weaning it is important to maintain close links with the future draught animals.

The first exercise concerns semi-wild animals, which are common in the cattle regions of Tanzania. Even if the steers are relatively tame and accustomed to people, it is always useful to start with the domestication procedure. This will place all animals at the same level of accepting people for the next exercise.

1.3.4 Domestication

A kraal with a flexible stock or a crush pen is useful during the first phase of getting a semi-wild animal used to people and accept being handled by a person. The stockade should be situated along the side of the kraal and it should be possible to open and close it in both ends (Figure 1.24). However, few villages have kraals and as the described draught animal training method is based on village/farm training, it is evident that one has to cope with fewer facilities.

**Figure 1.24:** Kraal with flexible stock on the side.

Most cattle are kept in a traditional cattle *boma* overnight in a village. *Bomas* are not an ideal ground for training but this is usually what is available. This means that the cattle herd is used to being confined in a closed *boma* made from thorny bushes or rough timbers, and with the ground heavily covered with manure. Generally, animals feel safe and calm in *bomas* and people can carefully move around in the *boma* without causing much disturbance.
A long pole can be put in the centre of the boma for tying selected animals to restrict their movements. The boma should be complemented with a simple stock close by where the actual domestication process takes place.

There are two domestication alternatives. These are:

- In a stock in a kraal
- In a stock outside and close to a cattle boma.

**Confining in a kraal**

Carefully, the animals under training should be taught to circulate through the open stock on the command for moving. This is best achieved by mixing the trained with the untrained animals. Then the front of the stock should be closed and followed by the rear rail trapping an untrained animal with a trained one. They should be left together alone, and fed. This is the first step in training.

After some repetitions of the above practice, the untrained animal should then be left in the stock by itself. The trainer should move around the stock slowly, while talking nicely to the steer and giving it small pieces of choice feed. After some practice, the untrained animal will move freely to the stock to be fed. Use the command “Bibo, stock” when it enters the stock. [“Bibo” is the name of the animal and the instruction to move into the stock is “stock” in English.] Give the command in a soft voice.

**Rieming in a kraal**

The next step is rieming. To avoid unnecessary struggling, it is always recommended to initially use a riem or rope on a stick. To avoid injuries only one animal should be trapped in the stock in the kraal. Carefully catch the horns using a riem with a loop on a stick (Figure 1.25). Your position in relation to the shoulder of the cattle can make it move forward or backward. The animal should be approached from the side towards the shoulder, when the animal is standing along an enclosure. If you move behind the shoulder it will move forward and backwards when you move in front.

This reaction is particularly useful when trying to slip the riem over the horn or head if the ox is de-horned. If the steer happens to be standing in front of you place the loop calmly in front of his head, move to a position behind its shoulder and drive the horns into the open loop. As soon as the riem is in position tighten it and unwind the stick.

When the animal has calmed down, it should be given some reward. Then tie the riem tightly to the rail (Figure 1.26). The animal will naturally resist at first but soon it will give in. Talk softly and nicely to the animal the whole time. Praise the animal always.

---

Figure 1.25 Catching a steer with a riem on a stick.
When the steer has accepted to be tied and calmed down, release the tension and lengthen the riem. Give it some feed as reward. Repeat the procedure of tying tight to the rail several times with the riem left around the horns until the animal stops resisting. Give rewards in between.

**Confining without a kraal**

It is easy to domesticate a young steer or cow that is used to people and agrees to be led by rope. It is more complicated if the animal runs away when approached. As mentioned earlier, most cattle that are kept in a *boma* overnight are used to entering willingly in the evening and going out in the morning. They feel safe and calm in the *boma*. People they are used to can walk carefully in the *boma* without causing disturbance. However, a *boma* is not best for the initial stages of draught cattle training, despite the fact that the structure is simple and cheap. Both people and beast can be seriously injured by the thorny bushes. Furthermore, deep manure is not suitable for moving around. Therefore, there should be a stock outside for the real domestication training (Figure 1.26).

A person who is known to the animals should move into the *boma* early in the morning with a riem on a stick, and carefully put the loop over the horn of the selected animal. Most likely the young steer will shake its head but it will soon calm down. Leave the animal to get used to the riem. When settled, tie it to the pole in the centre and let the animals out. Give the tied animal some good fodder and water, as it is hungry, thirsty and upset since its friends have left. Talk nicely to the animal and make it get used to your presence. When the fodder is finished carefully walk around the *boma* while holding the animal by the riem/rope. Tie it again and give it some more fodder. Repeat this procedure a couple of times. When this works well it is time to lead the animal to the stock. Put a rope around one of the rear legs if you suspect that it will run away when the riem is loosened from the pole.

If the animal is calm you can tie it inside the stock to the inner rail, otherwise tie it to the outside initially. Feed it and talk nicely to it. Use the command “Bibo, stock” when moving into the stock. Remember to talk nicely to the animal during the move and avoid beating.

Be around the animal and talk nicely to it as you give it good food and water. After a while, the resistance will fade away. The animal can be kept in the stock overnight if you expect problems. Make sure that the rope is long enough to enable the animal lie down and rise. It is important to develop a positive feeling for the stock. If you do not foresee problems let it loose together with the rest of the herd overnight and repeat the above procedure the next morning.

**Grooming 1**

The next step when the animal is tied in the stock is patting and scratching by the trainer. The steer should experience this as positive caressing. Start with the neck and move towards the horns. All animals like to be scratched behind the horns and the ears and also under the chin. When it accepts this treatment move backwards to the body. The legs and the stomach are also good for touching. Continue caressing and grooming the animal until it stops any kicking. Avoid tickling and keep on talking nicely in a soft voice.
When this exercise is accepted, repeat it with the longer tied rope to give more freedom of movement. Then continue grooming with a brush or a cloth. This will give the steer a positive feeling of having a person close by. It will stop kicking or charging when there are opportunities.

When the steer accepts that you can touch its head it is time to take off the riem. Remember that the riem should be on the horn the whole time until this stage. If you fail to touch the head during the first day the animal should remain tied in the kraal until the next day to continue the above exercise. The riem should then be long enough to enable the steer to eat, drink water and lie down to rest. It is rare that you have to tie an animal in the stock overnight. In the end, all animals will accept the above treatment providing no beating is used.

When all the different steps described are accepted, repeat them all in sequences after each other starting with catching them in the stock, tying to the rail, scratching and then taking off the riem.

**Catching in the stock**

When a young animal agrees to be caught by a riem on a stick, and accepts it without any fuss, and when it also accepts a person close to it, and to be scratched behind the horns and ears, it is time to carefully try to put the riem on and off by hand (Figure 1.27). Remember that this exercise should only take place in the stock at this stage. When this exercise works well with one animal in the stock, it is time to bring in another animal and repeat the sequences of catching, tying, scratching and taking off the riem.

The training procedure described is very important for trainers with little experience with cattle and oxen. Here they can see and learn how they can be friendly with a beast and develop control over it step by step. This model is particularly useful when training female ox trainers/farmers. In many training institutions, the participants will work only with trained draught animals. This will give a false picture of competence in handling these animals, which does not correspond to the actual life where semi-wild animals dominate.

![Figure 1.27 Catching a steer by riem in hand and releasing.](image-url)
**Grooming II**

When the trainer can catch, tie the animal and be close to it, the next training step is to lift the legs to inspect the hooves. The command “foot” should be used to get the animal to lift the leg. Always start with the front legs and move backwards close to the body. This will make the animal aware that you are moving towards his/her rear. If it wants to kick it will not hit you.

Do this exercise with one animal first and when it works well, repeat with two animals in the stock.

### 1.3.5. Rieming and walking

Rieming and walking is the natural continuation of the initial domestication process. It starts when part of the training moves outside the stock. When upgrading plough oxen there is little need for the domestication process.

**Catching an animal outside kraal and stock**

If the domestication process has been successful, the trainer should be able to move slowly towards the animal to be caught outside the kraal or stock, while repeating its name and the command. The animal should not shy away but accept quietly that the riem be put around the horn or neck and then be tightened (Figure 1.27).

Sometimes the steer will not accept to be easily caught when outside the kraal or stock. Instead of trying to chase the animal, a riem on a stick should be used alongside a hedge, fence or house (Figure 1.25).

**Pairing the draught animals**

Now it is time to pair two young draught animals in the stock and let them get used to being a team. Fit the head collars when they are riemed (Figure 1.28) and use the command for yoking (yoke). Be careful and do it slowly the first time.

*Figure 1.28* Pairing steers in a stock.

Then loosen the riem and let the animals get used to the head collar. Take it on and off until they accept it. Continue this exercise until you can do it without using a riem. When the animals get used to the collar it is useful to take them out for a walk, one by one, to get them accustomed to being led by the collar (Figure 1.29). Initially, use a rope around a rear leg to avoid wild rushing. Fit a coupling of a length of 90 cm between the halters. Leave the animals loose in the stock and let them get used to the sensation of being tied to each other. Make sure the collars are not too tight around the muzzles to prevent them eating.
1.3.6 Safety precautions

A trainer working in a kraal or stock with cattle must be aware of the basic safety precautions. These are:

- Wear proper boots to protect your feet
- Wear a long sleeved overall without a belt for protection against rubbing on fences
- Take off your wrist watch
- Move steadily and avoid dashing. Keep talking to the animals so they know where you are. This stops the animals taking fright, kicking and trying to protect themselves with their horns.

1.3.7 Handling advice

If you want to stop the cattle moving past you at a gate present a wide profile by facing them with your arms outstretched. You can appear wider by holding sticks, flags or simple pieces of cloth in your hands. The opposite comes when you want the cattle to pass you. Present a thin profile by turning sideways and stay to one side. The opening will appear wider and you no longer block the space.

Sometimes a herd in a kraal or boma becomes wild and moves about rapidly. If you start to move you can be trampled by mistake. Stand still or move slowly and you will be clearly seen and avoided.

On rare occasions an animal might charge at you. Wave and shout when it comes closer and it will stop. Do not run away; instead, you should pretend to attack. The animal will be very surprised and run away. If you run away, you have shown this animal that you are afraid and it will continue this bad habit.
1.3.8 Assessment sheet

A trainer undergoing training in draught animal mechanisation must perform according to a given standard. The assessment sheet below is an example on how to assess course participants. If a person fails at a specific stage he/she should not continue with the remaining parts. Most people can pass the domestication and rieming stage with a bit of work, but some need more training than others to gain confidence. Do not worry if you are afraid in the beginning because you will soon gain the necessary confidence if you make an effort to develop it.

The course instructors in the in-service training must assess the skill of each participant. Only those with the skill required will pass to the next step. The people responsible for the training will mark the participants as competent or in need of more practice. Course participants who do not want to improve their performance should be disciplined or expelled from the training as they will cause problems for the others during the course. It is essential to have a final practical test to grade the participants. The grading should be:

- Good
- Pass
- Failed.

An extension worker who fails to train a draught animal is not competent to promote improved farming techniques, like animal drawn conservation tillage.

<table>
<thead>
<tr>
<th>Assessment sheet no.</th>
<th>Name:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knowledge and skills</td>
<td>Competence</td>
</tr>
<tr>
<td>Know. training steps</td>
<td>Good</td>
</tr>
<tr>
<td>Approach to animals:</td>
<td></td>
</tr>
<tr>
<td>• Calm</td>
<td></td>
</tr>
<tr>
<td>• Patient</td>
<td></td>
</tr>
<tr>
<td>• Consistent</td>
<td></td>
</tr>
<tr>
<td>• Film</td>
<td></td>
</tr>
<tr>
<td>Use of command</td>
<td></td>
</tr>
<tr>
<td>Handling of riem</td>
<td></td>
</tr>
<tr>
<td>Following a leader</td>
<td></td>
</tr>
<tr>
<td>Directing animals</td>
<td></td>
</tr>
<tr>
<td>Yoking</td>
<td></td>
</tr>
<tr>
<td>Hitching implements</td>
<td></td>
</tr>
<tr>
<td>Handling animals</td>
<td></td>
</tr>
<tr>
<td>Handling implements</td>
<td></td>
</tr>
<tr>
<td>Repeating step</td>
<td></td>
</tr>
<tr>
<td>Rewarding</td>
<td></td>
</tr>
<tr>
<td>Use of training aids</td>
<td></td>
</tr>
<tr>
<td>Animal performance</td>
<td></td>
</tr>
<tr>
<td>Final remarks</td>
<td></td>
</tr>
</tbody>
</table>

1.4 Walking and yoking in pairs

1.4.1 Introduction

When domestication is successfully completed it is time to concentrate the training outside the kraal-stock. In this section the trainer will train a pair of draught cattle to follow a leader to be steered by command and by reins, and to be yoked.
The aim of this section is achieved when a pair of draught animals:

- Follows a leader
- Walks and stops following the spoken command for moving and stopping
- Can be directed by steering reins and obeys the commands to move, stop, turn left, turn right and walk straight
- Accepts the yoke to be put on outside the stock
- A yoked pair can be directed with steering reins.

The trainer has reached the expected level of proficiency when he/she can:

- Riem, yoke and fit the head collar and steering reins on the animals undergoing training without tying them to poles outside the stock
- Walk with a pair in training outside the kraal/stock moving straight, stopping and turning right and left without a leader.

1.4.2 Moving as a pair

Moving as a pair is a key step in draught animal training. During the later part of the domestication training the animals get used to being paired in the stock using the head collar and the coupling. The next step is to continue outside by simply letting the linked animals out of stock by themselves. Initially, they might fight the idea of being tied together in the open but they will soon give in and cooperate. It is essential not to tie the collar harness too tight around the muzzles as it will prevent the animals from grazing. Ensure that you have some fodder and water in the stock that will encourage the pair to return. The experience from Babati shows that you can save a lot of time and effort by working directly with pairs from now on.

When the tied animals move as a pair it is time to lead them around carefully to get used to being led. Repeat the process of catching, fitting the head collars and linking and letting them loose.

If you have a choice, it is useful to pair animals of equal size. Also keep them in the same position in the pair, for example the left animal should also be the left animal even when yoked.

1.4.3 Walking behind a leader

Training the young pair of draught animals to follow a leader who is holding the extension of the coupling is essential in the process of enabling precision tillage in a growing crop. The basic principle is that the pair of draught cattle should never move ahead of the leader. The starting point in this exercise is a pair of animals fitted with head collars and linked with a coupling of 90 cm. Initially one can tie a rope behind one rear leg of each animal (Figure 1.29).

Take the pair outside the stock, and walk around in the surrounding. Use the command for walking. The leader moves forward while pulling lightly on the coupling. At the same time the person behind lightly taps on the rear with a small stick to get the animal to move forward. Use the rear rope to prevent the animals from running ahead of the leader. Very soon they will follow the leader as required.

Add the command for stopping “whoa” or “stop”. When saying the command the leader stops and the person behind pulls the rope around the legs if necessary. The animals will then stop. Repeat the starting and stopping commands several times.

It is useful even at this stage to add the command for moving straight, “straight”, which means that the animals should follow straight behind the leader. If they move sideways the rear rope is used to control them while the command for straight is given. Soon the animal will follow straight behind the leader.

Repeat the command for walking, stopping and moving straight. This step is completed when the trainer can lead a pair properly without a person walking behind the animals.
1.4.4 Steering with reins

When the trainer is satisfied with the above steps, the next assignment is fitting the steering reins on the outside of the head collar on the pair (Figure 1.12). The starting position is with the leader in front holding the coupling and the operator behind holding the reins (Figure 1.30). Note that it is the person behind who gives the command in this exercise. Pulling on the left rein will give a signal to the left animal to turn left. When turning the head the coupling will be pulled to the left giving the right animal a pull on the left side of his head collar. When calling out the stopping command the operator should pull repeatedly on the reins to reinforce command.

![Steering paired animals with reins](image)

**Figure 1.30 Steering paired animals with reins.**

Begin by calling the starting and the stopping commands. When the animal accepts this procedure, add the turning commands “come left” and “come right”. When saying, “come left” the leader makes a left turn and the operator pulls the left rein. The same procedure is repeated for turning to the right.

In between the turnings, the steer must be able to walk straight. The signal for moving straight is the command “straight” and the operators hold the reins firmly to stabilise the animal.

After a while the animals can be guided from behind with the steering reins; at this stage repeat the above under the guidance of the operator only working from behind.

Now you are in the process of getting a good pair of draught animals and most people will admire your skill as a trainer when they see how you can direct the animals.

1.4.5 Yoking

The next step is fitting a yoke to the pair of animals. One can start carefully with a v-shaped single yoke (see Figure 1.15) or directly with the double neck yoke. For educational purposes we will start with the single yoke and then continue with the common neck yoke.
**Yoking with v-shaped single yoke**

Start by fitting a v-shaped single yoke on an animal tied in the stock (Figure 1.15). The intention is to accustom the steer to the weight, noise and inconvenience of a yoke.

When the yoke is properly fitted the animal should be let loose in the kraal/stock. Most likely it will try to get rid of the yoke at first, but will soon give up. When the animal has calmed down, let it go out of the stock for grazing. This should be for 1 or 2 days with the yoke on. Quite soon, the yoke will stop bothering it. However, tie the animal in the stock when taking the single yoke off to protect you from its horns the first time. Inspect the animal for injuries. Give the animal some rest to heal any injuries, if detected. Put the yoke on and off using the command for yoking. First with the head tied and then loose.

**Yoking with a double neck yoke**

The Babati experience shows that you can go for the double neck yoke directly, except in rare cases where one of the animals lies down when yoked and refuses to rise. In this case you have to switch to the single yoke first.

Tie the animals selected to form a pair in the stock (Figure 1.31), with the head collars fitted. The distance apart should be $D_{yoke}$. A ploughing yoke with $D_{yoke}$ of 90 cm is quite common for the exercise. As soon as possible a $D_{yoke}$ of 150 cm should be used as it is the standard yoke for conservation tillage.

![Figure 1.31 Yoking a pair of animals in the stock.](image)

It is essential that the trainer pair the steers according to size, weight and temperament.

When the animals are in the proper position, fit the yoke on their necks. The yoking command should be used when the yoke is put on. Start with the steer on the right hand side as the trainer is standing in front and fixes the straps on the skies and continue with the steer on the left side. Relieve the riem they are tied with, but the animals should remain in the stock until they accept the yoke after which you can let them loose in the kraal/stock. There will most likely be some confusion before they realise how to cope as a pair. Usually, it works smoothly as the animals are already used to being linked together.

When the animals have settled and accepted the yoke, the couplings should be fitted (Figure 1.13). Their heads should be parallel, and they should be led around in the kraal to get the feeling of working as a yoked pair. If there is no kraal they should be taken outside the stock. It is essential to put ropes around the rear legs to control wild galloping. The exercise of putting on and taking off the yoke should be repeated until the animals stop throwing their heads around.

After the first trial the head collar with the coupling should be fixed before yoking. This will give the animals a feeling of being tied together. The yoking will then be a natural step. When the yoke does not disturb the animals the training should continue with the reins through the holes in the yoke.
If the animals are troublesome in the beginning, keep them in the stock or tie them to a pole. Avoid fighting! Move outside the stock when both you and the animals are ready for it. Fit the steering reins and repeat the movements described in section 1.4.3 until the pair is in full control of the operator (Figure 1.32). Move back to the stock and take off the yoke. Repeat this exercise now outside the stock when you feel time is right. One person yoking a pair outside the stock is the first major goal. The second goal should be to gain full control of the yoked pair using steering reins and commands.

![Figure 1.32 Steering yoked animals with reins.](image)

**Yoking with the assistance of a trained ox**

Many farmers in the Arusha region use a system of pairing an untrained animal with a trained one. They have a long tradition of using oxen for ploughing. It is common to see two or three spans in front of a plough. Sometimes there is a mixture of oxen and donkeys in the same span. Weeding with oxen is not common.

With the help of a fast yoke (Figure 1.14) the farmers tie a young steer to an old ox (Figure 1.33). When the young animal accepts the yoke they will attach a log or plough to the yoke to be pulled. Working is an integrated part of the training.

A whip is used to force the animal to move forward. For ploughing, the pair leading the span should be more experienced. Then the younger animals undergoing training should follow the first span. The animals are directed with commands and with the help of the whip or sticks. No steering reins are used.

Every year, a large number of plough oxen are being retained at the beginning of the rainy season. Many farmers have developed high skill in this process but it is essential to realise that this is a rush training programme for a limited type of simple work. It works with ploughing if you have a good supply of castrated animals. However, it is not suitable for precision work such as conservation tillage. In addition, it is wasteful as far as efficient utilisation of ox-power is concerned.
In many parts of Tanzania it is essential to optimise the utilisation of limited resources of oxen, which suggests that the output and the quality of work from a pair of oxen should be improved.

If a farmer has lost an ox and the replacement is untrained, it is possible to speed up the training process even for conservation tillage by hitching the untrained to a trained animal. But this must be considered an emergency measure and not standard routine.

1.4.6 Assessment

Some people might argue that one should not deal with single animals but pairs only. However, handling one animal is a big step for many people who are not used to cattle. To start with a wild pair directly can be too much and may reduce the result of the training. A great advantage with the described training method is that the beginner trainer will gain skills, step by step, in training draught animals, both single and pairs, without being a master ox trainer.

When the animals have gone through domestication, walking and yoking, they are ready for the next step, which is pulling a load. When all the steps listed in the assessment sheet have been ticked as approved up to the end of training, the potential trainer has the skill to go further to the actual use of implements.

1.5 Pulling loads

1.5.1 Introduction

By this stage in training the potential draught cattle are accustomed to their trainer who has developed considerable skills in taming and training animals. The base exists to turn the previously semi-wild steers into an effective, valuable and diversified source of farm power. Now the trainer has full control over the draught animals but they are not yet ready for work, as they need to develop their muscles and stamina and be trained to pull loads.

The pain from the pressure of the yoke against the neck when pulling determines maximum traction force and ability to perform heavy draught work during a working day. An ox with soft neck skin is inadequate for
heavy conservation tillage work. A precondition for this task is a hard and horny neck skin that can withstand much pressure and long working hours without being sore with galls that can make the animals unfit for work for long periods. Furthermore, the animals must have strong and well-developed muscles to pull a ripper. Pulling such simple loads as logs can go a long way in preparing the oxen for this strenuous task. This is particularly important and effective when preparing young animals for hard work.

Logs, sledges or other objects of the required weight are used as training aids in this step of training, because the actual agricultural implements could be easily damaged. In addition, it would be difficult to find soft ground during the dry period which is the main ox-training period. By gradually increasing the weight of the load using a range of objects weighing from 15 to 20 kg, the animal avoids unnecessary strain and will work willingly. Both the skin on the neck and the muscles will gradually develop strength.

The aim of this chapter is achieved when a yoked pair of animals can:

- Pull a 50 kg load over a rough surface for 2 hours at normal active walking pace with short breaks every 15 minutes
- Obey commands to reverse, pass through lines of pegs and follow a furrow while they are yoked and pulling a 50 kg load.

The trainer should be able to develop the animals to achieve the required strength and to follow the listed commands.

To achieve the aim of the cattle doing sustained draught work at a steady speed under the control of the operator, the trainer must carry out the exercise of pulling a load for 3 to 4 hours per day for 7 to 14 days. If available, one starts the pulling exercise in a kraal. Otherwise select an open space close to the stock and then move out to different areas to give the cattle experience of pulling loads over different surfaces.

To develop muscles and strength is a slow and steady process. If the animals are inactive and poorly fed for a fairly short period they will lose muscles and strength. Work or exercise throughout the year in combination with enough feed will maintain the strength developed over many years.

### 1.5.2 Pulling loads

The trainer catches the specific animals in the kraal/stock and fits the head collars and coupling. They are then taken outside and yoked with a ploughing yoke and walked for a few minutes to calm them down with the steering reins attached. For the first part of the following exercise a leader should be used.

The trainer hitches the lightest load (15 kg) to the treck chain and carries out the walking phase (Figure 1.34) using the commands for moving, stopping, moving straight and turning left and right.

![Figure 1.34 Pulling logs at different weights.](image-url)
In addition, the command for reversing, “back”, should be introduced. The trainer pulls the reins as for stopping consistently and uses the command. The leader assists with the command too and taps lightly on the front legs with a small stick. The tension from the reins in combination with stick makes the animals move slowly backwards. Make sure you give large reward for the first step backwards. The animals should be trained to reverse at least the same distance as the length of the trek chain. The command for reversing should be repeated consistently until you actually cover the required distance.

Make sure that you take a short break in the pulling work at least every 15 minutes from the beginning and include reversing.

When the cattle can reverse with the operator’s (trainer) command only from behind, the leader should be taken off. This exercise should continue with 15 kg log weight until the animal can pull steadily for 2 hours with short rests every 15 minutes. When this target is achieved, change to the conservation tillage yoke with $D_{yoke}$ 150 cm and use this yoke during the whole load pulling session, as it is essential to train the animals to pull evenly with a long yoke. Increase the weight to 20 kg and carry on with the same practice. Increase further by 10 kg until a weight of 50 kg is reached. The aim is achieved when the last weight can be pulled for 2 hours with short breaks every 15 minutes and the oxen can reverse a trek chain length whenever required by the trainer.

To save time, this exercise can be combined with pulling the log in a furrow when one is close to using the 50 kg weight (Figure 1.35). This is good preparation for the imminent fieldwork. The command is “Bibo, furrow”. Bibo is the name of the ox. If you want Bibo to walk in the furrow you use this command. The name of the other animal and the command is meant for the other animal to walk in the furrow. The usual practice is to shift at the turning of the headland. By starting with the name, you alert the animal, which will then obey the command.

![Figure 1.35 Walking in a furrow.](image)

Another exercise, which can also be combined, is to put up narrow lines of pegs (Figure 1.36). The purpose is to prepare the animals for fieldwork such as planting, weeding and cultivation. The trainer uses the command “straight”, which means that the pair should walk straight along the lines.

![Figure 1.36 Walking pegged lines.](image)
It is also feasible to imitate crop rows using pegs to train weeding/ridging providing the ground is flat and the log is hitched in such a way that it does not move sideways.

Pulling a log to gain strength must be combined with a combination of furrows and pegs, obedience training and precision work. A track can be made to include all the aspects of tillage required.

1.5.3 Safety precautions

To prevent injuries to animals and operator, the training should be carried out in areas free of stumps, stones, termite mounds and holes where the log can get caught. This can cause sudden jerks on the chain or even throw the load against the animals or operator.

The operator should walk on the left side of the load behind the left animal and check that the load is not threatening him by rolling towards him.

When pulling on flat land it is advisable to have a u-shaped log like a sledge to avoid side rolling which can injure both the animals and the operator. It is easy to add extra weight on the sledge.

1.5.4 Assessment

Concerning skills development for the learner trainer, there is not much new to learn in this chapter but to gain experience and to develop further confidence. Here there are chances to remedy shortcomings, as it is always possible to involve extra training on weak points. After this section, there should be no weaknesses left in the training skills of the extension worker/ox trainer. Now the draught cattle are ready to undertake the conservation tillage training with implements.

1.6 Pulling implements

1.6.1 The aim

Pulling implements is the final step in the draught animal training programme. It involves actual fieldwork with conservation tillage implements and ox carts. If desired one can also include conventional tillage practices at this stage but it is not recommended as it complicates the training situation which can result in poor tillage work. The training in using ox carts depends on their availability. After 3 or 4 weeks of training, depending on the abilities of the cattle and the control achieved by the trainer, the cattle should be able to perform productive precision work, even in hard soils. Some retraining is advisable when no work has been done for a few weeks. Normally, after one cropping season, the trained draught animal should be able to do all the draught work on a small farm, under the control of the operator only, including conservation tillage.

The aim of Chapter 1 is achieved when the yoked pair of draught animals will:

- Pull a ripper/ridger for ripping, ridging, planting and weeding
- Pull a sub-soiler and a ripper to a depth of 30 cm in one operation or in stages
- Pull an ox cart
- Obey commands and signals from the operator to perform each of the above accurately, according to required precision.

When they can do these operations with accuracy, they can easily perform full conservation tillage work but also pull a plough, a cultivator and a harrow. However, if the training emphasises only ploughing, they will not be able to do conservation tillage without substantial retraining. This is the main reason for concentrating on conservation tillage from the very beginning.

The use and setting of the implements will be discussed in the next chapter. Here, the emphasis is more on the actual draught animal training aimed at precision work in conservation tillage.
To achieve the objectives of carrying out all necessary draught work with a pair or a span of animals under the control of one operator, the trainer must carry out the exercises in this chapter 3 to 4 hours per day for 1 to 3 weeks on fallow or cropped land.

It is an advantage if the fields for training have been prepared by trained oxen, as it is important that the training exercise is done properly with parallel rows along the contours. This is an almost impossible task with newly trained animals. Irrigation facilities are extremely useful at training institutions for draught animal training as the fields can be at different stages of development throughout the year. Unfortunately, the perfect conditions for ox training are uncommon in villages; one has to find local solutions to achieving the targets, for example pegs can be used to imitate crop lines.

The oxen should master the draught work required for one implement before being hitched to another. Each implement forces the draught animal to pull in a different specific manner. For example, a ripper requires full exertion of draught power in a straight line, while an unloaded ox cart will require less power from the muscles but more concentration on the commands to walk, stop and turn.

Successful basic training of the steers will have been achieved when:

- The trainer can control the team of draught cattle on his own and, while holding the implement, make them rip/sub-soil straight parallel furrows or split ridges steadily for 2 hours with short rests every 15 minutes
- The trainer can control the team of draught cattle on his own, while they are pulling the ripper/ridger in straight parallel lines for a full work period
- The trainer can control the team of draught cattle on his own and direct them accurately along plant rows while they pull a ripper/ridger for a full work period
- The trainer can control the team of draught cattle on his own and direct them safely on the fields and roads while they are pulling a cart on flat land and moving downhill.

The basic theme of this chapter is that the people undergoing the training in ox training and, particularly the extension workers, should be able to prove their skill in converting a pair of semi-wild steers into first class draught animals. This involves not only the skill for the actual physical training of the draught animals but also that of training extension workers, ox trainers, farmers and craftsmen (including women) in the art of draught animal training. All district extension staff should be able to demonstrate all aspects of the training. Emphasis should be put on training the trainers.

![Figure 1.37 Ripping, planting, ridging and weeding using a ripper/ridger and a ripper yoke.](image-url)
1.6.2 Training draught animals to pull a ripper

The trainer starts the ripping exercise by yoking the pair outside the kraal with ripper yoke with a $D_{yoke}$ of 150 cm. He/she fits the coupling and the reins and walks the animals to calm them. He/she then hitches the ripper and directs the team of animals to the practice area. A straight furrow should have been prepared in advance by older trained oxen. Use a leader when starting this exercise until the animals have learned what to do, and the operator can control them alone and hold the ripper at the same time (Figure 1.37).

The trainer starts by giving the moving command (“move”), followed by the furrow command (“Bibo furrow”), but no soil is ripped during the first rounds. Alternate the animal moving in the furrow. The cattle quickly learn their correct position in the furrow and on the unfulled land. Turn on to the headland and repeat the procedure along the furrow by giving the command to the other animals to walk in the furrow. Reward the animals with a short rest when this has been done successfully a couple of times.

The next step is to engage the ripper gently and increase the load slowly. Changes that are too abrupt will cause pain in the neck. There should be parallel ripper lines of 75 cm apart. The team must work steadily without interruptions, except for the short rests every 15 minutes.

When the team is being accustomed to pulling the ripper following the furrow and turning on the headland, the trainer directs them without a leader while holding the ripper. At the end of exercise, give the command “home” and direct the team back to the kraal/stock for unhitching and removal of yoke and head collar.

From now on, all training of the different steps should start with yoking outside the kraal and finish with the home command. This will strengthen the feeling among the animals that they have done a good job if they are allowed to go home. Another important aspect is to teach the oxen to return to the field after a short rest and continue the work. It is common to see oxen refusing to work until the next day if they have been unyoked or brought home. Many oxen will only accept to work during a specific time of the day. The inconvenience of bringing the animals back and forth will make them willing to work at any time during the day if required.

The ox-drawn sub-soiler is used in the same way as a ripper, so there is no need for any specific training for this operation. The sub-soiler is more demanding on power and therefore should come after the ripper training which will develop the strength and stamina to pull straight and evenly.

1.6.3 Planting by hand with a ripper

The yoke length, $D_{yoke}$, determines the row width when planting with a ripper. If you want a row space of 75 cm the $D_{yoke}$ must be 150 cm.

The normal ripping routine is applied for planting (Figure 1.38). The animals take turns to follow the previous row. Seeds are dropped in the new ripper furrow and it is covered by the feet of the person doing the planting work. It will be further covered by the hoof of the ox when doing the next row. This works well with larger seed like maize and beans. With small seeds that are sensitive to deep planting it is advisable not to follow directly behind the ripper, but wait without dropping the seed until the next ripper line is completed. In this way the oxen will not walk in the planted row.
The shallow furrow created by the ripper catches rainwater and ensures the establishment of an even and early crop stand. The covering of seed by foot will also ensure firming of the seed to the soil, which entails a good supply of water during the sensitive germination period. This method of planting will form parallel rows, which makes it possible to do ox-weeding between the crops rows.

### 1.6.4 Planting by planter

The same working principles are applied for oxen when using a ripper/planter (see Figures 7.3 to 7.5 in Chapter 7 in Conservation Tillage 1) as when planting by hand after the ripper.

### 1.6.5 Ridging flat land with a ripper/ridger

Cropping of upland crops on ridges is highly beneficial in semi-arid areas. It is therefore important to train animals to perform ridging on flat land (Figure 1.36). The procedure is the same as when ripping. The ripping yoke (D$_{yoke}$ 150 cm) should be used for this process. Note that the positions of the draught animals change for each new ridge. This means that the animal in the furrow will be on the flat on the next turn. Here again, it is important that the oxen respond to their names. The command line should include the animal’s name, first (e.g. Bibo), followed by the action desired (furrow), as we saw earlier.

The exercise should continue, first with a leader and then without, until the animals shift from furrow to flat land after each turn on the headland.

The ripper ridge should be equipped with extended wings to hill-up the soil properly.

### 1.6.6 Weeding with a ripper/ridger

The use of the ripper/ridger with extended wings for weeding is a more difficult task when applied in a growing crop. A mistake will most likely cause up-rooting of the crops and yield reduction. Poorly trained animals cannot be used for this operation. It is advantageous to use a cropped field with parallel rows for this exercise, but if this is not available, one can make peg lines with the desired row width to substitute crop lines.

A long weeding yoke should be used. The D$_{yoke}$ should be twice the row width. The guidance with a leader is recommended initially. The training should start when the crop is 20–30 cm high, so that the oxen can see the plants easily. The animals must work accurately between the rows of plants, pulling the ripper/ridger steadily. Use the command for moving straight.

When the oxen have learnt to walk along the rows, the leader can be taken away. However, the leader should remain nearby to assist quickly if necessary.

The ripper/ridger with extended wings should be equipped with a rudder to ensure accurate weeding work.

### 1.6.7 Split ridging

Split ridging is becoming more popular since it is 2 to 3 times faster than ploughing. It also causes less erosion than ploughing. The procedure is that the pair of draught cattle follows a ridge instead of a furrow (Figure 1.36).

The command for this task is “ridge”. This means that the animals should straddle the ridge the trainer directs them to follow. While splitting, the furrow command is confusing to the animals as the furrow change position during the work. A leader should first be used, but he can soon leave as the oxen quickly learn to straddle the ridge. There is great freedom on which ridge to split. If one wants to avoid sharp turns on the headland, each second ridge can be split and the missing ones done later.
Normally the plough yoke is used also for split ridging. One should be careful not to engage the ridger too deeply in the soil at the beginning of the training since splitting is heavy work. If ridges do not exist this training operation must wait until ridging has been carried out on flat land.

It is possible to equip the ripper/ridger with extended wings and a rudder to be able to guide and keep the ripper in the centre of the ridge.

A shallow split ridging technique without extended wings can be used to plant by hand on ridges. It is also possible to plant with the ripper/planter directly on the top of ridges with the same split ridging technique.

### 1.6.8 Pulling an ox cart

The trainer in spans the team in the familiar surrounding of the kraal/stock. The disselboom of the cart should be tied to the yoke with a thin riem. In case of emergency it can be easily cut to free the cart from the oxen (Figure 1.39). In fact, tying with a riem is as good as the complicated system with specially welded hooks.

The trainer uses a leader to help direct the cattle in the beginning on flat land. He/she walks the team around the kraal/stock giving the commands to walk, stop, and turn right and left. The animals must get used to the disselboom and the noise of the cart from behind. When the team of animals is pulling well, and obeys the commands, they can move further away from the kraal without the leader. The trainer keeps practising the art of guiding the cart around obstacles, which cannot damage it, such as boulders, drums or pegs (Figure 1.39).

If one animal walks slower than the other, it should be told to increase speed by calling its name and the command for moving. With a light tension in the reins, the team should slow down.

Transportation while on the road and in traffic requires the team to be able vary the speed as required. Therefore, it is important to practice this aspect whenever possible. The touch of the kraal gives a reassuring feeling to the team from the effect and noise of traffic.

Pulling a scotch-cart with a yoke on flat land or uphill is a straightforward exercise. Problems occur when going downhill. How do you stop the cart from running over the oxen? The strap tying the skies stops the yoke from moving forward over the heads of the oxen but it will press on their throats. A very effective system is to tie a braking riem or rope from the yoke around the hindquarters. When the cart is pushing forward the braking riem will stop the yoke from moving. This will work as a simple and excellent braking device. Select a slope and let the animals start and stop repeatedly while moving downhill.
If there are steep slopes it is advisable to cover the part of the braking riem around the hindquarters with soft material to avoid rubbing. Many accidents with oxen can be avoided with this simple device.

1.6.9 Ploughing

Fit the ploughing yoke and direct the selected animals to work in the furrow (Figure 1.40). This should be simple work for animals that have undergone training for conservation tillage.

Correct ploughing technique requires a high skill on the part of the operator. There are world championships in ploughing! This level of proficiency is not common in Tanzania. On the contrary, the plough is used mainly for working the soil. As ploughing is not the main concern in conservation tillage, we will only show how to set the plough and make it work well. Section 1.6 deals with performance.

The desire for ploughing is deep-rooted and farmers will hardly stop ploughing overnight. There will certainly be a transition period and ploughing should be practised mainly as for a means to reduce heavy weed infestation. A good starting point for effective weeding through ploughing is to have a team of well-trained oxen, which can exert enough power for deep ploughing. The next step is to set the plough properly. If this is not done the quality of ploughing will be low.

1.6.10 Weeding with a cultivator

The cultivator is used to weed in a similar way as the ripper/ridger. Hence the training of oxen for weeding with a cultivator (Figure 1.41) is the same as for using the ripper/ridger. There are two types of cultivators: one that leaves an even surface and another that builds shallow ridges. The main disadvantage is that they require fine and trash-free seedbeds, which increase the risks of runoff and erosion. To a large extent one can say that leaving crop residue on the surface is out of the question when using most cultivators. This means that the choice of implement can rule out conservation tillage as an option.
1.6.11 Harrowing

The trainer hitches the harrow to the treck chain and directs the team of animals to the ploughed land. First, with the help of a leader, the trainer commands the team to walk straight by shouting “straight” as the animals pull the harrow steadily over the ploughed land (Figure 1.42).

As the trainer becomes more confident that the cattle can pull the harrow straight, the leader is taken off the work and the trainer (or operator) carries out the whole operation on his/her own. He/she harrows straight in the right direction. This implement also rules out the possibility to leave crop residue on the surface as it will work as a big rake.

![Figure 1.42 Harrowing with a spike-tooth harrow.](image)

1.6.12 Safety precautions

Use a leader to help direct the team of animals away from the kraal/stock, since it might be reluctant be leave familiar ground. On returning after work, a leader may be necessary to stop the animals from racing out of control back to the kraal/stock.

Use a thin riem to hitch the implements during the field training. It can easily be cut off or will break in an emergency. Initially it is also advisable to hitch all implements near the kraal. Familiar surroundings will calm the animals and make hitching easier.

1.6.13 Assessment

At this point in the training schedule the assessment sheet should be completed. All sections should be ticked as necessary, particularly for the extension staff. Usually this is a formality if you have managed to bring a pair of steers from being semi-wild to being well trained draught cattle.

Congratulations! You have proved capable of training draught animals in a professional manner. Now you should be able to convey this knowledge to other extension staff, ox trainers, farmers and craftsmen. With oxen trained in this way it is not difficult to promote a good level of mechanisation efficiency of many times the subsistence level in a sustainable way. This is the starting point for successful conservation tillage.

The importance of the described mode of training is that it can be achieved with local resources at low cost. Failures to achieve the required proficiency should not be accepted since the procedure and requirements are within the reach of most small-scale farmers in Tanzania. Very little outside assistance is necessary.

If the agricultural education cannot produce the extension staff with the described knowledge and skill in draught animals mechanisation and conservation tillage, then it is not geared to the needs of the future and is therefore not adequately adapted to the reality of the Tanzania conditions.
1.7 Performance of implements

1.7.1 Introduction

In addition to healthy, well-trained and well-fed draught animals, the performance of an ox-drawn tillage implement is closely related to:

- Setting of the implement
- Quality and conditions of chisel points/shares
- Maintenance of the equipment.

For example, the quality of ploughing in Tanzania could be greatly improved with proper setting of the implements, sharp shares and proper maintenance of the plough. The quality and efficiency of conservation tillage is also linked to these factors. Deep tillage in hard soils requires an implement in good condition and that is set correctly. If this is overlooked the implements cannot perform as desired.

Generally, the same simple principles are valid for most ox-drawn tillage implements, except harrowing.

1.7.2 Setting of implements

Usually, it is the hitch point that sets the working depth and the cutting width of an ox plough. Here we will discuss two common standard types which are fitted to the plough when they are new (Figure 1.43). The old victory plough type is shown in Figure 1.43a. Figure 1.43b shows a hitch commonly called the Zimbabwe type.

The original idea of the Magoye ripper was to use a standard plough without the plough body fitted with a ripper unit. It works well provided a functioning depth adjustment is left on the plough. As this is usually not the case, there is an extra device available with the ripper for this purpose (Figure 1.43c). It looks different but the principle is the same.

The common victory type of hitch is usually poorly designed and manufactured and it simply cannot function. The Zimbabwe type, which is also common on the UFI plough manufactured in Tanzania, is a great improvement and it generally works well. However, the habit of throwing away the depth adjustments appears widespread and deeply rooted.

The depth wheel should only assist in stabilising the working depth of the plough and the ripper. The most common wheel assemblies are shown in Figure 1.44. Figure 1.44b shows the better designs, which are more durable and easier to adjust.

The common system of hitching the plough to the yoke is through a treck chain fitted directly to the plough beam through a bent iron rod and/or wires. It is not possible to adjust this system. It is the muscle force of the operator that guides the plough together with the plough wheel. This method has two problems. Firstly, it does not work well and secondly, it is a very hard job.
As mentioned earlier, most farmers in Africa do not use the depth adjustment on a plough. They depend on the plough wheel only. However, with a proper piece for adjustment, it could be possible to change the views of the most persistent opponents of setting the plough when they see what can be achieved.

The principles of depth adjustment and those of adjusting the cutting width are described on page 49. It is an easy task to set a plough or a ripper and there is really no excuse for not doing it.

The furrow slice
When ploughing with the common plough, the cut furrow is inverted and moved one furrow width to the right. An animal-drawn plough can be set to penetrate the soil to any required depth up to 20 cm and to any width up to 20–25 cm. However, this depends on the share, soil moisture content and the condition of the plough (how good it is, the plough share and how effective is the hitch). The ability to determine the ploughing depth is greatly reduced if the width adjustment is absent or broken. Then the plough will find its own way, which is usually determined by the prevalent ploughpan. It will skid on top of the pan.

Experience has shown that the best ratio between depth and width of cut is 1:1.4 down to 1:1. This will allow for deep ploughing and good weeding. Figure 1.45 illustrates the relationship between depth and width of furrow slice.

A shallow ploughing depth often has a depth:width ratio of 1:2. In this case, it is recommended to reduce the width, but this is difficult without a functioning width adjustment. Usually the operator tilts the plough to the left or right to regulate the width. This results in uneven cut and poor weeding performance.

Opening and finishing furrows
The plough throws the soil only to the right. It is essential to create ploughing patterns which maintain the soil in position. Therefore, it is necessary to reverse this action by alternating ploughing patterns. This concerns casting and gathering with a conventional plough.

Casting starts at the edge of the land and moves towards the middle. Start with an opening furrow on both sides of the field and end with a finishing furrow.

Gathering starts at the middle and moves towards the edges. Start by forming a crown.

To maintain an even field one has to alternate between casting and gathering after each ploughing event.

The layout of ploughing can be made very complicated. A well functioning depth/width adjustment is a precondition for a good ploughing technique. If the idea of setting the plough is rejected it is most likely a waste of time and efforts to discuss complicated ploughing patterns. What is essential is the basic setting, which allows for smoother and deeper tillage and better weeding.
Figure 1.46 illustrates the procedures for making a crown (double split) according to AGRITEX (1986) that is illustrated in the Zambian handbook (1989) on ox mechanisation from. Figure 1.47 describes the nine steps needed to make a double finishing furrow (AGRITEX, 1986).

![Figure 1.46](image1)

**Figure 1.46** Making of a double split crown.

![Figure 1.47](image2)

**Figure 1.47** The nine runs required to make a recommended double finishing furrow.

These recommendations on how to make a crown and a finishing furrow can be found in any handbook on how to improve ox ploughing in Africa. However the adoption rate is almost nil after decades of extension efforts. It is realistic to anticipate a slow future adoption rate too.

A simplified system for making a finishing furrow in Zambia is shown in Figure 1.48 (Jonsson, 1987). Unfortunately the adoption rate is, again, almost nil. As can be seen in these figures, there is need to reset the depth/width adjustments continuously when making a crown and a finishing furrow.

The farmers make a crown by simply letting the second run cover the soil of the first run (run 4 in Figure 1.46). No farmer will bother to make even a simplified finishing furrow as above. They will continue ploughing until all the land is inverted and the end furrow is a small ditch. Most likely, the farmers continue this practice while waiting for a better alternative.
Depth setting

On the hitch assembly of the plough beam there is a vertical adjustment unit which enables the operator to set the depth (Figure 1.43). The hitching point can be moved up or down and each level corresponds to a specific depth. The principle for setting the depth is the same for the plough as it is for the ripper and subsoiler. The following rules apply to all depth adjustments (Figure 1.49):

- Raise the hitch point to obtain a deeper cut/furrow (Figure 1.49a)
- Lower the hitch point to obtain a shallower cut/furrow (Figure 1.49b).

Before the depth of the furrow setting is done the plough wheel must be raised as high as possible so that it is out of the way and cannot interfere with depth setting.

Figure 1.49 Setting the working depth of a plough and a ripper.

Lower the plough wheel to the ground level once the correct depth is set, to stabilise the implement. The wheel should just touch the ground. In this way, minimum draught power is required for maximum work. In other words, the common habit of having a fixed point and then setting the depth by means of the plough wheel results in unnecessarily high draught power requirement and in a poor performance. After some seasons it will be the ploughpan that determines the working depth of the plough.
When working, the implement might meet hard and soft spots in the soil which cause it to work shallower or deeper. In a hard patch the operator is usually able to keep the working depth by pressing the handles down.

When the plough wheel sinks into the soil or makes a screeching noise it is a sign that the wheel is set too deep. If the depth is set properly, release the wheel slightly to relieve the pressure on it.

The sub-soiler requires an extension of the plough beam to get the correct angle of force for deep cultivation in hard soils.

**Width of furrow setting**

The hitch assembly (Figure 1.43) also sets the width of the cut when ploughing. The hitch is moved horizontally from left to right or towards the ploughed or unploughed land. The basic principle (Figure 1.50) is to:

- Set for a narrow cut by sliding the hitching point to the unploughed land side (Figure 1.50a).
- Set for a shallow cut by sliding the hitching point to the ploughed land side (Figure 1.50b).

![Figure 1.50 Setting the width of the cut.](image)

**Influence of treck chain**

The standard treck chain is 2.9 m long. This length allows the plough to be set for the required depth under normal soil conditions and using average sized local draught animals. However, a longer chain is required when ripping, sub-soiling and ploughing in hard soils. On the other hand, it may be necessary to shorten the treck chain in loose soils to avoid going too deep. To overcome the problem with tillage the ripper is equipped with an extra length of chain of 1 m. Another alternative is to use one-and-a-half treck chains.

The standard plough yoke ($D_{yoke} = 75–90$ cm) allows for ploughing up to full width of cut within the range of setting of the hitch assembly. A longer yoke makes it impossible to set the plough for the required width.
Conclusion
The quickest, simplest and most effective way to improve the quality of ploughing is to set the plough properly. The performance of a ripper and sub-soiler is also closely linked to proper setting. A sign of a weak extension service is farmers' rejection of the use of the depth/width adjustment. A widespread use of this device indicates a more professional approach towards better implement performance.

1.7.3 Quality and condition of chisel points/shares
Maximum performance will be achieved with tillage implements if the chisel points and shares are new and sharp. The quality of work will gradually decline as these parts wear out. Usually, the implements fail to work when these parts are worn out. Particularly, the penetration of the implements into the soil is sensitive to the condition of the chisel points and the shares, particularly in hard soils.

The ripper points are designed in such a way that they can be turned when one side is worn out. In this way they last longer. A sharp and narrow tine goes deeper more easily than a wider one. This means that the chisel point for sub-soiling is not as wide as the one used for more shallow operations, such as weeding.

Worn chisel points of thick metal can often be hammered by a local blacksmith and given a longer working life.

1.7.4 Preventive maintenance

Daily maintenance
When a farmer uses a tillage implement daily, he or she is often too busy to think of any maintenance. And yet simple maintenance work might save him/her trouble, time and money. The following should be included in the daily maintenance:

- Scrape off soil in the fields
- Tighten all bolts and nuts with a proper spanner
- Check wearing parts
- Wash and oil the implement if not in use for a week
- Store in a shed away from livestock.

Make sure that the farmers invest in some proper spanners of the right size. Too many implements are rendered useless simply by using poor spanners, which quickly damage bolts and nuts that makes adjustment impossible.

Seasonal maintenance
After the season's work the farmer should carry out the following maintenance procedures:

- Check implement body parts and wheel for wear and obtain replacements if necessary
- Strip the implement completely
- Clean all parts and paint them if possible
- Replace worn out nuts and bolts
- Assemble the implement and oil it if it is not painted
- Store the implement in a safe and dry place
- Make a list of needed fast moving spare parts and buy them before the next season.
2 Selection and care of working cattle

This chapter is developed from the United Nations Food and Agriculture Organization (FAO) *Draught animal power manual* (1994) and the animal husbandry manual of the Palabana ADP Development Programme. It has been modified to fit the LAMP/SCAPA areas and the specific requirements for conservation tillage.

2.1 Selection of cattle for work

2.1.1 Importance of adaptation

Humped, zebu cattle (*Bos indicus*), non-humped cattle (*Bos taurus*) and their crossbreds may all be used successfully for draught work. In general, local indigenous cattle breeds are more suitable for work on smallholder farms than temperate breeds or their crosses (Figure 2.1). This is particularly important in semi-arid areas which have inadequate feed supply and veterinary services.

![Figure 2.1 Humped zebu and a humpless taurine.](image)

Cattle in Tanzania live in a delicate balance with many stress-causing aspects of their environment, including heat, diseases and lack of good quality feed. The additional stress of work can seriously disturb this balance unless the animals are very well adapted to that particular environment. Local cattle breeds are better adapted to the prevailing climate, to the local disease challenge, to the quality and quantity of available food and to the traditional management systems.

The humped zebu cattle are very well adapted to the local East African conditions while the larger, humpless exotic cattle are less suited to village conditions.

2.1.2 Size and breed

Larger working cattle can perform more work than smaller ones because about 10% of the weight can be transferred to draught power. Animals of temperate breeds and their crosses are often bigger than local breeds. With high levels of management and favourable environments such large animals can make good work animals.

Most smallholder farmers do not endeavour to own specialised work animals. Their need is for animals with many different characteristics, including the ability to survive under simple management conditions. Large animals are more expensive than smaller ones, and require more food. They entail greater risk; for example the death or incapacity of one work animal is more serious for a farmer who owns two large animals than one who owns four smaller ones). Also, as draught animals often have multiple social and economic functions, a large number of smaller animals are considered more useful in terms of economic flexibility.

Local cattle breeds in villages are often small in size. Due to this, some extension staff and other interested parties may sometimes suggest that these animals be replaced with imported animals or improved by...
crossbreeding or selection. This needs to be thought through carefully. The size of village animals is often closely related to the environment. Work animals of exactly the same local breeds are generally much bigger when raised on government stations or agricultural colleges. This suggests that much can be done to improve animal size by improving village animal management. Furthermore, if the environment (food availability and disease) causes the well-adapted local animals to be small and stunted, it would probably have a worse effect on exotic animals or crossbreds, which would be more susceptible to the tougher village conditions.

Large exotic breeds are preferable in those areas where climatic, nutritional and disease stresses are low such as highland areas and where the animals are maintained entirely for special work functions (such as forestry, road construction and for full-time transport on commercial farms).

Crossbreeds of local/exotic cattle are usually intermediate, being larger than local animals but less well adapted. Sometimes such animals are easily and quite cheaply available, e.g. surplus males from a dairy programme. Farmers who have adequate feed and good health care facilities may try using such animals for work.

Generally, small farmers manage better off with the available indigenous breeds. They can select individual animals that suit their needs and budgets. Farmers can achieve considerable improvements in size and working performance through supplementary feeding and better training if this is economically justified. This is of less importance for plough oxen used during a short time of the year but highly essential with conservation tillage and transport work.

2.1.3 Sex

Males are heavier than females within the same cattle breed and age groups. Bulls are the strongest work animals. Uncastrated bulls are regularly used in some countries, including Malawi. Castrated bulls (known as oxen, steers or bullocks) are more commonly used for work and they are the dominant working cattle in Tanzania, eastern and Southern Africa. They are almost as strong as bulls, but are less aggressive. Oxen are generally the choice of transport entrepreneurs and those farmers needing working animals throughout the year.

Females (cows) can also be used for draught work. They are not as strong as oxen and they need good care if they are to be reproductively efficient. It is necessary to plan the mating and the work periods, so that the cows do not have to work hard in their last two months of gestation, or immediately after calving. The main advantage of cows is that they can produce milk and calves as well as draught power. Experience from Uyole, Tanzania, shows that a team of cows can plough more land in a day than oxen can as the cows move faster and cover more ground in a day.

As farming systems intensify, and management improves, cows tend to be increasingly used for work. In some countries in Asia, about 80% of work animals are females. In several parts of West, Central and Southern Africa it is fairly common for cows to provide draught power, and up to one-third of work animals in some villages may be females. The use of cows for draught is picking up in Tanzania too but there are still traditional objections to this practice in many areas.

In theory, a working cow is unlikely to give as much milk or as many calves as a non-working cow, if both are maintained under ideal conditions. In practice, the close attention given to working cows means they can sometimes achieve a better reproductive performance than non-working animals maintained in herds.

It is common in many countries to use cows which do not conceive to pull a plough. After a short period of work they usually come on heat and conceive successfully.

Whatever the reproductive performance of a working cow, it is always better than that of an ox. Thus, replacing existing oxen with cows is of good economic returns, particularly for farmers who only use their animals for a short time each year. Cows are therefore likely to be the choice of farmers who know how to manage their animals well, who have few animals and do not have much work for the animals each year.
2.1.4 Conformation

Conformation refers to the shape of an animal’s body. Cattle should have good solid legs and knees. Animals with bowed legs and/or knock-knees have difficulty in walking and should not be used as working animals. The legs should be straight and well muscled, with strong, thick hooves that do not separate too much when the animal is walking. Animals should have a deep, wide chest, a medium length neck and a straight and wide back (Figure 2.2 and Figure 2.3).

A well-developed hump is a good feature in zebu cattle, though not essential. Contrary to popular belief, animals without humps can be yoked effectively.

2.1.5 Temperament

Animals should have a good temperament and not be aggressive towards people and other animals. Bulls may exhibit this character as they become older and so castration is generally practised with male animals. Castration is usually performed at between 2 and 4 years of age, depending on the breed and growth rate. Castration at too early an age will cause stunting of growth. A certain amount of lively spirit in an animal is considered good, and very placid animals may end up being lazy and lethargic. Animals which always walk in front or remain behind should not be selected.

2.1.6 Determining age of cattle

The best method of estimating an animal’s age is to examine the incisor teeth of the lower jaw (Figure 2.4). Young cattle have a full set of 8 milk teeth or incisors at an age of 3 months. These are replaced as the animal becomes older. Beginning at about 2 years the first 2 permanent incisors erupt. At 3 years the second set erupts and at 4 years the third set are visible. At about 5 years the animal has usually reached maturity and permanent corner teeth replace the last two milk incisors. As the animal becomes older its teeth show different wear patterns. Older animals show more wear.

An alternative method of estimating an animal’s age is to count the rings on the animal’s horns. From the age of 2 years, a single growth ring appears each year (Figure 2.5).

Figure 2.2 Desirable and undesirable conformation features of draught cattle.

Figure 2.3 Conformation features of hooves.
2.1.7 Age and weight

The age/weight ratio should be considered in selecting animals for draught. An older animal (4–5 years) is hard to train and its working life is shorter than that of a younger animal (2–3 years). In addition, an older animal has reached its mature weight, thus limiting any profit from the eventual sale of the animal for meat. Except for little weight gain a small but mature animal might be suffering from body weaknesses which reduce its value as a draught animal. A young animal is light, cheap and easier to train, and has a good potential for growth and development of muscle strength. It does not reach its full capacity for a year and subsequently its work output is initially less than that of a heavy mature animal.

Selection can be done from the farmer’s own cattle herd as early as when the animals are 4–5 months old. The actual training should start when the animal reaches a weight of 175–200 kg. When buying a steer it is essential to link the age–weight characteristics to make a good choice of draught animals, which can serve well for many years. In some areas the local breeds are small and one has to use good local judgement in the selection process. Cattle over 300 kg should not be selected for training, as they can be cumbersome at training and difficult to control.

The weight of a steer is best measured with a cattle scale but if not available it can be estimated by measuring the girth and the length of the body (Figure 2.6) and using a table to estimate the weights. The measurements must be taken:

- In the morning before the animal drinks water
- With the animal standing squarely and holding its head in the normal position
- From the left side of the animal because the right side may be distorted by the amount of food in the rumen.

By referring to Table 2.1 a farmer can get a good estimate of the weight of the animal being measured. For example, a girth of 146 cm and a length of 133 cm will give an estimated weight of 269 kg. For selection purposes, eliminate cattle with weights outside the outlined figures.

Figure 2.4 Teething key for cattle up to 8 years of age.

Figure 2.5 Annual growth rings on the horn of an ox.
Figure 2.6 Measuring girth (A) and length (B–C).

Table 2.1 Estimated weights of cattle

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2.2 Husbandry of working cattle

Working animals are valuable assets that need careful attention. The prevention of injuries and disease is better than cure. Proper management with daily inspection, good handling and careful husbandry of the animals reduces health problems. Simple attention to animal condition, feeding and provision of adequate water is basic to maintaining animals in a healthy state so that they can work well.

Farmers participating in workshops for the preparation of this report claimed that they have meagre knowledge of what to do when an ox gets sick or wounded and extension workers do little to help them. In consequence they slaughter the animals to avoid unnecessary economic losses. The farmers expressed great interest in obtaining knowledge on how to care for the draught animals as they realised the importance of getting good work out of them.

2.2.1 Daily care

Work animals like routine. It is good to keep to a regular schedule for grooming, health checks, watering, feeding and grazing. Animals should be fed and watered daily, with grazing/feeding allowed whenever possible.

At the beginning of the working day call the oxen if they are outside or go up to them if they are in their stable. Greet them by name and continue talking to them in nice a way. Farmers throughout the world talk to their working animals and develop close relationships with them. If animals are fed supplements this is a good time to give them some. If there is no supplement, bring some form of treat such as a small amount of salt on the palm of the hand, some grass, grain or fruit. This encourages the oxen to enjoy human company and to develop a desire to serve man at full capacity.

Daily grooming of animals does not only keep them clean but also promotes a good working relationship between the handler and the animals. It allows the handler to observe any problems, signs of sickness, injuries, sores, wounds, eye irritation or damaged horns. The animals can be lightly brushed in the direction of the hair (i.e. head to tail) with a suitable hand brush (a scrubbing brush with plastic or fibre bristles is satisfactory). This removes dirt and promotes close contact with the animals. Some farmers do not bother with grooming, thinking perhaps that it is not essential for work, but the few minutes devoted to this are beneficial in the subsequent responsiveness of the animals and lessens injury time.
When grooming, the following 10 points should be checked as a daily routine to make sure that each animal is normal and healthy:

- Breathing normally and chewing the cud
- On raising itself, stretches legs and passes dung
- Dung piles up (not liquid) and urine is normal
- Walks normally
- Coat is smooth and shiny
- Ears alert, moving to and fro
- Eyes bright and clear
- Muzzle cool, moist and not watery
- No fresh wounds or swelling, no ticks
- Good appetite, no rapid loss of condition.

For more detailed and elaborate health checks and treatments see section 3.5.

Hooves should be regularly cleaned and checked for cracking or rot. Foot problems can lead to lameness which makes the animal unable to work. Foot problems are rare if stables and sheds have a clean dry surface. Paddocks or standing areas outside the shed should be well drained. Animals which stand in mud are more susceptible to serious hoof problems.

Animals should be checked for ticks each morning and if found removed immediately. Any sores or wounds should be cleaned with a solution of salt and water or with a wound cream or antiseptic, if available. Wounds should be kept free of flies and cleaned daily until they are sealed and dry.

Healthy animals tend to flock together, feed together and rest together. They are also curious and inquisitive. If they move away from the herd it is sign that something is not right.

Time spent watching animals is usually time well spent because it assists in developing an ability by the farmer/stockman to distinguish the normal from the abnormal behaviour.

### 2.2.2 Getting ready for work

Check that the yoke is in good condition and that there are no splinters or frayed guides. It should be comfortably fitted and should not rub excessively to cause blisters or sores.

Check halters, coupling and steering reins to ensure that they can be properly fitted and used correctly.

### 2.2.3 Working schedule

Work should be carried out during the cooler hours of the day if possible, i.e. the early morning and/or late afternoon. Cattle seldom work well between 10:00 am and 3:00 pm when the sun is strongest. In some countries animals start work by moonlight and finish before the sun gets too hot. Cattle should not be worked for more than 6 hours a day; 4 hours is the norm. While working, animals should be rested if they show signs of distress (excessive salivation, excessive sweating, panting, staring eyes). It is important for the animals and handlers to take a regular five-minute break every 30 minutes. The fields should not be too long (less than 200 m) as the turning at the end is also a recovery period.

### 2.2.4 Grazing

Animals need at least 6 hours a day for grazing if they are to obtain enough food. Even 6 hours may not be enough if the pasture is poor or scarce, and the work hard. Do not keep animals in their night pen longer than necessary, although cattle do need several hours a day for ruminating. It is always beneficial to reserve some good grazing land for the draught animals.
These simple grazing routines are usually sufficient for plough-oxen, which work for a short time of the year. However, if more work is required there is a need for supplementary feeding to meet the nutritive requirement for continuous work.

Working oxen should be given supplementary feed like bran, bean straw and other nutritious crop residues immediately after work. This should be a routine and a continuous activity to serve as a reward to the oxen reward for good work. Usually it is often more profitable to keep the oxen under zero-grazing conditions than it is to keep dairy cows.

More detailed recommendations on feeding is presented in section 2.4.

2.2.5 Animal condition

The condition of all work animals should be regularly assessed (Figure 2.7). If an animal is in poor condition, it may be necessary to feed it some supplement (See Section 2.4.5.). Animals in poor condition can work for only a limited time and continued loss of condition can be serious and even life threatening.

2.3 Housing for working cattle

2.3.1 Housing

In many traditional farming systems, cattle are kept overnight in open enclosures. Although cattle are hardy working animals they respond well to good treatment. Therefore, owners of working cattle can benefit from constructing a simple shed for their draught animals. This can be used to house the animals at night and to provide shelter against the sun, rain and wind when they are not out working or grazing. It should be located on a well-drained site near to any stored feed supplies and close enough to the family dwelling to allow easy access and supervision.

The design of the shed should be as simple as possible. Local materials, such as maize stover, sticks, mud bricks, wood etc. can be used to keep costs at a minimum. In warm and dry environments, a thatched roof supported by four poles may be adequate (Figure 2.8). Where temperatures are cooler it may be necessary to construct half or three-quarter sidewalls to provide greater comfort for the animals.

In the colder highland areas or in places where security is a problem, a shed which completely encloses the animals and has a door, which can be locked, may be required. Well-trained oxen are easy to steal on instructions to walk away which they obey readily.

Figure 2.7 Body condition of working cattle.
The size of the shed depends on the number and size of the animals kept. If the sides of the shed are partially or fully closed, leave enough space for an adult person to stand alongside the animal when it is tied in the stall. In general, a shed which is 2 to 3 m square and 2 to 2.5 m high is adequate to house two adult oxen and allow a person easy access.

If individual stalls are constructed, they should be wide enough to allow the animals to stand and lie down comfortably. Stalls should be 1.5–2 m wide and have a yoking bar fixed at a height of 90 to 100 cm from the ground (Figure 2.9). The yoking bar can be used to tie animals for feeding and watering, during harnessing and when carrying out routine health care, such as removing ticks. If several stalls are constructed in a row they can be separated by a horizontal bar attached between posts at the same height as the yoking bar.

Regardless of the design or size of the shed, it is important that it has good ventilation. The roof should extend about 0.5 m past the base to increase the shade area and reduce the problem of rain blowing inside. A roof made of corrugated iron sheets is likely to be expensive (although quicker and easier to erect and longer lasting than thatching). A metal roof absorbs and transmits more heat during the day, thus increasing the temperature inside the shed. This is not generally desirable, except in cooler environments. A thatch roof provides a temperature stability that is better for the animals.

The shed should open into a paddock where animals can exercise (Figure 2.10). To pass from the shed into the paddock the opening should be wide enough to allow animals to pass easily without any hindrance; check and remove any exposed sharp edges like splintered or broken rails or nails inside the shed or paddock which could injure the animals. Plant trees in the paddock for additional shade under which animals can rest. A simple crush is essential for holding the animals during spraying or treatment by veterinary personnel. It is essential that the paddock is well drained. Mud and manure should not be allowed to accumulate in the shed.
2.3.2 Feed storage

An additional room for storing feed supplies, such as concentrates and mineral supplements, also eases the feeding of supplements. Alternatively a “lean to” can be constructed, by extending the roof towards the ground on the side least exposed to the elements. Hay and crop residues should be properly stacked outside but near the shed. In some countries like Zimbabwe these reserves are stored in or on the roof of the cattle shed or on separate platforms (Figure 2.11) where goats are unable to reach. Stored feeds should be kept clean and dry as moulty feeds can cause digestive problems and make the animals sick.

A feeding trough can be made from a metal drum cut in half or sometimes more cheaply from wood (Figure 2.12). A drum cut in half may also be used for storing water. Both are placed in front of the animals behind the yoking bar. The trough can be used to feed concentrates or hay and crop residues. A feeding rack may also be used. If the trough or feeding rack are located in the paddock they should be firmly anchored so that the animals cannot knock them over. The trough and feeding rack should be readily accessible for daily cleaning.
2.3.3 Manure disposal

The shed should be cleaned daily and the manure piled outside should be spread on the fields at a later date. Good manure disposal technique is a simple and cost effective way of improving soil fertility and crop production. The longer the manure lies out in the open the quicker the nitrogen is lost. This can be partially overcome by making a pile about 1.5 m high and keeping it covered and moist (Figure 2.13). If flies become a biting nuisance to the animals the manure should be removed from the area of the shed.

Where there are large supplies of straw, an alternative practice is to distribute clean bedding in the shed daily. The animal manure mixed with bedding is allowed to accumulate and is only cleaned out occasionally, depending on the supply of clean bedding and the acceptable depth of the resulting compost. This makes good compost though, if large quantities accumulate, it becomes heavy to clean out. When clean straw is not available the stall should be scraped clean daily to keep the floor dry for the animals to lie on and to prevent build-up of ammonia.

Figure 2.13 Schematic illustration of bedding straw, covered manure pit and ox-cart for transport to the fields.

2.4 Strategies for feeding draught cattle

2.4.1 General

Animal drawn conservation tillage based on ripping, ridging and/or sub-soiling is a simple technique but puts more demands on the performance of the oxen than the common ploughing technique. Feeding the draught animal is a crucial issue. A basic requirement of an extension worker is the ability to calculate and prepare appropriate fodder rations for draught animals based on the existing fodder base. He/she must be able to identify feed resources and know how to manage them effectively. The extension worker should design proper feeding rations and also train farmers on how to manage them. The aim of this section is to give a sound base for better feeding management.

It is essential to look at working animals that perform well as athletes. They need good food, the right type of training and good care to develop the muscles, strength and stamina. When an animal loses weight due to lack of fodder both body fat and muscles are lost. Rebuilding lost muscles is a slow process. Losing weight is less important for plough oxen but is highly detrimental in conservation tillage where the oxen should perform at a maximum over a longer period of time at the end of the “hunger season”. It is always good practice to maintain the condition of the working animals even during the off-season.

Proper feeding, watering and sound management are required to keep animals in good working condition. All animals have basic daily needs essential for good health and constant weight. These are called maintenance requirements. In general, the larger the animal, the greater their daily requirements for maintenance. Animals in good body condition tend to have a rounded appearance, while those in poor condition are recognised by their thin and bony appearance. An animal in poor condition tends to be weak and listless, tires quickly and is more susceptible to illness and disease. Body condition for draught work is related to the amount of muscles developed and fat stored.
2.4.2 Feed components

Pastures, leaf browse and supplementary feeds contain different amounts of energy, protein, minerals, vitamins and water. The amounts are affected by plant species, growth stage, time of year, date of cutting, storage methods etc. These factors also influence the ease with which the animal digests food to obtain the nutrients. For example, new grass growth is relatively rich in nutrients and easy to digest, while rice straw contains a form of fibre which is quite difficult to digest.

For the micro-organisms in the digestive system to be effective, a balance of the different nutrients in the feed is required. For example, a small quantity of supplementary protein can increase the digestibility of roughage low in protein.

Draught animals require energy-giving feed for work and the most common energy feeds are grass, stover, hay and straw. Cereal grains, which are rich in energy, make excellent feed but are often too expensive. Fats and oils though not essential for work are present in oil-rich seeds such as cottonseed, groundnuts and sunflower, which make high energy feeds.

Protein-rich feeds such as legume forages, groundnut stover and grain legume haulms, beans and cowpeas, pigeon pea pods and oil seed meals are generally popular and easy to digest. Proteins are also found in cereal grains and the leaves of some fodder trees. Minerals such as calcium, iron and phosphorous, and vitamins are needed in very small quantities. They are generally found in most mixed grazing but are also easily provided by mineral blocks and licks.

2.4.3 Feed requirements of working animals

The total nutritional requirement of draught animals depends not only on their work, but also on their stage of growth (immature or mature). For female animals it also depends on their state of reproduction (pregnancy or milk production). Mature oxen in good condition have requirements only for maintenance and work. A young male work animal (2.5 to 4 years old) has feed requirements for its body and muscle growth, as well as for maintenance and work. Cows used for draught need adequate feed not only for their maintenance and work, but also for their reproductive functions.

The type of work affects the amount of feed needed for draught. Draught operations range from light, medium to heavy, but the duration of work is as important as the draught force required. Ploughing a heavy field may require a heavy draught, weeding may be a medium operation, while pulling a cart on flat ground can be a light operation. However, with heavy draught work, the animals may work for only 3 hours, with many resting stops. With the lighter tasks, the animal may work for 6 hours, with fewer rests. The total energy used in the light work can be just as much as the heavy work if the work duration is longer.

Some logistical problems are encountered when trying to improve traditional feeding practices of oxen. Farmers demand that the oxen work for 3 to 4 hours in the morning and 2 to 3 hours in the afternoon which gives a total of 5 to 7 working hours a day. As most farmers do not allow their animals to graze at night, this leaves the animals with a period of 4 to 6 hours for grazing. Unfortunately, this period falls during the hottest time of the day, which does not allow the animal to graze optimally.

Under normal conditions, cattle that have the whole day available for grazing rest in the shade from 10:30 am to 15:00 pm. This still leaves a period of 8 to 9 hours available for grazing, the same period required for animals to take in enough roughage from local pastures, and to chew the cud (ruminate).

Young stock should be fed well as they form the pool from which future work oxen will be selected. Hence, a good farmer should ensure a good and continuous growth of his young stock. This means that they have to be looked after properly by providing additional feedstuff especially at the time of weaning and at the later stages of the dry season.
To provide working animals with additional feedstuffs and supplementation, the following may be used:

- Crop residues, such as maize stover, pigeon peas or other bean straws
- Crop by-products, like bran, oil cakes etc.
- Conserved products which include hay or silage
- Special grown fodder, like Napier grass
- A few reserved paddocks should have star grass and Rhodes grass or other nutritious local grasses
- Leguminous trees, like *Leucaena*, *Caliandra*, *Gliricidia*, *Sesbania* etc.
- Mineral licks or powders.

2.4.4 Nutrients in feed

**General**

Any feedstuff consists of water and solid materials. This solid material in a feedstuff is called dry matter. If a feed is dried in such a way that all water evaporates, what remains is dry matter in the feed. This is the most important part of a feed as it contains the nutrients that the animal uses to maintain its body weight, grow, reproduce and work. Although water is essential for animals, the amount and composition of the dry matter is what satisfies the nutritional needs of an animal.

The amount of dry matter in fodder varies. Feedstuffs with a low dry matter content are banana stems, sweet potato vines, and Napier grass. Feedstuffs with a high dry matter are maize bran, maize stover and hay from various crops.

The amount of dry matter in a feedstuff is normally expressed in percent (%) of the total feed. For example: Hay has a dry matter of 80%. This means that hay contains 80% dry matter or 100 kg of hay contains 80 kg dry matter. The other part is water which is; 100–80 = 20 kg.

To make proper rations the amount of dry matter of various feedstuffs has to be calculated. The formula used is:

\[
DM (kg) = \text{fodder (kg)} \times \left(\frac{\text{DM}\%}{100}\right)
\]

where DM is dry matter. For example: A farmer feeds his oxen 40 kg of Napier grass which has a dry matter of 16%.

\[
40 \times \left(\frac{16}{100}\right) = 40 \times 0.16 = 6.4 \text{ kg dry matter.}
\]

**Water**

As mentioned before, feedstuffs contain water and dry matter. In the care of oxen, water is needed for body functions such as:

- Dissolution of nutrients (saliva)
- Transport of nutrients throughout the body (blood)
- Disposal of waste products (urine, faeces)
- Formation and maintenance of the body tissues
- Regulation of the body temperature (sweating).

An animal obtains water through feeding, by drinking water from a stream, water pond, water-trough etc. The water requirements of an ox depend on:

- The composition of the feed (wet versus dry foodstuffs)
- The climate (temperature and humidity)
- The amount of work done
- The size of the animal.

In general, the daily water requirement of an ox of 500 kg live weight is 30–40 litres under normal conditions; this rises to 50–70 litres when heavy labour is demanded from the animal during hot days.
Dry matter
The dry matter of a feed contains the following substances:

- Protein: referred to as crude protein
- Carbohydrates: crude fibre and nitrogen free extract
- Fat: crude fat or ether extract
- Minerals: referred to as ash
- Vitamins.

Protein
Proteins contain nitrogen which is absent in carbohydrates or fat. The protein content of a feed is usually expressed as crude protein. Not all the protein in a feed is utilised by an animal; part of it appears undigested in the faeces. The part of the crude protein that is digested by the animal is called digestible crude protein.

This digestible crude protein is the part of the protein fraction in the feed eaten that contributes to the maintenance and production requirements of the animal. The crude protein content of a feed varies considerably and mainly depends on:

- The growth stage and age of the fodder; the more mature the less the crude protein content as the material has a higher proportion of stem. Leaves contain more crude protein than stems.
- The soil condition; on poor soils which lack nitrogen, growth is slower and the crude protein content is lower than in fertile soils or in well fertilised or manured soils.
- The type of fodder crop; legumes fodder crops will contain more crude protein than grasses and also maintain a higher level of crude protein when they mature. This is the also case with their by-products. Those of grain crop residues such as stover and bran are lower in crude protein than the by-products of legume crops like soya cakes. Another good source of crude protein are the by-products of the oil seed industry like cottonseed, sunflower and groundnut cakes.

Protein is needed for growth and body maintenance. A shortage of protein results in:

- A weak animal, because of loss in body weight, and particularly muscles
- Reduced feed intake
- Reduced resistance against diseases.

Carbohydrates
These consist mainly of starches, sugars and fibres. They may be grouped into two:

- The easily digestible carbohydrates like sugars and starch (so called nitrogen free extract)
- The less easily digestible carbohydrates like crude fibre.

An ox, like any other ruminant, is able to digest part of the crude fibre in a feed. However, a certain part of the crude fibre is indigestible (the lignin) and this part in a plant increases with age (maturity). Stems contain a higher quantity of crude fibre than leaves.

Foods that are high in easily digestible carbohydrates are young and leafy fodder crops, molasses, grains and, to a lesser extent, bran. Those poor in easily digestible carbohydrates include overgrown fodder crops, pastures at the end of the dry season, hulls of oilseeds, rice bran and wheat straw.

The carbohydrates in a feed are the main suppliers of energy to the animal. Feeding animals roughage with a high content of indigestible carbohydrates might reduce total feed intake, which in turn results in a low energy intake by the animal.

Fats
Roughage in general has a low fat content. Feedstuffs derived from oilseeds have a relatively high fat content. In general the rations given to oxen have a low fat content, but some fat must be present in the feed in order to provide the vitamins (A, D, E and K). Fat also provides energy to the animal.
**Minerals**
The mineral content varies considerably depending on the type of feed and the growth conditions (soil, fertilisation) of the plants used as feed.

Minerals needed in relatively large quantities are calcium, phosphorus, salt, magnesium, potassium and sulphur. Calcium, phosphorus and salt are often the minerals that are in short supply in a ration.

Apart from those already mentioned, copper, cobalt, zinc, iodine, molybdenum etc. minerals are also essential in the ration, although in relatively small quantities.

A shortage of minerals in the ration may result in:

- Weak animals
- Deformation of the skeleton in young animals
- Deprived appetite (eating of soil)
- Other physiological problems, such as diarrhoea
- Skin and leg problems.

It is advisable to provide working oxen with additional salt, about 2 spoonfuls per day (approximately 50 g).

**Vitamins**
These are very important to an animal but are only required in small quantities. Rarely do animals fed on fresh foodstuffs suffer from vitamin deficiency.

### 2.4.5 Feed and body weight

**Feed intake**
The amount of dry matter from roughage eaten by an ox per day depends mainly on:

1. The size of the ox (body weight)
2. The type of feed. Consumption of young and leafy grass provides higher dry matter than overgrown or mature grass
3. Protein content (crude protein). When this is lower than 7% the feed intake is drastically reduced
4. Palatability of the feed
5. Condition of the animal, sick or healthy
6. Temperature/humidity.

The following could be a guide to calculate the quantity of roughage required by the ox:

1. The size/weight of the animal. The amount of dry matter eaten is often expressed in kilograms of dry matter per 100 kg of live weight per day:
   - Assuming that grazing is of a quality whereby an ox can eat 2.5 kg of dry matter per 100 kg live weight. This means that an ox of 500 kg live weight consumes
     \[ 500 \times \left( \frac{2.5 \text{ kg}}{100 \text{ kg}} \right) = 12.5 \text{ kg dry matter} \]

2. The quality of the roughage for:
   - Young leafy material, the intake is 2.5 to 3.0 kg dry matter per 100 kg live weight
   - Old and stemmy material, the intake is 1.8–2.0 kg dry matter per 100 kg live weight or less.

3. The dry matter content of the roughage:
   - Rainy season, 15% dry matter
   - Early dry season, 20% dry matter
   - Late dry season, 25% dry matter

4. Since the animals graze during the day only, supplementary feeding can be done both in the evening and the morning while they are resting in the boma or the stall. This way, they can eat almost the same
quantity fodder while resting; as when grazing.

Example: Live weight of an ox is 575 kg with very good roughage during the early dry season:

\[
(575 \times 3)/100 = 17.25 \text{ kg of dry matter}
\]

\[
(17.25 \times 100)/15 = 115 \text{ kg of fresh roughage.}
\]

**The nutritive value of feedstuffs**

i) General

The nutritive value (in terms of energy or protein) is that part of the feedstuff which can be utilised by the animal. To calculate a proper ration for an animal, the nutritive value of a feedstuff should be expressed in the same units as the requirements of the animal.

ii) Energy

In the following calculations the system called total digestible nutrients is used. This unit is normally expressed as a percentage of the dry matter content of a food. The requirement of an animal is expressed in grams or kilograms total digestible nutrients.

iii) Protein

The protein value of a feedstuff is often expressed in grams crude protein or digestible crude protein per kilogram feed or per kilogram dry matter in the feed. The requirements of an animal are also expressed in grams digestible crude protein or crude protein.

iv) Minerals

These are expressed in grams of a particular mineral per kilogram feed or per kilogram dry matter of a feed.

v) Fresh basis versus dry matter

It is difficult to make a comparison of various feedstuffs while fresh. A big variation in dry matter exists between them over different seasons. Therefore values of energy, protein and minerals are expressed in grams per kilogram dry matter of a feed.

In the case of concentrates, which have a fairly constant and high dry matter, (over 90%), the total digestible nutrients, digestible crude protein, or crude protein are expressed in grams or percentage per kilogram feed.

**Requirements of an ox**

i) Maintenance: to maintain its body at a constant weight.

The maintenance requirements for energy (total digestible nutrients) and protein (digestible crude protein) depend largely on the live weight of the animal (see Table 2.2).

<table>
<thead>
<tr>
<th>Live weight (LW) (kg)</th>
<th>Total digestible nutrients (TDN)</th>
<th>Digestible crude protein (DCP)</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>1,650</td>
<td>175</td>
</tr>
<tr>
<td>150</td>
<td>1,875</td>
<td>195</td>
</tr>
<tr>
<td>200</td>
<td>2,050</td>
<td>215</td>
</tr>
<tr>
<td>250</td>
<td>2,325</td>
<td>240</td>
</tr>
<tr>
<td>300</td>
<td>2,500</td>
<td>260</td>
</tr>
<tr>
<td>350</td>
<td>2,675</td>
<td>280</td>
</tr>
<tr>
<td>400</td>
<td>2,950</td>
<td>305</td>
</tr>
<tr>
<td>450</td>
<td>3,125</td>
<td>325</td>
</tr>
<tr>
<td>500</td>
<td>3,325</td>
<td>345</td>
</tr>
<tr>
<td>550</td>
<td>3,575</td>
<td>370</td>
</tr>
<tr>
<td>600</td>
<td>3,750</td>
<td>390</td>
</tr>
<tr>
<td>650</td>
<td>3,950</td>
<td>410</td>
</tr>
<tr>
<td>700</td>
<td>4,175</td>
<td>435</td>
</tr>
</tbody>
</table>
**ii) Production:** to enable the animal to work.

This is a very delicate issue for which there is no easy answer. In this report it is recommended that the workload be divided into three groups according to degree of heaviness (see Table 2.3).

<table>
<thead>
<tr>
<th>Type of job</th>
<th>Light</th>
<th>Medium</th>
<th>Heavy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Light harrowing (h)</td>
<td>1-4</td>
<td>4-7</td>
<td></td>
</tr>
<tr>
<td>Light transport (h)</td>
<td>1-4</td>
<td>4-7</td>
<td></td>
</tr>
<tr>
<td>Planting in loose soil (h)</td>
<td>1-4</td>
<td>4-7</td>
<td></td>
</tr>
<tr>
<td>Heavy harrowing (h)</td>
<td>1-2</td>
<td>2-4</td>
<td>4-7</td>
</tr>
<tr>
<td>Ripping/ridging in loose soil (h)</td>
<td>1-2</td>
<td>2-4</td>
<td>4-7</td>
</tr>
<tr>
<td>Weeding with cultivator/ripper (h)</td>
<td>1-2</td>
<td>2-4</td>
<td>4-7</td>
</tr>
<tr>
<td>Transport on bad roads (h)</td>
<td>1-2</td>
<td>2-4</td>
<td>4-7</td>
</tr>
<tr>
<td>Ploughing (h)</td>
<td></td>
<td>1-4</td>
<td>4-7</td>
</tr>
<tr>
<td>Groundnut lifting (h)</td>
<td></td>
<td>1-4</td>
<td>4-7</td>
</tr>
<tr>
<td>Deep ripping/split ridging (h)</td>
<td>1-3</td>
<td>3-6</td>
<td></td>
</tr>
<tr>
<td>Sub-soiling (h)</td>
<td>1-2</td>
<td>2-4</td>
<td></td>
</tr>
<tr>
<td>Heavy transport (h)</td>
<td>1-2</td>
<td>2-4</td>
<td></td>
</tr>
</tbody>
</table>

Depending on the workload the animals need additional amounts of total digestible nutrients and digestible crude protein according to their live weights (see Table 2.4).

Two spoonfuls of salt (approximately 50 grams) per day for working animals performing a daily job, should be mixed with the supplement.

<table>
<thead>
<tr>
<th>Ox LW (kg)</th>
<th>Light TDN (g)</th>
<th>Light DCP (g)</th>
<th>Medium TDN (g)</th>
<th>Medium DCP (g)</th>
<th>Heavy TDN (g)</th>
<th>Heavy DCP (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>200</td>
<td>750</td>
<td>90</td>
<td>1,500</td>
<td>180</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>300</td>
<td>975</td>
<td>117</td>
<td>1,950</td>
<td>234</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>400</td>
<td>1,200</td>
<td>144</td>
<td>2,325</td>
<td>279</td>
<td>3,525</td>
<td>423</td>
</tr>
<tr>
<td>500</td>
<td>1,425</td>
<td>172</td>
<td>2,700</td>
<td>324</td>
<td>4,050</td>
<td>486</td>
</tr>
<tr>
<td>600</td>
<td>1,650</td>
<td>198</td>
<td>3,075</td>
<td>364</td>
<td>4,500</td>
<td>540</td>
</tr>
<tr>
<td>700</td>
<td>1,875</td>
<td>225</td>
<td>3,375</td>
<td>405</td>
<td>4,875</td>
<td>585</td>
</tr>
</tbody>
</table>

**LW** = live weight; **TDN** = total digestible nutrients; **DCP** = digestible crude protein.

**iii) Growth** is another criterion which determines the amount of total digestible nutrients and crude protein required by an animal (Table 2.5). Note that the requirements for growth decrease when an animal is reaching maturity.

<table>
<thead>
<tr>
<th>LW (kg)</th>
<th>Fast TDN (g)</th>
<th>Slow TDN (g)</th>
<th>Fast DCP (g)</th>
<th>Slow DCP (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>200</td>
<td>875</td>
<td>625</td>
<td>220</td>
<td>160</td>
</tr>
<tr>
<td>250</td>
<td>1,125</td>
<td>875</td>
<td>220</td>
<td>160</td>
</tr>
<tr>
<td>300</td>
<td>1,625</td>
<td>1,250</td>
<td>270</td>
<td>210</td>
</tr>
<tr>
<td>400</td>
<td>3,125</td>
<td>1,500</td>
<td>300</td>
<td>190</td>
</tr>
<tr>
<td>500</td>
<td>3,625</td>
<td>1,750</td>
<td>310</td>
<td>170</td>
</tr>
<tr>
<td>600</td>
<td>1,250</td>
<td>625</td>
<td>220</td>
<td>90</td>
</tr>
</tbody>
</table>

**LW** = live weight; **TDN** = total digestible nutrients; **DCP** = digestible crude protein.
iv) Total nutrient requirements

The data used below is from Tables 2.2 to 2.5.

Example: A team of slow growing oxen are used for ploughing for 3 hours a day:

<table>
<thead>
<tr>
<th>Activity</th>
<th>Ox A (400 kg)</th>
<th>Ox B (500 kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>TDN (g)</td>
<td>DCP (g)</td>
</tr>
<tr>
<td>Maintenance</td>
<td>2,950</td>
<td>305</td>
</tr>
<tr>
<td>Work</td>
<td>2,325</td>
<td>279</td>
</tr>
<tr>
<td>Growth</td>
<td>1,500</td>
<td>190</td>
</tr>
<tr>
<td>Total</td>
<td>6,775</td>
<td>774</td>
</tr>
</tbody>
</table>

Rationing

It is now possible to calculate the ration and select the feedstuff it should consist of to fulfil the requirements of the oxen. For this a table with the total digestible nutrients and digestible crude protein contents of the different feedstuffs (Table 2.6) is used.

Tables 2.2 to 2.6 form the foundation of making realistic feed rationing plans based on the local conditions. Usually, the traditional grazing practices will not meet the demands of draught animals other than plough-oxen in semi-arid areas. There is no purpose of introducing animal draft power/conservation tillage if the draught animals cannot generate enough power to pull the implements due to inadequate feeding. Fortunately, many fairly priced feedstuffs are available besides pasture, which can be used by the draught animals to ensure maximum draught power. A few farmers already practise improved feeding for dairy production but there is a need for major improvements for draught animals.

Table 2.6 Nutrients of different feedstuffs

<table>
<thead>
<tr>
<th>Products</th>
<th>% DM</th>
<th>Grams per kilogram dry matter</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>TDN</td>
</tr>
<tr>
<td>Roughage</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Natural pasture, young</td>
<td>18-25</td>
<td>580</td>
</tr>
<tr>
<td>Natural pasture, old</td>
<td>18-25</td>
<td>540</td>
</tr>
<tr>
<td>Napier grass, young</td>
<td>12-16</td>
<td>600</td>
</tr>
<tr>
<td>Napier grass, medium</td>
<td>16-19</td>
<td>550</td>
</tr>
<tr>
<td>Napier grass, old</td>
<td>20-25</td>
<td>525</td>
</tr>
<tr>
<td>Panicum coloratum</td>
<td>12-20</td>
<td>590</td>
</tr>
<tr>
<td>Green maize, flowering</td>
<td>18-20</td>
<td>650</td>
</tr>
<tr>
<td>Maize, cob removed</td>
<td>30-40</td>
<td>650</td>
</tr>
<tr>
<td>Maize stover, fully matured</td>
<td>40-50</td>
<td>550</td>
</tr>
<tr>
<td>Sorghum stover, fully mat.</td>
<td>90</td>
<td>450</td>
</tr>
<tr>
<td>Bean straw</td>
<td>85</td>
<td>450</td>
</tr>
<tr>
<td>Pigeon pea husks</td>
<td>65-85</td>
<td>400</td>
</tr>
<tr>
<td>Cowpea straw</td>
<td>85</td>
<td>325</td>
</tr>
<tr>
<td>Finger millet straw</td>
<td>85</td>
<td>550</td>
</tr>
<tr>
<td>Soya bean straw</td>
<td>85</td>
<td>325</td>
</tr>
<tr>
<td>Groundnut hay</td>
<td>90</td>
<td>460</td>
</tr>
<tr>
<td>Banana stems</td>
<td>8-10</td>
<td>690</td>
</tr>
<tr>
<td>Banana leaves</td>
<td>15-18</td>
<td>640</td>
</tr>
<tr>
<td>Sweet potato vines, young</td>
<td>10-12</td>
<td>680</td>
</tr>
<tr>
<td>Sweet potato vines, old</td>
<td>10-15</td>
<td>680</td>
</tr>
<tr>
<td>Lucerne, pro-flowering</td>
<td>10-18</td>
<td>600</td>
</tr>
<tr>
<td>Lucerne, full flowering</td>
<td>22-15</td>
<td>570</td>
</tr>
<tr>
<td>Leuceana leaves</td>
<td>28-30</td>
<td>560</td>
</tr>
<tr>
<td>Hay, average</td>
<td>85</td>
<td>400</td>
</tr>
<tr>
<td>Silage, average</td>
<td>25-30</td>
<td>160</td>
</tr>
<tr>
<td>Kale (sukuma wiki)</td>
<td>14-18</td>
<td>700</td>
</tr>
<tr>
<td>Cabbage</td>
<td>11-15</td>
<td>680</td>
</tr>
<tr>
<td>Products</td>
<td>% DM</td>
<td>TDN</td>
</tr>
<tr>
<td>-------------------</td>
<td>------</td>
<td>-----</td>
</tr>
<tr>
<td><strong>Cereals</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maize and cob meal</td>
<td>88</td>
<td>750</td>
</tr>
<tr>
<td>Sorghum grain</td>
<td>90</td>
<td>760</td>
</tr>
<tr>
<td>Brewer’s waste</td>
<td>20-25</td>
<td>610</td>
</tr>
<tr>
<td>Pineapple waste</td>
<td>20-25</td>
<td>750</td>
</tr>
<tr>
<td><strong>Other Products</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Blood and bone meal</td>
<td>95</td>
<td>620</td>
</tr>
<tr>
<td>Fish meal</td>
<td>95</td>
<td>730</td>
</tr>
<tr>
<td>Poultry manure</td>
<td>90</td>
<td>360</td>
</tr>
<tr>
<td>Molasses</td>
<td>75</td>
<td>500</td>
</tr>
<tr>
<td><strong>Concentrates</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maize bran</td>
<td></td>
<td>800</td>
</tr>
<tr>
<td>Sorghum bran</td>
<td></td>
<td>600</td>
</tr>
<tr>
<td>Wheat bran</td>
<td></td>
<td>800</td>
</tr>
<tr>
<td>Rice bran (3-10% husks)</td>
<td>770</td>
<td>140</td>
</tr>
<tr>
<td>Rice bran (10-25% husks)</td>
<td>590</td>
<td>120</td>
</tr>
<tr>
<td>Cottonseed cake, no hulls</td>
<td>740</td>
<td>375</td>
</tr>
<tr>
<td>Cottonseed cake, with hulls</td>
<td>500</td>
<td>200</td>
</tr>
<tr>
<td>Sunflower cake (no hulls)</td>
<td>750</td>
<td>380</td>
</tr>
<tr>
<td>Sunflower cake (with hulls)</td>
<td>680</td>
<td>210</td>
</tr>
<tr>
<td>Soya bean meal</td>
<td></td>
<td>760</td>
</tr>
</tbody>
</table>

DM = Dry Matter; TDN = total digestible nutrients; DCP = digestible crude protein.


As can be seen in the example below, the farmers generally have the opportunity to feed their oxen well from local resources. Should there be too many cattle in the village using this feed base, a priority needs to be made as to which animals to feed properly during critical periods. Furthermore, a farmer may have to harvest and store crop residue to ensure that his/her animals get the crop residue from his/her fields if free post-harvest grazing is a common practice. To a large extent, organisation of the utilisation of the available feed resources is essential.

**Example:** The farmer above has available the following feedstuffs (see Table 2.6 for feeding value):

- Ample grazing of old natural pasture 2 kg dry matter per 100 kg live weight, total digestible nutrients 540 g, digestible crude protein 32 g
- Kale (sukuma wiki) at 5 kg fresh per ox per day 16% dry matter, 5 kg fresh = 0.8 kg dry matter, total digestible nutrients 650, digestible crude protein 120
- Concentrates: Sunflower seed cake with hulls; total digestible nutrients 500, digestible crude protein 350- Maize bran; total digestible nutrients 800, digestible crude protein 50

**Question:**
1. Is grazing and supplementary feeding of 5 kg kale/day enough to meet the demands for 3 hours ploughing work/day?
2. If not how much concentrate is required?

<table>
<thead>
<tr>
<th>Activity</th>
<th>Ox A (400 kg)</th>
<th>Ox B (500 kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>kg DM</td>
<td>TDN</td>
</tr>
<tr>
<td>Requirement</td>
<td>6,775</td>
<td>774</td>
</tr>
<tr>
<td>From grazing</td>
<td>8</td>
<td>4,320</td>
</tr>
<tr>
<td>From kale</td>
<td>0.8</td>
<td>520</td>
</tr>
<tr>
<td>Shortage:</td>
<td>-1,935</td>
<td>-433</td>
</tr>
<tr>
<td>Sunflower cake</td>
<td>1</td>
<td>500</td>
</tr>
<tr>
<td>Maize bran</td>
<td>2</td>
<td>1,600</td>
</tr>
<tr>
<td>Surplus:</td>
<td>+165</td>
<td>+17</td>
</tr>
</tbody>
</table>

**Conclusion:**
1. Grazing and supplementary feeding of 5 kg kale is not enough to meet the feed requirements of the oxen. The oxen will lose weight and power.
2. Additional feeding of 1 kg sunflower cake and 2 kg maize bran will make the feeding ration balanced with the demand of work. The oxen can carry on working efficiently for a long period of time.

DM = dry matter; TDN = total digestible nutrients; DCP = digestible crude protein.
2.4.6 Possible feed resources

Natural grazing is by far the most common feed. Animals feed themselves, obtaining what they can from available pastures/range. It is possible to increase the production from the natural grazing area through better management of the grazing animals and through better pasture production methods.

Establishment of specific fodder/pasture areas can play a major role in bridging the feed shortage during the dry season. Use of recommended fodder species, which are well adapted to the area and can be integrated in the existing farming systems is encouraged. Common fodder species grown in the programme area include Napier grass, Rhodes grass, *Setaria* grass, *Desmodium* spp., *Lablab* spp. etc.

Crop residues are the next most common feed. Usually, post-harvest grazing is practised but between half and one-third of the feed value is lost through trampling, bleaching, moulds and termites. In addition to large feed losses there is also serious damage to the soil. A superior alternative is to collect maize stover, hay/straw from groundnuts and beans and other crop residues after the harvest and feed them directly to the working animals as needed.

Another important factor determining the feeding value of crop residue is the time of harvesting the crop. When the seed has reached physiological maturity with a moisture content of 35–40% (black layer stage in maize) no more nutrients are added to the seeds. The plant dies and nutrients return to the soil. If the plant is cut, dried and harvested early, the nutrients remain in the plant and the feeding value of the crop residue is much higher than at normal harvesting time. This means that there is great potential for improving the feeding base substantially for the draught animals by taking better care of the existing fodder base.

Pecking is a commonly used system in Kilimanjaro to optimise the feeding value of a traditional maize. When the maturing maize grains have reached moisture content of 40%, part of the stem above the cob is cut off. All leaves below are stripped off and collected. The harvested green matter is dried and can be stored for longer periods. The lower coarse stem and cob remain in the field for further drying down to 13% moisture content. This is a simple, cheap and highly efficient system that ensures high quality feed for working animals and dairy cattle and mulch to protect the soil. Traditional drying preserves high quality feed from crop residues.

Collected crop residue can be stored in or on the roof of the cattle shed. The residue can be collected and stacked in the field, where it is preserved from wastage and trampling.

Treating crop residue with urea is a method of increasing the protein content in the fodder for ruminants. However, it requires a high level of management and further trials are required before one can recommend this at village level.

Hay (harvested grass/legumes that are dried and stored) can be fed to working animals. The nutritional quality of hay ranges from excellent to very poor. Conditions suitable for good hay production are generally found in the more temperate areas and highlands. Natural standing hay in semi-arid areas may also be of good quality. However, fire is a serious threat to any standing hay. In higher rainfall areas, dried tropical grass tends to be of poorer quality and such areas seldom have an absolute shortage of pasture, unless stocking densities are very high.

There is almost always a surplus of good quality green matter, 2 or 3 months after the onset of the rains. This excess grass could be cut with a sickle and sun dried. The principle of haymaking is to conserve roughage through sun drying (reducing the moisture content in the material and if done properly the resulting hay is an excellent fodder high in nutritive value.

Drying can take place on the ground or on simple racks such as those used for drying beans (see Figure 2.14). These racks can be made out of sticks and rope or bark, materials which are available to most farmers.

Rain can quickly damage hay that is drying on the ground and it is essential to select a dry period for haymaking.
Drying on a rack is less sensitive to rain damage provided that the grass is properly filled on the racks. It is essential to make the top layer a simple thatched roof to minimise rainwater penetration. If rains persist it is advisable to cover the top layer with some plastic sheeting. Air then circulates freely through the grass layers and dries it quickly and safely.

It is important to start hay making with good material, rich in nutrients, before the grass gets too tall, too old and too fibrous. Grass of approximately 50 cm height in the early flowering stage normally gives a good and sufficient quantity of hay. Examples of grasses that produce good hay are *Setaria* grass, Rhodes grass and *Panicum* varieties.

A common practice in haymaking is to graze the area once or twice and then leave it to produce a crop for haymaking. This way one can avoid the heavy rains. The quicker the grass dries into hay the better the quality obtained. The moisture content should be about 15–20% when the hay is stacked into a big heap. Termites can invade the haystack and to avoid this, stack the hay on a platform above the ground.

The heap of hay should have straight sides and a slope at the top like a roof. Form a layer of grass like a thatch on the top to avoid rain damage.

Baling by hand is a simple method of collecting, transporting and storing both hay and crop residue. Pack the hay/straw in a box or in a square hole in the dry ground. Ropes should be inserted before filling and compaction. When the bale is thick enough tie the rope by hand and pull out the ready bale.

Forage trees can be an important source of fodder. In some areas, farmers lop off branches of locally known suitable trees towards the end of the dry season. In intensive management systems, people harvest leaves especially for the animals. The leaves of many legume trees are good feedstuffs. Examples are *Acacia*, *Sesbania* or *Leucaena* species (local farmers and/or agricultural officers should know the most suitable local varieties).

Household/milling residue may be fed to draught animals. Maize bran, left after traditional pounding, is a good feed as is cottonseed. Rice bran tends to be less popular with cattle, but can be most useful when pasture is in short supply.

Purchased feed supplements include sunflower/cottonseed cakes, maize bran, wheat bran and brewers’ grains. Molasses not only supply energy, but also make crop residues more palatable. The use of such supplements depends on their availability and the economic importance of the work.

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**Figure 2.14** Simple drying racks for hay and beans.
2.4.7 Feeding strategies

The problems encountered in nutrition of draught animals is often more of cost than knowledge. However, the traditional beliefs that an ox should feed itself from the range are still prevalent and this can have serious negative effects when overgrazing is a common feature. In a situation of increased competition for fodder, work oxen living off the range have less time for grazing and need specific attention to avoid rapid drop in condition. Usually, better utilisation of existing feed resources is a cost-effective system of overcoming seasonal fodder shortage.

Farmers who use animals for ploughing only; may know how to feed their animals better but choose not to do so. Farmers with dairy animals or with animals which are hired out for tillage/transport are likely to feed their animals better because they get immediate cash benefits from them. Feeding plough-oxen well may only be economically justified if they work long and hard, and/or their condition is very weak and/or if cash income can be earned.

Oxen in poor condition may do some ploughing work in the short term. For farmers with great problems in feeding their animals this is important. Provided the animals are not at risk, and provided that they will gain weight when the grass starts growing again, it may be a reasonable strategy to allow them to lose weight before and during the ploughing season. Despite the hardiness of the working animals it is best to endeavour to keep them in good condition, if possible. No doubt, the feeding strategy is a key issue with improved draught animal mechanisation and particularly conservation tillage as the draught power is highly dependent on available feed.

There are low-cost, but effective ways of improving draught animal nutrition. The most obvious one is the pecking/stocking of maize stover, grass/legume hay and other crop residues. Stocking residues is easiest if the farmer has a cart and in many countries stocking of animal feeds has followed expansion of the use of the animal-drawn carts. Several household and farm residues are also valuable feeds. Planting multi-purpose fodder trees can provide feed supplements at little cost.

If land is fenced, or if farmers have control of grazing, specific areas can be left for the late dry season. This can be very effective, although it has risks. The reserved grass can be lost to fire, wild animals and other people’s cattle. Thus farmers often adopt the strategy of letting their animals graze all areas. Their argument is often that food reserves are best stocked within the animals themselves!

Since animal nutrition is mainly a seasonal problem throughout the world, over generations farmers have found ways of coping. If there are local farmers experienced with cattle husbandry, they are probably using their available feed resources quite wisely. Their expertise may be a valuable resource for others. However, it should be borne in mind that it is a priority to survive a bad season, not to provide hard work during this period. Despite great local knowledge on livestock, traditional management practices can sometimes prevent desired and very essential improvements to take place when there is a need to improve technology.

A precondition for a successful introduction of animal drawn conservation tillage is a feeding strategy that meets the requirement of producing the needed power. It is obvious that the basic plough oxen strategy of feeding is inadequate and it is essential to train both the extension workers and the farmers on how to utilise the existing feeding base more efficiently.

Under many circumstances the application in proper feeding of draught animals is the most profitable investment a small-scale farmer can make.
3 Regular health checks and treatments

This chapter is developed from the Palabana ADP Development Programme manual on animal health. It has been modified to suit the requirements of LAMP/SCAPA.

3.1 General

Many of the problems identified in the daily health check require treatment. This section describes common remedies. The principal health problems requiring treatment in working animals are specific illnesses (due to disease-causing organisms), parasites, poisoning and wounds. These health problems vary from place to place, and the local veterinary services should give advice on the recommended routine treatments such as de-worming, vaccinations, tick control and treatment of various illnesses. Local veterinarians may provide the necessary drugs or advice on where to obtain them. Having undertaken training based on this report, extension staff should be in a position to guide the farmers on relevant actions to take.

In addition to the local veterinarians and extension staff, advice can be sought from local stockowners. In many cases, they can recommend certain management practices (areas to avoid and things to do) or traditional remedies that may help maintain the health of working cattle.

3.2 Signs of ill health

The farmer/stockman who is able to recognise ill health and abnormal behaviour can often prevent minor problems from building into major ones.

A working animal is likely to be sick if:
- Reluctant to stand, walk and/or work
- Often on its own, or leaves the main group when able to do so (although this is normal for cows during labour)
- Refuses to eat; its eyes may often be dull and watering or even swollen
- Has diarrhoea or constipation – (a dirty tail can be a first sign of digestive upsets)
- Is seen limping, carrying a foot off the ground, or has swelling in the joints
- Has a dry rough coat or skin and dry muzzle
- Mouth, nose, eyes, anus and reproductive openings have excessive discharges or are exuding pus
- Breathing is rapid, often coughs and has running nose; for a rested ox, a breathing rate of over 15 respirations per minute is very high and is indicative of disease.
- Any radical diversion from normal temperature, pulse and respiration on either side is usually a sign of sickness.

For working oxen the normal rates are:
- Pulse rate/min measured under the jaw 60–70
- Respiration rate/min 30 breaths
- Temperature 38.5–39.5°C.

If a working animal is ill, it must be rested and given food and plenty of water. It should be kept away from other cattle. Assistance from a veterinarian should be sought if it shows no improvement or if a serious health problem is suspected.

The following sections will cover:
- General wound care
- Disease control at farm/village level
- Castration, dehorning and hoof care.
3.3 Restraining cattle

3.3.1 Introduction

The purpose of restraining animals is to enable the ox-handlers to treat the animal without trouble from violent movements. This should be done such that the risks of being hurt or injured by the animal, or the animal hurting itself are avoided.

When handling animals avoid scaring them with shouts, uncontrolled movements and large groups of people. They should be handled as calmly and normally as possible to avoid exciting them. Animals require restraining during:

- Castration
- Dehorning
- Branding
- Hoof-trimming
- Wound care etc.
- Vaccinations or any other treatments.

3.3.2 Methods of restraining

The following methods are commonly used to restrain cattle:

- A halter: made out of a length of rope
- Nose hold: using either hands (pressing the wall between nostrils with thumb and middle fingers) or nose pliers (Figure 3.1)
- A tail hold: prevents an animal from backing up in a crush (Figure 3.2).

![Figure 3.1](image1.png) A nose clamp or pliers.  
![Figure 3.2](image2.png) Tail hold.

A crush can be used to restrain a single or several of animals to allow for vaccinations or hand spraying. A crush equipped with a head yoke at the end of the chute will allow activities like dehorning or deworming of adult animals. Where no head-yoke is available, the animal is put in the crush.

For de-worming, hold the animal by its lower jaw, at the same time hold the far away horn with other hand and lift the head upwards and towards you. An assistant should insert the drenching gun or a beer bottle containing the pre-measured amount of dewormer and drain it into the mouth. The head should be held up until one is certain that the animal has swallowed all the dewormer.

A cubicle of 1 m wide and 1.50 m long is useful when hoof-trimming. The animal should be tied properly in the front with a rope, applied like a halter. The operator should then push his/her side against or into the animal just behind the rear leg, with their back turned to the front of the animal. Next the operator should try to lift the leg by grabbing it just above the hoof and putting it on their knee in one smooth movement. Standing in this position the animal is unable to kick the operator. The animal should not lean on the operator while standing on the other three legs. If keeping the animals leg on the knee is difficult, use a rope and tighten it with the help of a stick. This rope should be placed just above the heel hock.
A rope is used to prevent the animal from kicking. When the operation requires standing behind the animal, run a rope around the body of the animal just in front of the udder or scrotum of the animal. When this rope is tightened it stops the animal throwing its legs backwards. This method is preferred to tying the rear legs together with a rope, because in difficult animals the latter method can cause severe wounds on the legs. This method may also be used for milking dairy animals.

During castration or branding the animal needs to be cast down. Normally this would be difficult, but by using a rope as shown in the drawings of Figure 3.3, the animal goes down relatively easily after pulling and tightening the rope. Releasing the rope soon after the animal has fallen down makes the animal stand again up very quickly. When the animal is down, an assistant should tighten its legs together, enabling the castration or branding to take place.

The rope should pass on top of the back of the animal, as this will be more effective (less power required). Also it prevents the animal from turning to the left or the right, when the rope is being tightened.

A traditional method of throwing an animal down is to throw a lasso around the rear legs, and pull, while another person takes the animal by the horns and pulls in the opposite direction. When the animal falls, somebody should sit on its neck and keep its head down while the rope around the rear legs is pulled tight.

Throwing down a calf is comparatively easy. The operator stands beside the calf and passes his/her arms between the legs, then grabs the legs on the other side, and pulls/lifts these legs inwards whereby the calf falls over quite quickly. The operator then sits on the animal holding it by the nose with one hand and keeping the rear legs down with the other hand. This method can be used to de-bud the calf with a hot iron.

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**Figure 3.4** How to throw down a calf.
3.4 General wound care

3.4.1 Wounds

This section describes basic precautions that should be taken to avoid wounds and other injuries to draught cattle. It also gives guidelines on general care of wounds and other injuries already inflicted on the animal.

The aim of treating a wound is to create an environment as favourable as possible for the wound to cure rapidly. Care must be taken to ensure a complete anatomic and functional recovery, by determining:

- The site
- Parts of the body involved
- The chances of infections
- The disturbance of functions.

Wounds on animals might be caused by thorns, barbed wire fences, fighting, yokes, riems (reins made out of raw hide), ropes which have been used badly, insect bites, beating and even by the implements drawn by the animal.

An important part of wound care is to prevent and/or combat wound infection. This can be done by:

1. Cutting away the hair around the wounded area.
2. Disinfecting the area around the wound.
3. Removing alien objects from the wound, the heavily damaged pieces of skin and coagulated blood.
4. Pieces of dirt, which are stuck, need to be removed with a pair of pincers or with a wet piece of gauze.
5. The wound should be washed with a weak antiseptic, such as a salt in water solution, or dettol (an antiseptic).
6. Lastly the following may be applied:
   - A sulpha powder and/or an antibiotic powder
   - An antibiotic spray (e.g. alamycin, tetracyclin, E.S.50, eusol)
   - Healing oil (which contains an antiseptic)
   - Pure honey
   - Fly repellents, extract from local trees (e.g. olendimwi) and/or Stockholm tar or tick grease if it is only a bruise or a slight cut. This will prevent a fly strike (flies laying eggs in the wound; the eggs hatch into maggots).
7. Cover the wound with bandages (blood should circulate around the wound freely thus the cover should not be airtight).

In case of a deep cut, close the gap using a bandage after covering the wound with gauze. If the wound is too deep or is situated where a bandage cannot be applied, then the wound will have to be stitched. Preferably a veterinary officer should do this. If forced to do it, then act as indicated in Figure 3.5. When a wound has been stitched, stitches are removed after the number of days recommended by the veterinary surgeon, otherwise, approximately after 10 days is appropriate.

Figure 3.5 U-shaped stitch.
The animal should be given rest and all efforts should made to ensure the most comfortable conditions by providing:

- Sufficient food and water
- A dry and clean area to lay down
- Shade to protect the animal from the sun
- A shelter to provide protection from the rain.
- If the wound gets infected, a smelly discharge is normally noticeable within 3 to 4 days. In this case the following steps should be taken:
  - If the wound has been stitched remove the stitches first, otherwise remove the bandage (if applicable).
  - Clean the wound thoroughly with clean boiled water to which an antiseptic or weak disinfectant has been added. This should be repeated daily (if no disinfectant is available, use boiled water with one spoon of salt per litre).
  - Give the animal a general antibiotic injection; make sure you complete the course of antibiotics, as indicated on the prescription.

If normal healing takes place then do not clean the wound unnecessarily. Apply sulpha powder or an antibiotic powder or spray as per prescription.

Scabs which may develop as the wound heals should never be removed. In case of severe cuts on the legs, which may cause severe bleeding, the first task is to stop the bleeding by applying a tourniquet on the wound for about 30 minutes. A clean pressure pad can also be applied directly over the wound. Normally a pressure pad is applied after ensuring that bleeding has stopped or has been reduced by using a tourniquet.

### 3.4.2 Eye infections

Eye wounds and infections are relatively common and require immediate and correct attention if blindness or impairment of sight is to be avoided. Stockmen should check for eye problems in their cattle daily. Any animal showing discharge from its eyes should be restrained and the eyes inspected closely.

The eye can be washed with lukewarm water with some salt in it (half a teaspoon of salt to half a litre of boiled water). Foreign bodies can be washed out this way.

If the eye is infected, use antibacterial eye ointment or powder. Apply daily until recovery.

Dry dusty feedstuffs can cause eye irritation; this can be avoided by wetting the feedstuffs with water or molasses before feeding.

### 3.4.3 Abscesses

An abscess normally develops in response to a penetrating foreign body or a piece of dead body tissue. They are generally recognised as enlarged fluid filled swellings. A syringe might be needed to make sure that it is an abscess that contains pus and not a haemorrhage, which should never be opened.

If it is certain that an animal has an abscess containing pus, make a cut with a sterile scalpel, sharp knife or razor blade. This cut should in all cases be made as deep in the swelling as possible, to allow all pus to be discharged from the abscess. If the cut is made quickly it is painless to the animal, which actually gets relieved. The operator has to be careful of the position they adopt when opening an abscess, as the pus may be discharged quite fast and hence splash on him/her.

Flush the abscess with saline, or with a weak disinfectant solution and leave a large opening to ensure further drainage.

If the abscess forms again on the same position, it normally means that the foreign body is still present. In such circumstances cut the abscess right open and explore the area to remove the foreign particle.
3.4.4 Bloat

Bloat usually occurs when the animals have sudden access to lush green grazing after a long period of less favourable grazing (e.g. after the dry season). The cattle will then eat a large quantity of low roughage fresh grass or legumes with a high sugar content. This ferments rapidly in the rumen and produces more gas or foam than the animal can get rid of.

The rumen gradually fills with gas and grows like a balloon, which causes the animal great discomfort. Without relief, the animal could die.

A typical sign of bloat is a pronounced ruminal swelling on the left side of the abdomen, just behind the ribcage. The abdominal wall feels as tight as a well-tuned drum; the animal shows signs of pain and salivates excessively.

As the situation progresses, the animal is unable to stay standing and will typically lie on its side with its legs straight out. The first action should be to relieve the gas pressure. This can be done by making the animal stand and move around, on condition that it is detected early enough. In addition try to drench the animal with one of the following:

- Mineral oil, approx. half a litre
- Paraffin 50 ml in a vegetable oil, 500 ml
- Washing powder dissolved in water (approx. 20 g in half a litre of water)
- Sodium bicarbonate (80–120 g in half a litre of water)
- A shop bought anti-bloat, or stop bloat drench.

In more severe cases, no time should be lost and the rumen should be punctured with a trocar and cannula (Figure 3.6).

![Trocar and cannula](image)

If the trocar and cannula are not available, use a long needle and hold it in place until the gas ceases to come out.

As a last resort a very sharp knife can be used, which should be twisted after the rumen has been punctured. Another alternative is a pair of scissors, which should open the rumen after the puncture has been made.

The point of puncturing is between the last rib and the point of the hip, a few centimetres down from the spine. This area is normally called the hunger groove and is situated on the left side of the animal (Figure 3.7).

Often it is difficult to distinguish these markings, in which case the stab should be made in the most prominent part of the swelling.

Keep the passage open until all the gas has escaped then remove the trocar and cannula, the knife or the scissors. After, dose the animal with an anti-fermentation drench to prevent recurrence of gas build up.

Once the animal has regained its power, it should be made to walk, to enhance dispersion of any remaining gas.
Figure 3.7 The hunger groove.

Precaution: If animals have to be feed on a lush green pasture after the dry season, allow them there only for a short time, starting with 2 hours, and extending it by an hour each day. After 10 days they can be allowed free access, as the animals will have fully adapted themselves to the new diet, which is rich in sugar and poor in fibre.

3.4.5 Poisoning

Many substances, both natural and manmade, can poison animals. The first sign may be sudden death or a more prolonged illness generally with marked diarrhoea. If poisoning is suspected, the first task is to identify and remove the poison. Poisoning can take place through a toxic plant, a chemical such as a cattle dip, a plant herbicide, a fertiliser or lead containing paints.

Advice should be sought for the specific therapy for the poisoning as this varies markedly with the type of poison involved. The most important action is to accurately identify the source and prevent other animals from also getting poisoned.

There are many poisonous plants in the range and many stockmen have good knowledge on how to avoid them. Make sure that there is a good understanding where they are and how to get rid of them if they are a threat in the grazing area.

Some examples of poisons and their treatments are:

1. Urea: 1–2 l of vinegar
2. Strychnine: tots of strong tea
3. Cyanide: intravenous injection with sodium nitrate, and sodium thiosulfate
4. Salt: lots of water
5. Nitrate: mineral oil
6. Insecticides, herbicides and fungicides: check the labels of these items to find the treatment e.g.
   • Chlorinated hydrocarbon compounds: lots of water with salt.
   • Organophosphate basis: injection with atropine sulphate.
7. Plant poisoning:
   • Lantana: restrict animals from eating; if they have eaten keep them in the shade
   • Sorghums and millets below 2 feet (0.6 m) contain prussic acid (cyanide poisoning).
8. Feed poisoning:
   • Aflatoxin, caused by moulds: these develop when feeds are stored in moist and high temperature conditions. As a precaution stop offering all feeds and identify the feed which has the aflatoxin before starting to use the others again. There is no other known treatment.
9. Snakebites: Venomous snakes fall in to two classes:
   • The elopine snakes, e.g. cobra, mamba etc.: their venom is mainly neurotoxic and kills by paralysing the respiratory centre
Viperine snakes e.g. the puff adder: their venom is mainly hemotoxic, causing pronounced local damage around the bite and bleeding everywhere in the body.

Speedy treatment is very important:

- Keep the animal quiet
- Place a tourniquet just above the snakebite, to be released every 15–20 minutes, for a period of 1 to 2 minutes
- Inject a polyvalent antivenin as early as possible, the smaller the animal the more antivenin is required
- If spat at in the eyes by a spitting cobra, wash out the eyes with water
- The Belgian black stone (*jiwe la nyoka*) is a local method used to treat snakebites. The snake-bite site is cut open and the stone is pressed to the open wound.

### 3.4.6 Foreign bodies or hardware disease

Metal objects, especially those with a sharp point such as nails or pieces of barbed wire, are dangerous when swallowed by a cow. Since the cow does not thoroughly masticate her feed before swallowing, these materials are sometimes taken in whilst eating. Cures can be complicated but prevention consists of strict vigilance in picking up all pieces of wire, nails or other metal objects and crushed glass that might get into the feed.

Other objects such as plastic bags, nylon cloths, plastic ropes etc. can cause serious digestive problems. In principle the same precautions of picking up and burying all potentially dangerous materials should be followed strictly.

### 3.4.7 Fractures

Fractured limbs often result from an animal stepping in a ditch, or when legs are trapped in the side rails of a crush or gate. An animal can also sustain fractured limbs from fighting.

In a fully-grown adult animal, a leg fracture is generally irreparable; it is advisable to slaughter the animal as soon as possible. With calves and young oxen, plaster casts or splits can be used provided the fracture is relatively simple and mid-shaft healing likely to take place.

Correct realignment of the broken bones and immobilisation of the fractured part plus the joints immediately above and below are the key elements for a successful repair. A minimum of 5 weeks’ support is required to enable a strong callus.

### 3.4.8 Lameness

As discussed in the topic of selection of oxen, a lame animal is automatically disqualified.

Lameness in a trained draught animal can render it useless for draft work, as this can seriously affect the working performance.

Severe lameness is recognised when the affected limb is held up when at rest. Slight lameness might not be so easy to detect and correctly identifying the affected limb takes patience and skill (see section on hoof care).

Having determined that an animal is lame and which leg is affected, the next task is to identify the site and cause of the lameness and treat it accordingly. In most cases, the problem site will be in the hoof. Sprained tendons, inflamed joints and strained muscles can also be sites of pain. Examine the affected limb for swellings, cuts and penetrating foreign bodies.

Sprains and strains are cured by rest and with time. Bathing the affected area with cold water will initially reduce swelling and inflammation. Using hot water subsequently improves blood circulation and hasten the healing process. Remember in cases of lameness to check for ulcers in the mouth as the animal may have foot-and-mouth disease.
3.4.9 Summary of general wound care

- Act immediately, delays increase the danger to the animal
- If in doubt try to contact a veterinary officer for advice and other expert help
- Hygiene is very important, always use boiled water; wash hands and utensils before and after the treatment
- Prevent flies from laying eggs in the wounds.

3.5 Disease control at farm/village level

3.5.1 Introduction

Hardworking draught animals are more susceptible to disease stress than non-draught animals and it is essential to have a basic strategy to minimise the threats of diseases both at farm and village level. This must include a combination of traditional livestock knowledge and selected animal husbandry and veterinary practices. The veterinary service has inadequate resources to cover all demands and therefore it is essential to upgrade the general extension and the village competence to avoid and deal with selected diseases.

This section aims at introducing suitable management practices to prevent animals from contracting the most common and important diseases.

- Some diseases can be prevented by one single vaccination whilst others need repeated vaccinations at specific intervals or at a particular age
- Other diseases can be prevented by administering a prophylactic or curative drug at specific intervals or particular times of the year
- Lastly, some diseases can be prevented by ensuring that animals do not get into contact with the vector of the disease by means of:
  - stall feeding
  - hand-spraying/dipping
  - trapping the vector
- Well-fed and well-protected animals are less likely to get diseases.

3.5.2 Bacterial diseases

Anthrax (kimeta)
Anthrax is a very serious disease of all domestic animals, and man, which can be spread and carried by wild animals. The anthrax bacilli are very difficult to kill, as they are able to form spores, which can stay alive under unfavourable conditions for up to 25 years in the ground and in any kind of animal tissue.

Animals are mainly infected through food (grazing, blood and bone meal) and water whereby they ingest of the spores, or by spores that may be carried by flies or hypodermic needles.

Incubation period: 1–3 days, occasionally up to 14 days

Symptoms:

a) The acute form:
   - Sickness seldom seen, death occurs immediately (sudden death without previous signs of illness).

b) The sub-acute form:
   - Sudden high fever which never lasts longer than a day, followed by death
   - After death, blood oozes from nose, ears, mouth and anus; gas forms quickly in the abdomen.

Caution: Never touch or open a dead animal suspected to have died of anthrax!
Treatment:
• Penicillin and tetracycline are effective but disposal of the diseased animal is advisable to avoid spreading the disease.

Prevention:
• An annual vaccination exists which protects animals fully
• Report immediately to the livestock officer when anthrax is suspected
• Bury all carcasses and cover them with quick-lime or a 2.5% formaldehyde solution (6 feet depth, 1.8 m) or burn and bury the ashes
• No produce should be eaten, including milk; this should be properly destroyed
• All tools clothing and parts of the human body which have been into contact with an infected animal should be cleaned and disinfected properly
• All who have touched the carcass should go to the hospital immediately for treatment.

Blackquarter (chambavu)
This disease affects cattle and sometimes sheep and goats. It is caused by a bacterium that multiplies only in the absence of air. The disease is characterised by gassy swellings under the skin. Some grazing lands are known to harbour this disease as the bacteria can assume a very resistant form (spore) and may be picked up either by ingestion or through wounds.

Incubation period: 2 to 5 days.

Symptoms:
• Usually the affected animal is between 3 months and 2 years old
• A swelling is found on one of the heavily muscled areas of the body, but mostly on one of the quarters, which crackles if pressed or sounds hollow when tapped
• Acute lameness, stops rumination, temperature and respiration increase and become laborious.

Treatment: penicillin in combination with streptomycin is useful if the muscle tissue is not too damaged.

Prevention:
• Annual vaccination before the onset of the rains (often combined with anthrax)
• Disposal of carcasses (see anthrax)
• Cleaning of tools clothing and parts of body (see anthrax)
• Report suspected cases immediately to the livestock officer.

Tetanus (pepo punda)
This disease affects all animals and man; infection is through wounds which may be anywhere on the body. The bacteria (Clostridium tetani) is present in soils in spore form. As it is an anaerobic bacterium, it multiplies only in the absence of air. In this condition it produces a toxin, which is a poison, affecting the nervous system. When present in feed or water, it is only dangerous if it enters through a wound in the first part of the digestive tract, as it will be destroyed by the acidity in the stomach.

Incubation period: generally 1–2 weeks, but varies from 24 hours to several months.

Symptoms:
• Stiffness in walking, a rise in temperature and nervous behaviour
• Goes into nervous spasms when attempting to move; loud noises produce spasms in which the muscles appear rigid especially in the throat and jaws
• In a later stages swallowing becomes difficult or impossible, froth/saliva appear at the mouth
• Saliva may drop down the windpipe, causing pneumonia
• The eyelid may flicker.
Prevention:
- All fresh wounds should be cleaned and treated on the spot using hydrogen peroxide or eusols.
- Septic wounds need cleaning with hydrogen peroxide.

Treatment:
- Keep animal quiet in a dark place; it should be handled slowly and gently.
- If wound is found, wash it out thoroughly and dress it with iodine or an antibiotic.
- Food and water should be provided frequently.
- Other animals at risk can be vaccinated.

Haemorrhagic septicaemia (pasteurellosis)
An infectious disease, usually acute, caused by bacteria called Pasteurella septica. Occurrence of this disease is mainly in ruminants, e.g. cattle, buffalo, goats, sheep. Young animals are more susceptible than adults. It is often associated with stress, e.g. over-crowding and over-working, or with malnutrition, unbalanced diet and mineral and/or vitamin deficiency. Infection takes place by ingestion of feed and water, by inhalation. Insects can also play an important role in spreading the disease.

Incubation period: 1–3 days.

Symptoms:
- The skin form
  - Severe swelling of the head, the throat, the neck or the dewlap
  - The skin in the affected area is tightly stretched, warm and painful; Conjunctivitis (infection of eye ball) with a lot of watery discharge
  - Death occurs within 12 to 36 hours.
- The lung form
  - Characterised by body temperature increases up to 42ºC
  - Difficult breathing, dry painful cough, a frothy/watery discharge from the nose
  - Rumination stops and there is loss of appetite
  - Rapid loss in body weight
  - In the chronic form there might be diarrhoea spotted with blood.

Treatment: penicillin and/or sulphonamide.

Prevention:
- Good well ventilated housing and proper, well balanced feeding
- Vaccination every 6 months
- Chronic cases to be disposed of by destroying the carcass or burying it deep
- Identification aids at post mortem are:
  - haemorrhages in fourth stomach and other parts of the body
  - pockets of yellow fluid under the skin and in body cavities

Contagious bovine pleuropneumonia (CBPP) (homa ya mapafu)
This is a disease of cattle and closely related species like buffalo, antelopes etc. An organism known as Mycoplasma mycoides causes it. The infection mainly takes place through the respiratory tract, by coughing standing face to face. It may also occur by mouth, as the organism is also present in the urine, milk and foetal fluids. The disease is spread by direct contact and animals that have recovered remain carriers for several years.

Incubation: from 2 to 4 weeks.

Symptoms:
- The course of the disease is usually slow
- A rise in body temperature
- Animal stands alone in the shade
- Appetite is poor, rumination slows down, swelling of the throat region
• Coughing is occasional at first, but later more frequent
• Breathing is painful and elbows are held outwards

In later stages:
• Coat is rough and dull
• Constipation alternates with diarrhoea
• Discharge from the nose
• Cough is dry, later moist
• Death because of weakness can occur after 3 – 4 weeks, but it may take up to 2 or 3 months
• As recovered animals remain carriers, these should be disposed of by destroying or burying the carcasses deep

Identification aid (necropsy/autopsy finding):
• Hydrothorax: yellow straws
• Hepatisation: necrotic fibrillation in the lung giving marbling appearance.

Treatment: Neither practical nor advisable.

Prevention:
• In danger areas vaccination should be carried out once a year. Advice should be sought from a veterinary officer as the vaccine can cause severe side effects.

Tuberculosis (kifuu kikuu)
The disease is of worldwide distribution and all mammals, including humans and birds, are susceptible. The causal organism of tuberculosis is Mycobacterium tuberculosis, which occurs as a human, bovine and avian type. It is very resistant to adverse conditions because of its waxy protective covering. The sources of the infection are human beings and animals suffering from the disease, infected foodstuffs like milk and other dairy products, eggs, meat and meat products and also faeces, particularly of birds. The infection is spread through the air, food, feed and by contact (wound infection).

Symptoms:
• Chemical picture shows great variation depending on the extent and site of the infection
• TB should be suspected when there is severe loss of condition without any apparent cause and despite good feeding
• Accompanied by swelling of the lymph nodes, below the jaw and in front of the shoulder
• The cough either remains dry and rough, or becomes soft and moist, with a yellowish grey, or even blood stained sputum
• Intestinal tuberculosis may be suspected when there is colic, with constipation or uncontrollable diarrhoea.

Treatment: none.
It is advisable to destroy all animals that test positive. Animals can be tested with tuberculin, which if deposited in the deep layers of the skin, gives rise to a local reaction (swelling) in infected animals.

Control: test and slaughter if positive.

Prevention: none in animals.

N.B.: Seek advice of livestock officer if tuberculosis is on the increase.

Senkobo disease
A common skin disease in Tanzania (referred to as cutaneous streptothricosis in most literature) caused by a fungus like organism called Dermatophilus congolensis. The disease occurs particularly in the wet season and mainly in cattle sheep and goats. The disease is transmitted through direct contact and or through sharp plants and insects. Beware of a blowfly strike in the skin-lesions.
**Symptoms:**
- Animal suffers from lesions particularly on the back, about the size of a pigeon pea seed, that consist of tufts of hair which stick together because of the exudate.

In general, the infection is not that extensive and has little effect on the general health of the animal. The animal overcomes the infection in about 3 weeks. Should the infection be more extensive, especially in young animals, this can be fatal. Sometimes the infection becomes chronic and the crusts build up into large horny masses.

**Prevention:** none.

**Treatment:**
- Single large dose of streptomycin, combined with procaine penicillin, or a long acting terramycin.

### 3.5.3 Viral diseases

**Foot-and-mouth disease (ugonjwa wa miguu na midomo)**

Foot-and-mouth is a very contagious, acute disease which can effect all cloven-hoofed animals. The disease spreads very rapidly, through direct and indirect contact. Usually many animals are affected within a short time. It is mainly spread through the contents of the blisters on bursting, and by the milk, urine, nasal discharge, clothing, vehicles, harness, hay and straw and other animals. The disease in general is not a killer, but it causes severe economic losses:

- Loss of body weight (beef animals)
- Loss of production (milk)
- Loss of body strength
- Abortions and animals take a long time to conceive again
- Secondary infections
- Serious damage can be done to muscle cells (e.g. heart muscle); these animals will be very weak after recovery.

**Incubation period:** 2 to 6 days.

**Symptoms:**
- Fever of short duration
- Loss in appetite, slow rumination, saliva from the mouth, in long ropey strands
- Blisters with a clear yellow fluid appear in the mouth and on the feet
- Blisters burst leaving raw lesions behind, which are prone to secondary infections
- Lameness, because of painful blisters and lesions on the feet; There is a further drop in feed intake because of the same in the mouth.

**Treatment:**
- None known; antibiotics and hygiene measures against secondary infections
- Clean with normal salt solution or wash wounds with ashes
- Apply honey or potassium permanganate to wounds.

**Prevention:**
- Vaccination of all cattle from 4 weeks of age, every 6 months with a quadruplet vaccine
- In case of an outbreak, quarantine, typing of the strain from fluid in the blisters, and vaccination campaign against that particular strain is the most frequent course of action
- Animals which have recovered from the disease are immune to the same strain for up to 2 years, but can also remain carriers of the disease.

**Rinderpest (sotoka)**

This is a very dangerous peracute viral disease affecting cattle, pigs, goats, sheep and game animals. Cattle of exotic blood are more susceptible; mortality is almost 100%. It spreads by excretion of any kind from the sick animal. Pigs suffer a mild reaction, but can spread the disease to cattle. This disease is characterised by inflammation of the mucous membranes. The virus may live for a long time in wet/moist conditions, but only 1 day in sunshine.
Incubation period: 3 to 12 days.

Symptoms:
- High fever
- Staring coat (hairs standing out)
- Red and watery eyes
- Signs of colic with constipation at first, then diarrhoea; faces are black and may be blood stained
- Ulcers can be found in the mouth and large sores on the skin, ropey foul smelling saliva is discharged
- Animal prefers to stand alone
- Coughing and rapid breathing can be present and the animal may grind its teeth as if in pain
- Severe weakness, loss of condition and finally death follows.

Treatment: none.

Prevention: vaccination of all animals over 1 year of age.

Lumpy skin disease
A serious infectious viral disease in cattle only, characterised by swellings in the skin. The virus is spread by mosquitoes and, possibly, other biting insects.

Incubation period: 2 to 4 weeks.

Symptoms:
- Lumps or nodules in the skin measuring up to 5 cm across, which in due course rupture at the base
- Hair stands on the top of the nodules
- There may be discharge from the eyes, nose and mouth
- Temperature may rise to 40°C, after which it drops to rise again after a week
- Lumps can persist for about a year in animals that recover; such animals may be sterile
- Mortality rate is low, except in calves.

Treatment: none exists, except good nursing, antibiotics against secondary infections and treatment of skin lesions.

Prevention:
- Movement of cattle must be controlled
- Annual vaccination is successful.

Rabies
This is a dangerous and fatal disease, chiefly in dogs and related wild animals, but cattle, sheep, goats, pigs, game animals and humans can be infected through the bite of a rabid dog or other animal. The virus is present in the saliva of the infected animal. Symptoms appear as soon as the virus has reached the brain.

Incubation period: may vary from 15 to 50 days but in some cases it may be months.

Symptoms:
- Hydrophobia (fear of water)
- Unusual behaviour, like salivating, aggressiveness, bellowing; rumination stops and body condition quickly deteriorates
- Exhaustion and paralysis, followed by death.

Treatment: none.

Prevention:
- Destruction of uncontrolled dogs
- Regular vaccination of domestic dogs
- Do not use milk/meat from affected animals.
3.5.4 Parasitic diseases

**Helminths (internal parasites)**

The majority of grazing livestock is infected with internal parasites (helminths). The severity of the situation differs, related to the rate of infection, age, nutritional and immunological status of the ox. Under favourable climatic conditions this can lead to clinical disease and severe losses.

The effects of helminths on cattle can be tremendous in terms of loss of production. For oxen this can mean loss of strength and capacity to work because of a slower growth rate and weakness.

Problems caused by the helminths:

- A slower growth rate and weight gain
- Reduced feed intake
- Reduced food utilisation
- Deposition of protein in the carcass is reduced
- Deposition of minerals in the skeleton is reduced
- Anaemia, resulting in reduced oxygen supply to muscles
- Skin, liver and lung infections
- Infection of veins and nasal mucous
- Liver and lung damage.

The two main groups of helminths are:

**a)** Roundworms—their development is direct; eggs from the faeces develop into larvae, which climb on to grass and are eaten by the host. The eye worm is an exception as it is transmitted by flies. Examples are:

- *Haemonchus/*large stomach worm
- *Ostertagia/*medium stomach worm
- *Trichostrongylus/*small stomach worm
- *Bunstonum/*hookworm
- *Dictyocaulus/*lungworm.

**b)** Flat worms—their eggs from the faeces of the host hatch into larvae, which need an intermediate host, such as the water snail in the case of liver fluke. In the next stage they attach themselves to grass and are eaten by the host. Examples are:

- Cestoda/tape worm
- Trematoda/liver fluke.

**Symptoms:**

- Animal does not thrive
- Coat is dull
- Anaemia
- Diarrhoea, sometimes with blood
- A thin appearance with a ridge spine and pot belly.

**Diagnosis:** through faecal samples.

**Prevention:**

- Regular dosing of young stock, up to the age of 1 year, at 3 months interval, starting at 6 weeks of age
- Adults and young stock over 1 year only twice a year, at the onset of the rains and at end of the rains
- Implementing a rotational grazing system
- Avoid high stocking rate
- Separate the young animals from the adult when grazing
- Graze the young stock before the adult animals.
Treatment: dosing of all animals twice with a 3-week interval.

The administration of the de-worming agent, if liquid can be done using a single, or automatic dosing gun, or a soda, or beer bottle. If the de-worming agent is in tablet form, deposit the tablet far enough into the mouth and make sure the animal has swallowed the tablet, by holding the head high.

Dewormers that might be used are:
- Liver fluke: Trodax, Albendazole, Panacur, Nilzan and Milsan.
- Roundworm: Nilverm, Panacur, Nilzan and Coopane (only for *Ascaris* spp.).
- Tapeworms: Ivomec and Nilzan plus.

NB: Broad-spectrum anthelmintics are recommended for roundworms and flukes, e.g. Trodaxi and Albendazole.

3.5.5 Protozoan diseases

**Tick borne diseases**

Of all external parasites, ticks cause the greatest losses in livestock production through:
- Disease transmission
- Loss of blood, 1–3 cc for every tick
- Irritation resulting in lower feed intake
- Damage to the hides
- Leads to animals being more susceptible to other diseases:
  - because animals are weaker
  - because of wounds left by the tick bites.

All ticks have a four-stage life cycle. The adult lays eggs on the ground, which hatch into larvae. The larvae develop into nymphae, which turn into the adults (Figure 3.8).

![The lifecycle of ticks](image)

**Figure 3.8** The lifecycle of ticks

Ticks species are classified into the following three groups according to the number of hosts they use during the above-mentioned lifecycle:
- Three-host ticks—each stage from larva to adult, attaches itself to a host, feeds and falls back to the ground, to develop into the next stage. It then awaits a passing host, to which it attaches itself.
- Two-host ticks—in this case the larvae develop into nymphae while feeding on the host (without dropping to the ground). Then they fall on the ground to develop into adults before climbing on to a new host.
- One-host ticks—these ticks develop through all stages while feeding on one and the same host; they only drop to the ground to lay eggs.

The time taken for completion of a life cycle differs and is largely dependent upon climatic factors. In most species, each stage takes approximately a week on the host. However, the time spent between these stages on the ground may be up to several months. During this period there is no further development of the tick itself but the grazing area remains infested.
Transmission of diseases:
Ticks transmit disease if they feed on a host whose blood contains the protozoa of that disease.

The protozoa remain in the blood stream and may be transmitted to other cattle by ticks. With two- and three-host ticks, the protozoa are picked up at the larval or nymphal stage, and are transmitted to another animal in the next stage. This implies that one host ticks are harmless in respect of transmitting diseases but unfortunately they have the ability to pass the protozoa on to the next generation through the eggs. This makes them very dangerous as the disease is passed on from one tick to several thousand young.

A tick is called a vector or carrier of a disease because it is able to transmit a disease from one animal to another.

Theileriosis (East Coast fever) *(ndigana kali, lendela)*
This disease has a very high mortality rate, which may reach up to 90%.

**The vectors:** *Rhipicephalus appendiculatus* (1,2), *R. evertsi*, *R. simus* and *R. capensis* (1).

**Incubation period:** 10–15 days.

**Symptoms:**
- Increase in temperature
- Lack of appetite
- Failure of rumination
- Swelling of superficial lymph glands
- Difficult breathing, cough
- Tar-like diarrhoea
- Petechial haemorrhage below the tongue and other mucus membranes
- Death if untreated.

**Treatment:** Clexon, Territ, Butalex, Parvexon or a combination of one of the above with Lasix plus antibiotics.

**Control:** dipping/spraying, ECF immunisation.

Babesiosis *(kukojoa damu)*
This disease is also called cattle redwater, red urine or tick fever. Economically, the most important type of tick borne disease is the bovine babesiosis, caused by *Babesia bigemina* and *B. bovis*, which live and multiply within the red blood cells. The animals most at risk are cattle over 6 months of age especially if they are brought into an infected area.

If there is no treatment, mortality might be as high as 50–90%. In endemic areas cattle normally have a high level of immunity, which they acquire at calf hood.

**The vector:** *Boophilus* spp., *Rhipicephalus* spp. and *Ixodes ricinus*.

**Incubation period:** 7–20 days.

**Symptoms:**
- Rise in temperature to high fever
- Lack of appetite
- Red urine, anaemia, jaundice
- Emaciation, which can lead to death.

**Treatment:** Berenil.

**Control:** spraying/dipping.
**Anaplasmosis (gall sickness) (ndigana a bandi)**

The disease might be caused by several *Anaplasma* species, the most important of which is *Anaplasma marginale*. Cattle of all ages are affected but in general, the disease is more severe in adults than in calves, especially in animals which have been brought into an infected area. After recovery, animals remain carriers but are immune to the disease themselves.

**The vector:** *Boophilus* spp., *Rhipicephalus* spp. and *Dermacentor* spp., and needles/equipment (mechanical a) may also transmit the disease.

**Incubation period:** 15–40 days.

**Symptoms:**
- Increase in temperature to high fever
- No appetite
- Anaemia, jaundice
- Constipation, with hard and shiny faeces
- Loss of condition and death.

**Treatment:** Immizol, Tetracyclines, and relief of constipation, with Epsom salt, molasses, vinegar and/or liquid paraffin/soap (foamy type).

**Control:** dipping/spraying.

**Heartwater (kizunguzungu)**

This is a septicaemic (blood) disease which occurs only in Africa, in sheep, goats and cattle. The cause is an organism called *Rickettsia ruminantium* which invades the cells of the blood vessel walls. Animals that have recovered from the disease develop immunity and calves under 3 weeks of age possess a strong natural resistance to the disease.

**The vector:** *Amblyomma* spp.

**Incubation period:** 14–28 days.

**Symptoms:**

a) Peracute form: convulsions with no previous symptoms; death follows.

b) Acute form:
- Steep increase in temp
- Stiff legs, high stepping gait
- Diarrhoea, staggering gait
- Convulsions and death.

c) Sub-acute form: similar symptoms to the acute form but more prolonged.

**Treatment:** tetracyclines; sulphonamides.

**Control:** dipping/spraying.

**Control of ticks**

- Burning grass and bush is a traditional method to control tick infestation in the programme area though not a recommended practice
- Ploughing grassland is more efficient to a certain extent
- Prevent animals from grazing on communal land, instead keep them in separate paddocks
- Stall feeding animals reduces the chances of picking up ticks
These methods however may not be a substitute to spraying or dipping.

Under normal farm practices, it is advisable to spray or dip the draught cattle at least once a fortnight. This should be done on the same day every fortnight. If there is an outbreak of a tick borne disease in the neighbourhood, it is advisable to spray or dip once or even twice a week with a 3 to 4 day interval, especially if a three-host tick transmits the disease.

Management of a plunge dip

Cattle are directed through a crush, with a footbath at least 3.5 m long, which cleans off most of the dirt from the feet. Then, they plunge into the dip tank, containing 14,000 to 22,000 litres of dip wash mixture.

Since dip wash level is about 30 cm below the jump off point and 2 m deep, the animals are completely immersed before resurfacing. They swim to the end and walk up the ramp to a concrete draining pen. Cattle must remain in this draining pen long enough to allow most of the wash to drain from their bodies.

Filling and maintenance of the dip

It is most important to follow the instructions by the makers of the dip acaricide regarding the quantity, method of mixing and preparation of the dip wash. Precautions are necessary when using acaricides because they are concentrated and very poisonous. Two different acaricides should never be mixed.

A useful tool is a calibration stick, on which the content of the dip tank is marked. The last 5000 litres should be sub-divided into 500 litre units.

It is important to keep a dip tank register in which to record the number of animals passed through, the amount of water filled and the amount of acaricide added.

Before each dipping

The pipe at the side of the draining race must be opened to allow the return of wash drain from the animals.

The wash is channelled into a small sump and then to the dip tank. At the same time, the pipe that normally carries rainwater from the drain pen must be closed. The small sump needs to be cleaned out regularly, as it collects sludge from the drain pen. In addition to premixing by hand after adding the acaricide, at least 20 animals should be put through the dip to mix the dip wash thoroughly. These 20 animals should be dipped again after the other cattle have been through. Animals should be watered before each dipping.

After each dipping

The level of dip wash will be lower after each dipping. Every animal removes 2 to 3 litres, even after the excess has drained from its body. Some of the acaricide remains on the animal so that the dip-wash draining back is under-strength. Therefore, rates of acaricide to water are higher for topping up than for the first filling. For example the rate for Delnav DFF is 1:2,200 parts of water for first filling and 1:1,500 for topping up. It is essential to follow the manufacturer’s recommendations for each specific dip chemical. As there are modifications to the dip constructions one has to know the specifics of each dip.

After all the wash has drained back into the dip tank, close the drain-pipe and open the rain-pipe, measure the level in the tank and fill the tank to the right level.

Immediately before the next dipping add the required amount of acaricide.

Dip testing

It is advisable for the technician responsible for a dip to take a monthly sample of the dip wash to analyse its strength. A sample is taken by tying a bottle to a stick and holding it 1 m under the surface, at the side of the tank, while animals are actually swimming through. The following information is appended when presenting the sample to the laboratory:
• Name of the owner
• Name of the location/farm
• Type of acaricide
• Capacity of the dip tank
• Dipping interval practised
• Date sample taken.

More frequent controls are necessary during the rains.

**Hand spraying**

The advantage of hand spraying over the plunge dip is that only freshly prepared wash is used for each individual animal, undiluted by partially exhausted runoff wash.

Tick control by hand spraying entails application of the spray wash to each animal by means of an appropriate hand spraying pump like the bucket sprayer such as Solo knapsack sprayer.

Successful spraying of wash by this method depends on:

• Adequate control of the animal to be sprayed
• Accurate measurement and correct mixing of the wash
• Thorough application of the wash with an efficient pump.

For small herds with less than 10 animals, it is often sufficient to tie an animal to a post. A simple three-post crush (Figure 3.9) is very useful as it can fix the animal. The ox is haltered and led into the V of the crush. The halter rope is then tied to the apex post. This crush allows free movements all round the animal and maximum freedom from obstructions when spraying.

Where more than 10 animals are to be sprayed, it is better to use a simple crush fed by a collecting pen.

![Figure 3.9 A three-post crush.](image)

When preparing the wash, the correct volume of acaricide should be measured and diluted with a small amount of water. The container for holding the wash should be carefully calibrated.

The concentrate is then further diluted to obtain the final volume of wash. A minimum amount of 4–5 litres of wash is required per animal.

**Hand spraying procedure**

The following standard routine, which ensures complete wetting with a minimum of wash, should be followed.

• The hind legs
• Udder or scrotum, in between the legs
• The tail (which should be laid across the back)
• The belly of the animal
• The flanks and the back line
• The front leg.
• The brisket, neck and head
• Finally the inside of the ears.

Traditional tick control with Teprosia

*Teprosia vogellii* is a legume that can be used to effectively rehabilitate degraded soil. Another important quality of this plant is its strong insecticidal and acaricidal properties. A concoction of water and *Teprosia* leaves can be sprayed on animals that will successfully kill the ticks. The concoction comprises 5 kg of fresh Teprosia leaves crushed and soaked in 20 litres of water for 24-hours. This is then strained before use in a sprayer.

Pour-ons

New preparations for tick control have entered on the market. These acaricides are packed in plastic bottles, which are equipped with a calibrated compartment. The required amount of these acaricides, to be applied to the back of the animal from the shoulder to the tail, has to be calculated, according to the live-weight of the animal. The amount can then be measured in the calibrated compartment and applied to the animal. The advantages of this method are:

1. No equipment and/or structures required like dip tanks, spray races or hand sprayers.
2. Each animal gets the right amount of acaricide if the live weights are established properly.
3. No risk of using the wrong concentration of acaricide.
4. The only structure required is a continuous crush, or a 3-post crush, depending on the number of animals.

Trade names of some of these acaricides are Decatix, Spot on, Bayfical and Ectopour.

Clipping and hand dressing

Tails and the hairy fringes of the ears should be clipped regularly, as a routine procedure. This makes it more difficult for the ticks to attach themselves.

If the tick population increases despite the correct dipping or spraying routine, or in the event of an outbreak of tick-borne disease, hand dressing may be carried out as described below.

After the cattle have come through a dip or have been hand sprayed, and while they are standing in the crush, they should be held there and a tick-grease specially made for hand dressing, or a high concentrated dip wash is then smeared by a brush in the ears, under the tail and around the udder or scrotum. These are the highly preferred areas for the two- and three-host ticks.

Tsetse fly (*Glossinidae*) (*ndorobo*) related diseases

The tsetse fly has a typical feature of crossing its wings when resting. There are a number of different species, well adapted to different habitats. They feed entirely on the blood of game, domestic animals and humans. Tsetse flies are the major transmitter of the protozoan disease, trypanosomosis; the protozoa belong to the group called trypanosomes.

Trypanosomosis

a) Although drugs are available, the first aim of the farmer should be to reduce the challenge by these flies through either of the following measures:

• Clearing the farm land (changing the habitat of the fly)
• Preventing movement of animals at dawn or at dusk, when the flies are most active
• Preventing cattle from moving through bushy patches
• Practising stall-feeding.

b) To attack the flies directly: use flytraps, made of a dark blue cloth (most attractive colour), and use cattle urine in a bottle to attract them.
The three major parasites in bovine trypanosomosis are \textit{T. vivax}, \textit{T. congolense}, and \textit{T. brucei}.

**Symptoms:** these may vary considerably, but may include the following:

- Anaemia, weakness
- Severe loss of condition
- Irregular fevers
- Watering eyes
- The disease can turn from chronic, to acute.

**Diagnostic method:** the only way to identify an infection with trypanosomosis is to examine a blood smear of the sick animal under a microscope.

**Prevention:** the following drugs can be used as prophylaxis:

- Samorin, 0.5–2 mg/kg of body weight, deep intramuscular injection, 1–6 months of protection depending on the challenge
- Ethidium, 1–2 mg/kg of body weight, intra-muscular injection, gives 1 month of protection
- Novidium.

**Treatment:** the following drugs can be used as a curative measure:

- Berenil, 3.5–8 mg/kg, intramuscular
- Ethidium, 1–2 mg/kg, intramuscular
- Samorin, 1–2 mg/kg, intramuscular
- Novidium, 1–2 mg/kg, intramuscular.

For \textit{T. vivax} in the acute form, Samorin can be given intravenously.

**Summary**

The most important activity in control of protozoan diseases is their prevention. Preventive methods are:

- Vaccinations
- Administration of prophylactic drugs
- Avoid contact with the vector, transmitting the disease, by:
  - chemicals (such as Dominex, Decatix and Spot on)
  - changing the habitat
  - trapping

Secondly, early identification of disease symptoms in the animals is essential to enable starting of appropriate treatment in the early stages of the disease, or to allow time to call for veterinary assistance, which is very important especially in tick-borne diseases.

Thirdly, to have a high standard of management, especially regarding feeding, as healthy, well-fed animals have a higher level of resistance to diseases.

### 3.6 Castration

**Introduction**

Castration can be defined as the removal of the testicles or the severance of the seminal cords from the rest of the body.

**Advantages:**

- Prevents the animal from breeding
- Improves the meat quality of beef cattle
- Castrated animals are generally more docile and easier to handle than non-castrated animals which is important for draught oxen.
**Disadvantages:**

- The animal cannot be used for breeding
- If done too early, an animal does not become as powerful as it would have if not castrated
- It causes stress on the animal.

Farmers who aim at working with oxen, should be competent in handling them. Ox-handlers should catch, restrain and immobilise their animals without much difficulty. This is necessary as it enables them to harness the oxen and allows them to execute the techniques required when working with the oxen.

Experience from various places in the world has shown that castrated and/or dehorned animals are easier and much safer to handle than non-castrated animals.

Male animals, selected as work animals, are in most cases castrated to reduce their aggressive behaviour. However, it has been observed that non-castrated animals are stronger though more difficult to manage.

Although early castration, when still a calf, causes little stress on the animal, it causes a suppressed muscular development of the fore and hindquarters, especially of the shoulders, the neck and the thigh areas. The male animal develops feminine characteristics, which make it less powerful. Thus castrating too early impairs the development of the muscles and stamina. The ox then becomes less suitable for work.

Therefore, it is recommended to castrate potential work animals at an age of 1.5–2.0 years. In reality, the older they are the stronger they will be.

If castration is not carried out correctly, the animal becomes a rig whereby it still possesses the ability to breed.

**Methods of castration**

There are various pieces of equipment, which can be used to castrate animals:

- The elastrator
- The Burdizzo
- The knife.

**Closed castration**

**The elastrator**

This piece of equipment is only suitable on young calves (up to 6 weeks of age). The best results are obtained when it is done before 10 days of age. It is a very safe method and if applied properly does not cause complications.

With the elastrator (special pliers) an elastic rubber band is stretched to enable the stockman to pass the scrotum (including testicles) through the rubber band. After this, the pliers are released, which allows the rubber band to return to its original seize. The rubber now sits tightly around the scrotum, above the testicles, and it prevents blood circulation. This causes the whole scrotum, including the testicles, to die and after a few days the scrotum falls off completely (Figure 3.10).

*Figure 3.10* The elastr, a tight rubber ring closing the blood supply to the scrotum and testicles.

Remark: It does not leave a wound behind, as the scrotum grows together again just above the elastic rubber band.

N.B.: Due to the young age of the animal it is not recommended for intended draught animals.
Sequence of activities

1. Place the rubber ring over the four points of the elastrator and open the points of the pliers, enlarging the rubber band.
2. Press the testicles down as far as possible in the scrotum, then through the rubber band.
3. Ensure that both testicles have passed through the rubber ring. Release the pliers and the rubber band.
4. The rubber band now tightens around the scrotum, cutting off supply of all blood. This causes the whole scrotum to die and after approximately 7—days it completely falls off.

The Burdizzo

This piece of equipment can be used to castrate animals of all ages and is therefore perhaps the most commonly used. It is a very safe method of castrating as no wounds are made and if applied properly causes no complications.

With the Burdizzo the cords which go to the testicles are crushed, about 2 cm above the testicles (Figure 3.11 and Figure 3.12).

Sequence of applying the Burdizzo method

1. Cast the animal down to the ground and slide one of the testicles as far down into the scrotum as possible. At the same time squeeze the scrotum as far as possible upward from the testicle. Apply the Burdizzo a short distance above the testicle.
2. Close the Burdizzo jaws using one hand and the knee, until the cord is slightly compressed and cannot slip.
3. Use both hands to clamp the jaws firmly together and leave it closed for several seconds.
4. It is advisable to crush the same cord a second time slightly higher up.
5. Repeat the same exercise on the other testicle.

Open castration (knife)

Open castration should only be carried out by veterinary officers or by a very experienced and well-trained stockman, as it is an operation (Figure 3.13).

Sequences

1. Requirements: disinfectant, soap, boiled water, a knife or a scalpel.
2. The animal has to be cast down and restrained properly (see restraining module).
3. The whole scrotum area is washed thoroughly then disinfected (see wound care module).
4. A local anaesthetic is applied.
5. A cut is been made at the bottom of the scrotum to allow proper drainage of any bleeding and/or other wound liquids.
6. A testicle is squeezed through the cut and pulled out until the seminal cord and blood vessels are held.
7. Apply clamp scissors to the seminal cord and blood vessel, as high up as possible.

The seminal cord and blood vessel are then severed by scraping with the knife/scalpel. A straight cut should not be made as this causes excessive bleeding.

8. Repeat the same exercise on the other testicle.
9. Wash down the operated area and clear it of all blood.
10. Dress the wound with sulpha powder and release the animal.
11. Observe the castrated animals for several days as infections might develop.

Remark: Do not keep recently castrated animals in a dusty or muddy place as this increases the possibility of infections.

3.7 Dehorning

Introduction

The main objectives of dehorning are to make animals docile, easier to handle and to reduce injuries inflicted on each other leading to damaged hides, carcasses and secondary infections.

However, it may be an advantage if well-trained and docile animals have horns.

Dehorning should take place when the animal is very young. The animal is easier to handle then and also causes less stress to a young animal than to an older one. Nevertheless, it can also be done on adult animals, although it is more complex, causes more stress on the animal and is very painful.

Hot iron method

This method should be applied to calves of approximately 3 months of age and/or after the horn buds are felt. The equipment used, consists of a wooden handle with an iron rod of about 50 cm long at whose end is a brass round bar of about 8–10 cm long and 3–4 cm thick. This brass piece tapers in the front and has a hole drilled into it of about 1–1.5 cm (Figure 3.14).

Figure 3.14 Dehorning iron with brass tip

Sequences of application:
1. One has to ensure that the iron becomes red hot.
2. While heating the iron start clipping the hairs around the base of the horn buds to expose them properly.
3. Put the red-hot iron on the horn bud and press.
4. After the iron has burnt the horn bud for approximately 0.5 cm scoop the centre of the horn bud out with the iron.
5. Take care not to go to deep into the head of the calf.
6. After doing that, apply some Vaseline or tick grease or py-grease.
**Horn pliers/shears**

These are very big pliers which are placed around the base of the fully developed horn on older animals after which the whole horn is cut off. This method has the disadvantage that it often causes severe bleeding (Figure 3.15).

The animal should be anaesthetised. This should be applied on the bone-edge between the eye and the horn, where the nerve that controls the horn base area (*nervus cornalis*) passes. Xylocaine (5–6 ml/cc should be sufficient.

![Horn shear](image)

**Figure 3.15** The horn shear.

**The wire saw**

This piece of equipment is most commonly used to dehorn older cattle. First, ensure that proper anaesthesia has been given. Place the wire saw at the back of the horn just on the skin, then start cutting. Due to friction, a lot of heat develops, which prevents bleeding.

An assistant should hold the animal by the nose to keep the head in such a position that allows the operator to cut horizontally and straight.

After the horn has been removed check for bleeding. Severe bleeding very often can be stopped by pushing a matchstick into the blood vessel, or by using a soldering iron to cauterise the blood vessel.

After the whole exercise has been completed, use some kind of wound spray or Vaseline or py-grease to cover the wound.

**3.8 Hoof care**

Hooves are very important parts of a working animal, as they affect the mobility. They have great influence on the way the animal stands, walks and contribute to the ability of an animal to deliver all its power in pulling a load.

**Procedure of hoof care**

Step 1 - Close observation of the draught animal:

- Observe the animal when it walks. If it is has a lame front leg a nodding movement of the head will be noticed. The nodding normally goes in the direction of the healthy leg. Also the time spent standing on the lame leg is shorter than that spent on the healthy leg and the healthy leg is brought forward quicker than the lame one.
- In the case of a lame rear leg watch the pelvis since this movement is normally on the lame side. The movement is in such a way that the animal stands for a shorter period on the lame leg than on the healthy leg, which is brought forward quicker than the lame one.
• A normal healthy animal stands square. This means that it stands equally on all its four legs. A lame-legged animal stands on three legs, trying to relieve the lame leg, or trips.
• The above signs are clearly visible if the animal is trotting. Therefore, it is very useful to train the animals to trot following a leader. Sometimes the pain comes only when pulling a load and in this way it is difficult to identify lameness. When trotting, these problems are easier to diagnose.

Step 2- Check the leg:
• If the lame leg has been determined, then investigate the whole leg from the top to the bottom to find the cause
• Look for wounds and foreign objects
• Look and feel for swellings
• Feel for hot spots
• Smell for infections.
Always make comparisons with the healthy leg.

Step 3- Check the hoof:
• Have a close look and feel for differences with the other hoof
• Knock on the hoof with a small hammer, or bolt; if the animal reacts try to locate the exact spot causing the reaction
• Smell for infections
• Lift the leg and clean the hoof underneath and in between
• Repeat 1, 2 and 3.

Specific hoof problems
There are several causes of lameness induced by hoof problems.

Foreign bodies
In case a foreign object has entered or penetrated the hoof:
• Remove the object and explore the wound to make sure that nothing has remained
• Clean and disinfect the wound (hydrogen peroxide, potassium permanganate) and apply a dressing, or pack the wound with Stockholm tar, hot lard/fat or healing oil
• Any discharging wound should be cleaned at least twice a day with luke warm boiled water and thereafter sulphur powder applied.

Foot rot
Occurs mainly during the wet season or in animals which are kept in a feedlot. This is a wet infection of the skin in between the claws that causes deep grooves in the rear part of the hoof and distorted growth of the horn layer. It hardly causes a swelling but is very painful and the skin/horn is covered with a smelling exudate. The animal is very impatient and trips when standing. The following remedies are recommended:
• Take away the loose horn and cut it such that the horn layer goes over into the sole gradually
• Reduce the point of the hoof to reduce the pressure at the rear of the hoof
• If foot rot has been detected in one of the animals it is advisable to look into the housing or the kraal to see what improvements can be made
• Inspect all the other animals’ claws since they may also be infected
• A good remedy is to keep animals on a dry/hard area and to make them stand in a formalin bath (solution of 2–3%) or a copper sulphate bath (10% solution) for 1 hour a day
• Soaking in salty water is a simple but less effective alternative.

Sole ulcer
This is an ulcer which most often develops in the rear part of the rear outer claw. It develops inside the hoof because of too much pressure due to poorly developed hooves. Since the outer claw develops faster then the inner claw, the animal tries to place the legs outwards, which causes even more pressure (Figure 3.16). This pressure may cause light bleeding which in turn may be the cause of a septic infection. In a later stage, small
fractions can occur which will lead to a septic infection. Foot rot is caused by wet and dirty conditions. A sole ulcer is a result of weak or poorly trimmed hooves.

The treatment consists of:

- Trimming the claws to the right shape cutting away all infected material, exposing the whole infected area

This may cause a pododerm prolapse; to avoid this, we have to make the sole very thin from front to back.

**Badly shaped hooves**

An animal with bad hooves should be disregarded as a potential working animal, as most probably the bad hooves have already affected the way the animal places its legs when walking and when standing. However, if there is no choice proper hoof care can improve this situation

The three most common foot deformations are:

1. A rear outer claw which is too high.
2. Cracks in the claws.
3. Upward pointing and long claws, which are round shaped at the bottom, instead of flat (Figures 3.17 to 3.19).

![Figure 3.16 Higher outer claw, plane bearing surface (lifted hoof seen from above).](image1)

![Figure 3.17 Higher outer claw, inclined bearing surface.](image2)

![Figure 3.18 Excessive growth of the inner claws on fore feet.](image3)

![Figure 3.19 The three common hoof deformations.](image4)

Before correcting the deformations on claws by cutting them to the right shape, it is advisable to have a look at them when the animal is standing to make observations, to clean the claws thoroughly and ensure that the cleft between the two claws is cleaned properly.

Bearing in mind how a proper claw should look, the operator should decide what kind of alterations to make.

Then lift the leg, and determine the difference in height of the two claws. If there is a difference, cut one of the claws to ensure that both are of the same height. In general this means that one has to reduce the height of the outer claw. Make sure that the animal is now able to place its leg straight on the ground. Figures 3.20 and 3.21 show some common hoof trimming tools.
Observe the stand of the leg and the shape of the claws. The carrying area of both claws should be in one line and should be perpendicular (90° angle) to the bottom leg bone.

The carrying area (Figure 3.22) of the claw consists of:

- Outer rim of the claw which continues halfway through the cleft (1 and 2)
- As large an area as possible of the ball of the claw (3)
- The outer part of the claw itself (4)
- The complete remaining part should be hollowed but flat into the direction of the cleft (5) after correcting this look at the point of the claw

Reduce the length sufficiently and cut/shape the front part of the under sole.

A golden rule is never to cut too much away from a healthy sole or sole ball. Do not cut more than necessary to effect a proper positioning of the claw.