Heifer Project International

Integrated Smallholder Dairy Farming Manual

Erwin Kinsey
Heifer Project International
Tanzania Representative

A Heifer Project International Publication
Heifer Project International
P.O. Box 808
1015 South Louisiana
Little Rock, AR 72203, USA
(501) 376-6836

Editorial Services by Dan Gudahl

Book Design and Type by *Spectrum Graphics*—Little Rock, Arkansas

Printed by **Perfect Printers Ltd.** Arusha

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Foreword:

"HPI's Integrated Smallholder Dairy Farming Manual" has been written especially for smallholder dairy cattle farmers in East Africa. However, most husbandry practices promoted herein are applicable for any subtropical or tropical area where dairying is being promoted and developed. Although the emphasis is on cattle, many of the principles are the same for successful dairying using traditional livestock such as buffaloes, goats, sheep, camels, yaks, and carabao, although each of these has its own idiosyncrasies as well, and deserves special attention which is not possible yet in this edition. The information contained herein about dairy cattle-rearing alone is selected and incomplete of itself, not to mention the other species of dairy livestock. It is my hope that this book can continually be enlarged and edited to become more useful for other species. It is not intended to be HPI's last dairy manual!

In order for it to be readable, concise and still comprehensive, it became necessary to write it in a narrative way. The format I have chosen is question and answer. I do not assume to have asked all possible questions but have tried to lead the reader by key questions into the general discussion topics, not simply to my answer to **the** question! I hope it will not mislead. It would perhaps have been better to teach the skills contained herein in a more procedural, step-by-step manner, but I hope the method I have chosen also gets the information across and flows better as narrative. Indeed, much of the information contained can be put into practical exercises, and this work for the present time I will leave to the curriculum developers.

In order that this information may be made easily available to all who need it, no copyright is sought, and HPI encourages you to extract any or all portions of this booklet for reproduction and use in farmer trainings anywhere.

This booklet has been compiled from many resource books, booklets, periodicals, research papers, and from 15 years of my personal experience with dairying in Tanzania, East Africa. I have written it on request of HPI. I submit it as an attempt to synthesize in a simple way the experience, and knowledge which has been entrusted to me by small farmers, agricultural and livestock extensionists and other HPI colleagues over the years. I have attempted to highlight the interrelationships among various aspects of sustainable farming in general, and smallholder dairy cattle keeping, in particular. I also aim to highlight common constraints and emphasize the correcting of common mistakes farmers make which prevent them from achieving an equilibrium and sustainable relationship with their land and livestock. Although I desired it to be simple and concise, it keeps enlarging during each revision.

We are gaining much knowledge over time from working with 'salt of the earth' small farmers who are willing to share their know-how with others.

"The substance of a diligent [farmer] is precious." Prov.12:27

To those who are faithful stewards of their land and wise keepers of livestock appropriate to their environments, the farmers who have become my teachers, including my parents and their neighbors, and to HPI for its vision for these people, I dedicate this attempt.

INTRODUCTION:

What is integrated smallholder dairy farming?

A smallholder dairy farming system must be integrated into the total agricultural, social and ecological system. The result, integrated smallholder farming, will enhance the total system. Disintegration is the result of these systems not interacting together.

How can I improve the environment with livestock?

In recent years livestock have unfairly been condemned by some more radical prophets of environmental doom as being culprits in the destruction of the environment. Without exception livestock **keepers** are the culprits, if anyone is to be blamed for the unwise use of livestock, but on closer examination, one can see the important role livestock play in improving the environment. Instead of listing those myriad benefits which they bring, it will be more helpful to discuss practices which bring about a more sensible use of livestock, and solidify their key role in the ecosystem.

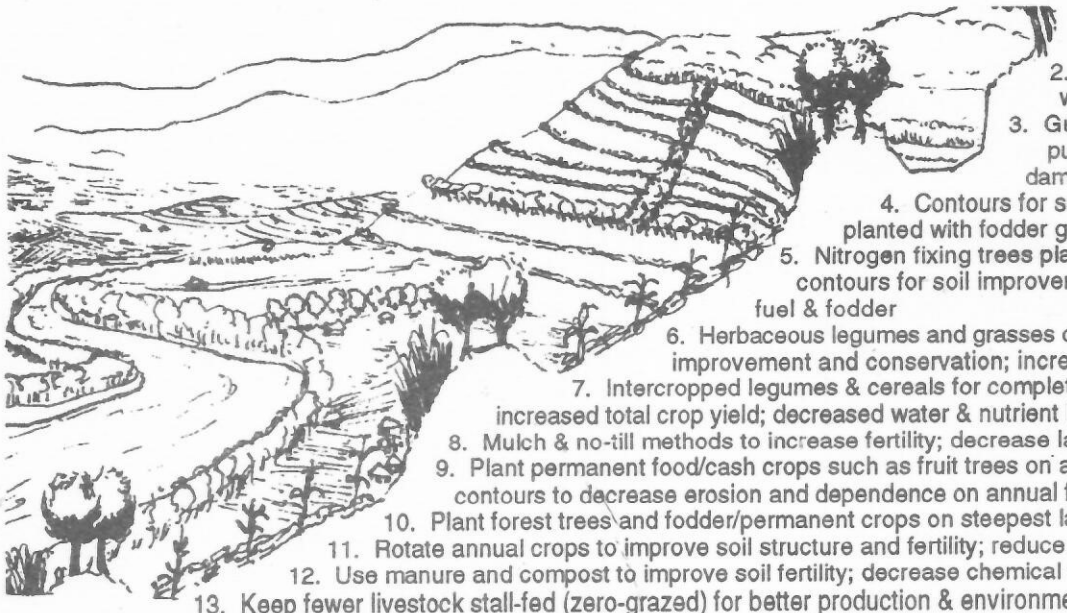
An awareness is growing of the need to balance agricultural activities with a wide assortment of complimentary activities which bring about an improved environment for one's family, neighbors, and all creation. Part of doing this requires each farmer to consider all aspects of the farming enterprise and modify those practices which detract from a harmonious, sustainable system, adding new practices where necessary to make improvements. The innovative farmer is constantly trying new ideas to keep abreast of possible changes which can improve productivity, regenerate or improve the environment, and reallocate labor to activities which lead to lesser dependence on outside inputs or harmful chemicals. The importance of livestock raising cannot be overemphasized in this effort.

The importance of manure in reducing the need for chemical fertilizers, increasing compost production, improving soil structure and fertility cannot be overemphasized. Farmers need to make full use of this valuable resource. It can further be used to obtain pollution-free biogas for fuel, lighting, and a variety of related uses, and still be used on the crops.

The growing trend toward zero-grazed, stall-fed livestock induces farmers to keep fewer, more productive livestock, and at the same time reduces soil erosion problems caused by trekking animals over dry or steep terrain, reduces reliance on chemicals for the control of ticks and disease treatment, and increases their productivity.

As land pressure forces people to use steeper, marginal lands for food production, incorporation of permanent fodder crops, including trees, planted on the contours, helps to reduce soil erosion and increases moisture retention in the fields, and at the same time, keeping livestock provides an outlet to the various by-products of this farming system.

Animal proteins are more complete, and provide a better, steady income throughout the year compared to plant proteins which are generally more seasonally pro-



1. Reforest hilltops using multipurpose trees
2. Cut-off drain for excess water control
3. Gullies planted with multi-purpose trees and check-dams
4. Contours for soil and water conservation, planted with fodder grasses & trees
5. Nitrogen fixing trees planted in double-rows on contours for soil improvement, mulch, green manure, fuel & fodder
6. Herbaceous legumes and grasses on terrace risers for soil improvement and conservation; increased fodder production
7. Intercropped legumes & cereals for complete ground cover and increased total crop yield; decreased water & nutrient losses
8. Mulch & no-till methods to increase fertility; decrease labor & erosion
9. Plant permanent food/cash crops such as fruit trees on alternative strips between contours to decrease erosion and dependence on annual food/cash crops
10. Plant forest trees and fodder/permanent crops on steepest land
11. Rotate annual crops to improve soil structure and fertility; reduce crop pests
12. Use manure and compost to improve soil fertility; decrease chemical fertilizer use
13. Keep fewer livestock stall-fed (zero-grazed) for better production & environment
14. Use diverse types of crops; avoid monocropping or total reliance on hybrids
15. Maximize use of non-chemical weed & pest control, using resistant varieties, specific pest control (do not kill every insect/bird/beast!), diverse cropping, manual methods
16. Keep complementary livestock, such as cattle, goats, sheep or swine with fishponds and poultry/ducks; keep diverse livestock species; use local breeds where applicable which are resistant to disease, requiring fewer treatments, less risk

duced. Animals also provide a means of investment or savings which increases in value rapidly, and can be available for emergency use. Livestock provide an activity which can bind the family and community together as we work jointly to solve the challenges to their upkeep. In so doing, as we humans relate to animals, a different perspective on our humanity can be reached.

All these factors help to reduce our poverty and improve our general well-being; after all, human beings, too, are part of the environment which must be included in conservation efforts.

The illustration attempts to show a farm which integrates several aspects of regenerative, sustainable farming with livestock. This book attempts to encourage farmers to seriously consider where they can improve in this vital integration on their own farms.

DAIRY CATTLE SELECTION:

What type of dairy animal is appropriate?

Should I keep a dairy cow, dairy goat, buffalo, camel, yak, sheep.... or ...?

"Much food is in the tillage of the poor, but there is that which is destroyed for want of judgement." Prov.13:23

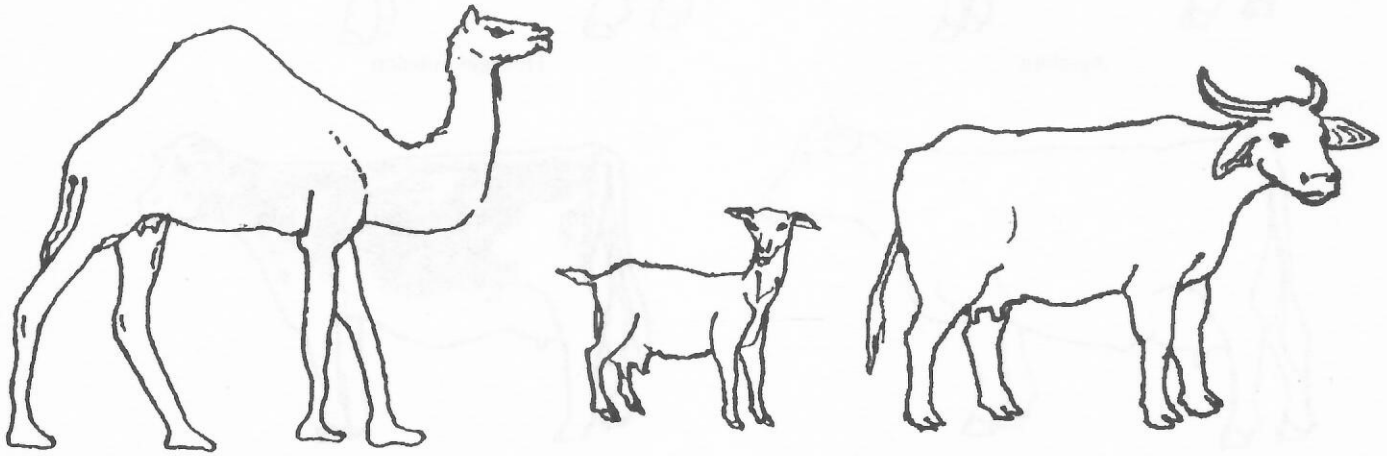
A serious farmer should ask her/himself whether s/he has the resources, especially for feed, housing, and preventive medicine to keep a dairy cow, or whether another animal such as a dairy goat is more appropriate. The dairy goat, being the "poor farmer's cow", may likely be the best option for a suburban/city dweller or farmer without at least one tenth of a hectare on which to grow feed. The goat will need about one fifth of the feed of a cow, and can utilize browze from trees and shrubs which are not likely feed for other animals. They produce more offspring per year, and thus can provide an income from sale of excess stock more often than a cow. Their milk is easier to digest and normally can be expected to be in the range of 2–4 litres per day, enough for home consumption. Their costs in the way of feed, housing, and preventive medical care are similarly about one fifth or less. The dairy goat farmer can more easily spread her/his risks by keeping several goats, whereas the ability for a dairy farmer with cattle to increase the size of the herd is limited.

A similar question arises concerning the buffalo, camel, yak, sheep or whatever beast is being used for milk production by particular people in a given area. A dairy improvement program will most likely involve those very beasts traditionally used in that particular area. In summary, think it through thoroughly before choosing to go for cows. I am not trying to discourage a farmer from keeping dairy cows, but there are too many farmers keeping dairy cattle even though they lack the resources to adequately manage them, and they become the poorer for it, not to speak of the poor cows. But, back to our subject...!

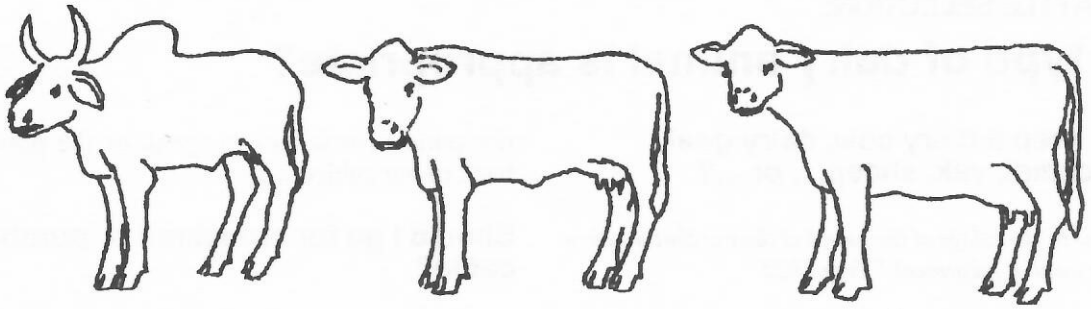
Should I go for crossbred or purebred cattle?

"Where no [cattle] are, the crib is [empty]..." Prov.14:4

You must choose carefully. The notion that local or indigenous cattle are not dairy cattle is wrong, because they, too, produce milk, however little it may be. Great variation exists in the milk-producing ability of African traditional cattle. More efforts might well be made to select for milk-producing ability from within the traditional herds in order to develop a breed of dairy cattle, i.e., cattle with a predictable milk-producing ability, which might also maintain all the desirable traits of the traditional cattle. However, the chosen route to most dairy development efforts has been the use of already selected [modern!] dairy breeds because much progress has been made in the selection of dairy cattle; these cattle and/or their semen are often available, and fast progress can be made towards increased milk-production by the traditional smallholder farmers by using them. In Africa, for hundreds of years, local cattle have adapted to the heat, to rigorous local conditions and management, and developed some resistance to the diseases that abound. They deserve praise and are a valuable resource because they have developed an ability to survive in the most difficult environments and under the harshest of management systems, conditions which upgraded or pure dairy cattle cannot withstand. These local cattle can become slightly better milk producers and reproducers if raised in improved environments and husbandry. Many of the practices promoted in this book, if used with the local cattle, may produce dramatic and



Camel Goat Buffalo

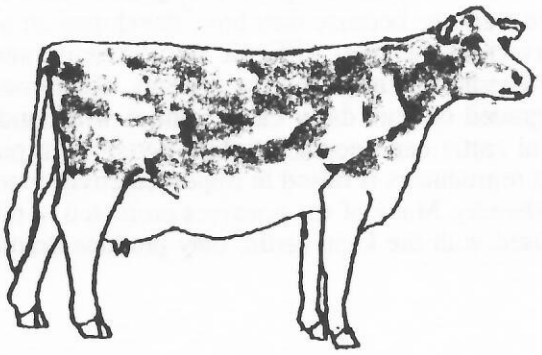


Zebu Crossbred Jersey

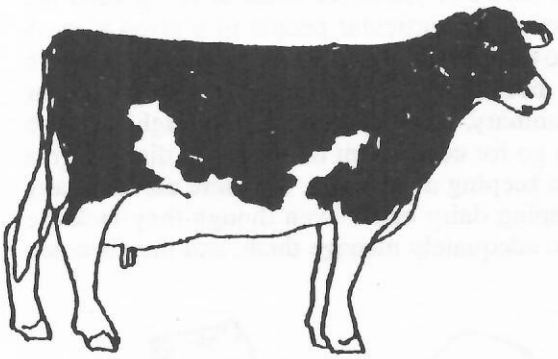
favourable results for the traditional farmer and possibly more milk. However the basic aim of this book is to address the task of motivating traditional farmers to adopt improved husbandry techniques in the keeping of upgraded dairy cattle. The hope is to increase the output of these cattle bred for milk, and obtain improved results for the farmer's efforts.

Purebred dairy cattle have been selected for hundreds of years, with most of the known popular breeds coming from colder temperate climates. As such they are characteristically large consumers of forages and water, producing anywhere from ten to fifty litres of milk per day, and they are quite delicate animals in comparison to the local African cattle. Some high producing dairy cattle not only benefit from the feeding of concentrated cattle feeds (concentrates), but cannot maintain their body weight and milk production levels without them. They have little resistance to disease if they are introduced to new environments and although succeeding generations do develop some adaptive tolerance/resistance to disease, they remain with a characteristically higher susceptibility to disease than the local cattle and suffer worse under poor management. In this book for clarity of understanding we refer to dairy cattle as pure or crossbred cattle having at least 50% *Bos taurus* bloodlines from the dairy breeds such as Holstein Friesian, Jersey, Ayrshire, Guernsey, or Brown Swiss, or from the *Bos indicus* bloodlines selected for dairy such as Sahiwal, Sindhi, and Gir.

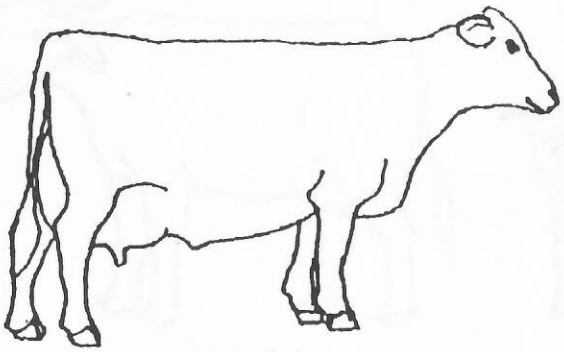
In order to maintain up-graded dairy cattle, a significant attempt must be made to improve their environment, control disease, and feed them adequately. Fortunately this has been shown to be very possible, even by the marginal farmer with limited resources. The resulting benefits to the land and the families with these cattle have caused interest in dairy farming to grow dramatically in recent years.



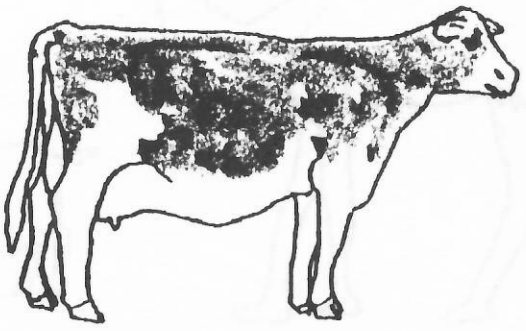
Ayrshire



Holstein Friesian



Brown Swiss



Guernsey

What breeds are available from which to choose?

Holstein Friesians tend to lead in milk production, followed by Brown Swiss, Ayrshires, Guernseys, Sahiwals and Jerseys. Size of frame and the amount of feed required to keep the various breeds also follows this general order, with Holsteins and Brown Swiss at the top of the list. Comparing the relative amounts of milk solids and fats contained in their milk, the list is reversed with Jerseys and Sahiwals in the lead. They are also the easiest to feed requiring less maintenance.

When one chooses a breed, it is advisable to choose one according to one's preference, ability to feed and manage, and availability of stock. Often the best choice for the new farmer with limited resources is to go for a crossbred to acquire experience with it, and to aim to increase slowly the amount of dairy blood in the subsequent offspring by selecting from the dairy breeds for bulls. Often the increase in 'improved' dairy blood does not lead to higher milk production, but only to higher maintenance costs or losses.

Unfortunately, most farmers have to learn for themselves which breed is appropriate through sometimes costly errors. Eventually each farmer has to be the best judge of the right type of cattle for him or her, but it is best to seek advice from the local livestock officer.

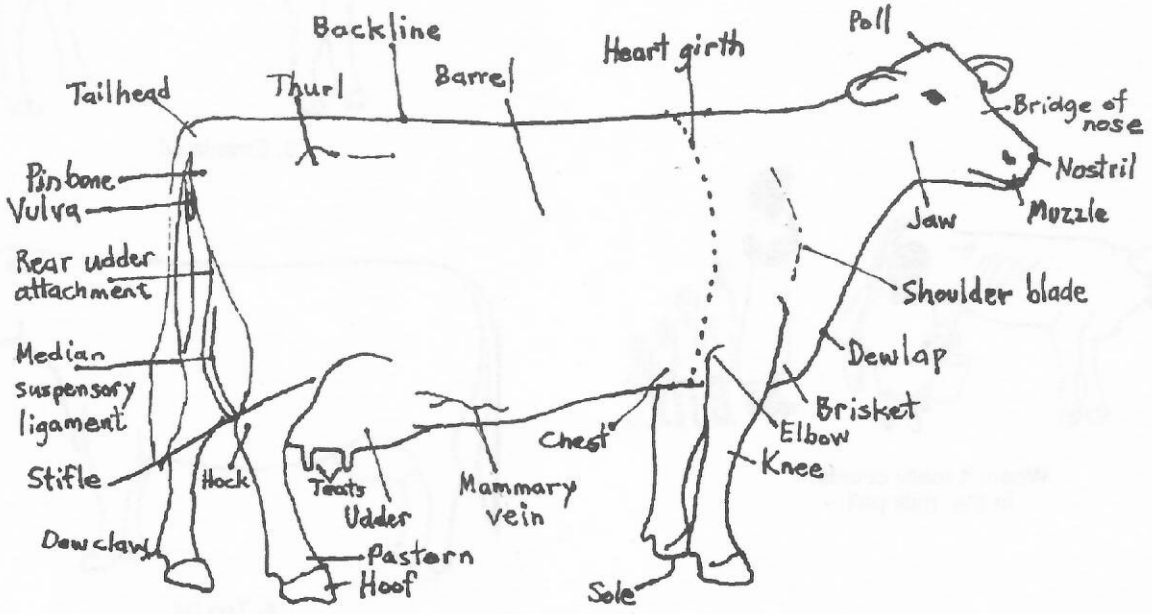
How can I choose a good quality cow?

A lot of variation exists within any particular breed, and more so with the crossbreeds. There are not many foolproof methods until you see what comes out in the milkpail, for body conformation to the ideal does not correlate to milk-producing ability. The amount of milk during the first lactation does give an indication, but not a rule, about future milk-producing ability. However, it is valuable to look at some key points when choosing cattle to purchase, if you have a choice! In general it is wise to go for animals with known pedigrees, and those of good-milking mothers bred to artificial insemination should be without question the best calves/heifers to seek for purchase. Every farmer has a few criteria of her/his own which are also important. The author likes red cattle and hates horns! But whatever you choose, test the body conformation against the four illustrations following. If you have a choice, choose carefully, because some of the variations mean milk in the pail, and you might have the instinct to choose the right ones.

Cow number one shows the ideal dairy character, shape and frame. She far surpasses all the others. She has the capacity to consume much feed which, unfortunately, is important in order to produce much milk and has a body like a barrel which widens from the shoulders as you proceed toward the rear. She has a wide, deep udder, teats well placed, not too low below the hocks, and attached high in the back and far forward underneath. Her legs are straight, but not too straight, so that she has some 'spring'; her hooves are strong. Her backline is straight, and her rear end is wide and square, which will facilitate easier calving and shows strength. Her mouth is wide and she can consume much feed quickly. She is alert and feminine, with no excess fat.

Cow number two obviously is the opposite, showing no dairy potential, and appears more bull-like, having the bulk of her body forward near the shoulders. She has no apparent udder, and will likely put on flesh and fat if challenge fed. She has a crooked mouth which is undesirable. However she does have a strong backline.

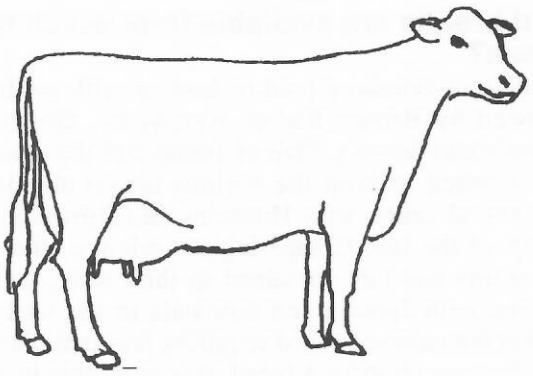
Cow number three has had a difficult life. She is emaciated, and although good feeding and treatment might transform her into a good milkcow, it will cost



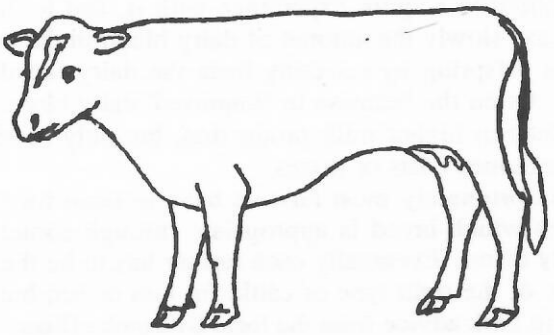
Parts of a cow

quite a bit before she will become a productive cow, and she may never regain her full genetic potential due to permanent damage she has suffered. Her backline is arched and weak, and has a very unattractive slant forward in the rear, which makes her prone to difficult breedings and not cleaning out well after calving (metritis). She does not have the capacity to eat much, and her legs are rather long and weak. However, she shows more milk-giving potential than number two or number four whose udder is full of fat tissue.

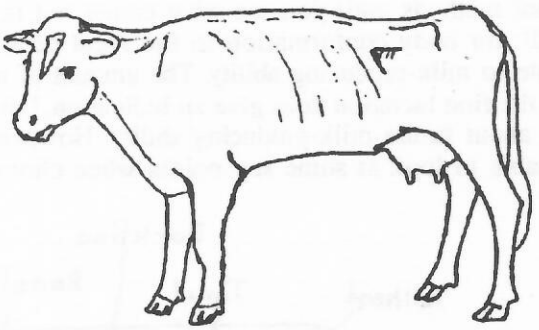
Cow number four may look enormous but she does not have dairy character; she could be of a dual purpose breed for meat and milk, but they require a lot more feed to fill the milkpail than the specialized dairy cow. She is too fat, resembling the Minister of Agriculture's desk. She will have a difficult time conceiving, as she has fatty tissue in her reproductive tract, as well as everywhere else. That fatty tissue in her udder will prevent her from producing much milk. She might have been a better milkcow had she not been so grossly overfed; quite a rarity she is! This problem is rarely seen of limited-resource farmers, but is quite a common site in the smallholders' farms in town who gorge their cattle on brewers grains and concentrates without much roughage. The cow might produce quite a lot of milk if the owner can get her into calf, but woe to the low-resource farmer who chooses her and then wants to give her a diet of fodder alone. It should be noted that some dairy breeds are more dual purpose than others depending on their place of origin, and that dual purpose cattle have their place for the farmer who can manage to adequately feed them.



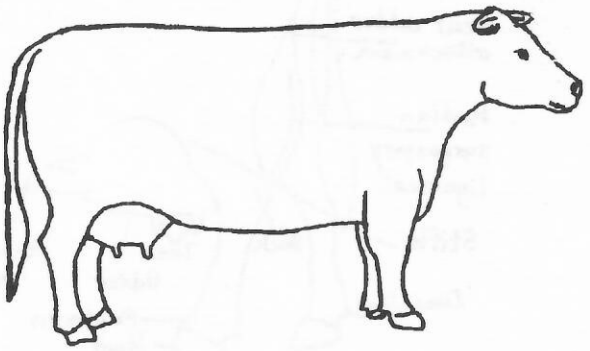
1. Ideal type



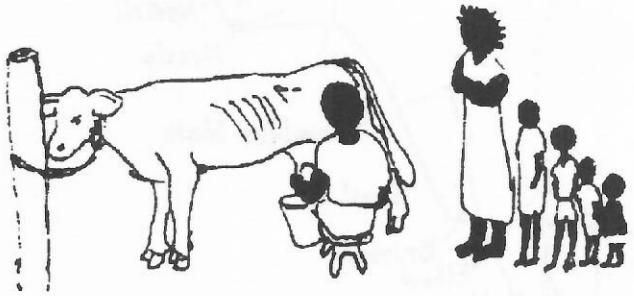
2. Too masculine



3. Emaciated



4. Too fat



Where it really counts:
in the milk pail

CONSERVATION:

Do I need to take steps to conserve the environment?

What are possible methods for improving the environment?

"A good man leaves an inheritance to his children's children..."
Prov.13:22

One of the greatest problems farmers are encountering is the degradation of the environment in slow and sometimes subtle ways even in the areas which have been farmed by their forefathers for generations. It can be evidenced by reduced crop yields, changing climate patterns, the amount of time involved in obtaining fuel and water, and the general health of livestock and of the family itself. Methods need to be found to reverse these trends, which regenerate forests and trees, water sources, and the capacity of the soil to retain moisture and increase fertility.

Some or all of the following methods may be applicable in your dairy farming system:

- Plant a stand of leguminous trees as a small forest, fodder bank and/or boundary to your farm. Besides providing fodder for your cows and building materials for future farm structures, these will improve the microclimate, draw up nutrients from the subsoil, increase the nitrogen in the soil and, perhaps most importantly, provide high quality mulch.
- Plant other trees for firewood, fruit, marketable timber and other uses, to increase the water holding capacity of the land, reduce labor for fuel collection and help to reduce erosion by wind and rain. Several farmers have also begun to start small nurseries to generate income as well as cater their own needs. Mixing one part sand and one part manure to three parts soil, or simply using forest soil or topsoil, they have started seedlings from tree seeds they have collected themselves, even from native species which are going out of existence unless they are safeguarded by these stewards.
- Plant fodder grasses or, more importantly, leguminous fodder trees on contour bunds dug so as to preserve the soil and water throughout your land holdings. Contours planted to fodder not only provide an improved method of growing fodder for your livestock because they produce more (grasses and legumes) on less land, but they also retain the valuable topsoil, create a leveling effect to your land, retain valuable water on your land and enable you to grow thriving food crops above the contours. They provide a high-quality, late dry season feed, as well as sticks for fuel, and mulch if there is an excess, or from the waste from the feedtrough. Another advantage this method has for fodder production: you are still able to farm food crops in between the contours, so that you do not feel you are losing so much land to fodder crop production. By using leguminous trees, you increase the nitrogen in the soil by nodulation and valuable leaf mulch. Above all you are renewing the land for the generations which follow you.

Degrading environment

Improving environment

What are ways to control erosion and improve the soil?

Starting on the top of a hill, a forest should remain or be planted which maximizes the water percolation into the deep layers of the soil. A variety of species is best planted which can be harvested some in the short term through thinning the density, some in the mid-term by fast-growing species, and some more valuable, slow-growing timber species in the long term.

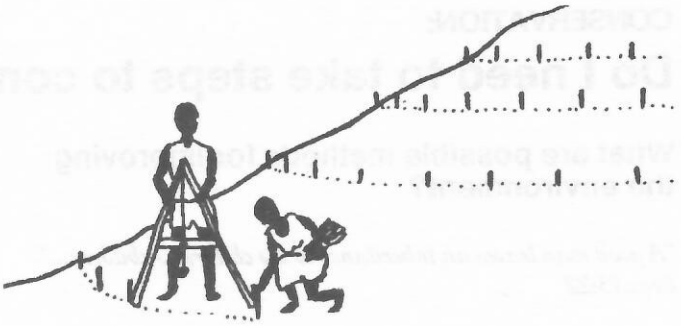
If there is runoff water from the forest into your field, or from the fields above your field, then a cut-off drain which will control the excess water entering your field should be dug; this should be at a slight incline so as not to collect water but to divert it.

This should be followed by measuring the contours of your entire field area with an A-frame, or line level; the distances between contours take into account the steepness of the fields but in general should be between 1.5 to 2 metres vertical interval, or greater if there is hardly any slope.

Following the laying-out of the contours, several contour establishment methods are used. It is wise to plant two densel rows of leguminous fodder trees along the measured contours, or grass strips using productive fodder grasses and herbaceous climbing legumes if you keep livestock. A less intensive method is to simply leave unplowed grass strips on the contours, in order to control erosion. If there are rocks and brush refuse,they should be laid along the contours to strengthen them and be out of the way of cultivation of crops.

If there are gulleys, they should be repaired by simple dams to reduce their continuance and promote their being filled. Boundaries should be planted with long-term tree species to prevent wind erosion and slow gulley erosion from the cut-off drain. In addition, fodder trees can be planted on the boundaries to increase their availability.

All-important food crops should be planted adequately according to your needs on the portions of your land between the contour bunds. Permanent crops such as fruit trees, coffee, sugarcane, bananas, fodder banks,

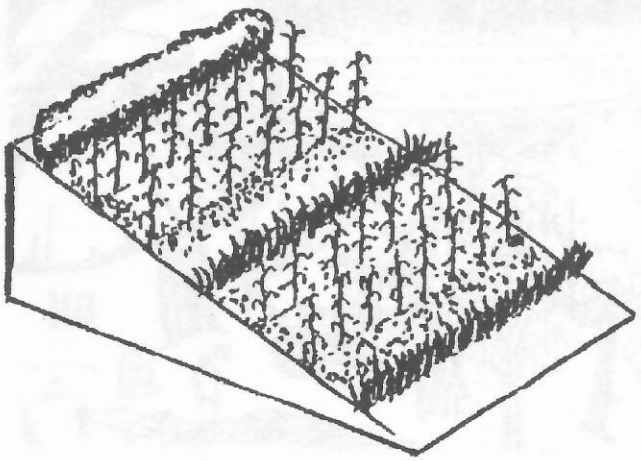


Measuring contours with an A–Frame

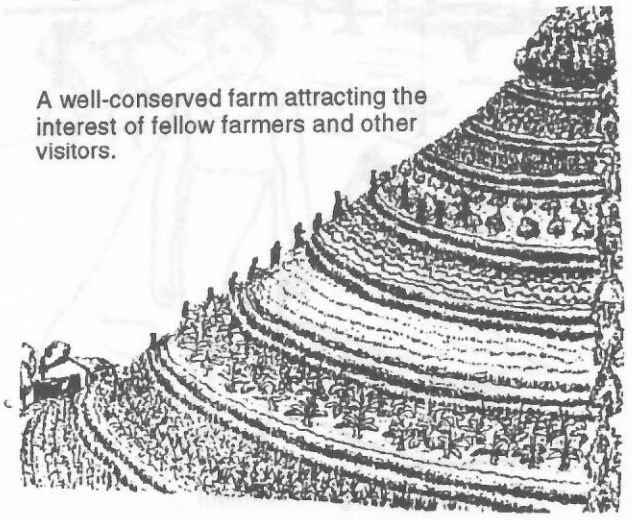
etc. should be planted on every third strip to ensure adequate soil and water retention lower down the hillside if there is any runoff from your annual crops. It is good to do intercropping of legumes within your other food crops, such as maize with beans, or soy beans with millet. Plant cover crops that also reduce moisture and soil nutrient losses and the pelting of the soil by rain. Some cover crops are great as green manures, especially the legumes which increase fertility when mulched or incorporated in the soil. It will be important to do crop rotation each year so as to reduce pests and diseases and improve soil structure and fertility.

All excess hedgerow cuttings, crop residues, weeds, and remains from the feed trough should be laid between the crop rows to act as mulch. This retains water and increases soil fertility above the ground which will slowly be available to the crops and also reduce weeds.

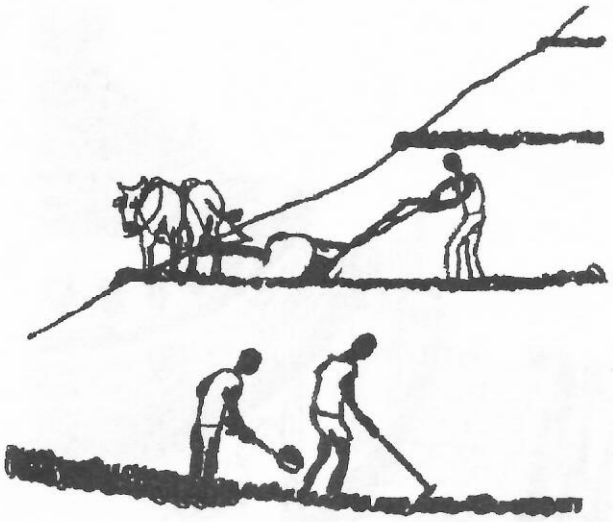
One important method of soil conservation and improvement gaining an increasing interest is zero-tillage. Start with adequate mulch cover by cutting down any undesirable growing plants/weeds on the land, remaining crop residues, and mulch from the hedgerows. Holes for planting of the seeds can simply be made with a pointed stick large enough for the seeds to be dropped into them and covered. The land can produce a respectable crop with only 1/4 of the normal fertilizer requirement for cash crops or no fertilizers for



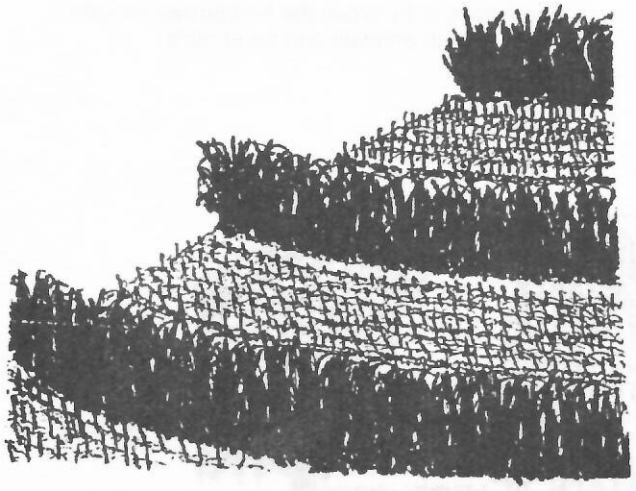
Planting crops on the contour, and fodder trees and grasses on contour bunds



A well-conserved farm attracting the interest of fellow farmers and other visitors.



Plowing contour ditches



Contour bunds planted with fodder grasses

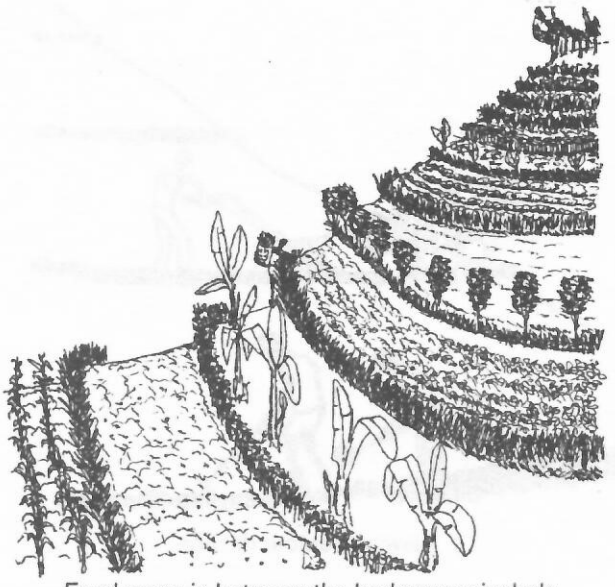
Cutting the hedgerows for use as mulch and fodder

permanent crops. No cultivation is necessary. Only minimum weeding is necessary shortly after emergence of the seedlings and again if any weeds remain prior to the flowering stage of the crop. The mulch reduces weeds considerably. This method resembles the forest floor on which the sun cannot beat down to dry it out; earthworms and other insects actively break down the layers of mulch above ground making nutrients available to the crop. Moisture is retained by the mulch both from increased absorption of rainfall and decreased evaporation, the work of the mulch. In the badly depleted soils of the tropics and subtropics, this low external input alternative shows great hope for increasing yields and being a sustainable system. It can work without manure so this allows manures to be used on other crops, although it is enhanced by manures and compost if available.

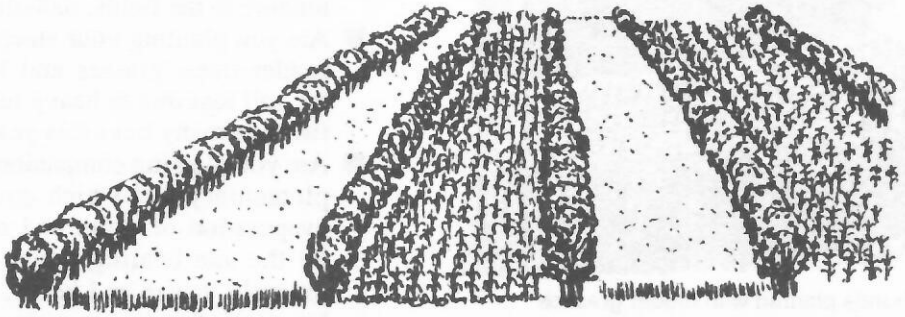
How else can I maintain a good environment?

- Are you burying your manure after taking it to the fields, to prevent loss of valuable nutrients to the air, and possible run-off into streams and lakes? Are you returning all your farmyard manure to the fields, including the urine?
- Are you planting your steepest land to permanent fodder trees, grasses and forest trees to reduce the soil loss due to heavy rains? Have you planted twice as many trees this year as you harvested?
- Are you planting companion crops which are complementary and which cover the soil to reduce evaporation of water and nutrients from the soil by the sun beating down on bare ground? (for example, maize and beans, sweet potato and millet, etc.) Are you covering the soil with unused crop and fodder residues? This maintains soil moisture and increases earthworms and other soil organisms from the mulch produced, rather than burning them, so that you increase the humus of the soil. Are you making compost with the residues to increase their immediate availability to the crops and reduce the need for purchased fertilizers?
- Are you rotating crops to give the land a rest from the same crop year after year? Do you use green manures in rotation on some of your land to increase the humus and fertility and decrease the need for chemical fertilizers?
- Have you tried using any herbal remedies rather than using chemicals to reduce insect pests or diseases on your crops? Have you tried using a vigorous cover crop to reduce or kill unwanted weeds rather than herbicides? Does the method of tick control you use ensure that no contamination of the ground water or environment will take place?
- Social, Physical, Spiritual environments:

Can you help to raise environmental consciousness of your neighbors through participation in a local group? Have you built latrines? Can you encourage your neighbors to do family planning or to be environmentally conscious? Are you careful to reuse most containers, or dispose of them in a safe place where no living thing can be harmed by them? Are you encouraging your sons/daughters (without preference) to bear responsibilities at home and to be involved in the home enterprises? Do you also support positive activities for them with other village youth such as sports, vocational crafts, other learning activities? Do you have a spiritual life evidenced by spiritual activities?



Food crops in between the hedgerows include both annuals and perennials

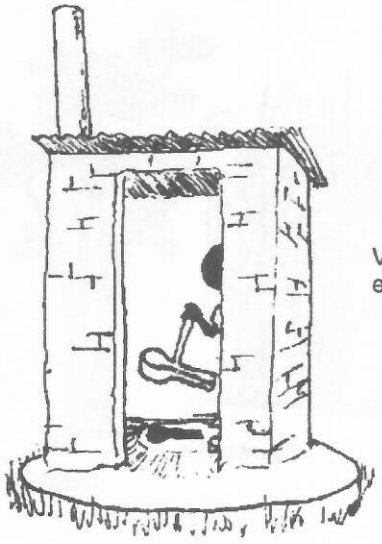


Hedgerows are also needed on flat land to increase green manure and decrease wind erosion.

Intercropping of grains and legumes for better ground cover and higher total production

Mulching to reduce soil moisture loss and weeds, and increase fertility

Spreading and burying compost and manure brings maximum benefit of recycled nutrient



Vented latrines for clean, disease-free environment

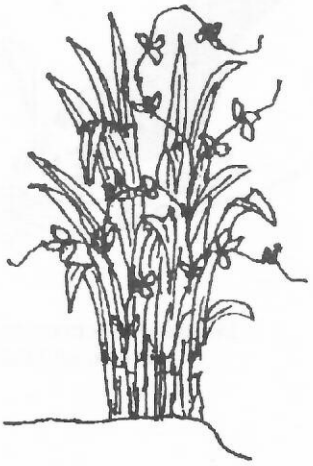
PLANTING FODDER:

How do I plant the various types of fodder?

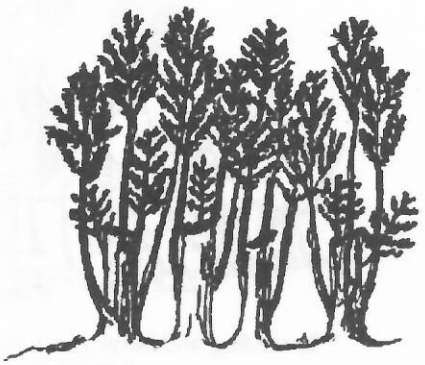
What are the characteristics desired in a fodder?

Dairy cattle, especially cows in-milk, need much more feed than local cattle. As land becomes more scarce many farmers are realizing the necessity for planning for adequate fodder for their cattle year-round by planting part of their land to permanent grasses and legumes, with increasing understanding of the suitability of leguminous fodder trees as a large part of the feed. In most areas farmers obtain the most fodder per unit of land area by planting high-producing leguminous fodder trees and other grasses which are cut and carried to their cattle. Legumes and grasses which are appropriate to this system are the perennials which do not need reestablishing each year, and that give a high production of high quality feed, rapid regrowth, and are suited to a variety of soils and climates. Some species maintain their high feed value longer than others; a mixture of fodder types can often be planted which follows a plan to stagger the maturation time so as to cover a larger part of the year, providing good quality fodder even late in the dry season. The increased use of fodder trees has been instrumental to achieve this. Careful selection of the right species of legumes and grasses needs to be done to obtain a balanced supply of quality feed throughout the year. It is wise to consult your livestock officer to know which are the fodder types best suited to your area and how to obtain seeds or cuttings.

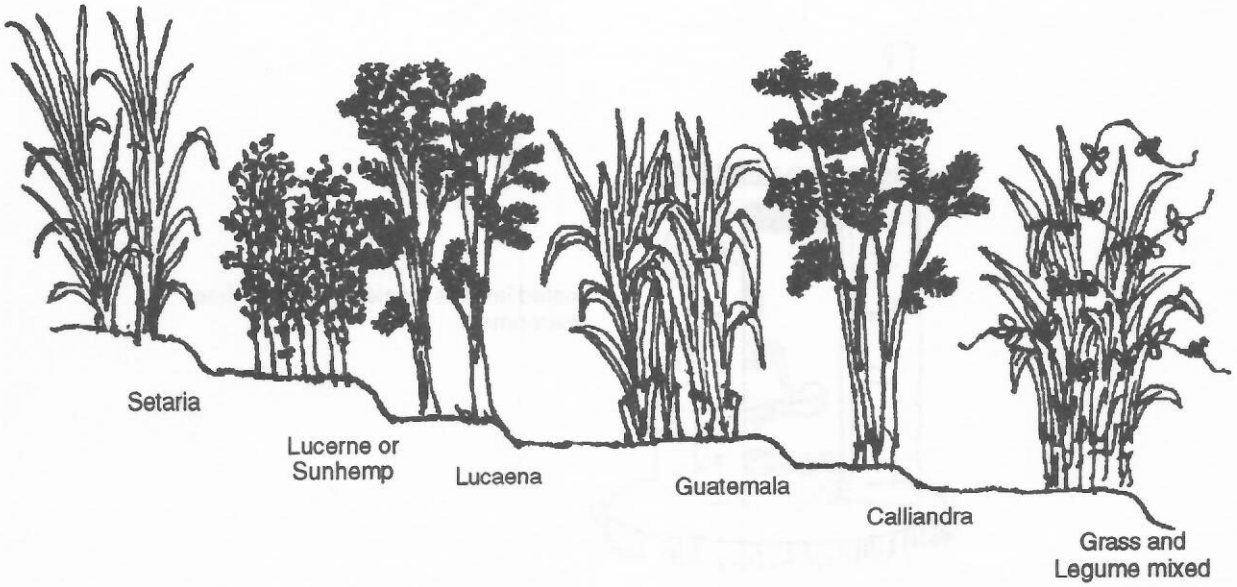
The following are popular species being used in various zero-grazing systems:



Mixing Napier with Desmodium provides higher yields of balanced fodder.



Frequent cutting of fodder trees stimulates fast regrowth of lush, high quality feed even in late dry season.



Is it really necessary to plant fodder?

Many types of natural grasses and weeds which may be found in your fields and on communal or roadside lands are good feed for a short period but they mature early; their feed value does not remain high for most of the year nor are they available in adequate supply. Thus they are insufficient for a high-producing dairy cow, and may be taking up needed land space. They may fill the cattle's stomachs, but will not produce a constant supply of milk. In general grass which is everybody's (on common land) eventually becomes hard to come by, especially as the demand for dairy cattle and for easy methods to maintain them increases. In the long run a planted area of fodder for each family has proven to be the surest and least work for the majority of farmers. Farmers who have adopted the soil conservation measures recommended above have been doubly thankful for the constant, handy supply of feed as well as the maintenance of soil fertility and increased crop production for their families year after year.

If enough higher quality legumes are available, cattle can do well purely on legumes without grasses. However, in order to obtain an adequate supply of fodder, it may be necessary for the dairy farmer to plant high-producing grasses.

What information applies to all fodder types?

The following apply to all types of fodder:

1. Occasional weeding is required especially during establishment of the fodder in the first year. For those planting fodder on contours, this will be easier because at the same time that the fields are cultivated, the contours will automatically benefit by not being left to the last as is usual.
2. Harvesting should be done before the flowering stage; waiting until fodder grasses have produced seeds will reduce their feed value considerably.
3. Fertilizing with manure, compost, mulch, and/or chemical fertilizers will help to maintain high yields. Mixing with legumes, if kept in balance, also has the effect of increasing total bulk yield of the same unit area. As with any crop, if yields are inadequate, the farmer will lose interest to keep it.
4. There will come a time when it will need to be replanted.

Frequent weeding, if necessary, proper harvesting, regular returning manure/mulch/compost, and occasional chemical fertilizers will extend the lifetime of the fodder. Fodder trees will tend to last longer due to their deeper root systems, especially the legumes which are self-fertilizing. Again it should be emphasized, fodder planted on contours also benefits from the topsoil it retains, thus increased fertility, and also from the improved water retention. These factors will enable the fodder to last additional years before renewal.

What are the popular fodder grasses?

Elephant grass or 'Napier' *(Pennisetum purpureum)* is a tall, sterile grass (reproduced by vegetative cuttings, not seeds) which can reach from 2–3 metres in height. There are many varieties, one being especially popular in E. Africa called 'Bana grass'. It produces a maximum of green matter per unit area when supplied with adequate water throughout the year, but is most palatable and nutritive when fed at an immature stage when the stem is still soft and no seed head has formed, usually at 1 to 1.5 metres in height. If allowed to mature it forms a very hard stem so is less useful if not periodically harvested. It is drought resistant but tolerates high soil moisture, and can be established in both clay and/or sandy loam soils, by use of mature stems buried along a row or contour, by cut stems planted at a 30 degree angle along the row, or by splitting up a mature bunch and planting splits. It is best to plant close within the row despite its ability to spread to prevent soil erosion and unutilized gaps; plants should be only 20 cm apart within the row, and rows may be planted one metre apart. This distance facilitates interplanting with climbing legumes and/or inter row cultivation and manuring. Elephant grass spreads quite quickly, and will need to be replanted in the event of becoming root bound, in three to six years. It generally competes well with desmodium spp. as an ideal companion grass/legume mixture. If it becomes dominated by the companion legume, it may be given a boost by nitrogen fertilizers which give it an advantage. It should be harvested close to ground level at 3 to 5 cm height during the wet season and at a 10 cm height during the dry season. It should **not** be grazed, as this will likely result

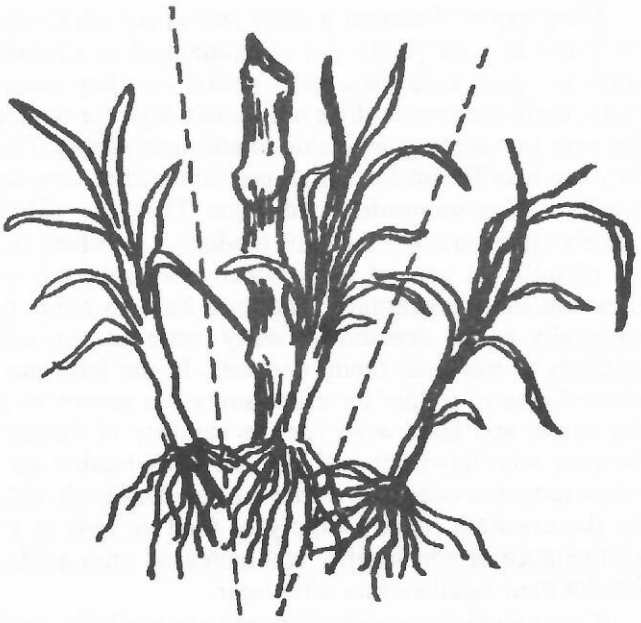
in damage to the growing portion of the plant and retard regrowth.

Setaria *(Setaria sphacelata)* is similar to Elephant grass, being a sterile, highly productive grass, growing up to 1 metre height. It is established from splits and utilized in a very similar manner to Elephant grass, but is slightly more tolerant of cool, high altitude. It is commonly planted at distances of 20 cm within the row in order to form a solid row or contour within the first few months, and rows should be at least one metre apart to allow for ease of cultivation/fertilization, spreading roots, and a companion legume if so desired. It is not as drought resistant as elephant grass and performs well where there is irrigation. The nutritive value is similar to elephant grass, but an advantage is that it does not produce a seed head nor form a hard stem if left to maturity so that it remains highly palatable throughout the dry season even with infrequent harvesting. If planted in rows running along contours, it is an effective soil erosion control. It can perform well with companion legumes such as desmodium spp., although it may be less competitive and have to be managed by fertilising with nitrogen or more frequent legume harvesting to maintain a balance. Two varieties, Nandi and Narok, commonly are used which are excellent fodders and soil erosion controls. The Narok variety is gaining increased acceptance for its superiority in holding soil on a contour line.

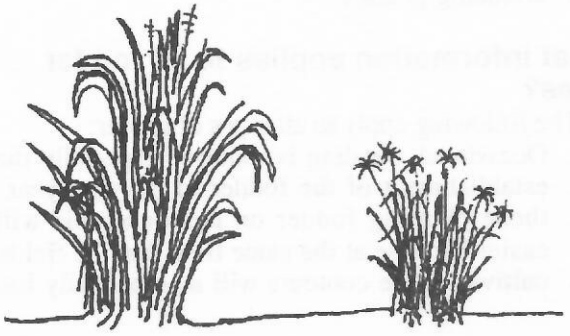
Guatemala grass *(Tripsacum laxum)* is a third type of highly productive, sterile perennial grass, growing to over one metre height, and having the same value and specifications as 'setaria' and 'elephant grass'. Like 'seteria' it does not readily form a stem, such that it maintains its high feed value long into the dry season even with infrequent harvesting. It is ideal for use on contours for erosion control, and performs excellently with companion legumes such as desmodium spp. It should be cut close to the ground at 5 cm (wet season) to 10cm (dry season).

Rhodesgrass *(Chloris gayana)* produces less bulk per unit area than the above three, but is more popular for drier climates, being drought resistant. It can grow to a height of one metre including the tall seed head and is a desirable pasture species tolerating heavy grazing. It mixes well with companion legumes such as desmodium. It is also ideal for hay making in that it dries quickly and is easy to handle. It can be established from seeds or cuttings and spreads readily by it's stolons and seeds. The seeds can be broadcasted or planted in rows with 10cm between the rows. Cover with no more than 1 cm of soil. Some other grasses in use (not at all exhaustive) and some of their advantages include:

Guinea grass *(Panicum maximum)* is similar to Napier but not nearly as productive; it is more drought resistant. It has the advantage of being able to be planted from seeds as well as splits as do several of the grasses. Para grass *(Brachiar ia mutica)*, Molasses



Dividing of a Napier grass clump for vegetative propagaion

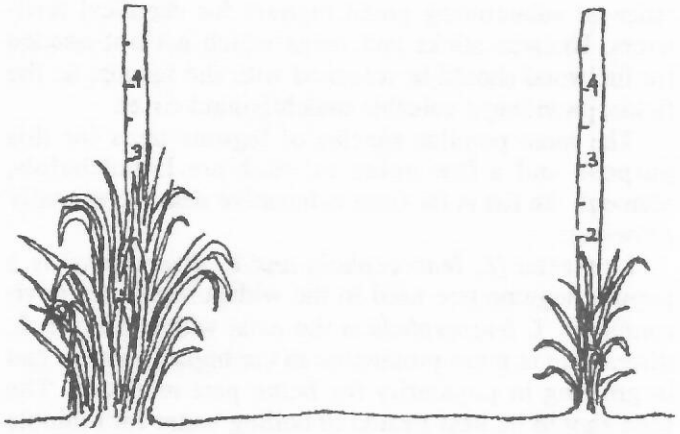


Guinnea grass Rhodes grass

Fodder planting can be a group or family activity

grass *(Brachiaria sp.)* and Congo signal *(Brachiaria decumbens)* are good for wetter areas and also can be planted from splits or seeds. They are not as highly productive as Napier. Alternatives for dry areas, and which are planted from seeds, are African stargrass *(Cynodon plectos tachyus)*, like a miniature Rhodes grass, Buffel grass or African Foxtail *(Cenchrus Ciliaris)*. A good grass for banks of fishponds and for a small exercise yard is Kikuyu grass *(Pennisetum clandestinum)* which is recumbent, starts easily from cuttings and tolerates heavy trodding. Grasses for use in high elevations for pastures include Cocksfoot or Orchard grass *(Dacty lis glomerata)*, Perrenial ryegrass *(Lolium perenne)*, Phalaris *(P. aquatica)* and Tall fescue *(Festuca arundinacea)*, all started by seeds.

In addition to these, some annual food crops of the grass family which produce grains are planted commonly for fodder. These include maize, sorghum, and oats.



The increase in fodder production can be significant from the use of compost, manure or other fertilizers

Guatemala grass mixed with Desmodium gives mutual benefit to both plants

What herbaceous legumes are recommended? (the list is not exhaustive)

Desmodium, both greenleaf *(D. intortum)* and silverleaf *(D. unculatum)* varieties, is the most popular herbaceous legume used as a companion to the tall growing grasses in the fodder plots and forage strips of E. African smallholder dairy farmers. It is a perennial established by seed or mature stems, and elimbs well to form a good mixture. It tolerates grazing, combining well with Rhodesgrass, but is usually used in cut-and-carry systems. Other climbing legumes which are planted from seed, are also popular and similarly used are Glycine *(G. sp.)*, Siratro *(Macroptilium atropurpureum)*, Centrosema *(C. pubescens)* and Tropical kudzu *(Pueraria phaseoloides)*.

Lucerne *(Medicago sativa)* has been popular as a legume to plant in a pure stand, and with regular weeding and good management it can be harvested for several years. It can withstand drought and frost, and can be cut each month under irrigation. It may be planted by seed in rows 10 cm apart during either the long or short rains and harvested 5 cm from the ground.

Another perennial herbaceous legume of importance is Stylo *(S. guyanen sis)* which is useful in dry areas, and can be planted by broadcasting without tillage. For high elevations with frost, White or Red clovers *(Trifolium repens or T. pratense)* are the most easily established for grazing systems. Giant vetch *(Vicia dasycarpa)* is also used in the higher elevations. Other short-lived or annual legumes whose herbage is popular as forage and whose beans are human food are lablab or 'cowpea' *(Dolichos lablab)*, velvet bean *(Mucuna pruriens)*, phasea bean *(Phaseolus acutifolius)*, and the various beans, ground nuts and peas. Another important native legume to Africa is Sunhemp *(Crotelaria spp.)*. zdome varieties contain no toxins and make ideal fodder besides having several additional advantages: it kills nematodes and has the effect of inhibiting weed growth so is an excellent green manure. What are some other plants often grown for fodder? Russian comfrey *(Symphytum peregrinum)* is a high-protein non-leguminous plant which is grown for both human and animal feeds. Edible canna *(Canna edulis)* is a fast-growing plant which has a feed value to equal grasses and its roots are also edible. Swedes *(Beta vulgaris)* and potatoes are occasionally grown or produced in excess and fed to cattle.

Which are the most popular trees planted for fodder?

Several trees are useful as fodder for cattle because they remain green and of high quality through out the dry season, producing ample green matter at a time when there is little available, and they regrow at a fast rate, actually producing more feed per acre than the highest producing grasses! For these reasons, the use of these trees, especially the legumes trees, will undoubtedly increase in the future, taking importance over grasses in cut-and-carry systems, and even in some grazing systems. Many grow wild in the forests, but an increasingly important method of using them is by planting them for fodder. They can be planted on fodder strips or contours to improve the soil and prevent rain erosion in the wet season and wind erosion in the dry season, or they can be planted as pure stands (fodder banks). The most useful of these are legumes which can play a key role to improve soil fertility by nitrogen fixation, high quality mulch and soil erosion control, and which do not compete for nutrients with the adjacent crops as fodder grasses on the contours tend to do. In addition some trees left to grow tall can provide building poles, and fuelwood.

The legume trees can be planted on the contours in 1–2 rows spaced about 20 cm between rows and only 2–3 cm apart or closer if planted as seeds, on contour bunds or in hedgerows (alley cropping) in level fields such that they form a close hedge preventing soil from escaping through from rainwash during the wet season and reducing wind from sweeping over the bare fields in the dry season. When planted as stands, or fodder banks, they can be planted in rows with distances between rows alternating at 30 cm and 70 cm intervals, in order to decrease weeding by more effectively cutting out the light, to provide an easy path between the rows for harvesting and mulching, and to increase production. It is important to plant various types together so as to avoid the likelihood of disease or pests causing damage to the stand. It is also important to use various varieties in order to obtain more fodder; some varieties produce more than others in the wet or dry seasons. Some are better as mulches. Some are less palatable and need to be mixed with other fodders. Because the popular legume fodder trees have taproots, they do not interfere with crops planted beside them, and can be planted on the top of the contour bund, whereas other trees should be planted 1/3 of the way down the riser of the contour or terrace so as to hold the soil on the wall intact.

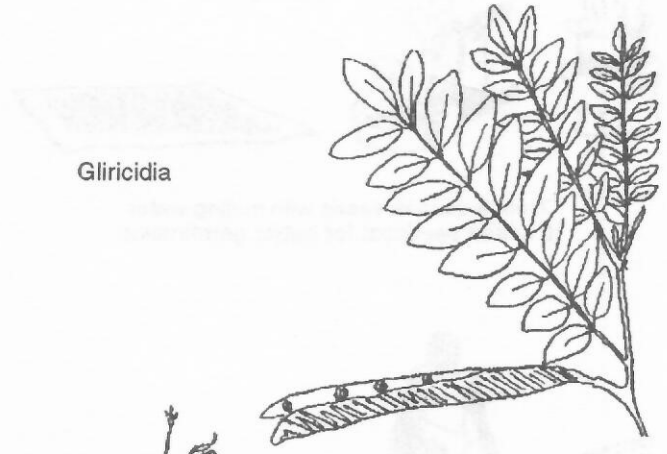
Harvesting of the trees for fodder or mulch normally should be done by cutting them back frequently (monthly during the wet season, every three months during the dry season) at a height of one half to one metre from the ground, depending on the crop planted beside them and according to the type of tree. They should be cut before they begin to shade the companion crops by the time they reach one and one half to two metres height. The preferred cutting tools are sharp pruning shears or secateurs, which do not split or damage the shoots, compared to saws, knives, hatchets, or machetes. Choice of cutting tool can affect the overall regrowth rate as much as 30%! Any excess fodder should be placed between the crop rows as a valuable green manure/mulch. Many farmers use the hedgerow greenery entirely for green manure/mulch whereas legume trees for fodder are planted between the hedgerows/contour rows, thus emphasizing the importance of substituting green manure for chemical fertilizers. Uneaten sticks and twigs which are not needed for fuelwood should be returned with the manure to the fields, providing a valuable mulch/ground cover.

The most popular species of legume trees for this purpose and a few notes on each are listed below, although the list is far from exhaustive and is constantly grow-ing:

Leucaena *(L. leucocephala and L. diversifolia)* is a popular legume tree used in the widest variety of environments. *L. leucocephala* is the most widely known; *L. diversifolia* is more productive in the higher altitude and is growing in popularity for being pest resistant. The seed should be heat treated in boiling water for 1 minute before planting. Although this tree is the most commonly used fodder tree, caution should be taken not to base your farm solely on one type of legume tree; in parts of Asia this tree has been attacked by a small psyllid which has killed it in some places, especially along contours, causing havoc to those farms which depended solely on it. Where there is psyllid infestation, it is most harmful to new-growing shoots during the early rains and early dry season, during which times the tree should not be harvested. New varieties are being found which are psyllid resistant. Some types of lucaena produce foliage containing mimosine which is a mild poison; cattle rations should not exceed 50% of leucaena as a safe, general rule although steps can be taken to enable them to consume higher rates. One reason for its high popularity has been the high production of seeds which makes it easy to propagate. When harvesting for fodder it can be cut as low as 10 cm from the ground repeatedly, although higher yields are obtained by cutting it at one half metre to a metre in height. Uneaten sticks and twigs make good fuelwood or mulch when returned to the fields.

Gliricidia *(G. sepium)* is a tree which is fast becoming popular throughout Africa. It has similar praise as leucaena and has the added advantage that it can be grown from cuttings as well as from seed. It will grow on poorer soils than leucaena, and is not quite as palatable so it must be introduced together with familiar feeds at first. It is an excellent pole producer and makes an excellent living fence besides producing much fodder. Its seeds need no pretreatment prior to planting, and should be covered with a very shallow layer of soil.

Leucaena



Gliricidia

Desmodium rensonii

Planting out seedlings

Care should be taken that a highly poisonous caterpillar which often lives in this tree is not fed by accident to livestock.

Desmodium rensonii is a very popular tree which can also be established from cuttings or from seed. It is highly productive and very palatable, recovering fastest during the wetter months. The seeds should not be pre-treated, and care should be taken not to cover the seeds with much soil as they are small. It is ideal to plant within all hedgerows as it seeds heavily and thus helps to fill in gaps in hedgerows by volunteers, growing well in the shade. It is a very effective fodder tree planted as a pure stand (fodder bank).

Sesbania *(S. sesban)* is native to Africa, and is becoming popularized as a fodder tree. It is not quite as long lasting as the above three species and must not be severely cut back below one and one half metres. It is very tolerant of waterlogging and even grows in the water on lakeshores. It has adapted nodules which are in the air above the water! It is also drought tolerant and very palatable. The seeds can be planted directly or soaked overnight to improve germination.

Flemingia *(F. macrophylia)* is fast becoming a popular fodder tree with many of the good characteristics of lucaena, and also tends to produce many shoots coming up from one rootstock, thus aiding in filling in gaps and is ideal for contour lines. It is a superior mulch and regrows well even at the end of the dry season. It is also highly palatable and provides fast regrowth in a variety of climatic and soil conditions, being especially encouraging for the dryland farmer. The seeds should be soaked overnight prior to planting. Calliandra *(C. callothyrsis*—'red' and *C. tetragona*—'white') is similar to leucaena and even resembles it. It is a poor seed producer, and its fodder contains tannin which causes it to be less digestible or palatable than the above fodder trees, but it produces much leaf matter and is excellent as a mulch or green manure if not utilized as fodder. 'White calliandra' is able to be established from cuttings, unlike 'red calliandra', which helps to overcome the problem of being a poor seed producer, and it is also more productive. Calliandra seeds should be soaked overnight before planting.

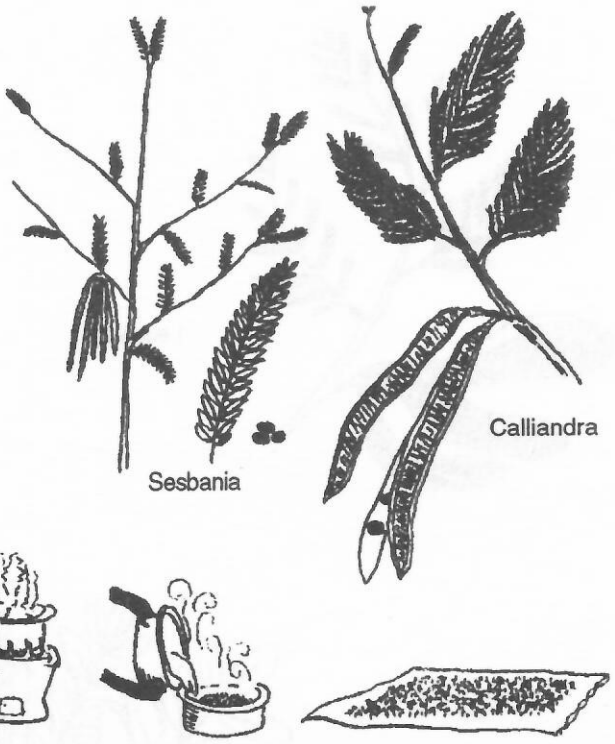
Tagasasteë—'tree lucerne' *(Chamaecytisus prolifer)* has the advantages of being drought tolerant and from a temperate climate, so it performs well at high altitude and cold environments. The seeds need to be boiled for 5–10 minutes so that they will sprout.

Pigeon pea *(Cajanus cajan)* is a short-lived fodder tree which has the advantages of being a dual purpose, human and livestock food, and establishes easily. It is ideal to plant together with slower establishing fodder trees to get a fast crop the first year before it may be slowly eliminated by the longer-lived tree varieties. New varieties can live up to five years.

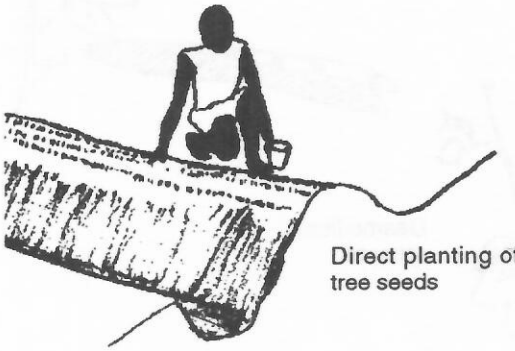
Desmodium gyroides is similar to *D. rensonii* but does not recover so well from frequent harvesting.

Several other non-leguminous trees are excellent fodder producers and useful to plant on the contours. One of the most popular is the mulberry tree *(Morus alba)* which produces an abundance of leafy material besides fruit. Other indigenous trees are valuable to maintain or propagate to supplement the dry season feed when fresh fodder reserves are depleted. Consult your local forestry office or neighbors with this traditional knowledge in order to utilize these valuable resources which should not be lost.

Other trees, whose common names only are mentioned and which are popular for planting above the contours, are fruit trees of all types, (some of which also produce good fodder) such as bananas, jackfruit, peach, fig, and avocado. If fodder needs are met, other non-fodder species can be planted on the contours for mulch or green manure, such as cassia siamea, or for other forest uses such as timber, beehives, firewood, shade, and beauty. Be careful to choose species which can be cropped, and which do not interfere with the crops around them. Grevillea is a very popular example. Certain popular species which are better planted in separate forest plantations rather than alongside crops as they compete significantly for water and light, include eucalyptus, pine, cypress, and black wattle.



Treat leucaena seeds with boiling water to soften seedcoat for better germination



Direct planting of tree seeds

Planting of cuttings of Gliricidia

FODDER UPKEEP:

How do I maintain, harvest and use fodder?

What are the key principles of fodder upkeep?

However fodder is planted, maintained or harvested, some key principles should be followed:

- Keep the soil covered so that sun, wind and pelting rain will not destroy or remove nutrients or harm soil structure. Fill in gaps in the field and especially on contour lines so as to prevent erosion as well.
- Plant boundary hedges or trees to keep out other livestock and to reduce erosion by wind.
- It is usually advisable to do mixed cropping to maximize the ground cover so important in the subtropics/tropics, and to enable the legume to provide some nitrogen for the companion plant.
- It is important to return something back to the soil, not merely to harvest and take away from the field. Crop residues should be incorporated or lie as mulch rather than be burned or removed. This includes slashed or uprooted weeds.
- It will eventually be necessary to replant fodder in order to renew it when rootbound and to aerate the soil. The care used to maintain and harvest fodder usually will determine the time before it will need replanting. Follow good advice on harvesting and maintaining fodder by learning from local conditions what works best, as well as knowing and following the correct harvesting method for each fodder.
- It is wise to rotate your cropland including your fodder plot, to enable soil structure and nutrients to be improved/replenished.
- Use or store the forage when it is in its optimum state of nutritive value balanced with its optimum volume, because when cut too young, it will set back its rate of regrowth, and if it matures beyond an optimum state its growth again becomes slower. You may need to learn these times based on local conditions through yours or your neighbor's experience, or from advice of a livestock assistant.

What is the importance of cultivation/weeding/mulching?

"[S/he] that tilleth [her]his land shall be satisfied with bread.." Prov.12:11

No matter how well the land has been prepared and seed planted, crops will do poorly unless they are well attended to after germination. A frequent mistake is to wait too long before weeding or cultivation. Due to other priorities, the fodder plot is usually the most neglected area of the small farm. Weeding should start soon after the young plants have grown a few cm high, and should be done again whenever weeds are competing for nutrients, root space, water or sunlight. It is especially good to turn weeds into mulch by cutting or pull them up after each harvest of fodder to eliminate regrowth of undesirable species, and promote fodder regrowth by increasing soil aeration, fertility, soil cover, and water infiltration into the soil and at the same time decrease evaporation of soil water and nutrients into the air. It is better to slash the weeds during the dry season and lay them between the crops or fodder rather than uproot them in order to mulch them. This prevents disturbing the soil surface and causing the soils to dry out.

If putting manure on dry season fodder is done it should be followed by covering the manure with crop residues to decrease nutrient losses into the air. A good time to spread manure or other fertilizers is during the rainy season after each cutting as then it is easier to incorporate the fertilizers into the soil, thus reducing loss of plant nutrients into the air. A vicious cycle recurs when a fodder plot is neglected because it fails to produce adequate fodder. It should be replanted, rather than eliminated, before it is seen as a wasted area to the farmer with limited land. The consequence of a neglected fodder plot is poorly fed cattle and a downward trend of the farm in general.

It is easier to eliminate undesirable weeds by cutting them and laying them down as mulch, before they have produced flowers or seeds. They should be kept down around field boundaries and, if possible, in your neighbors fields also, as their seeds are often blown by the wind into the field and weedy hedges are places where insect pests find shelter.

Cultivation should be done when the soil is fairly dry ,if possible. It is better not to cultivate soil when very wet because it becomes very hard and the weeds may take root again if pulled out merely to be left on the wet ground. Similarly, cultivation should not be done if the soil is too dry as it promotes erosion.

How do I best utilize manure?

As plants grow, many essential nutrients are removed from the soil which need replacing. Farmyard manure is a nearly complete fertilizer containing among other nutrients the three major elements: nitrogen, phosphorus, and potassium.

It improves the texture of soils by increasing the growth of humus, the dynamic biomas which increases soil fertility and structure. Both urine and cow dung contain nutrients which should be returned to the fields. The urine, if collected separately, should be

transferred immediately to the field so as to prevent loss of the nitrogen it contains into the air. The cow dung may as well be taken directly to the fields in the form of a slurry by mixing it with the urine.

If you decide to take it daily to the fields, more nutrients will be conserved by putting it between the rows of grasses or on a field you want to cultivate and then burying it immediately after spreading. The same goes for slurry which is emitted from a biogas plant. Take care that the newly applied manure or slurry is not allowed to wash off the field by the next rainfall; incorporate it into the soil.

How do I make compost?

If you decide to store it before utilizing it, there are some advantages. By composting it the manure can be extended to more than twice its volume by mixing it with other slowly-degrading organic matter such as unutilized feed, sawdust, ashes, excess crop residues, etc., and leaving it over a time to degrade. In order to speed up the composting process, you may dig a hole in the ground, e.g., one metre by two metres by one metre deep. Placing first a dry layer of crop residue, deposit layer by layer of each of the above mentioned 'ingredients', and cover it with a shallow layer of soil. Add 50 litres of water every three days, and turn it over after two weeks putting the upper layer down and vice versa. After four weeks mix the contents once again, and cover it again, imbedding an upright stick in the mixture. After six weeks, when the stick imbedded in the compost comes out cool, the degrading process is complete enough for you to begin to use the compost on your field.

A less labor-intensive method of composting is to dig narrow trenches in your fields, into which you deposit manure and slurry, and cover it with the crop residues, weeds, ashes, sawdust, and any other materials which can slowly break down in the trench. Plant short-term crops adjacent to the trench and you will note that they thrive.

If you water these crops, put the water into the trench. By the time you next cultivate, you can mix the degrated compost with the soil around the trench, and then dig the trench again, redepositing any materials which have not decomposed, and repeat the process. This method allows you to utilize the plant nutrients as they become available, and avoids the need for a special compost heap or trench on an area which could be used for other purposes.

A less labor-intensive method of composting manure, but which does not increase its volume, is to merely pile it in a convenient location and cover it for use later when needed. Composted manure's nutrients are more available to the plant than the fresh manure. Composting should not be done too close to the cattle shed so as not to encourage the breeding of flies there.

What are some common chemical fertilizers and their uses?

Although it is hoped that farmers will always maximize the use of farmyard manure and compost, soils may be depleted of some nutrients for which it is advisable to apply chemical fertilizers as well. These will replenish the soil and help to obtain higher production in a shorter time.

Chemical fertilizers are convenient for use where farmyard manure is insufficient and enable extensive areas to be fertilized for crops. However, chemical fertilizers do not improve soil texture, so they should be used in combination with organic fertilizers whenever possible to obtain healthy soils.

Nitrogen fertilizers such as ammonium nitrate, sulphate of ammonia, urea and NPK are helpful to all grasses, but only in the early establishment of legumes; they are not recommended for subsequent fertilization of legumes because they inhibit the self-production of nitrogen in the soil by legumes through nitrogen fixation. In a grass-legume mixed stand, it is advisable to use nitrogen if the legume becomes dominant, in order to inhibit its growth and to promote the grass to grow.

Phosphorus fertilizers such as triple super (TSP) and rock phosphate supply a nutrient frequently deficient in East African soils, especially in those which are farmed. Phosphorus is much more readily available in TSP than in rock phosphate, and therefore is usually recommended even despite its higher cost. In a grass-legume mixed stand, if grasses are dominant, phosphorus fertilizers give a boost to the legumes, and as such, are useful to recover the balance of legumes just as nitrogen fertilizers assist the recovery of grasses.

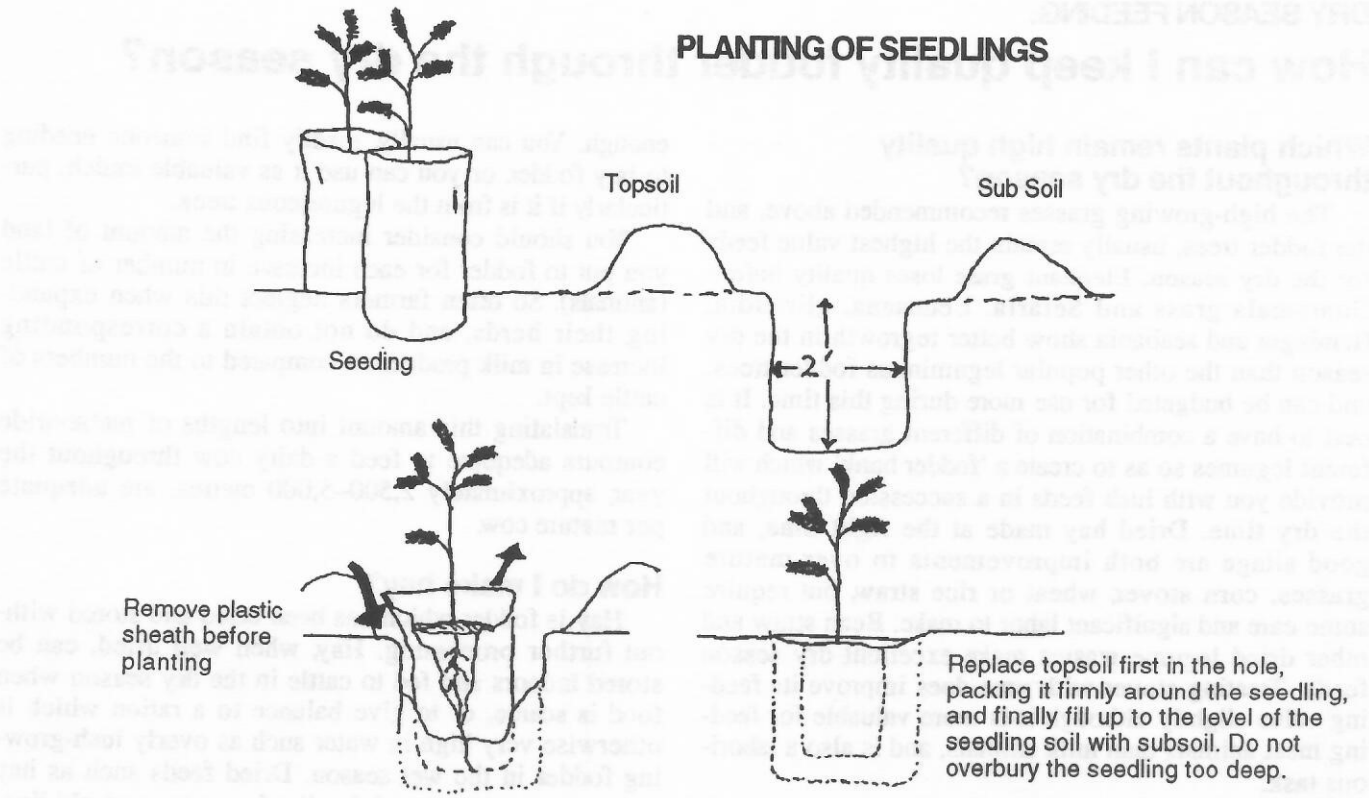
NPK is a balanced fertilizer containing the three most commonly lacking soil nutrients: nitrogen, phosphorus and potassium. It is useful when all these are lacking in the soil, as in monocropping, and where there is no farmyard manure incorporated in the soil.

Where soils are acidic, lime is an essential ingredient to bring the soil into a balance, and enable the plants to utilize the other nutrients which are there or are to be added.

The soil conservation department or agricultural office may be of help to recommend the best fertilizers for your specific conditions, as chemical fertilizers are too expensive to apply extravagantly by haphazard, uncontrolled application. Get a soil analysis to be sure, if at all possible.

How do I apply chemical fertilizers?

Most fodder crops are planted in rows, making fertilizer application simple to ensure it reaches the plant. Where crops are planted in rows, it is simple to fertilize in the row at the time of planting, then mix with a stick dragged through the row so that the fertilizer will not burn the young roots after they germinate. When apply-



ing fertilizer to row crops it can be placed close beside the crop and then covered, reducing possible losses into the air, especially for nitrogen fertilizers.

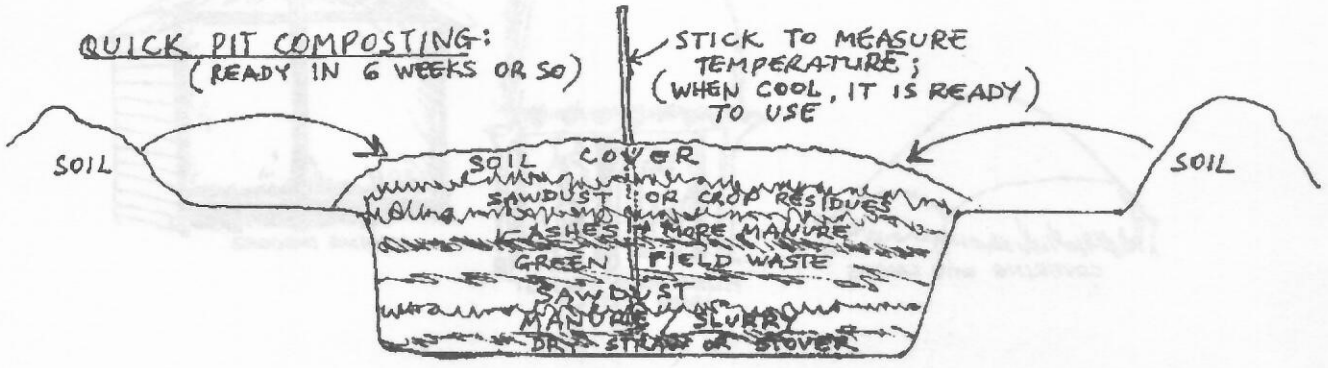
Where the seed is broadcast at planting, chemical fertilizers may also be applied in an even layer on top of the soil and incorporated.

After that fertilizers can be broadcast over the top of the crop but not worked into the soil. Soil moisture will dissolve chemical fertilizers and avail the nutrients to the plants.

How do I prepare the land for fodder planting?

First, evenly apply farmyard manure and/or NPK, especially if the field was previously cropped. Then plow the field well so that the manure is well covered by the soil. Weeds and crop residues can remain on top of the soil to act as mulch as long as they do not hinder the germination of the seeds/cuttings, as they help by preventing the soil from drying out. As these decompose, they will slowly become valuable compost, and actually decrease the need for cultivation. An exception is the removal of subterranian or stoleniferous weeds which can choke the fodder if allowed to remain on or in the soil; these can first be dried out completely before being used as mulch (from the soil improvement stand point, burning of undesired weeds should be avoided where their use as a mulch is possible). If no mulch is available, it becomes more important to prepare a well-plowed seedbed to aerate the soil and promote rain water infiltration prior to planting.

When planting on the contour bund, it is equally important to prepare a good seedbed prior to introducing the planting material, following the same principles mentioned above.



DRY SEASON FEEDING:

How can I keep quality fodder through the dry season?

Which plants remain high quality throughout the dry season?

The high-growing grasses recommended above, and the fodder trees, usually remain the highest value feeds for the dry season. Elephant grass loses quality before Guatemala grass and Setaria. Leucaena, gliricidia, flemingia and sesbania show better regrowth in the dry season than the other popular leguminous fodder trees, and can be budgeted for use more during this time. It is best to have a combination of different grasses and different legumes so as to create a 'fodder bank' which will provide you with lush feeds in a succession throughout the dry time. Dried hay made at the right time, and good silage are both improvements to over-mature grasses, corn stover, wheat or rice straw, but require some care and significant labor to make. Bean straw and other dried legume wastes make excellent dry season feeds. Treating stover with urea does improve its feeding value slightly although it is more valuable for feeding meat animals than milk animals, and is also a laborious task.

How much is an adequate fodder bank?

As a general rule, one quarter hectare (one half acre) of irrigated fodder, or one half hectare (one acre) of rain fed fodder are recommended for a mature dairy cow through the year. Of course soil variation and level of intensity of cultivation/soil fertility practices make room for significant variation in this recommendation.

It is far better to have too much fodder than not enough. You can usually, readily find someone needing to buy fodder, or you can use it as valuable mulch, particularly if it is from the leguminous trees.

You should consider increasing the amount of land you put to fodder for each increase in number of cattle (animals). So often farmers neglect this when expanding their herds, and do not obtain a corresponding increase in milk production compared to the numbers of cattle kept.

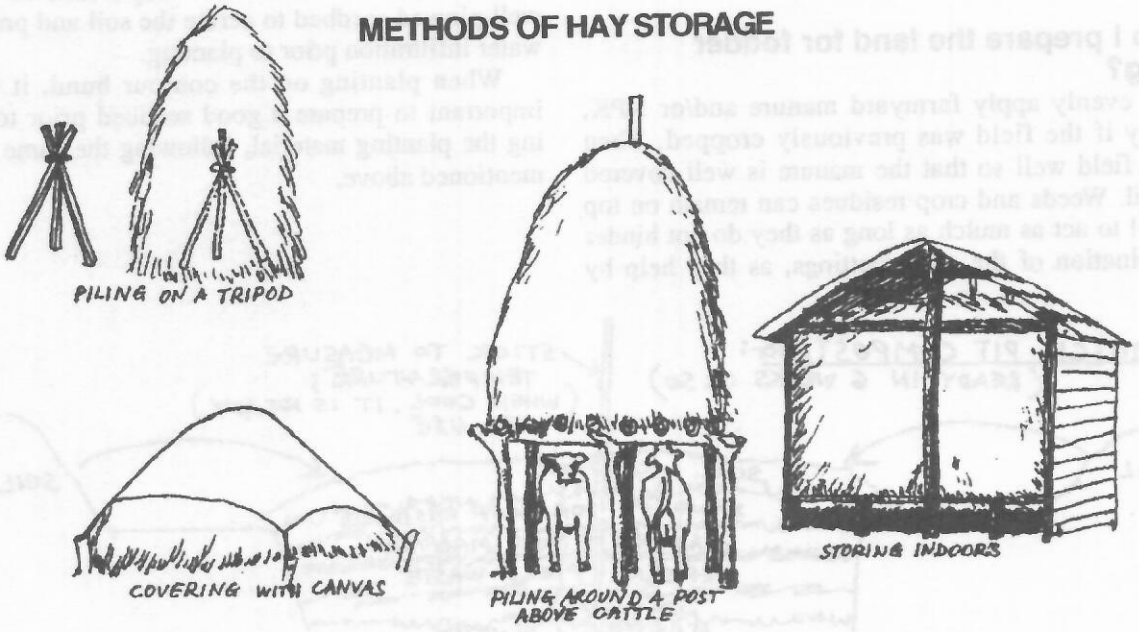
Translating this amount into lengths of metre-wide contours adequate to feed a dairy cow throughout the year, approximately 2,500–5,000 metres, are adequate per mature cow.

How do I make hay?

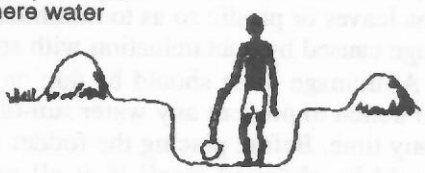
Hay is fodder which has been dried and stored without further processing. Hay, when well dried, can be stored indoors and fed to cattle in the dry season when food is scarce, or to give balance to a ration which is otherwise very high in water such as overly lush-growing fodder in the wet season. Dried feeds such as hay are an important part of the diet for young and old livestock alike.

Grass to be made into hay should be cut prior to the flowering stage in order to obtain the highest feed value. After cutting, it should be dried if possible in the sun, being turned so as to be evenly dried but not overly dried, a day or two for the finer grasses and more for the high-growing grasses. After drying, hay should be stored, preferably indoors, where it will not become

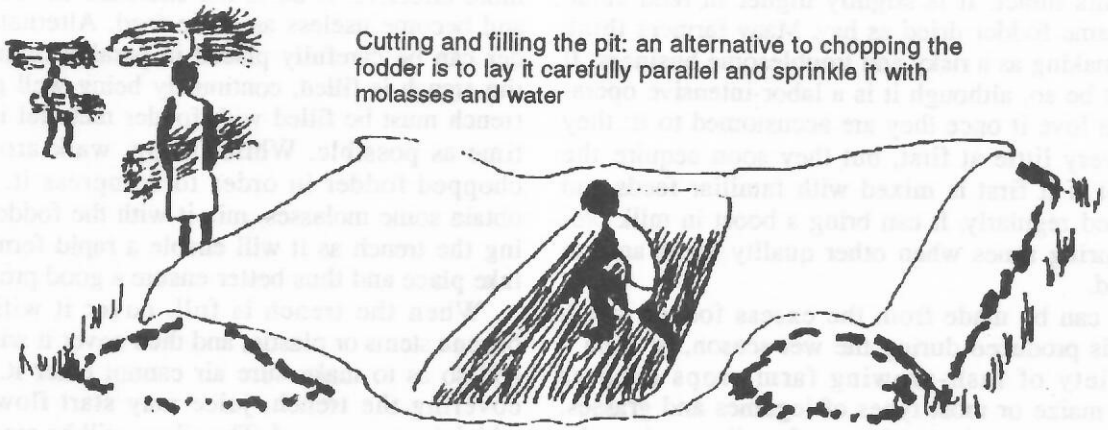
METHODS OF HAY STORAGE



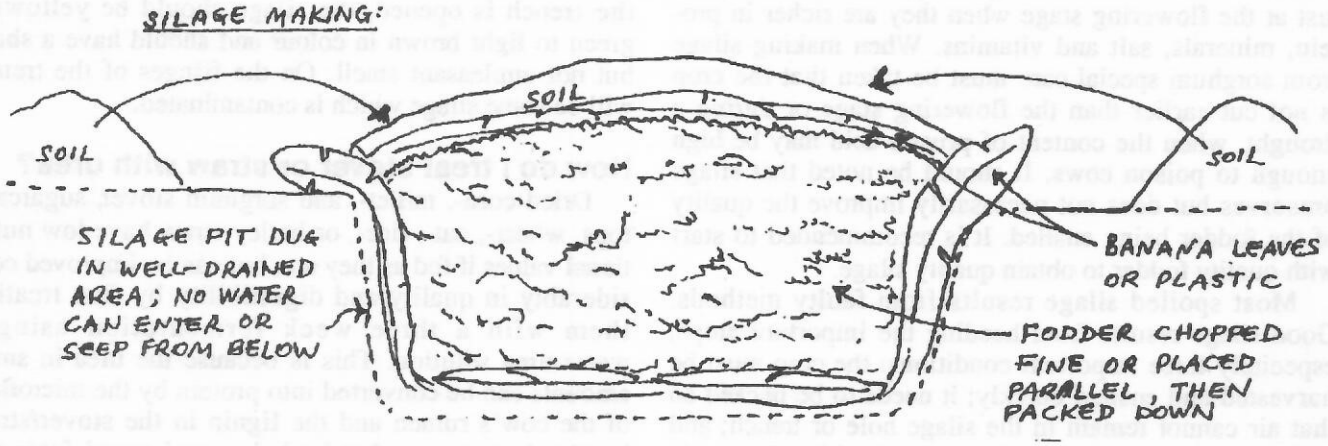
Digging the silage pit in well-drained area where water cannot seep in



Laying plastic sheet or banana leaves to reduce air and soil moisture infiltration



Cutting and filling the pit: an alternative to chopping the fodder is to lay it carefully parallel and sprinkle it with molasses and water



This silage pit should be filled in as short a time as possible, and well packed prior to closing up the pit. Silage will be ready in 1 to 2 months but can last for years.

Close the pit so that air and rainwater cannot enter; cover the plastic with dirt to help compress it.

damp or contaminated. Optional methods of storing hay are depicted on the preceeding page. Note that it is important that the hay can shed rain readily or be kept indoors so as not to decrease in value.

How do I make silage?

Silage is fodder preserved without drying by an anaerobic process which ferments it, keeping most of the nutrients intact. It is slightly higher in feed value than the same fodder dried as hay. Many farmers think of silage-making as a risky and troublesome business. It should not be so, although it is a labor-intensive operation. Cows love it once they are accustomed to it; they may eat very little at first, but they soon acquire the taste for it if it first is mixed with familiar feeds and then offered regularly. It can bring a boost in milk production during times when other quality feeds are not to be found.

Silage can be made from the excess fodder which normally is produced during the wet season, or from a wide variety of lush-growing farm crops such as sorghum, maize or most types of legumes and grasses. Maize or sorghum should be cut for silage when the grains are still soft and milky, and grasses should be cut just at the flowering stage when they are richer in protein, minerals, salt and vitamins. When making silage from sorghum special care must be taken that the crop is not cut earlier than the flowering stage or during a drought, when the content of prussic acid may be high enough to poison cows. It should be noted that silage preserves but does not necessarily improve the quality of the fodder being ensiled. It is recommended to start with quality fodder to obtain quality silage.

Most spoiled silage results from faulty methods. Good silage results from heeding the important steps, especially three important conditions: the crop must be harvested and ensiled quickly; it needs to be packed so that air cannot remain in the silage hole or trench; and no water should be allowed to enter it either from rain or from the ground.

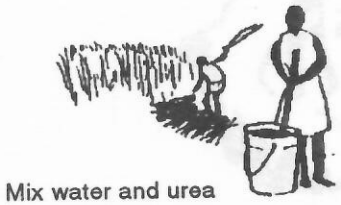
Silage can be made in a hole or trench. The trench should be dug in ground which is well drained such as a hillside. The size of the trench can vary according to the amount of silage needed or amount of excess fodder available. The floor and sides should be covered with banana leaves or plastic so as to minimize the amount of spoilage caused by contamination with soil or soil moisture. A drainage ditch should be dug on the upper side of the trench to prevent any water run-off from entering it at any time. Before placing the fodder into the trench, it should be chopped small if at all possible, which makes compression easier, and the exclusion of air more effective. If air is not excluded the silage will rot and become useless as cattle feed. Alternately the fodder can be carefully placed in parallel orientation until the trench is filled, continually being well packed. The trench must be filled with fodder material in as short a time as possible. While filling, walk around on the chopped fodder in order to compress it. If you can obtain some molasses, mix it with the fodder while filling the trench as it will enable a rapid fermentation to take place and thus better ensure a good product.

When the trench is full, cover it with pieces of banana stems or plastic, and then cover it with a layer of soil so as to make sure air cannot enter it. Soon after covering the trench, juice may start flowing from it which is very normal. The silage will be ready after 1 to 2 months but can lay untouched for a long period. When the trench is opened, the silage should be yellowish green to light brown in colour and should have a sharp but not unpleasant smell. On the fringes of the trench will be some silage which is contaminated.

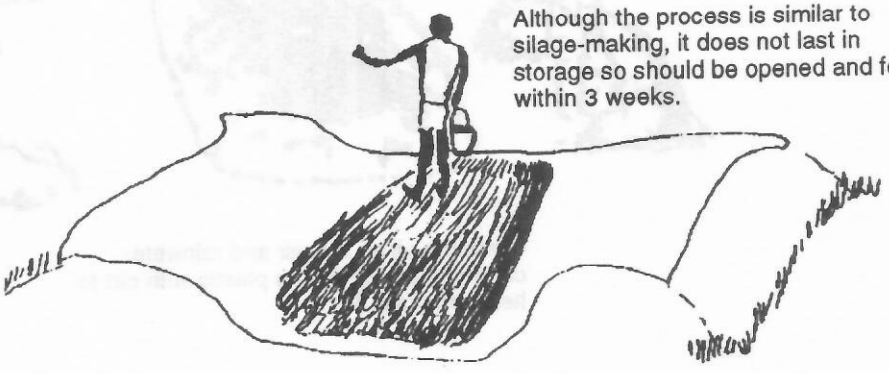
How do I treat stover or straw with urea?

Dried corn-, millet-, and sorghum stover, sugarcane tops, wheat-, oat-, rice-, or barley-straw have low nutritional values if fed as they are, but can be improved considerably in quality and digestibility by first treating them with a three week fermentation using a water-urea solution. This is because the urea in small amounts can be converted into protein by the microflora of the cow's rumen and the lignin in the stover/straw breaks down somewhat by being moistened from the urea-water mixture. Because urea is potentially poisonous, it is important that the following steps are followed carefully so as not to take chances.

1. Prepare a trench identical to the one used for silage, including lining it with plastic or banana



Mix water and urea in correct proportions.



Although the process is similar to silage-making, it does not last in storage so should be opened and fed within 3 weeks.

leaves on the sides and floor. If you intend to use this continuously, make two trenches and alternate filling them at three week intervals which is the time it takes for the treatment to be completed. Since the mixture does not store indefinitely like silage, make only enough to utilize for three weeks at a time. Some farmers prefer to build cement tanks for this sole purpose, which is indeed a good idea, after you are convinced of the value of doing the treatment of stover/straw for your cattle.

2. The treatment is more successful if the stover or sugarcane tops are chopped small to aid infiltration of the urea-water solution and improve packing it in the trench; the straw need not be cut smaller. Prepare, all at one time, enough stover/straw for a three week period.
3. Mix 1 kg urea 46% with each 10 litres measure of water. You will need 10 litres of water for each 16–20 kilos of stover/straw. Because you will now be filling the trench with stover/straw in layers and then sprinkling the solution over each layer, you can continue to make more of the urea-water solution as you go along, making sure that the solution is adequately mixed each time so that the granules are completely dissolved.
4. Fill the trench with the moistened stover/straw and cover it immediately with plastic or banana leaves and then soil to keep out the air and reduce evaporation into the air of both the water and the nitrogen from the urea.
5. After three weeks it is ready to open from one side or end. You will be repulsed by the strong ammonia smell (like urine), and otherwise it will appear slightly moister and browner than the dry stover/straw. Take out the amount you wish to feed and let it sit out until the next day before feeding it. You can slowly reduce the time required between taking it out and feeding it as the cow gets used to the odor. Surprisingly the cows like it and will consume more treated stover/straw than they will regular untreated straw. Unfortunately, it has had more effect on fattening cattle than on increasing milk, but certainly it is very beneficial to the maintenance of cattle through the dry months.

CAUTION: This mixture should **not** be fed to calves, other immature ruminants or non-ruminants.

What other field residues are acceptable as forages?

Almost anything brought from the field is potential filler for the cow during the dry months, although the value is quite variable, so you are discouraged from making the greater part of a ration based on these, and you should beware of plants which are poisonous in your area and not feed them. However, one of the great advantages of a ruminant is that it can digest much of what man considers waste. The following are typical field residues not already listed above which are fed to cattle; they are listed in order of their importance/feed value: sweet potato vines, bean, ground-nut- and other legume straw, avocado, guava and mulberry leaves, banana skins and tops, wild grasses and weeds, and finally, banana stalks which are little more than fibre and water.

Whatever you do, it will likely be more advantageous to provide concentrate feeds together with the above fodders to improve the feeding levels of cattle in the dry season in order to maintain productivity. However, the farmer who is most self-reliant in the production of quality fodder of various types will need less purchased, high-cost concentrates, and will make milk at more of a profit, unless the land will be more productive producing alternate crops, and fodder/feeds can be readily purchased.

FEEDING REQUIREMENTS:

What do dairy cattle need?

What types of nutrients are required?

A dairy cow has been described as a factory which transforms feeds unusable by humans into milk. These feeds must also supply nutrients used for growth of the body, reproducing offspring, energy and storage within the body of fat, protein, minerals and water. These may be later utilized during times of deficit feeding when requirements are greater than intake. These are all functions for which nutrients are necessary. Different kinds of nutrients are needed for most of them, for example:

Water is an essential feed needed to produce body fluids and flesh, and is the daily feed most required by weight, supplied directly or through green feeds. Water helps to digest food and get rid of waste materials. The body contains over 65% water! It is usually the cheapest among the feeds to obtain, but surprisingly is commonly deficient on many farms, leading to low productivity and general unthriftiness.

Carbohydrates are needed from feeds to provide energy, build up fat and help to produce milk. They are required in a large quantity, by weight second only to water, and are provided by such feeds as the various fodder grasses, grains (concentrates) and milling by-products, mollases, and crop residues. Cattle are able to convert many carbohydrate feeds which are unusable by humans into milk which is usable.

Proteins are needed to produce body organs, muscles and blood, and help produce milk. They are required in the third highest quantity by weight, and are provided through such protein feeds as legumes, and by-products such as oilseed cake. Even non-protein nitrogen sources such as urea or ammonia can be fed in small quantities. Microbes in the stomach (rumen) of mature cattle can convert them, in small amounts, to protein.

Various minerals, including salt, are needed to produce bones, muscles, and body fluids such as blood. They are present in almost all feeds but some minerals must be provided by additional supplements for optimum health and productivity, as they are usually inadequately supplied in normal feeds.

Calcium and phosphorus are needed in the highest quantities, followed by magnesium, sodium, chlorine, iron and sulphur in relatively smaller amounts. One litre of milk contains about 10 gm of these minerals, so the requirement for these minerals by a milking cow is very high. Feeds vary in the amounts of minerals they contain, based on their source, stage of growth, etc. Grains and oilseed cake generally are high in phosphorus but low in calcium and salt. Leaves and stems of legumes are rich in various minerals. Fish and bone meals are rich in all minerals. When these feeds are lacking it is recommended to feed mineral mixes or blocks to supply the shortfall. Lack of minerals may often be a cause of infertility, slow growth rate and low milk production.

Vitamins are needed to maintain health and body functions, and are usually adequately supplied from normal feeds, or synthesized by microbes in the stomach (rumen) of cattle. Young stock receiving a ration low in vitamin A do not grow as well as they should, and any animal suffering from vitamin A deficiency will be more susceptible to infectious diseases. The main source of vitamin A in food is carotene, which is part of the colouring matter in all green plants. It follows that any animal eating grass or other green foods is not likely to suffer from a shortage of Vitamin A. Carotene is lost to a certain extent when grass is made into hay, but the amount lost will depend mainly upon the speed of hay making. Other food containing Vitamin A are milk, yellow maize, kale and cod-liver oil.

Growing and pregnant animals receiving a ration low in vitamin D will suffer from inadequate growth and malformation of the bones as it is required with calcium and phosphorus in bone formation. Vitamin D also appears to be important in converting calcium and phosphorus from the bone into milk minerals. The chief source of vitamin D is sunlight on the animal's body, and thus sunlight is needed by all classes of livestock. Hay dried in bright sunlight will contain some Vitamin D. Cod liver oil is also rich in vitamin D.

Lack of vitamin E has been known to produce sterility in cows and bulls, being connected to selenium deficiency. Vitamin E is present in all cereal grains.

Microbes in the rumen (fourth stomach of cattle) produce most of the vitamins needed by them. Cattle receiving fresh, green or well preserved feeds and having access to sunlight will seldom lack vitamins. The need of vitamins for young cattle, especially vitamin D, is much greater than that of adults. Livestock most likely to need vitamin supplements are young or old which are kept indoors in the dark under intensive conditions, and stallfed cattle, particularly milking cows fed on poor quality hay, crop residues or grass only.

Cattle require nutrients to provide for the following:

1. Maintenance, to enable the body to perform its essential functions. These include movement of muscles that cause the heart to beat, force air in and out of the lungs, maintain the body temperature, and many other processes such as digestion, excretion, circulation, etc. that take place in the body of the cow at rest.
2. Growth, build up bone, flesh, fat and other substances in its own body.
3. Production of milk, in lactating cows.

4. Reproduction of the developing young, in pregnant cows.

Grasses and legumes, hay, silage and nearly whatever you grow in your fields, called roughages, in most cases are sufficient for meeting maintenance and minimum growth level requirements for most classes of cattle. However, they are not enough for maintenance of the cow or heifer in the ninth month of pregnancy and certainly not for producing the maximum milk production according to the ability of purebred dairy cattle. To meet these larger challenges, concentrates should be fed. An option which the progressive farmer will choose is to feed concentrates to all cattle in order to maximize growth rates and production levels, following recommended levels such as those given in this book.

Weaned calves have a higher requirement for supplemental feeds than yearlings which can get their growing requirements from good forage alone. Large cows require more feed than small cows. Cows having high milk production need more feed than cows having low production, and extra feed is needed for reproduction. Body weight is nearly constant throughout the lactation cycle, so the amount of feed required for maintenance is also nearly constant. However, about two weeks prior to calving and for some eight weeks after calving as milk production increases, the feed requirement is greatest. Feed required for reproduction is greatest in the eighth and ninth months of pregnancy, but during this time the cow should not be milked, so there is a corresponding decrease in feed required for milk production.

Thus, to summarize, the total feed requirement is greatest in early lactation, decreases gradually until the cow is dried off, then gradually increases up to the next calving. Feed supplementation is also needed for first-calf heifers to enable them to grow to their mature weight, and for breeding bulls doing frequent breedings.

FEEDING LEVELS:

What amounts of feeds should be given to dairy cattle?

"A righteous [farmer] regardeth the life of [her]his beast." Prov.12:10

How important is it for water always to be available?

Cows, heifers and calves should have access to clean, cool water **all the day long**; if not they must be watered at least three times a day. Research has shown that this simple requirement is one of the most frequently neglected among smallholder dairy farmers. Lactating dairy cattle are simply not physically capable of drinking enough water once per day for optimum production; they will drink the most when clean water is available at all times. This is probably the least expensive feeding requirement of dairy cattle; it should never be neglected.

How much fodder is required?

As a general rule fodder should be ever present in front of the cow to eat as much as she will. This is especially true for milking cows. So the value of weighing the fodder before giving it to the cow has limited use; as an educational experience one might realize how much cows actually can eat, but you are not advised to limit their feed to the amounts designated below, nor are you wise if you fill the feed trough wastefully without encouraging cows to finish the quality feed in front of them. The amount of fodder required per day per cow depends on several factors. The following chart may be helpful:

As can be seen from this, in general, the amount of fodder required per cow per day depends on the size of the cow, whether rainy or dry season, i.e., the amount of water in the fodder, and the amount of concentrates that are being fed. It should be added that on adequate, good quality fodder alone a cow should be able to produce 7–8 litres of milk per day, but that a cow producing twice that much milk needs more nutrients than she can get from fodder alone, and production will decline as her body reserves become exhausted unless she is fed concentrates. It should also be noted that as concentrates are increased, there is a reduction in the amount of fodder required by the cow.

When is it economical to feed concentrates?

As shown above, it is economical to feed concentrates when the price of concentrates fed will cost less than the value of the extra milk likely to be produced; if the extra concentrates fed will not increase milk production, it will not be economical to feed them, unless one of the following conditions is involved:

- when the animal is recovering from illness or poor condition; the value of the animal is worth far more than the value of the concentrates fed.
- when the pregnant animal is being 'steamed up' (see below) two to three weeks prior to calving; these concentrates will pay off in additional milk later.
- when the young calf is being weaned of milk in a short period; a good start in life is recommended for all young calves and at least up to 6 months it is advisable to feed them some concentrates until they are growing well on grasses alone.
- when the bull is being heavily used, and needs some additional feeding.
- when for whatever reason, fodder is not available in sufficient amount to meet the basic maintenance requirements of livestock disaster prevention. In such instances it may be more economical to dispose of the livestock rather than to buy concentrates.

What are recommended levels of concentrates to feed?

Cows and lactating heifers should be fed concentrates (dairy meal) in the ratio of 1 kg concentrate per 2–3 litres of milk. Thus, for a cow to produce 10 lts of milk per day she should be fed 3–5 kgs concentrate per day using dairy meal. If using maize or wheat bran (which is not as good as dairy meal) increase the ratio by half a kg per 2 lts of milk (e.g., 1.5 kg per 2–3 lts of milk). A heifer in first lactation should be fed concentrate in a higher rate than other cows in order to allow

Cow type	Amount of fodder fed during Rainy season		Dry season	Together with (x) kgs Concentrated fed	
Large size cows	100 kgs	or	80 kgs	+	-0-
--	80 kgs	or	65 kgs	+	5 kgs
--	60 kgs	or	45 kgs	+	8 kgs
Small size cows	75 kgs	or	60 kgs	+	-0-
--	50 kgs	or	40 kgs	+	5 kgs
--	35 kgs	or	30 kgs	+	8 kgs

growth.

After calving the cow should always be fed a little more concentrates than her milk yield justifies in order to encourage milk production to rise during the first part of the lactation. This extra concentrate feeding should continue for about 3 weeks.

Why is it unwise to overfeed concentrates?

At a certain point an increased level of concentrates will only fatten the heifer or cow if she is already producing up to her physical ability. Over-fat dairy cattle frequently are problem breeders and may deposit fat in their udder tissues which physically can limit milk production ability. Farmers who feed their dairy cattle essentially a concentrate-based ration, as for swine, only end up having problems.

When is it most important to feed concentrates, if I cannot afford much? If necessary, reduce the use of concentrate feeding to only the time when it is most needed, i.e., during 'steaming-up' just before calving, for the first three or four months after calving, for young weaned calves, and for bringing sick cattle back into condition. After this, it is best to feed concentrates according to high milk production levels only.

What is the importance of 'steaming-up'?

'Steaming-up', the feeding of concentrates to the heifer or cow towards the very end of pregnancy, is important to give her very nutritious feed to gear up her body reserves and to help stimulate the development of milk-producing cells in the udder. Steaming-up usually is begun between 2 to 3 weeks before calving, beginning at a low level and slowly increasing daily to a maximum of 5 kgs per day at time of calving. If the pregnant animal is in poor condition she should begin receiving concentrates earlier, a month or more before calving.

How can I make my own dairy meal concentrate?

The makeup of a dairy concentrate is usually from three general types of ingredients: a high energy source such as brans of maize, rice, wheat, or other grains; a high protein source such as the oilseed cakes—cotton, copra, sunflower, sesame, rape, soy bean or others; and a mineral/salt mixture. Relative proportions are described below. You can obtain the general ingredients and do it yourself.

You might obtain a bonding agent with high energy molasses to improve the texture and palatability of the ration. If using molasses-urea mixture, take heed the amount you mix in will not exceed the recommended amount per day for any species of livestock.

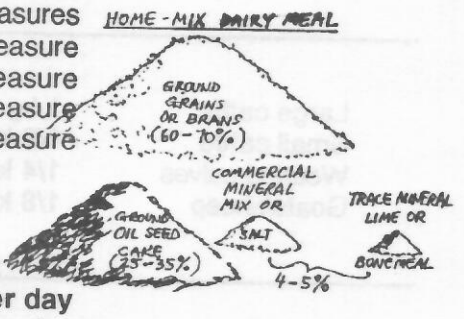
What are recommended mineral and salt levels?

The answer to this question depends on which theory is being pushed; experts do not agree! The daily supplementation of between 10gm–50gm of a mineral mix and an equal amount of salt may be adequate depending on size of animal and feeds being used. Higher amounts of minerals can be found in certain feeds. However 10 litres of milk contains about 100 gms of minerals. If the cow cannot get it from her feed, she will consume her natural reserves. Some farmers feed a powdered mineral mix, which includes salt, ad-lib, i.e., so that their cattle take as much as they want. It is unusual for any animal to consume more than it requires; although it may at first consume a high level, it usually balances off within a short period of time. Other farmers provide a mineral brick ad-lib which does not allow the animal to consume as much but does allow it full access. Others provide it only when expecting the visit of a livestock officer. It is recommended that you choose one of the ad-lib methods.

Ingredients for home-made dairy meal — **Propotions**

Brans (or milled, whole grains of maize, rice, wheat, oats)	3 measures
Oilseed cake (cotton, sunflower, sesame, copra, soy, rape)	1 measure
Trace mineral mix, such as super Maclik	1/10 measure
Regular ground salt	1/10 measure
Lime	1/10 measure

(& optional: add molasses to taste!)



This homemade dairy meal may be fed in the following amounts:

Type of livestock	Amount of concentrate fed per day
Weaned to two years old	not to exceed 2 kgs per day
Milking cow of 5–10 litres per day	not to exceed 4 kgs per day
Milking cow of 10–20 litres per day	from 5–8 kgs per day
Milking cow above 20 litres per day	ad lib, 10+ kgs per day

How can I make my own mineral mix?

If you can obtain ordinary salt, a good trace mineral mix, and lime, you can make your own cheaper mix, in equal proportions, and feed it from 20 to 100 gm per day to your cattle from young up to mature. If you cannot obtain these, another option is to mix deflourinated rock phosphate, well-ground bonemeal (steamed if possible), and salt (iodized if possible) which can also be mixed in equal proportions and fed in the same quantities as the previous mixture. A third alternative is to merely mix salt and bonemeal, and feed it as above recommended.

A fourth alternative which, is of less value, is wood ashes, bicarbonate of soda or unpurified soda from the soda lakes, lime and/or rock phosphate, and salt, all mixed in equal proportions and fed as above.

How should I use the molasses-urea mixture?

Molasses-urea mixture is a very high protein source (urea) with a good energy bonding agent (molasses). Only ruminants can utilize urea, non-protein nitrogen, as explained above, by the flora within their rumens. It is highly poisonous to other animals, and to ruminants if given in slightly excessive amounts. This underlines the importance of following directions with its use. The molasses urea mixture, if available, has a certain concentration which you should know, or at least the recommended feeding levels given by the livestock department, prior to using. The mixture presently available in Tanzania has several recommendations for feeding. It should be fed either using a licking wheel, or by pouring it over the fodder and mixing it so that it sticks to the fodder. You should not mix it with water which will allow some of the urea to be freed into the air and measuring intake will be more difficult. Be sure only to feed cattle at least two months past weaning, or only mature ruminants, at the following levels:

Large cattle	1 kg in the morning, I kg in the evening	=	total 2 kgs
Small cattle	1/2 kg in the morning, 1/2 kg in the evening	=	total I kg
Weaned calves	1/4 kg in the morning, 1/4 kg in the evening	=	total 1/2 kg
Goats/sheep	1/8 kg in the morning, 1/8 kg in the evening	=	total 1/4 kg

How can I make a molasses-urea-mineral block?

A molasses-urea-mineral block can be made easily and is an ideal way to supplement energy, protein and mineral levels which may be inadequate during certain times of the year. You may also add vitamins which may be in short supply when no green fodder is available. A mature cow ideally should consume up to half a kilogram of the brick per day, but seldom will consume that much, although the method you use may encourage her to consume more. It is important to use fine milled bran so that it will not chaff her tongue, and the block should be hard enough that it will not ooze, as then it tends to be wasted. It is important not to increase the relative amounts of urea or cement, because the former can be poisonous in higher amounts, and the latter will cause the block to be too hard to consume. It should be placed in a special box so that it cannot be pushed around; it should not be hung as it will tend to be broken and wasted by the playful activity of the cattle. It should not be fed to calves until after they are weaned when their stomachs have developed and begin ruminating. The method of preparation is as follows:

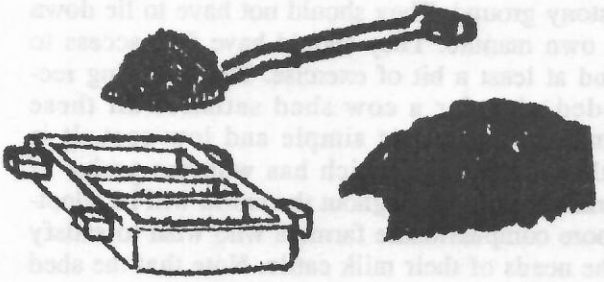
Obtain the necessary ingredients in the following ratios by weight, **not** volume; an example measurement is provided; **use scales**, not volume measurements. Prepare the forms in advance for the quantity of blocks you will be making.

Molasses reduces the binding capacity of the cement so increase water from 1%–3% if the mix is too dry (1–3 kgs in the example). First weigh out the molasses, then mix the urea into it until it is completely dissolved. Then add the bonemeal (or mineral mixture), salt, (vitamins), cement (benzonite) and mix it uniformly. Finally, add the finely ground wheat bran or rice polish, mix it well and pour it into (wooden) frames. The 100 kgs example should make 30 blocks of 3.3 kgs each measur-

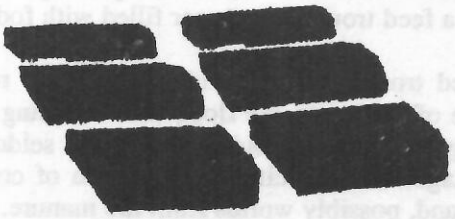
MOLASSES–UREA–MINERAL BLOCK RECIPE:

Ingredients	Ratio	For example
Molasses	32–40%	35 kgs
Urea	not to exceed 15%	15 kgs
Bone meal or mineral mix	2%	2 kgs
Salt with/without vitamins	5%	5 kgs
Cement or bentonite	not to exceed 13%	l3 kgs
Fine ground wheat or rice polish	25–33%	30 kgs
Total ingredients	100%	100 kgs

ing 10cm x 20 cm x 6 cm. It is best to dry for 2–3 days before beginning to use. If this is to be made commercially it may be wise to invest in a machine mixer, as it is important to mix the ingredients well, especially the urea into the molasses. If available, bentonite should be used instead of cement because it binds better.



Mix well ingredients as for concrete, and pack well in mold.



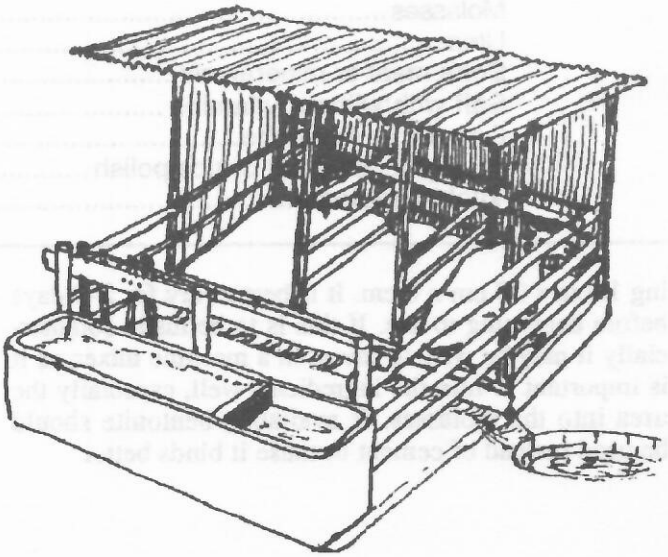
One brick of 10 kgs. will last one cow for 2 weeks.

Always feed together with other feeds.

BUILDINGS:

What is appropriate housing for dairy cattle?

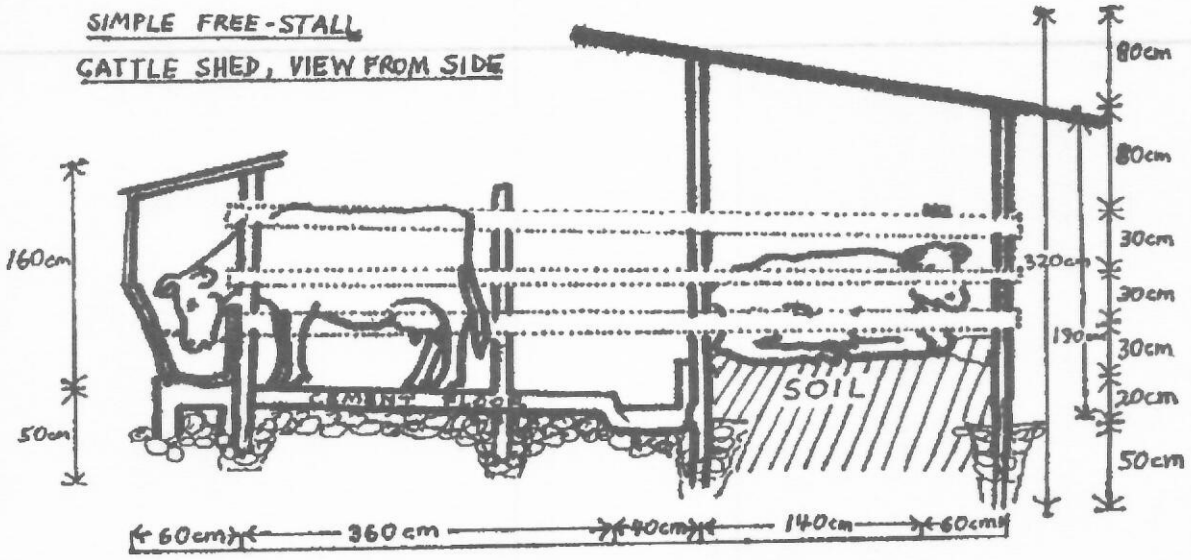
"Prepare thy work without, and make it fit for thyself in the field; and afterwards build thine house." Prov.24:27

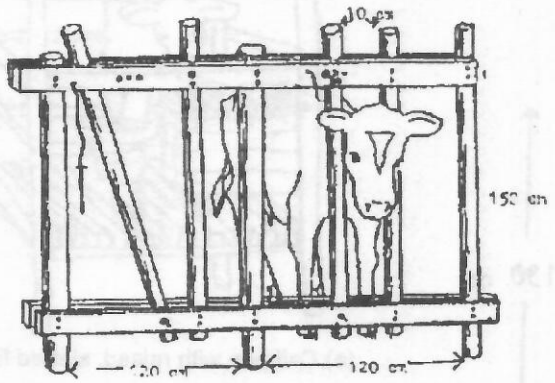


How should I construct the cowshed?

The simplest shed for cattle should have a firm place where they can stand comfortably while eating, and a dry protected place where they are able to lie down in comfort. They should not have to stand for prolonged periods in mud or their own manure, nor should they stand on sharp stones, slippery surfaces, nor very rough, stony ground. They should not have to lie down in their own manure. They should have free access to water and at least a bit of exercise. The following recommended plan for a cow shed satisfies all these requirements, and yet is simple and low cost. It is hoped that this design which has won the praise of many small farmers throughout the world will be adopted by more compassionate farmers who wish to satisfy better the needs of their milk cattle. Note that the shed is large enough for cattle to move within it freely from one area to the other;, has partitioned resting areas enough for all to rest at once; has adequate, permanent water; and a feed trough or manger filled with fodder at all times.

The feed trough has sides high enough to restrict the spillage of feed onto the floor, thus reducing costly feed wastage to the smallholder farmer who seldom can afford wastage, and reducing the ingestion of contaminated feed and, possibly worms from the manure. There is separation of different sizes of livestock so that they will not hurt each other. A part of the shed is open to allow sunlight to enter and provides adequate ventilation. The resting area is sufficiently roofed so that it remains dry. The shed is adequately enclosed to prevent other livestock, pets, and, possibly in some areas, wild predators, from entering. It must also be unattractive to thieves. The resting area need not have a cement floor; the cattle will rest more comfortably on a soil bed. It should be raised about 15 cm above the level of the floor of the eating area to prevent any manure or urine there from dirtying the resting area; this raised bed also discourages the cow from backing in to lie down, and thus helps to maintain the bed clean and dry. These beds should be divided into cubicles of 1–1.2





metres wide by 1.5–2 metres long, depending on whether for small or large size breeds to keep your mature livestock from disturbing each other when they are resting and to keep them clean. They will usually enter the bed head first if it is constructed according to the plan. A pole is fixed 60 cm from the wall and 1 metre high which causes the cow to move backwards when standing up, thus causing the bulk of manure and urine to land on the floor of the eating area, keeping the resting area clean and dry. The resting area must be narrow enough so that the cow cannot turn around within it, but wide enough so she may lie down. In this case, bigger is not better.

The eating area can be in the open air with only enough shade required to protect the manger from the sun and rain. If you can afford it, the eating area should have a concrete floor where the cattle walk, not too smooth to cause slipping but smooth enough to aid in cleaning. This will lend itself easily to biogas construction.

Make sure that the floor is nearly level with only a slight slope backwards away from the manger. This way the liquid manure can drain off into a biogas digester or into a collection hole dug into the ground outside the shed where it can be mixed and brought later to the grass plots or fields.

Lining this hole with cement or a cut-off half metal drum enables you to prevent loss of any of the urine or manure before it is carried as a slurry to your fields. This slurry can best be incorporated into your soil or buried near your grasses or crops to give them an excellent boost. You may prefer to collect the dung separately, compost it, and use this collection hole solely for urine collection.

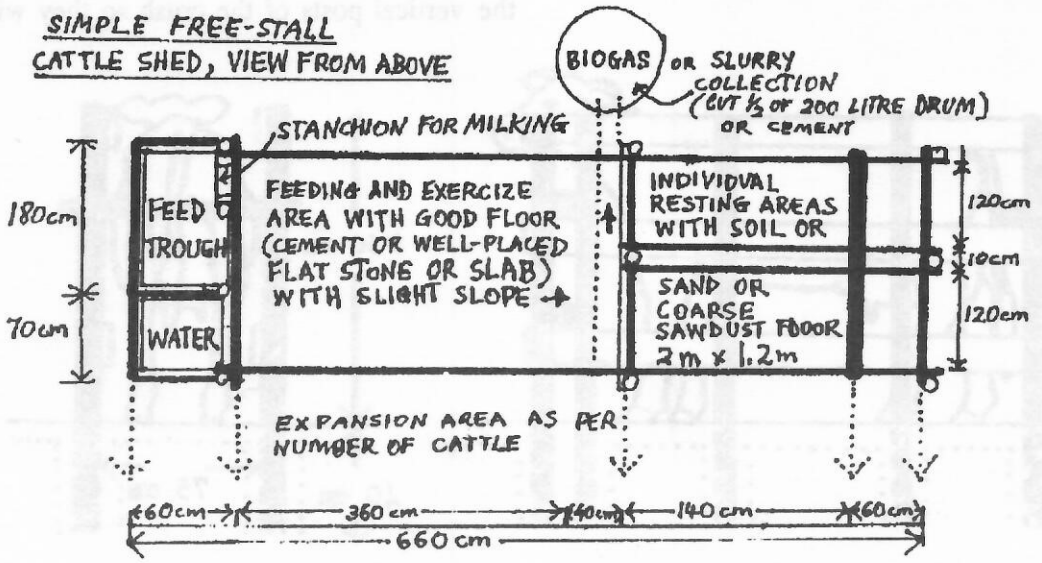
The feeding area should contain a manger or eating trough not under 2 metres by 0.5 metre by 0.5 metre per adult cow. Divide it so that there is a small area 40 cm x 50 cm for concentrates and another little box for a mineral lick. The cow should be able to drink whenever it wishes which means you should build a permanent water trough near to the manger, or make a kind of raised holder for a large water bucket or cut-off drum so that the cow cannot spill or contaminate the water.

You may wish to build a stanchion by which to tie the cow for milking or simple treatments. This is normally at the feed trough, and can use simple materials and design as the picture shows.

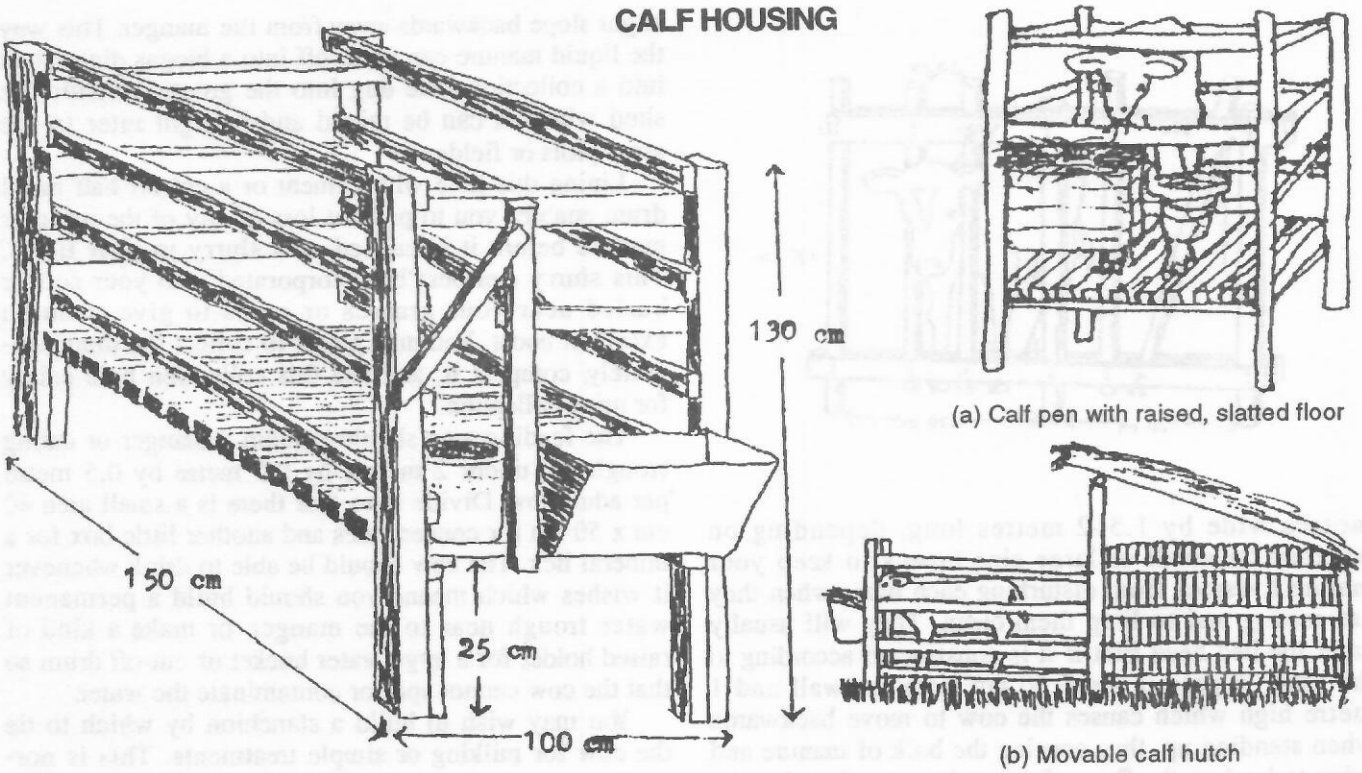
The progressive dairy farmer will also construct a milkroom in which to store milking utensils in a clean place, a feed store in which concentrate feeds can be stored, and a separate shed or structure in which to store hay and stover near to the cattle shed.

How should I construct a calf shed?

The following designs are recommended for keeping calves in a clean environment to reduce the problems of pneumonia, scours, and worms, the three most common causes of calf losses. Note that in both structures water



CALF HOUSING



(a) Calf pen with raised, slatted floor

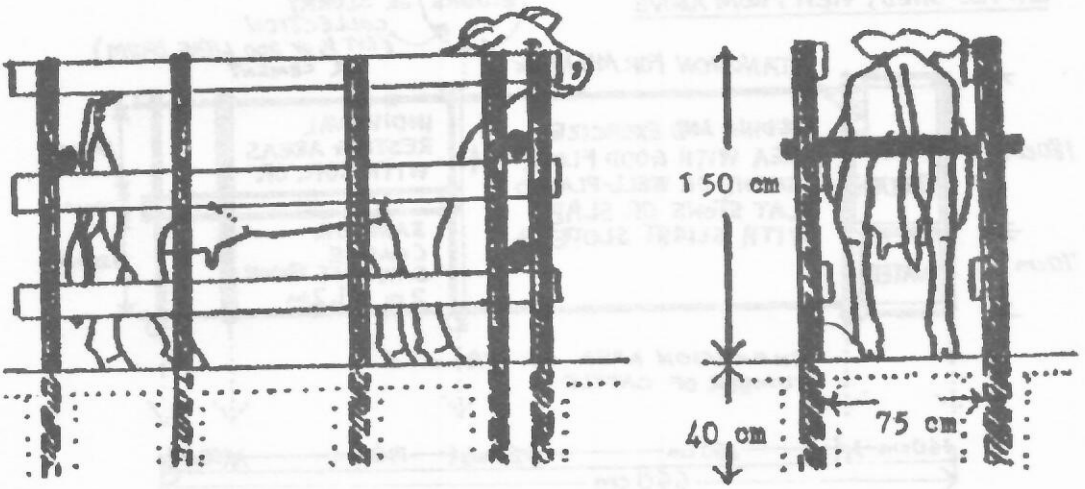
(b) Movable calf hutch

is available free-choice, and a trough is constructed to enable the calf to eat clean feed at all times. In the raised, slatted floor design, the calf has the added advantage of not lying in its own manure and urine; however this structure is quite open and needs to be housed under a larger shed. The portable design is self-contained and may be moved around to encourage a clean place for the calf to walk and rest.

A crush is also a necessity for the smallholder, and separate storage areas for feeds and dairy equipment are eventually required for the serious dairy farmer.

How should I construct a cattle crush?

A cattle crush enables the farmer and livestock attendant to handle a cow or bull easily for vaccinations, treatments, examinations and spraying against ticks. It is commonly built too wide, providing too much room for the animal to move about, encouraging it to struggle or attempt to jump over the sides. It should not be too short or too low. By following the recommended measurements and design it will function well for all classes of cattle. Always build a crush with the vertical posts well placed, deep in the ground or cemented into the ground, and attach the horizontal poles to the inside of the vertical posts of the crush so they will withstand



the pushing of the animal. Short poles can serve as gates to prevent the cattle from moving forward or backward inside the crush.

What if I want to obtain a biogas plant?

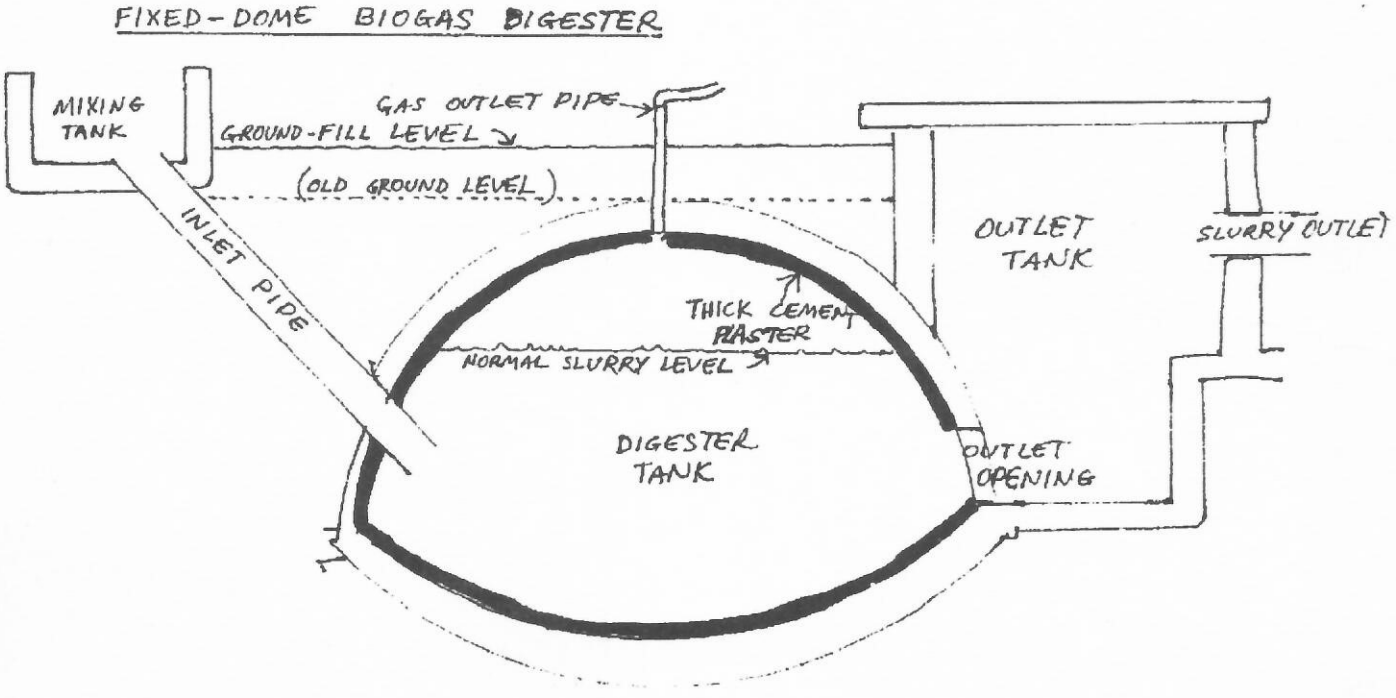
Although it is beyond the scope of this booklet to train a farmer how to build a biogas plant, this information might encourage a farmer to seek the necessary assistance to invest in this extremely useful structure to improve home life and the environment using a renewable resource. As few as two cattle are adequate for a 1 cubic metre digester which can provide for household cooking and lighting needs for a family of four. The initial investment is the major constraint to acquiring a biogas plant, and careful plant management can help to maximize its effectiveness. The following information will help a farmer to reduce costs and increase output of a biogas plant, which includes the cattle shed, a digester and appliances which use the gas:

(i) Plant selection: It is important to build the size of the plant according to (a) the quantity of dung available and (b) the needs of a household. A 2–3 cu. metre digester will be adequate for a family of 5–8 household members, requiring 3–4 cattle. It is important to select a plant design with maximum efficiency and least cost; for this reason the preferred type is usually the fixed dome plant as per the following design. The actual size of the plant is not given in the drawing because this depends on the family's requirements but the design remains the same.

(ii) Plant placement: The digester should be placed near to the cattle shed and also near to the kitchen for best efficiency. It should be built in the open where heat from the sun will assist more rapid fermentation.

(iii) Plant construction/installation: An improved cattle shed needs to be constructed which will enable easy collection of dung and urine to be mixed with water. It is important that the design prevents other materials such as straw, unconsumed feeds, and soil from being mixed with the dung because the digestor should not be filled with such non-fermenting solids. Ensure a proper digester foundation is built, and pack earth adequately around the outside of the digester to reinforce its sides and top to prevent damage to it. Follow the plan especially with regard to materials; do not skimp on the use of cement or necessary fittings! If possible, use plastic or stainless steel pipeline which will not corrode, and bury it so that it will not be damaged by sunlight or weather. Use good quality appliances for which the flames can be adjusted to be an optimum blue color for burners or white color for lighting. An appliance should not be placed in a windy place to maximize its effectiveness. The outlet tank should be adequately covered to prevent accident, and the slurry should be free to flow out to garden or compost tanks for future use.

(iv) Plant utilization: Ensure that the slurry when added is free from soil and straw with a proper dilution of 4 parts manure to 5 parts urine and water, and well mixed. It is important to add ade-



quate slurry periodically although not necessarily daily. The fermentation needs three conditions to be efficient: lack of air (anaerobic), warm temperature, and not constant mixing. However, weekly stirring of the slurry within the digester helps to create even fermentation of all the contents and prevents formation of a crust on top which actually inhibits gas formation.

Make prior preparations before lighting the gas burner to save gas wastages. Open the gas regulator to light only after a match has been lit, and adjust the air regulator of a burner to get a proper blue color and lamp to a white color. Clean burners and lamps periodically and check for leakages, repairing or replacing non-working parts. With careful use it may not be necessary to empty the digester until four to five years have passed in order to remove accumulated soil and sand which inevitably may enter it. When this is done, it can be refilled immediately and use resumed.

DRY COWS:

How should I keep dry cows?

How and when should I dry off the milking cow?

Dry periods in the subtropics/tropics tend to be longer due to short lactations. A cow should be confirmed pregnant prior to drying her off, if at all possible, to avoid the unhappy chance of her not being pregnant. It would be hard to cause her to begin milking again after drying her off without her first calving again. For limited-resource farmers it is usually more economical to continue to milk cows which are late to conceive up until they are two months away from calving, unless the milk is no longer satisfactory in quality or amount. In case the milking cow which should be dried off is giving a considerable amount of milk still, she can be gradually dried off over one week by either milking her out once per day or only milking her out partially to relieve pressure within the udder if necessary. If the cow is giving less than 5 litres per day there is seldom reason not to dry her off immediately when the time comes for her two month rest to begin.

Often limited-resource farmers are tempted to continue to milk their cows up until just before calving. This is a big mistake to make because for the small, immediate benefit rendered, a more significant loss in milk production during the next lactation will be suffered. Do not fail to let your dry cows rest for two full months (60 days) prior to their next calving date! If the cow does not have a dry period between lactations its subsequent yield will be reduced. The dry period allows the udder to rest and the cow to become strong again, to build up a body reserve ready for the next lactation.

A first-calf heifer should be given a longer dry period than a cow to enable her to grow; up to a 90-day dry period is advisable. Cows in poor condition and undersized heifers also should be given longer dry periods.

How should I feed the dry cow?

During the dry period the cow should be well, but not lavishly, fed. Nutritional stress will be at a minimum at this period of her life so that she does not have to be challenge-fed as does a milking cow, provided that she is in good condition. Overfeeding of minerals at this time is not wise. She should not require any concentrates until she is "steamed up" two weeks before calving. Observation is the key: if she is not in good condition she should receive improved fodder, concentrates, and minerals during her dry period to enable her to give birth to a strong healthy calf, withstand post-calving problems, and have reserves to enable her to produce lots of milk.

HEIFERS:

How should I keep heifers?

How should I feed heifers?

Heifers should be provided with good quality fodder or hay, adequate clean water, salt and minerals, and concentrates during the first six months, two months prior to calving and whenever other feeds are scarce.

The danger of low-level feeding of immature heifers is most critical during the first six months of life, and the last two months before calving. If heifers are underfed during the growing period, weaknesses are often created. These eventually tend to reduce milk production potential and lead to problems if the heifers are subjected to any serious stress. Such stress is undergone when they become ill, produce calves, or begin to produce milk. They differ in their ability to recover to their full potential size and weight after a period of low-level feeding. The longer the animal is underfed, the less likely it is to recover in size, and the longer such recovery will take, if at all. It is better to keep a few, one or two, well kept cattle than several kept poorly.

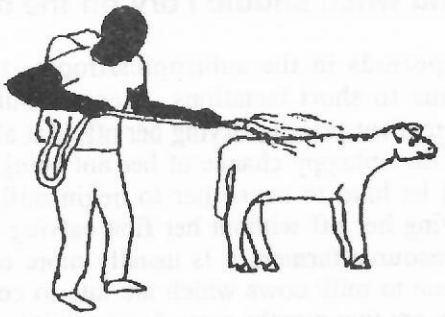
Growth rates are governed primarily by the quantity and quality of feeds which the young heifer receives, but the ultimate size is primarily genetically controlled. Poor feeding, therefore, does not affect her ultimate size so much as it affects the time required to reach maturity. However, size CAN be permanently reduced by severe underfeeding at an early age. A poorly fed heifer will appear 'leggy' and shallow-bodied with a small pelvis and narrow, lean frame. She may tend toward infertility and have difficulty in future calving.

What about their health care?

They should be frequently observed. They should be receiving tick control, periodically dewormed and if possible, you should adhere to a strict vaccination regime as described in the back of this book.

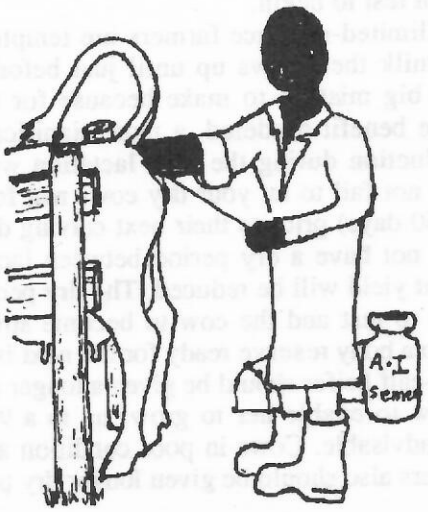
When should heifers be bred?

A purebred exotic heifer can grow large enough to be bred at the age of 18 months under good management. Crossbred heifers tend to take longer, as well as poorly grown heifers. Recommended age at mating thus depends on the way heifers are raised and their breed type. Breeding weights recommended for various breeds of dairy cattle are as follows:



Weekly spraying calf against ticks

It is sometimes recommended to use bulls from smaller breeds on heifers of any breed to avoid calving difficulties for the first time. Subsequent breedings can be done within the breeds in order to develop pure lines of cattle.



Artificial insemination to obtain superior offspring

What else should I do until they calve?

Pregnancy checking of heifers is wise, just as with mature cows. Observation for repeated heats is very important, just as keeping records of breeding dates. As explained above, 2–3 months prior to calving they

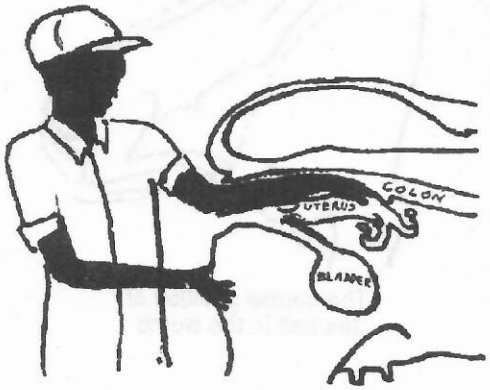
Friesians, Friesian-Boran crosses, Brown Swiss	300 kgs
Ayrshires, Guernseys, Sahiwal, Friesian-Zebu crosses	275 kgs
Jerseys, Crosses of smaller breeds	250 kgs

should receive improved fodder, and 'steamed-up' with concentrates beginning one month prior to calving to ensure a healthy calf, to be able to withstand disease, and to induce milk letdown leading to increased milk production later.

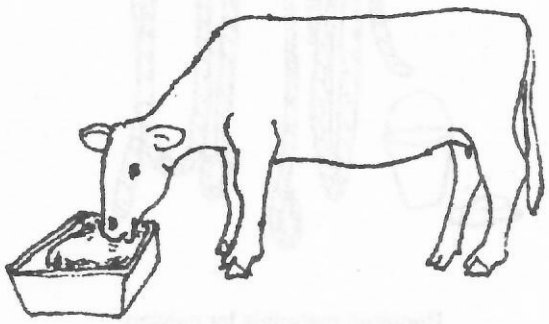
A clean, dry place should be prepared for the pregnant animal prior to calving, where she can be watched but not easily disturbed, where the calf can be born into a clean environment.

Should I pre-milk?

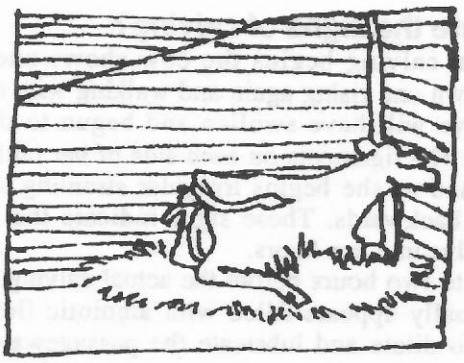
Pre-milking is not recommended. Gently stroking the heifer's udder starting a few weeks prior to calving is a good way to accustom her to the touch of human hands. If you do not do it, you may find she becomes very nervous when you begin milking her after calving and she may kick. However, you must not squeeze the teats which are sealed with a natural plug which prevents bacteria from entering into the udder. When you begin milking, you remove this plug, and once you have begun milking, you must continue or risk mastitis. If you begin milking before the calf is born, there will be no collustrum, the important first milk for the calf when it is finally born. Pre-milking is advisable only in extreme cases of udder swelling close to calving time.



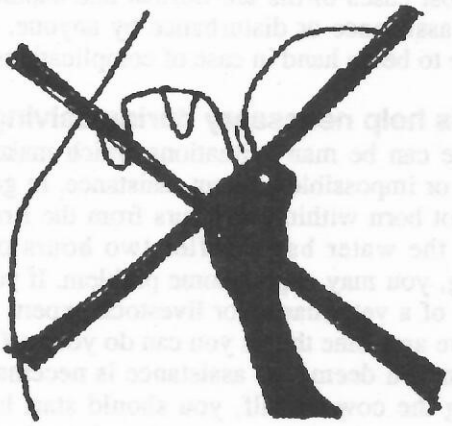
Pregnancy check for improved breeding efficiency.



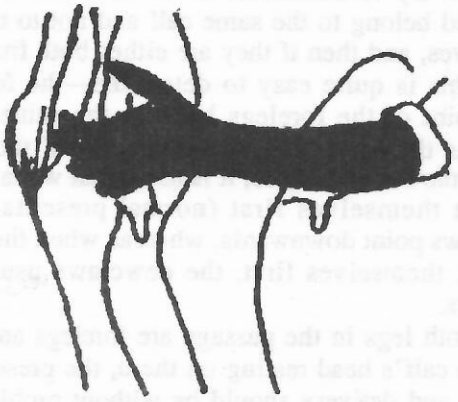
Steaming-up dry cows and heifers prior to calving



A clean, bedded place indoors for safe calving



Do NOT pre-milk



Accustom the pregnant animal to being handled

CALVING:

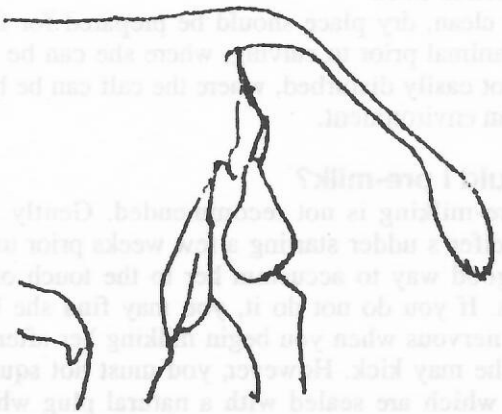
What should I expect at calving time?

What are the signs of calving?

When calving begins the cow shows uneasiness, lying down and rising again and walking with difficulty. Her vulva will have swollen and begun to discharge mucous. The ligaments on each side of her tailhead will loosen and as she begins irregular straining she often glances backwards. These signs indicate that she will likely calve in a few hours.

One to two hours before the actual calving, a 'water bag' usually appears filled with amniotic fluid which assists to dilate and lubricate the passageway through which the calf will pass. During a normal, unassisted calving two feet should appear before two hours have passed since the water bag appeared, followed by the nose, and within one hour the whole head. Within minutes the shoulders and finally the entire calf will quickly be thrust out.

In most cases births are normal and should proceed without assistance or disturbance by anyone. However, it is wise to be on hand in case of complications.



Appearance of 'water bag' of amniotic fluid indicates calving has begun.

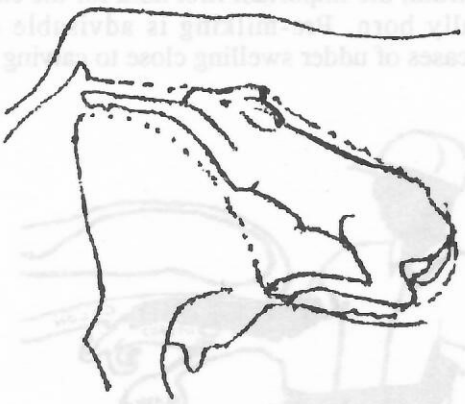
When is help necessary during calving?

There can be many situations which make calvings difficult or impossible without assistance. In general if a calf is not born within two hours from the first appearance of the water bag or after two hours of regular straining, you may expect some problem. If you can get the help of a veterinarian or livestock expert, seek it. If not, there are some things you can do yourself.

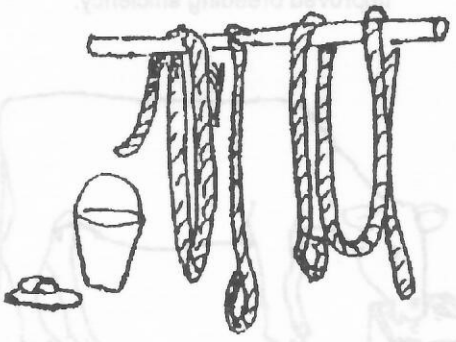
When you deem that assistance is necessary, before touching the cow or calf, you should start by making sure that your hands, arms, and assistant's hands are clean and fingernails cut short. Try to avoid infection by using clean, washed ropes or calving chains, lubricated with plenty of soap or disinfectant.

Then try to determine if the feet that might have appeared belong to the same calf and not to two different calves, and then if they are either both front or rear feet. This is quite easy to determine—the fetlock and knee joint of the forelegs bend in the same direction whereas the hocks of the hindlegs bend the opposite way to the fetlocks. Also, it is usual that when front legs present themselves first (normal presentation), the dewclaws point downwards, whereas when the rear legs present themselves first, the dewclaws usually point upwards.

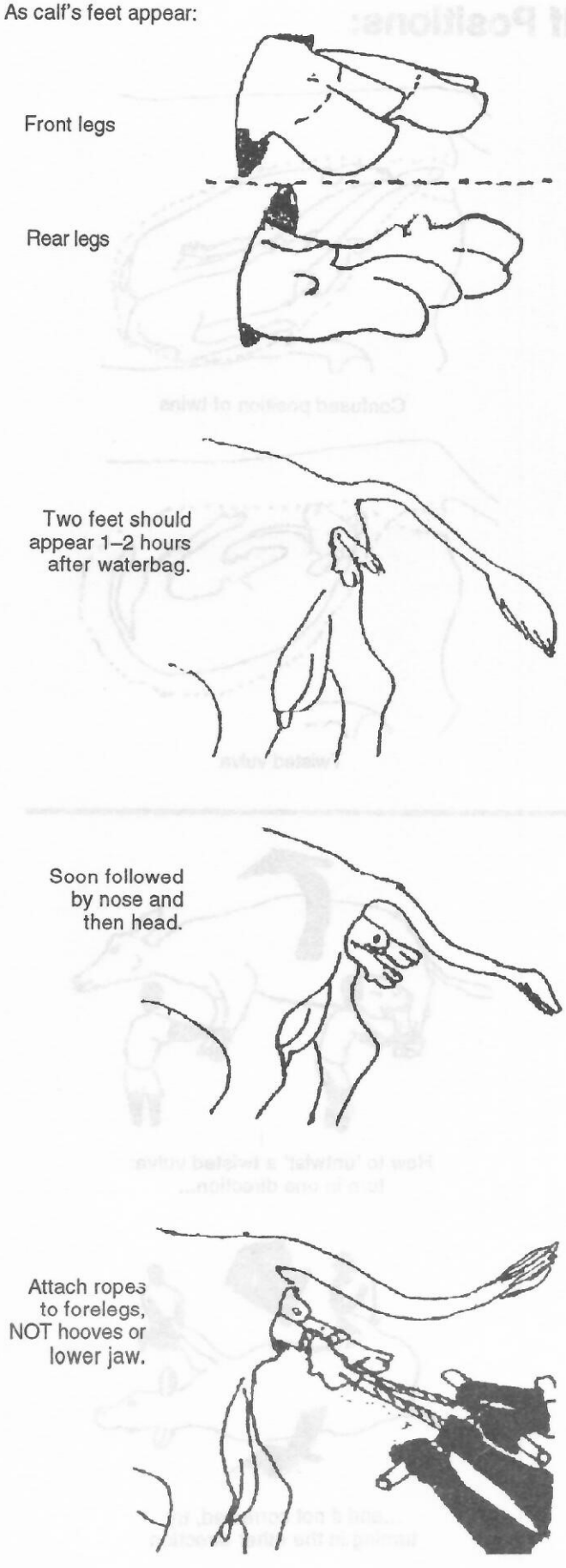
If both legs in the passage are forelegs and you can feel the calf's head resting on them, the presentation is normal and delivery should be without problem unless the calf is too big. If the cow still cannot deliver by itself you can assist by applying ropes or calving chains onto the two feet above the dewclaws, never to the mouth or jaw. Begin by pulling straight backward and downward,



The normal position of the calf in the womb



Required materials for calving assistance: soap, water and ropes



so as not to injure her, engaging the mother in the rhythm by which she is straining until you pull out the calf. Once the shoulders are brought through it is usually simple to pull out the rest, aided by twisting the body one quarter turn before resuming to pull. Any pulling of the calf, unless the cow is exhausted and has stopped straining, should be in rhythm with the natural contractions of the cow. However, it is important when assisting a cow to get the calf out fast. Once it is partly out, any prolonged time in the birth canal restricts blood circulation and may eventually cause postcalving paralysis to the cow and possible strangulation to the calf by reduced oxygen supply from a pinched umbilical cord.

Perhaps the most common problem is when one or both of the forelegs are back. In this case the head has to be pushed back inside to allow the legs to be drawn up to the vaginal opening. When the legs are lifted within the womb, care should be taken not to scrape the uterine wall with the hoof. To do this, cup your hand over each hoof as you raise it. Then calving can proceed normally.

If the head is twisted backwards to either side, it must be pulled around before the legs can be pulled. It is often necessary to return the legs inside the cow again in order to do this. One surprisingly effective method to bring the head around is to put your index finger into the eye socket of the calf to pull it around straight. Be careful when trying to pull the head straight by the jaw; the calf's teeth are sharp as razor-blades!

A common presentation is when the hindlegs come out first, for which the cow may be able to give birth alone, unassisted. If assistance is necessary, some livestock attendants prefer to turn the calf around within the womb, but many succeed by pulling the calf out backwards, taking care not to be too long about it because the calf's oxygen supply will have been cut off earlier by the pinching of the umbilical cord.

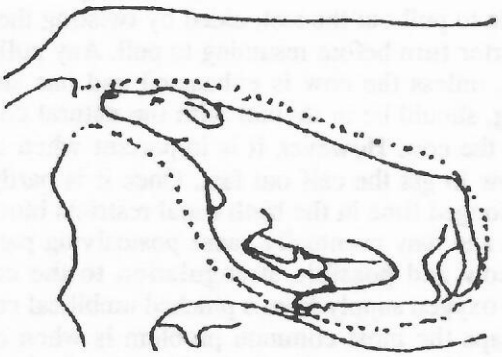
Another, less common, presentation is when the tail/rear of the calf is at the opening, when it will be necessary to reposition the calf by completely turning it around within the womb into the correct position.

A not-so-common presentation is when the entire reproductive tract has twisted, which requires some careful examination to determine; if you cannot insert your hand far beyond the vulva and no sign of a calf or 'water bag' has shown, this may be the case. As shown in the drawings, try to steady the uterus, and turn the cow over completely sideways to 'un-twist' it. If you discover it has become worse, try to twist it in the opposite direction, until the passageway becomes open.

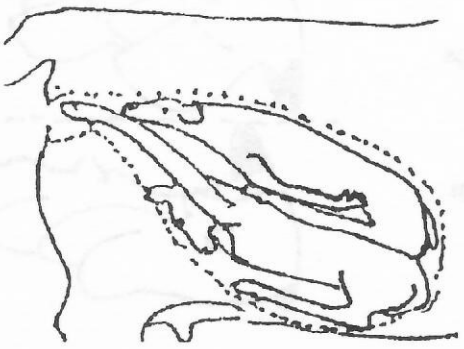
As a general rule, it is necessary with any abnormal presentation that the calf is turned about so as to be born in a normal position.

If you cannot get qualified help, try to do it yourself, for a cow or calf saved is a milk factory saved. Generally priority is given to saving the mother cow compared to

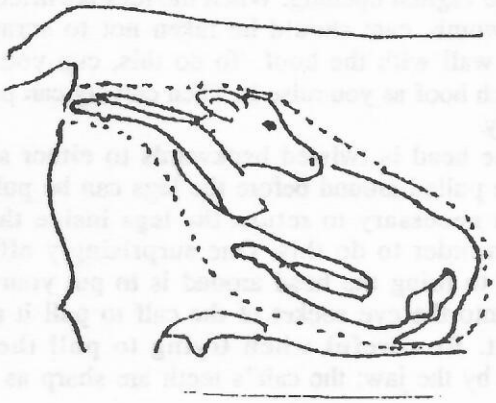
Abnormal Calf Positions:



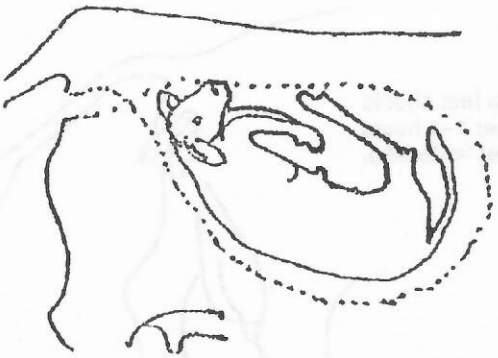
Forelegs back



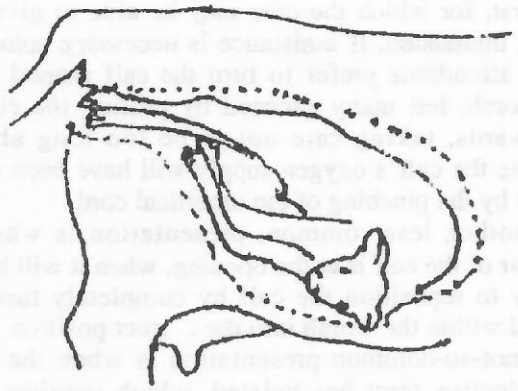
Confused position of twins



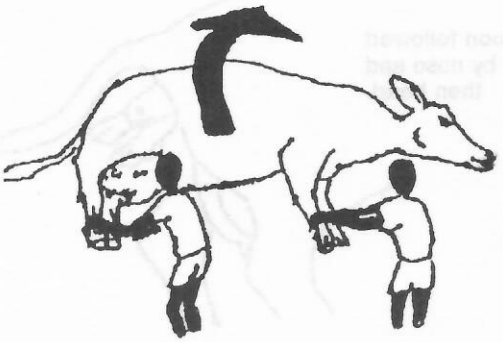
Head turned back



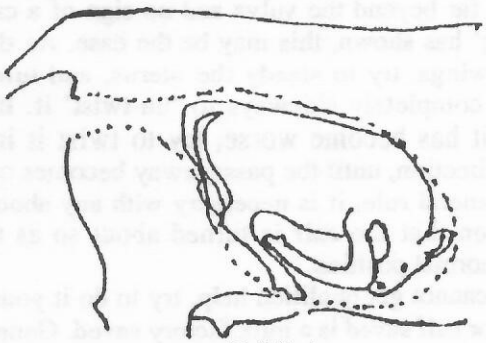
Twisted vulva



Hind legs first



How to 'untwist' a twisted vulva:
turn in one direction...



Tail first

...and if not corrected, try
turning in the other direction

the calf. At times it is necessary to open the cow's flank (Caesarean section) in order to remove an enormous or abnormal calf. At other times it may be necessary to remove a dead calf or rotten or mummified calf by pieces. These operations should be performed by qualified veterinary staff.

Whenever help is given to a cow giving birth, it is good to remember to do the following:

(1) Use plenty of soap, warm water and antiseptic; use clean hands, arms and tools. If the cow's vulva has dried out after time, lubricate it anew with clean warm water and soap.
(2) Avoid injury to the cow by placing ropes so that no chaffing occurs when pulling, cutting fingernails, cupping the hand over hooves and jaw of the calf when straightening it within the cow, and not using excess force to pull the calf before it is surely oriented in the normal position.
(3) When help is needed, not too much time should lapse before help is given. Get the calf out as soon as possible and get the cow up immediately after birth so as to avoid calving paralysis.
(4) Whenever hands or ropes have been inserted into the cow, she should be treated with antibiotic pessaries or injection to avoid infections later.

What if the calf is not breathing?

As soon as the calf is born, the pieces of afterbirth must be removed from the nose and mouth of the calf, and the tongue pulled forward, making sure that the calf can breath normally. If it does not, you may try splashing a bucket of cold water over the calf's body or slapping its sides or shouting into its ears. If the calf still does not start breathing, the chest walls should be alternately impressed and relaxed, lifting the shoulder and bent leg up and down, compressing the thorax firmly and then releasing. Or you may try to lift the calf by the rear legs and swing it about in a circle to help to expel fluids from the lungs and stimulate breathing. This may be followed by mouth-to-nose resuscitation, blowing into one nostril after having clamped shut the mouth and the other nostril. There is not much time to act; time is critical, and your opportunities to revive a calf are very limited. Do not give up without trying them all. A calf saved is a potential milk factory saved.

What do I do after calving is completed?

If the navel cord does not sever naturally it will require cutting. Simply cut the cord with a sharp, clean knife or new razorblade, about three or four inches from the calf's body. Then tie it about an inch from the body with a piece of thin thread which has been soaked in disinfectant or boiled. It is always advisable to treat the naval cord with iodine solution to prevent entry of bacteria into the calf prior to the drying up of the cord.

Once the calf has been born, its mother will usually want to lick it dry. Let her do so; the rough action of her tongue will stimulate circulation in the calf and the licking will dry its coat. If the cow fails to lick the calf dry, you can entice her to do so by sprinkling a handful of concentrate over the calf.

If she will not or cannot get up, help her up one way or another. It sometimes induces her to get up by placing the calf out in front of her or briefly removing it from her.

What if there is a retained afterbirth?

The afterbirth or placenta inside which the calf has developed is normally expelled soon after calving, by contractions of the womb which squeeze out its contents including any fluids left behind. The afterbirth may be discharged within a short time, in which case all should be well. You should not let the cow eat the afterbirth without first cutting it into pieces; it may choke her. It is of questionable benefit to her, containing minerals, blood and protein, but not very digestible.

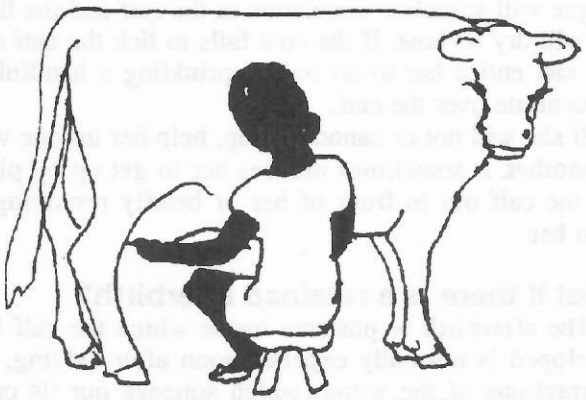
If it remains inside the cow or hangs partially outside, it may be necessary to seek help for its removal. Should the afterbirth hang from the cow down to the floor, tie up all that extends below the hocks so that it will not drag on the ground. Do not hang bricks or sticks on it as they may get caught up and cause it to tear away too soon. Various recommendations are given; you may desire that it be removed soon after calving by qualified livestock staff. However, it may hang for up to three days before being discharged by itself; thus assistance may be withheld for three days without causing serious problems.

If it goes beyond this period you should call for assistance. **Do not** try to remove it yourself. The livestock officer normally attempts to remove it entirely and place a large pill (pessary) in the womb to help clear up any infection that may have occurred.

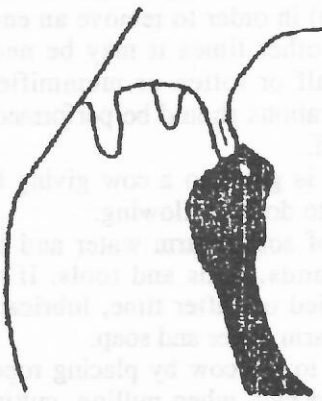
What do I do if there is a prolapsed uterus?

Sometimes after a difficult calving certain cows continue to strain to expel the contents of the womb, and in so doing expel part of or the entire inverted womb. This occurs more often when the cow is not lying on level ground during calving, but certain cows are predisposed to doing this. If the prolapsed uterus is not returned inside the cow within a short time and in a sanitary manner, her life is in danger; she may die of shock within a few hours. If qualified help is available, it should be sought. If not, you had better attempt to save the animal during the short time you have to act. If the cow can still stand, it is easier because it reduces her constant straining; if she cannot stand, place her facing downhill or lift her hind-end onto straw, pulling her backlegs backward to raise her slightly.

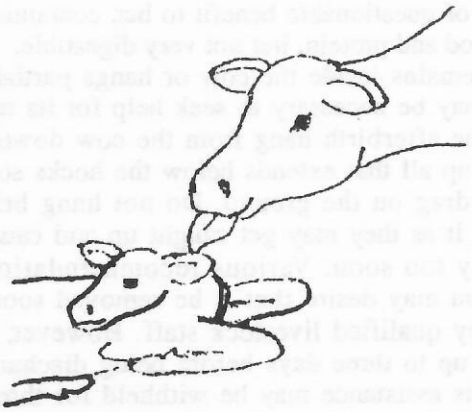
The inverted uterus should be cleansed with abundant, **cold**, clean water; if it has swollen much, the swelling can be rapidly reduced by soaking it in a sugar-water solution. Then it should be pushed back



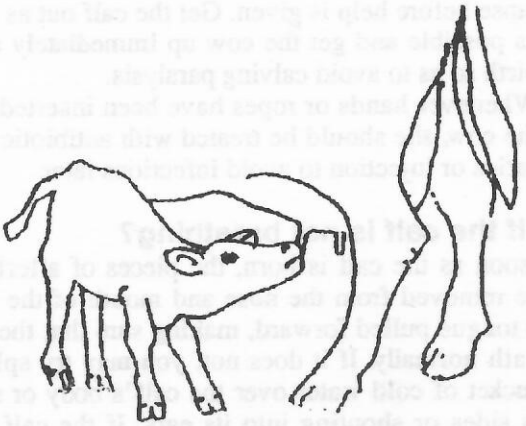
When beginning to milk, if possible, train cow to be milked without tying legs.



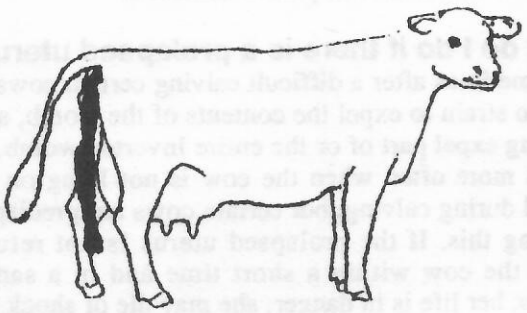
Milk using correct technique; do NOT pull the teats or strip milk as this produces scars within teats causing future problems.



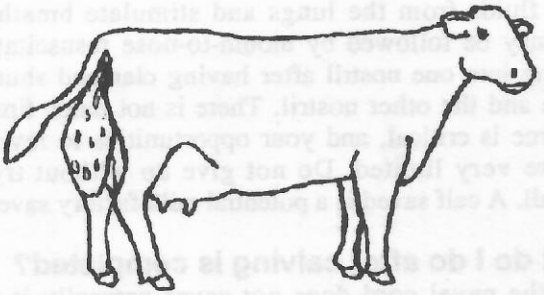
Encourage the cow to lick the calf clean.



Encourage the calf to suckle the cow within two hours after birth to obtain maximum benefit from the collostrum.



The retained placenta may be treated immediately or up to three days after giving birth if it has not already been expelled. If a pussy liquid continues to be discharged after two weeks, a follow-up antibiotic treatment should be given.



In contrast, the prolapsed uterus MUST be treated immediately; after cleansing it with cool water, apply 1kg. white sugar to reduce swelling, if necessary. Replace it, taking care not to tear or leave any part of it still inverted. Orient the cow with the head downhill, and distract it from further straining by tying ropes or suturing to hinder straining.

inside the cow a little at a time until it is completely inverted, with care not to cut or damage it. Try not to return any of the afterbirth inside if it can be helped. This operation should be followed by antibiotic treatment to prevent or treat any infections which may have been introduced. If the operation is done early on, the womb will not have had time to swell, and will be less difficult to perform. If the cow continues to strain, which is common, try to keep her on her feet, or headed downhill, or you may tie ropes from her neck underneath her legs, up by her tailhead, and back to her neck, tying several knots near the vulva to prevent her from pushing.

Another method used to prevent her from continuing to push is to sew the vulva closed, but that should be performed by a qualified livestock officer. Ways to prevent this occurrence are to rest the cow in a level place while calving, and to get the cow up immediately after calving unless it is obvious twins are being born. This also helps to reduce the likelihood of calving paralysis, a condition where trauma during calving causes paralysis of the rear legs.

What do I do if the cow cannot stand?

For various, common reasons, cattle become unable to stand. Five common causes are here mentioned, and cures which sometimes work. As first aid to all five conditions, the recumbent animal needs to be turned from one side to the other while it recuperates, as well as isolation, and tender loving care.

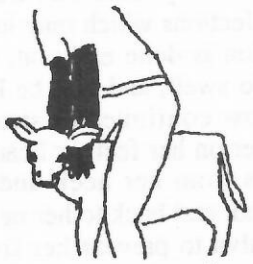
Condition	Cause/symptoms of recumbency	Treatment/Preventions
'Milk fever'	Calcium metabolism problems, usually occurs soon after calving, lays her head back on shoulder; death within a few hours unless treated, then recovery immediate	Discontinue milking until recovery; Calcium intravenous when symptoms occur usually once enough
Ketosis	Carbohydrate metabolism problems, cow becomes weak and wasting away soon after calving; usually occurs with highest producing cows or cows which are too fat	Glucose intravenous repeatedly until recovery; adequate concentrates fed to milking cows
	(If you cannot tell whether it is 'milk fever' or ketosis, you can treat with calcium borogluconate which treats both conditions.)	
Obturator nerve paralysis	Often occurs before calving in underfed cattle, as pressure of fetus pinches nerve causing paralysis	Continue to keep cow turned from side; no treatment but some cows recover
Calving paralysis	Occurs during difficult calving, or afterward by trauma and obstructed circulation in legs	Try to exercise legs, and get cow up by lifting and support
General weakness	Emaciation, weakness caused by poor feeding management or by another disease, worms	Improved feeding, treatment of disease

CALF CARE:
What is good calf management?

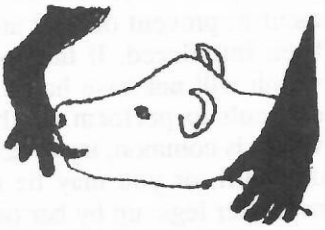
How important is colostrum?

The newly-born calf requires its mother's first milk, called colostrum, immediately after birth and for the first three to four days. Colostrum is highly nutritious, rich in vitamins and minerals, and antibodies which give the young calf resistance to various diseases. It is of utmost importance that the calf receive this colostrum before two hours have passed from birth, as already its stomach is rapidly changing; the natural immunities against diseases are derived from the first colostrum absorbed during this brief time, and give the calf the best chance to survive diseases most commonly affecting newborn calves.

A vigorous newborn calf usually struggles quickly to its feet and within a short time finds its way to its mother to start suckling. If it seems unable to find its way or the cow resists being suckled, you should help the calf and, if necessary, constrain the cow with legs tied in order to let the calf suckle its mother. For the first 24 hours it is wise to let the calf remain with its mother and after that her colostrum and subsequent feedings may be fed from a clean bucket.

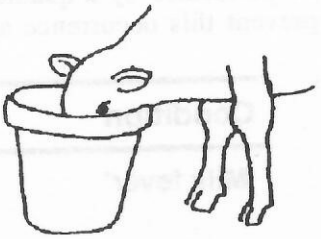


Restrain the calf



Dip fingers into milk and then into calf's mouth.

Coax head into calf bucket.



Place bucket down once calf can drink.

Should I let the calf suckle the cow?

Some farmers prefer to continue to feed their calves by a restricted suckling method, either by letting the calf start suckling before hand milking begins or follow afterwards but before milking is finished.

This method has advantages over bucket feeding and is recommended if the milk is periodically measured to ensure that the calf is getting enough, by milking the cow out occasionally to know what proportion of the total milk the calf is getting. Advantages are that the milk stays clean, at a constant temperature and may stimulate the cow to give more total milk. The cow may also suffer less mastitis by the fact that the calf may more completely extract all the milk. However, care must be taken that the calf does not get too much or too little milk.

Others prefer to feed in a clean bucket to ensure that an exact amount is fed, and to discourage the cow from withholding milk if the calf is not present. Disadvantages to this system are related to poor sanitation and irregularity in feeding of the milk which may lead to diarrhea (scours).

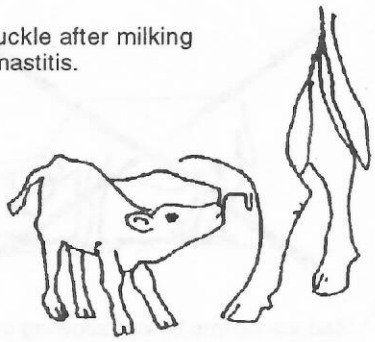
Because both systems work, it might be emph[illegible]zed that careless farmers should probably let their calv[illegible]lo restricted suckling as there are less dangers with [illegible]is method.

How much milk do I feed the calf?

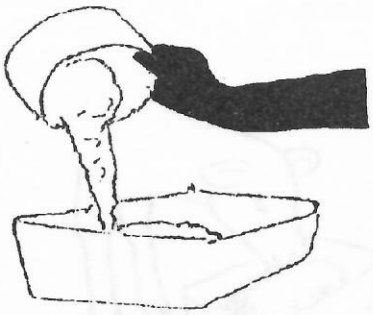
The following amounts are recommended so that the calf should grow at an average rate. It is important to begin to feed water, concentrates, hay and grass within two weeks of age or the amount of milk should be raised. The calf may be fed 2–3 times a day for the first week, then twice per day until the time that it is weaned at two to four months, depending on the feeding regime. Feeding up to 50% higher rates of milk is possi-

Weeks Old	Litres of milk			Total Per day
	Morning	Midday	Evening	
1	1	1	1	3
2–3	1.5	1	1.5	4
4–14	2	-	2	4
15–18	1.5	-	1.5	3

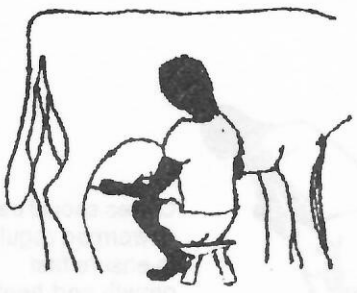
Allowing calf to suckle after milking helps to prevent mastitis.



Lift pail if the calf drinks too fast to prevent scours or milk in the lungs.



Begin feed in dry feeds by two weeks of age.



Bucket feeding allows more accurate measuring of milk fed but more risk of scours and mastitis.

ble with careful observation to avoid scours. It is not recommended to go below this amount, and any calf should be entitled to 300 litres minimum of milk before it is weaned, however long the period lasts of feeding it.

Some farmers will wish to challenge-feed the calf at higher levels of milk for a shorter period, while others may prefer to feed a smaller quantity for a longer time, supplementing with concentrate feed. Both ways are acceptable. A third method, if economical, is to replace the feeding of cows milk with milk replacer or powdered milk if either are available; however, this method is only for the advanced farmer who is conscientious about cleanliness and accurate mixing with clean, warm water in regular amounts. Amounts of milk replacer needed are the same as for fresh milk. For economic reasons, it is advisable not to feed a calf on milk for longer than 4 months, and by that time to have replaced its diet with forage and concentrates.

How do I teach the calf to drink from a bucket?

The calf should be confined firmly between your legs. Dip your clean hand into the milk, then entreat the calf to suck your two middle fingers by working them into its mouth. It is best to spread your fingers slightly apart as you guide the calf's head into the bucket until its mouth is immersed in the milk. Hold the bucket off the ground and the calf should drink readily. Do not try to let the calf drink with its head down at first so that it cannot gulp the milk too fast. After two or three feedings, the calf should be able to drink with the bucket on the floor. The calf should be encouraged to drink slowly. If it drinks too fast, milk may enter the lungs and cause coughing and be more prone to diarrhea from incomplete digestion.

How do I prevent and treat scours?

Changes in a calf's diet should be made slowly, as sudden changes may cause scours. Feeding times should be the same every day, and the milk temperature at feeding time should be the same, either always cool, or always lukewarm. Cleanliness and sanitation are very important to prevent scours, pneumonia, and other diseases of the calf. It is also important not to overfeed milk. As a precaution against diseases, the calf should be fed as soon as possible after milking to prevent the build-up of harmful bacteria in the milk. The calf-feeding buckets should be thoroughly washed after use, first in cold water and soap, then rinsed in hot water (with some disinfectant, if possible). The buckets should be inverted in the sun for drying, stored away and not be used for anything except feeding calves.

If the calf begins to have scours, immediately stop feeding milk until it has recovered. Replace feeding of milk with frequent feeding of warm, clean water with salt and glucose added, if available. Do not feed sucrose (normal table sugar) in place of glucose; it is not easily

digested by the calf and may make matters worse. It is most important to provide the calf adequate water at this time, up to 6 to 8 litres per day(!), as dehydration (lack of body water) is the usual cause of death in scouring calves. For the scouring calf, besides discontinuing the feeding of milk, it may also be advisable to treat with antibiotics unless the sure cause of the scours was overfeeding of milk. In this case, usually no medicine is necessary, and the calf should recover quite quickly.

What should I do if the mother cow dies?

If the cow dies before the calf has received colostrum and if it is available from another cow, it is important that it should be acquired and given. If it is unavailable, the following substitute can be fed:

Recipe for colostrum substitute:
1 fresh egg
1 litre of clean, warm water,
1 teaspoonful cod liver oil
3 teaspoonsful of castor oil

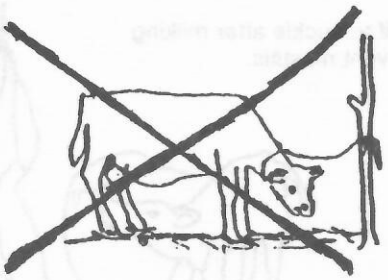
Mix it well and feed to the calf three times a day for the first four days; then continue with regular milk or milk replacer.

What more should I do for the calf up to weaning age?

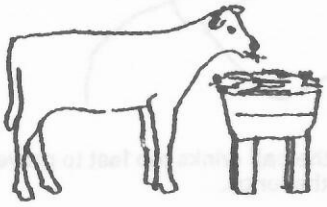
A supply of clean fresh water should be constantly in front of the calf after two weeks of age when it starts eating a little hay or soft grass. Concentrates can begin to be given at this time and increased as the appetite grows, up to 2 kgs per day. Salt and minerals in small amounts should also be provided, either in the form of powder mixed in the concentrates, or as mineral blocks.

Calves that are eating dry feeds are less likely to suffer from diarrhea than those fed entirely on milk. It is therefore desirable to induce calves to eat dry feeds as early as the second week from birth. You may encourage the calf to eat concentrates by rubbing a little of the concentrates on its nose, or by putting a small amount in the bucket just before the calf has finished drinking its milk. Let the calf eat as much concentrate as it desires.

For more information on calf rearing, see the important sections on calf hutches, internal parasites, external parasites and vaccinations, in appropriate sections.

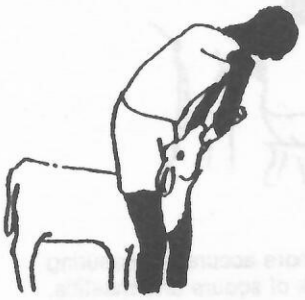


Reduce worms by not allowing calf to tread on its feed.



A healthier calf eats feed from a trough.

Dry feeds reduce overall milk requirement and risk of scours while maintaining fast growth.



Calves should be dewormed regularly to ensure fast growth and health.

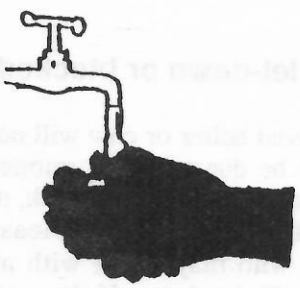
MILKING:

How do I maximize milk production?

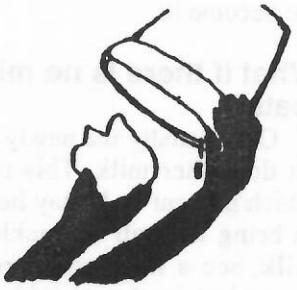
Is sanitation important for high production?

One of the greatest losses for dairy farmers is from infections of the udder or 'mastitis', for three reasons: the affected milk cannot be sold, expensive drugs are usually required for treatments, and the production level of the cow will be reduced for that lactation especially, and if not immediately corrected, for subsequent lactations if it becomes a chronic case. Mastitis can also cause progressive worsening of the health of a cow, abscesses and even death of a cow, and infection in other animals. These underline the importance of prevention and early treatment of mastitis. Most mastitis is caused by unclean surroundings for the cow or improper, incomplete milking by those involved. Important steps to prevent losses from mastitis are the following:

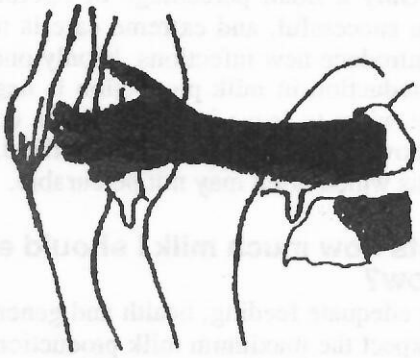
- Keep the cow in a clean environment; often cows which are kept in a well-designed cattle shed, such as the one recommended in this book, cannot easily get themselves dirty, and the chances are reduced that they will get mastitis. Some other designs of cattle sheds would require that someone remain present at all times removing her manure, in order that she not lie in it.



Clean hands



Clean pails



Clean udder with disinfectant

- Learn to milk properly (see below). If you are not sure you have removed all the milk, let the calf suckle after you have finished.
- If mastitis occurs, treat it early, being careful not to transfer it to other quarters of the udder, or to other cows, by your hands or by other cows lying down in an infected area.

It should be mentioned that sanitation is important not only to prevent mastitis, but to promote a quality product which will readily find a market, and be beneficial to the community. Quality milk products can be made only from clean milk; it is more critical that milk be of high quality, low in bacteria and without a trace of antibiotics or water additions, when used for processing to improve storage value, taste, and the ability to make high quality products. A dairy farmer is worthy of the title only if s/he has integrity and cares to produce a quality product. The rest are counterfeits!

In order to produce clean milk, use clean, metal (bacteria can grow in plastic even when cleaned well) containers which are solely used for milk. When they are cleaned, after each use, first rinse out the milk with cold water, then wash with hot water and detergent or disinfectant, and rinse with hot water.

Air dry in a dustfree place, ready for the next use. The same is true of strainers, calf buckets, milk cloths, and other utensils used with milk. When sanitation becomes a habit, even attitudes are developed which lead to the discipline of a good life.

What is the recommended milking technique?

Before milking the cow wash your hands and wash the cows udder with a clean cloth preferably in warm water with disinfectant. If the calf will assist to suckle the cow, see precautions under calf feeding by suckling. Begin milking by first massaging the udder and teats, stimulating milk let-down just as the calf does prior to sucking. First test all four teats for mastitis by milking two squirts of milk from each teat on a separate black saucer or plate to see if there is any abnormality such as blood or coagulated milk. If not, proceed to milk the cow using the squeezing, not pulling, method described in this book under the captions and pictures. However, if there is any abnormality in the milk, those teats should be left until after the normal quarters are milked out completely.

Be sure not to leave milk in the udder, as this is usually the start of mastitis. A good milker can finish two quarters at a time, within 4–6 minutes, and thus should not take more than 10 minutes per cow, unless the teats are particularly small or milk particularly hard to extract through a narrow teat canal. The faster the milk is

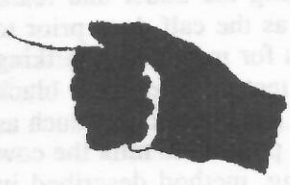
removed, the more there will be to be removed, as the cow emits natural oxytocin for a brief period after milking has begun, and during that time if the pressure within the udder is already removed, the possibility for additional milk let-down is there. It makes little difference if you begin by milking the front quarters or the rear quarters or those on one side first. If there are two people, so much the better in order that milking should be finished in a short time.

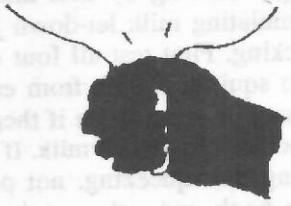
First close one finger tightly around top of teat...

...then follow with second finger...

...and third...

...and fourth...





...pull sightly downward without stripping the teat to avoid irritation, scars and mastitis.

What do I do if there is some mastitis?

When there is mastitis in one or more of the quarters, milk them into a separate pail after completing the normal quarters. If there is only a small trace of coagulated milk, it is still far better to forfeit that milk sale and treat the animal than to ignore it. If possible, you should take a milk sample of the infected quarter to be tested at a veterinary investigation centre, and an appropriate drug prescribed, but this is not often possible and early treatment is the key to success. The most important part to curing mastitis is to keep the affected quarters 'milked out', that is, keep milking them out after every two hours throughout the day until the milk becomes normal. Countless cows have recovered from mastitis from early detection by this simple method, without use of antibiotics!

Whether or not the milk has returned to normal by evening, you are wise to infuse the quarter with a special preparation of antibiotic, or treat the animal with an antibiotic injection to be more certain that any infection has been covered. Note how to infuse the udder, as per the picture shown. Be sure to treat with the infusion after the last milking of the day, and massage the medicine upwards so that it is absorbed throughout the quarter. You should not consume the milk from any of the quarters for three days after having treated with antibiotics, although it is commonly fed to calves or swine, etc., or thrown down the drain.

This is because we should not become accustomed to these antibiotics, rendering them ineffective when we become ill.

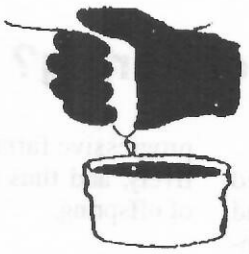
What if there is no milk let-down or blocked teats?

Occasionally the newly calved heifer or cow will not let down her milk. This may be due to her hormones which prevent it. It may help to persist to try to milk, or to bring the calf to suckle. If neither help to release milk, see a livestock expert who may assist with an oxytocin injection to initiate milk let-down. If the teats appear to be blocked, which sometimes occurs especially when heifers are suckled prior to calving, also seek expert care. Only a small percentage of operations to open teats are successful, and extreme care is required so as not to introduce new infections. If only one teat is blocked, the reduction in milk production is negligible, and it may be wiser to leave it alone. If this condition occurs with cows who have previously milked, it is a type of mastitis which often may not be curable.

What affects how much milk I should expect from my cow?

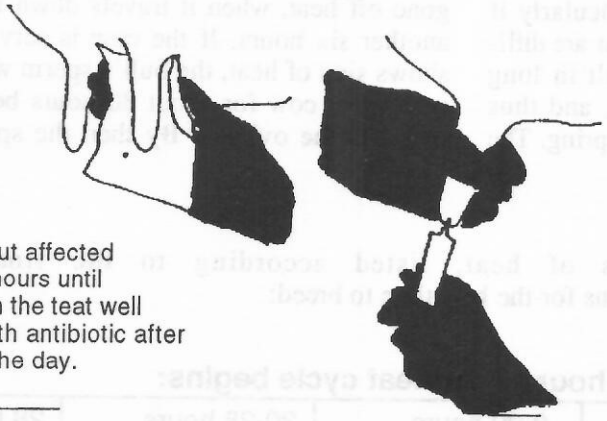
Assuming adequate feeding, health and general care, you should expect the maximum milk production within a few weeks after the heifer/cow has calved and a slowly decreasing amount after the third to fourth month, unless you have begun to introduce improved feeding at

A painful mastitis case: a big loss to the dairy farmer; to be avoided.

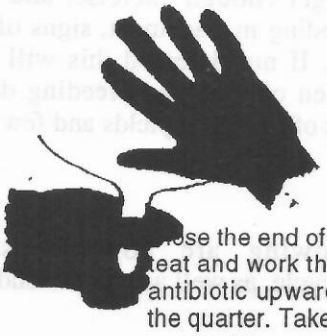


Test for clotted milk prior to milking.

First milk out all non-affected quarters. Then milk out affected quarter.



Continue milking out affected quarter every 2–3 hours until evening, then clean the teat well prior to infusing with antibiotic after the last milking of the day.



...se the end of the ...eat and work the antibiotic upwards into the quarter. Take great care not to spread infection to other teats.

some point in the lactation. By the tenth month the production usually has tapered off to a very low level which some cows can produce indefinitely until it is time to dry them off.

Heifers usually produce only about 75% of the amount of milk which they will produce in subsequent lactations. Production usually increases, reaching a maximum in the third to sixth lactations, and then declines after the seventh or eighth lactation.

As mentioned earlier, purebred, exotic dairy cattle in ideal environments can produce milk ranging from 10–50 litres per day, de pending on breed, genetic potential and most importantly, feeding. Among the more popular dairy breeds, Friesians tend to lead in milk production, followed in descending order by Brown Swiss, Ayrshire, Guernsey, Sahiwal, and Jersey. Comparing the amounts of milk fat and solids contained in their milk, the list is reversed with Jerseys and Sahiwals in the lead.

Crossbreeds produced from these exotics and indigenous breeds, de spite there being great variation, often produce from 6–15 litres per day under good conditions, and can surpass the purebred exotics if environments are not ideal. The crossbreeds have greater survivability and are most appropriate for the beginning farmer and for environments of high heat stress, disease incidence, or limited access to supplementary feeds. As a farmer increases in experience and if s/he improves the environment for the cattle through time, s/he can backcross the cows to purebred exotic bulls and expect levels of production which correspond to purebreds within two generations.

It is much easier to make genetic progress (improved breeding) than to improve the environment (more adequate feed, water, disease control) for the cattle. Too often farmers put the emphasis on genetics and lose (inadequate production, infertility, death) as a result.

Farmers with adequate resources are encouraged to follow the recommendations given in this book with regard to concentrate levels in order to maximize production. Where possible, limited-resource farmers are encouraged to do so, in order to obtain the maximum from their cattle. Usually it is economical to feed a certain level of concentrates at least during the strategic times of the lactation earlier mentioned.

Farmers feeding their cattle with a good balance of legumes and grasses can expect from 6–10 litres maximum from their best cattle, if they are paying careful attention to all the other needs of their animals. Farmers who do less than the minimum for their cattle should expect production levels corresponding to that level of care. Feed/care for the cow and she will feed/care for you! If you cannot afford to do the minimum, you may be better off not keeping cattle!

BREEDING:

How do I obtain many good offspring?

What is the key to good 'heat' detection?

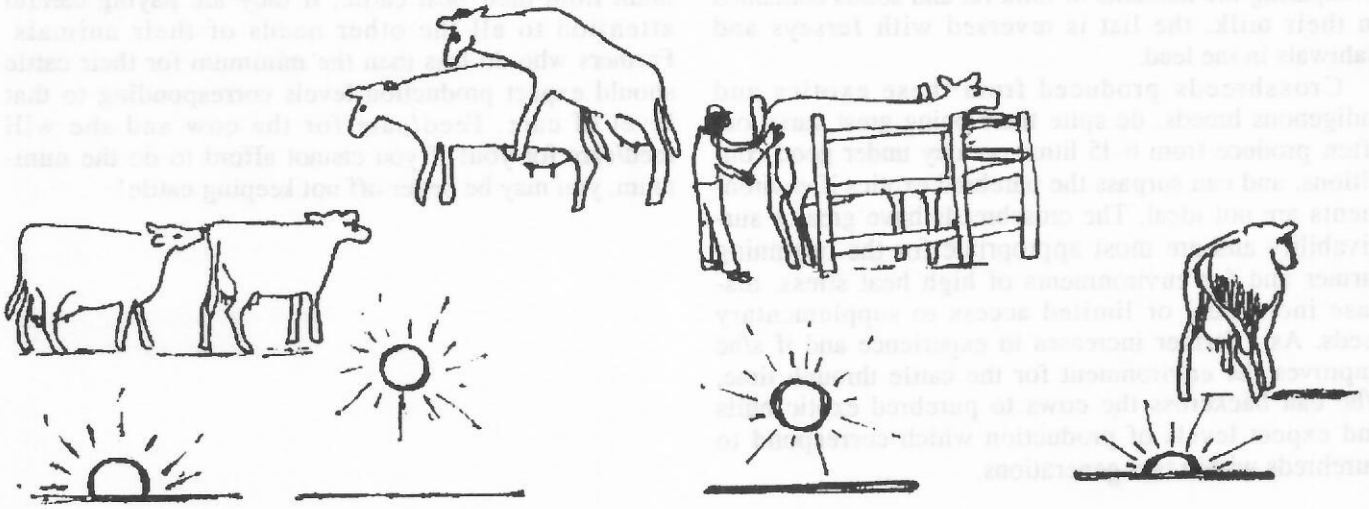
The most important and most frequently missed opportunity for dairy farmers to become successful and prosperous is in the detection of estrous (heat) and subsequent breedings in order that cows become pregnant again as soon as 45 days after calving, if possible. Under zero-grazing, where cattle are isolated from each other and may not get enough exercise, and particularly if under poor feeding management, signs of heat are difficult to detect. If not detected this will result in long periods between calving and breeding dates, and thus long lactations of low milk yields and few offspring. The progressive farmer must know how to detect heat effectively, and thus maximize milk production and number of offspring.

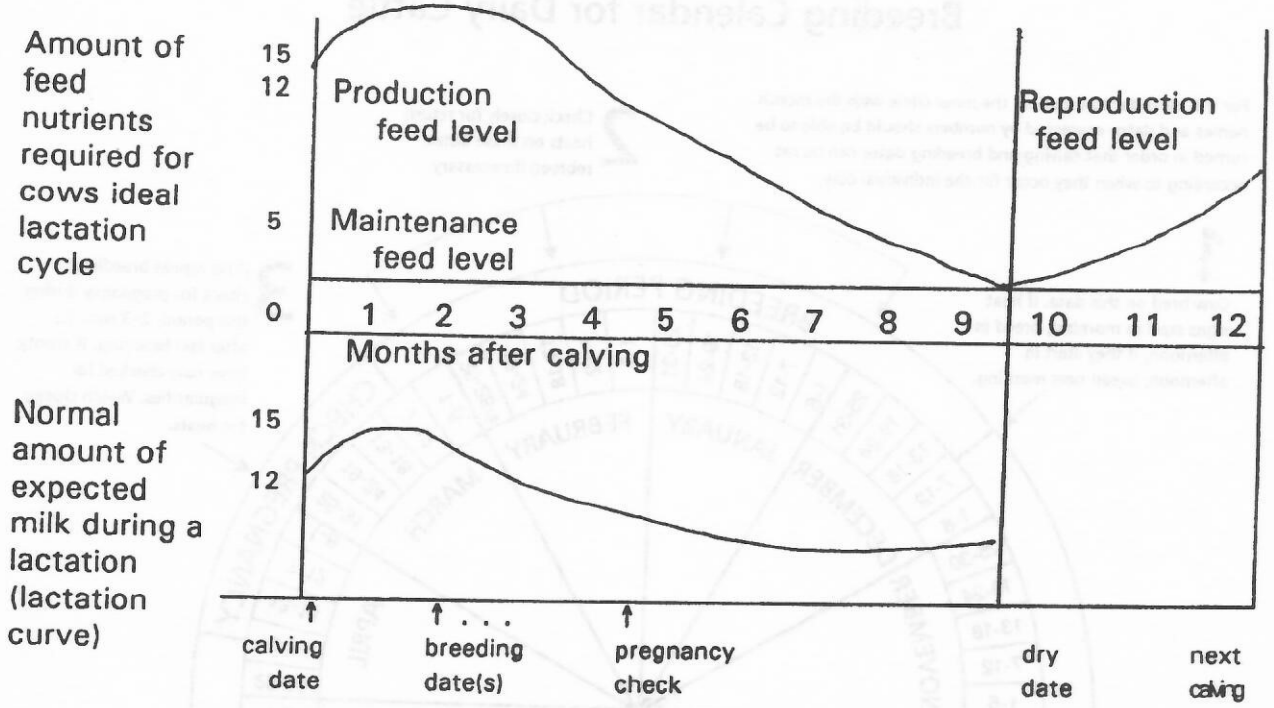
What is the best time to serve?

The cow's reproductive system produces an ovum, her 'egg', which is released about 12 hours after she has gone off heat, when it travels down the oviduct taking another six hours. If the cow is served when she first shows sign of heat, the bull's sperm will have to remain within the cow for about 30 hours before it meets the ovum in the oviduct. By then the sperm will be weak

The following are common signs of heat, listed according to the times they occur within a heat cycle, as well as recommendations for the best time to breed:

Number of hours after heat cycle begins:				
1-6 hours	6-9 hours	9-20 hours	20-28 hours	28 hours
Time to breed:				
Too early	Early	Best time	Still possible	Late
Signs of heat and when shown:				
Cow bellows, Smells other Cows, ears are alert, stops eating, less milk produced	Cow mounts other cows and stands when mounted, swollen vulva	End of standing heat,clear mucous discharge from the swollen vulva	Cow no longer stands to be mounted, dry mucous at tail	Bloody discharge





and conception may not take place at all. For this reason it is best to breed animals in the latter stage of heat when conception is more likely because the sperm is more verile. Thus, if a cow shows a heat period of ten hours, service should be at the end of the ninth hour. Whether by natural service (bulls) or by artificial insemination, the following holds true:

1. Cows first seen in heat in the morning should be inseminated/bred in the afternoon/evening of the same day.
2. Cows first seen in heat in the afternoon/evening should be inseminated/bred in the morning of the following day.

In the tropics/subtropics cattle often show signs of heat for shorter periods of as few as 12 hours. Therefore, one must be extremely alert, keeping in mind the dates when heat periods are expected, and looking for the slightest signs. Often signs of heat are more noticeable in the early morning hours; it is the best time of the day to check for heats, and logically most heats detected at this time of day will require breedings to take place later in the afternoon of the same day.

Mature heifers and cows which are not pregnant normally 'cycle' (show signs of heat) every 18 to 21 days until they conceive through breeding by a bull or through artificial insemination. After breeding, if they d not "settle" (become pregnant or "incalf") they normally will cycle again in 18 to 21 days.

Young heifers actually begin heat cycling before they are of adequate size, even before one year old. If bred they may either have difficulty calving if they do conceive, or their growth may be stunted because of the pregnancy, and the potential milk production for the first lactation will be significantly less. Thus, to review, it is generally advisable to breed heifers at 18 months age or thereafter, when they are more physiologically mature and have reached a weight which corresponds to 70% of their expected mature weight. This would mean a different weight depending on the breed, as was previously outlined under the care of heifers section.

How soon should the cow be bred after calving?

To review, it is advised that cows should be bred between 45 to 90 days after calving. Breeding on or about the 85th day results in a calving interval of 12 months. It is more difficult to get cows in calf if they are not served before the 85th day after calving. Therefore, it is advised that they should be served at the heat period that occurs approximately 45–50 days after calving.

A short lactation is characteristic in the tropics so that usually the problem that confronts farmers is a long dry period. For this reason it is of paramount importance that mature dairy animals are bred on time to reduce the time between calvings. The ideal calving interval and goal for the progressive farmer is 12 months, or a calf every year during the same month.

If the cow calves every 12 months it should be milked for 10 months and rest for 2 months. By attaining this goal, a maximum of offspring and a maximum of milk will be obtain during the lifetime of the cow.

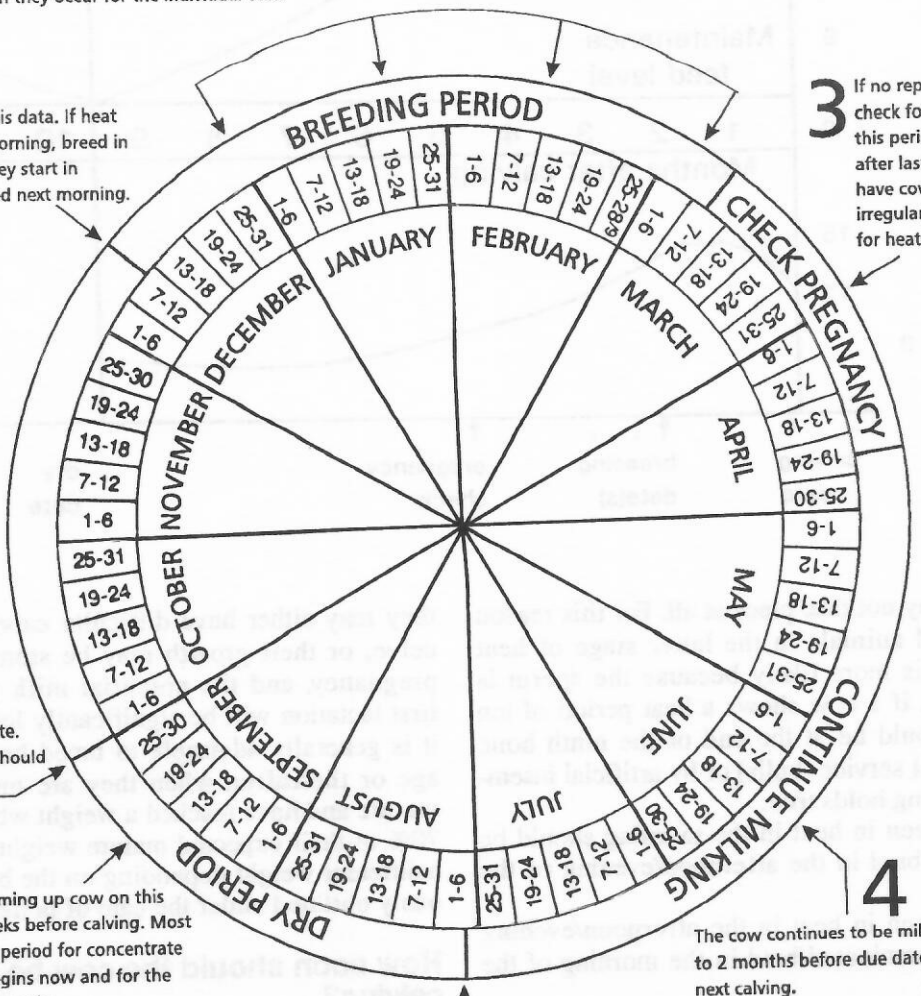
Breeding Calendar for Dairy Cattle

For this calendar to function, the inner circle with the month names and dates expressed by numbers should be able to be turned in order that calving and breeding dates can be set according to when they occur for the individual cow.

2 Check closely for return heats on these dates: rebreed if necessary.

1 Cow bred on this data. If heat signs start in morning, breed in afternoon; if they start in afternoon, breed next morning.

3 If no repeat breedings, check for pregnancy during this period, 2–3 months after last breeding. If empty, have cow checked for irregularities. Watch closely for heats.



7 Cow calve on this date. Next breeding date should be where '1' lies.

6 Begin steaming up cow on this date 2 weeks before calving. Most important period for concentrate feeding begins now and for the next four months.

4 The cow continues to be milked up to 2 months before due date for next calving.

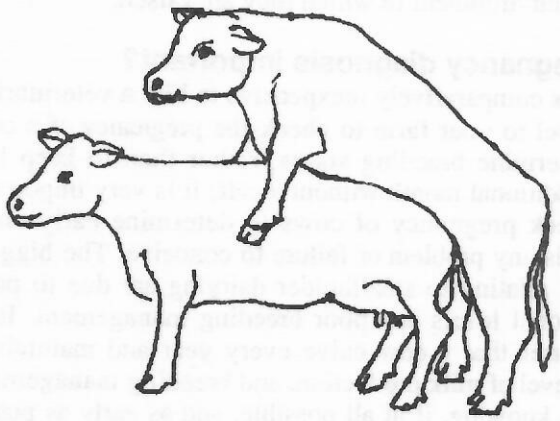
5 If the cow is still being milked, it should be dried off by this date, 2 months before calving.

If possible, a heifer should be bred when reaching 18 months of age or at 250 kg. weight. A cow should be reared within 2–3 months after calving in order to calve every year. Turn dial so that current breeding date starts at '1'.

The best breeding seasons vary from country to contry. For East Africa in general, for maximum milk production, avoid breeding your heifer/cow from October to December so as to avoid their calving down at the mid-to-late dry season when lush feeds are scarce. It is advisable to breed between February to August so as to calve down during months of lusher feeds.

For this calendar to function, the inner circle with month names and dates expressed by numbers should be able to be turned in order that calving and breeding dates can be set according to when they occur for the individual cow.

Natural Service



The normal period between breeding and calving (gestation period) for cattle is 275–285 days. That leaves 85-90 days range from calving to conception in order to get the cow to calve within one year (365 days = 280 + 85). If the average cow needs to be bred twice, it becomes more important that breedings begin soon after calving.

Artificial insemination ensures the best offspring and eliminates bull keeping costs and most diseases which can be passed by the bull. However, delivery systems and heat detection are common causes of failure.

What care should be taken when using a bull for natural mating?

Care should be taken in the choice of a bull to ensure that he has no obvious defects in either his testicles, penis, legs or other general features. He should also be free from disease. Tests can easily be conducted to test the viability of his semen. He should be of an appropriate breed for your heifer/cow, and not of the same family line (father, brother, son, etc.) Consult a livestock officer before choosing a breeding bull if you do not know whether the bull could function or whether he is fit to serve your heifer/cow.

When the bull is stimulated by a cow or heifer in heat his penis stiffens. He mounts the cow or heifer introducing his penis into her vulva and ejaculates sperm. If the sperm meets the ovum and conditions are right it enters the uterus where it attaches to the uterine wall and grows into a fetus, the premature calf. If fertilization does not take place, or if conditions are not favorable in the uterus, such as an infection, the egg passes on out of the cow, appearing as a bloody discharge the day after the end of the heat cycle. Then another 18 to 21 days must pass before another cycle can begin and a subsequent breeding.

When improper heat detection occurs, a heifer/cow bred too early or too late will not conceive. Care should be taken to bring the two animals together at the right time. Both animals should be in good shape and not overly stressed.

A calm setting with the heifer/cow slightly restrained, for example confined in a short crush, are conducive to a stressless breeding.

If the bull has not been overworked, allowing the heifer/cow to be bred more than once is advisable to increase the chances of conception.

As practical information, bulls determine the sex of offspring, whereas heifer/cows determine the number of offspring. In general bulls, produce offspring of an equal number of each sex. However, some bulls are prone to produce more of one than another.

In general, there is little one can do to increase the number of offspring, although good feeding has a slight effect on twinning, and new technology has been developed to extract embryos from cows and implant them into host cows, thus increasing the number of possible offspring from one superior cow. At present this technology is as expensive as paying the price for a mature cow in order to obtain an embryo-transplant calf. It may be feasible in the future, but at present it is not an option for limited-resource farmers.

Does artificial insemination produce the best quality calves?

By far the most economical method for a farmer to obtain improved dairy calves is through artificial insemination. Frozen (stored) or fresh semen from selected bulls of high quality can be transferred to female cattle

by artificial insemination.

Artificial insemination, or A.I., is a very important method of improving productivity in cattle. With it, a farmer may use a very expensive, purebred dairy bull of predictable value which may not be physically available in the area, eliminate the costs and inconveniences of keeping a bull, and avoid many contagious diseases which can be passed on by bulls to other cattle. A.I. drawbacks are usually in the failure of farmers to accurately detect the time of heats in their cattle, or breakdowns in the delivery system of A.I., especially common in developing areas. Artificial insemination is preferred to use of bulls if the delivery system is dependable. The A.I. technician needs to be called, come at the right time and inseminate quality semen in the correct method.

It has been repeatedly proven that A.I. produces an equal number of male and female offspring. The common complaint about A.I., that it only produces bull calves, is false. Normally A.I. should be preferred, if available for the first 2–3 breedings or heat cycles after calving. If the cow still has not conceived (continues cycling), natural mating (a bull) is usually recommended; it is better to try a surer means to get the cow into calf as soon as possible, for the economics of keeping empty cows is very poor, and it is better not to take the chance again that the A.I. may fail. The risk of failure of A.I. is slightly greater than that for natural mating, in other words, but the value of the A.I. sired offspring is far greater, so it is worth the risk the first few times around. However, it should be noted that the quality of the calves does not only depend upon genetics, but also in the environment in which they are raised.

Is pregnancy diagnosis important?

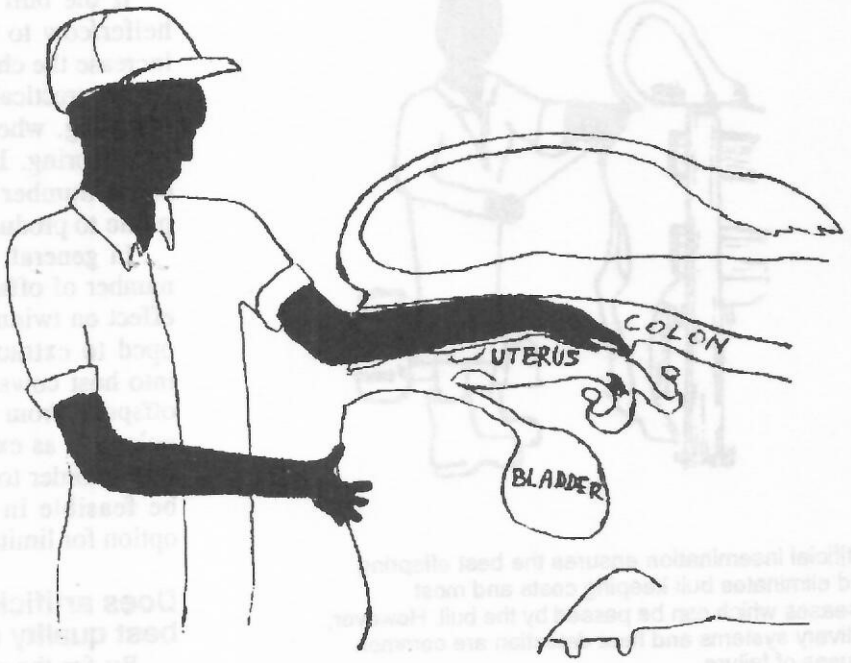
It is comparatively inexpensive to hire a veterinarian to travel to your farm to check the pregnancy of a cow or determine breeding status, rather than to keep her one additional month without a calf; it is very important to check pregnancy of cows to determine early on if there is any problem or failure to conceive. The biggest losses relating to smallholder dairying are due to poor nutritional levels and poor breeding management. It is far better that a cow calve every year and maintain a high level of milk production, and breeding management means knowing, if at all possible, and as early as possible when there is a problem.

Cows and heifers should be pregnancy tested between 60 to 90 days after their last breeding. If a cow does not show signs of heat within 75 days after calving, it is also advisable to seek help.

Always try to avoid a long interval between calving and the next breeding, and between the last breeding and calling for a pregnancy diagnosis.

How can I predict the date of calving?

Cows generally carry a calf for 275–285 days, a period of time called the gestation period. Therefore, it is



Pregnancy checking at 60–90 days after the last breeding date is the best way to ensure efficient breeding and quickly pays off when compared to the losses incurred by cattle kept which were thought to be pregnant. It is wise to do it for all cows at the appropriate time each year.

important to note down the dates of breeding, especially the last breeding, to determine the expected date of calving. A simple way to do it in your head is to add 9 months and ten days to the breeding date, or subtract two months and 20 days and add a year, to determine this date. For example, if the cow was bred on June 11th, by adding 9 months and 10 days, you will get March 21st. Or by subtracting two months and 20 days, you get again March 21st. As the day approaches, you will notice whether signs of calving are beginning to show, and thus whether she will be earlier or later than the expected calving date. On occasion a cow will have been bred by mistake **after** she has conceived. Then she will calve earlier than the last breeding. At such times you will be glad you kept a record of her breeding dates. Can infertility problems be solved? The most common reason for cows not conceiving is poor nutrition, usually by lack of energy, or protein, but also minerals. The first step to take if a cow does not show signs of heat is to be sure she is in good condition. The second most common reason for a cow not conceiving is improper heat detection. If your cow does not show signs of heat, or has been bred more than twice and still repeats, you may have her stay with a bull for a few days around the next heat period, if possible. If she continues to cycle, or has not conceived, you should take the third step of inviting a qualified livestock officer to do a rectal exam to see if there is any abnormality, such as a cystic ovary.

The cow may be treated either by hormones or by mere palpation and manual removal of the cysts. Frequently, cattle begin to cycle (show signs of heat estrous) soon after such treatment, and may or may not conceive during that first breeding. However, they usually 'settle' (become pregnant or 'incalf') if bred on the following heat 18 to 21 days later.

If there is an infection in the female reproductive tract, or if conditions are not favorable, such as poor health of the cow, the fertilized ovum (zygote) may not adhere to the uterine wall, and instead will pass out of the cow, appearing as bloody mucous on the vulva one or two days after heat ends. If there is an infection in the uterus, the mucous discharge, during times of heat, may appear bloody, milky white or yellow. In such cases it is recommended to seek assistance of a livestock officer to 'irrigate' the female reproductive tract using a mild disinfectant or antibiotic solution.

BULL CARE:

What is good bull management?

What feeding and housing are recommended for a bull?

Maintenance of a breeding bull requires good feeding, housing and general management. As with a heifer calf, a good diet for the young bull calf and proper treatment as he develops are foundations of a long, useful life. Regular exercise each day, if the calf is reared indoors, helps to strengthen the bull and regular handling helps to tame him, preventing him from being temperamental later. Undue confinement, with inability to see and take part in the activities of the rest of the herd, may lead to depression and loss of libido, the active urge which a bull needs to be a successful breeder.

At what age can a bull start serving heifers or cows?

At about 10 months of age; although the bull may show the ability to be sexually active, to allow the young bull to begin at this age is too risky. Although he may be already fertile, it is best to wait until he is eighteen months old and only then should he be allowed to do gradually regular matings.

It is often best to allow them to start by breeding heifers, and later cows. Under pasture conditions, no more than ten at a time are recommended for a young bull. However, controlled mating is preferable in order to avoid an excessive number of breedings and exhaustion.

How many bull services per week and per cow are recommended?

A general rule is to allow one service per week until he is two years old, and then two per week for the next six months. Afterwards you can consider three times per week a safe figure, or up to 150 matings per year. More than this may produce exhaustion and a short breeding life of the bull.

It is sometimes recommended to allow a bull to mount a cow more than once to increase the chances of conception. It is particularly advisable if he has not serviced other cattle for two to three days, as the semen ejaculated at the first service may not be viable. A second or even third service is recommended when you have a problem breeder or you are not sure of the time of the heat. However, it is not recommended if the bull is in heavy use.

How do you restrain a mature bull?

Restraint of a mature bull is often possible by a bull ring. On the other hand, abuse of it can drive a bull mad before his time. Care should be taken to install it to ensure that it is sufficiently far back into the nostril to avoid the risk of subsequent tearing of the flesh when in use. Usually about half an inch back from the nostrils is satisfactory. After the ring has been closed, fasten it carefully and tightly so that it will remain intact. Removing rough edges with a file is wise to avoid unnecessary damage to his nose, and waiting for two weeks for the wound to heal is humane. When leading the bull with the nose ring, undue force by pulling is not necessary, for it will shorten the period of its usefulness, likely making him grow temperamental sooner.

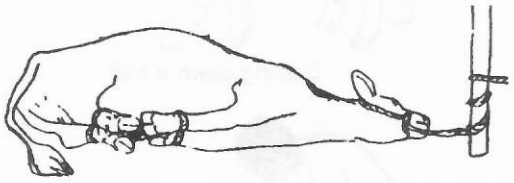
Is it wise to dispose of young bull calves or raise them?

Due to the poor economy of feeding milk to non-breeding stock many farmers opt to slaughter bull calves at one to two weeks of age for consumption as meat, rather than incur the high cost of feeding milk compared to the low value of the bull at weaning age. Others opt to keep them because the value of the bulls for breeding, draft power, or beef warrants keeping all stock. You are advised to consult the local livestock assistant before you make your decision. If you opt to raise them, but not for breeding purposes, it is wise to castrate them so that they will not cause undesired matings. This skill is described under the next section of this book.

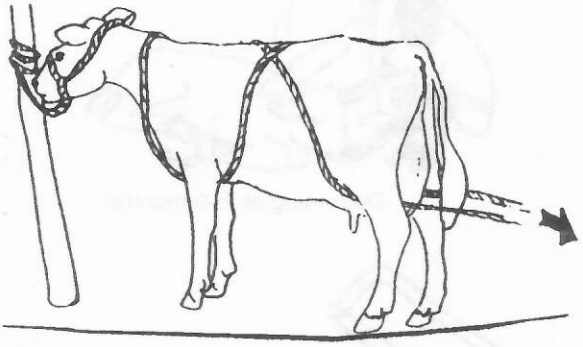
OTHER SKILLS:

What are some additional skills useful to know?

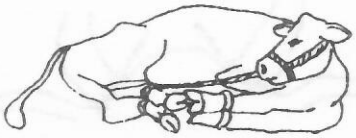
Bull nose ring



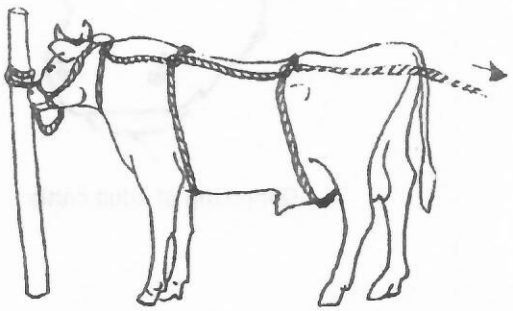
Casting down the cow, method number 1



Casting down the cow, method number 2



Casting down the cow, method number 3



Casting down the bull, method number 4

How do I restrain cattle for treatments?

In order to perform various treatments, it is necessary to be able to restrain cattle. If you have built a cattle crush or stanchion, this task is made easier. However, some operations require additional methods of restraining. It is important that all methods should be used in a quiet, gentle manner to avoid exciting or hurting the animal, if at possible. If cattle are handled frequently from birth, restraining them becomes less difficult. The following illustrations show various methods used for restraining cattle for treatments.

How is a halter made?

A halter is a useful tool to lead or restrain cattle. It may be helpful when taking the animal for breeding, holding it for treatments or showing it in competitions. Cattle learn very quickly how to be lead by a halter; it certainly beats having the cattle lead you where they want to go! A way to make your own simple halter is shown by the following illustration. Teach your cattle to be lead with a halter, first by haltering and tying them to a pole for 15 minutes a day for a week, then leading them around until they follow easily. Firmness is required, but it is not helpful to pull them too hard when leading. If they still resist, continue to tie them to the pole.

How do I perform dehorning/disbudding?

In order to prevent cattle from wounding one another or you by their horns, or having to remove broken horns from accidents, it is advisable to remove them by disbudding as calves or dehorning adults. It is the least stressful, if done during calfhood by disbudding. At this stage, the calf can be easily restrained and healing is rapid. At 5–8 days age it can be done by perhaps the simplest method if you have caustic soda. To do it, cut and shave the hair close at the points where the horns will begin growing, scraping slightly the skin as well but not enough to draw blood. Apply a pinch of caustic soda to each place, or rotate a caustic soda pencil at that point until a small wound has been made but bleeding stopped. If caustic soda is not available, a super-heated iron can be used to cauterize this same area. If you are not sure where the horns will protrude or prefer to wait a bit, then when small horns start to protrude at two to three months age, they can be cut with a super-heated knife or machete which at the same time cauterizes the small wounds preventing any loss of blood. The amount of pain is minimal and it utilizes things which any farmer has available.

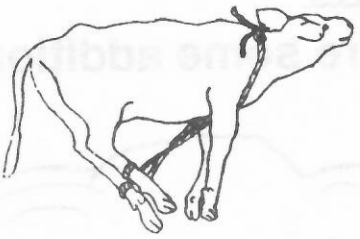
Dehorning of more mature stock requires very good restraint such as casting the animal and tying together the legs. The horns may be cut with special clippers, a

special embriotomy wire, or a common pruning or hand saw. The cut should follow the approximate curve of the head, and be close enough to take one centimetre of skin with hair around the base of the horn, in order to prevent the horn from regrowing. When the horn is nearly cut through, it should be supported and care taken not to allow the skin to tear with the last few cuts. This requires more skill and should be practiced first with an experienced person. In order to prevent continuous bleeding, cauterize the wound and thus close bleeding vessels by searing them with a super-heated knife or machete. It may be advisable to apply a fly repellent cream adjacent to but not on the wound, especially if there is a hole produced into the skull where they could enter and breed maggots. If such a hole has been produced, do not lose heart; it is normal and should heal quickly. It should be left open to air to promote rapid healing from within, although some technicians prefer to plug it with a cotton swab doused with iodine. It is important that normally produced fluids in the wound should not be allowed to accumulate and become pussy, but should begin to be poured from the head wound early on by loosing the scab which may cover the hole, lifting the nose and tilting the head to each side, and shaking it out each day until no more fluid remains, usually for about the first week. Healing usually takes place in two to four weeks.

Judging from the big difference in amount of effort, stress on the animal and healing time required, it can be deduced that it is preferable to disbud calves than wait and have to dehorn mature stock.

How do I perform hoof trimming?

Maintaining sound hoof care strengthens the muscles in the leg, enables cattle to stand more erect, and prolongs their useful life. Trekking cattle and cattle standing on a cement floor are less likely to need hoof treatment as their hooves tend to be ground down by walking. The problem is more acute for those standing in mud or on wood floors. As with most treatments, early treatment is easier then letting the condition get chronic. As the illustration shows, a simple wood chisel and mallet can be used, placing the hoof on a wood slab to reduce the shock of the hammering. The animal may only need to be moderately restrained if it is done in a calm manner. Someone may be required to hold the leg down, or keep the animal from shifting. If it is necessary to cast the animal down, proper hoof clippers are better suited to the task. The ideal outline of a hoof is shown. Because the inner part of the hoof is softer, by simply removing the outer part, the hoof will usually go right, or a sharp knife can be used, if necessary, to cut away any undesirable soft tissue under the hoof. In cases of chronic or seriously overgrown hooves, it is best to remove a little bit at a time, and frequently.



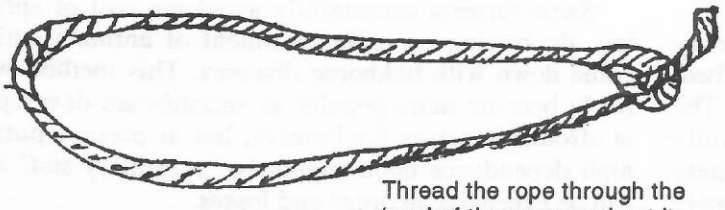
Restraining a calf

Casting down a calf

Dehorning at 2–3 months

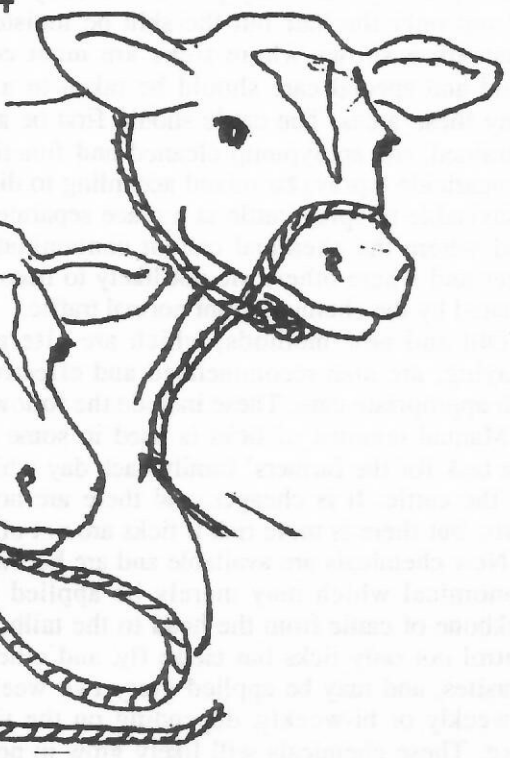
Dehorning of adult cattle

1



Thread the rope through the 'eye' of the rope, and put it over the neck loosely.

4



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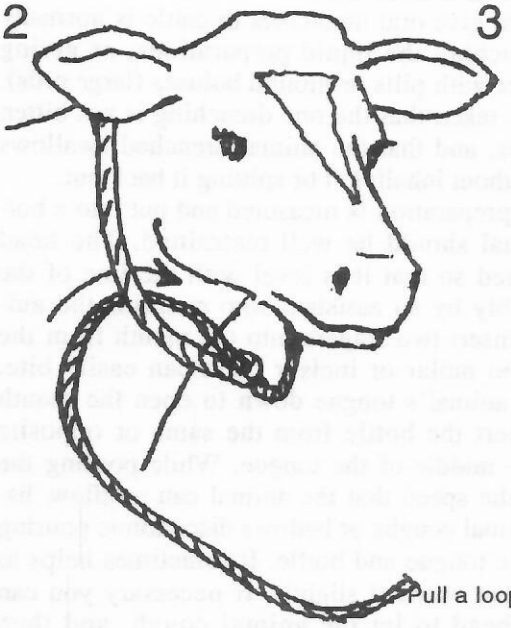

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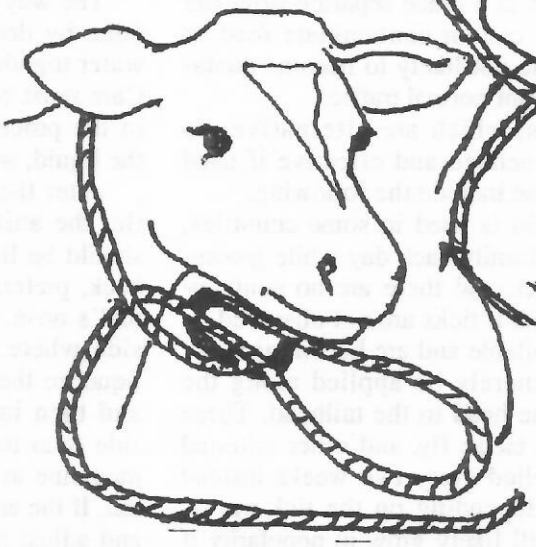
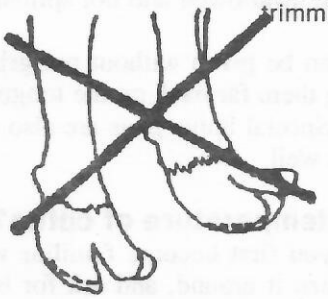
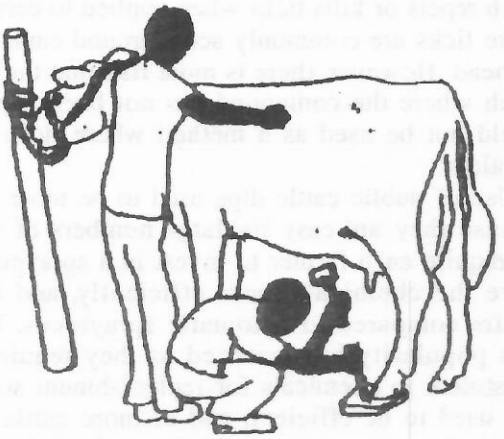


Pull a loop forward and loop it over the nose, then pull the end of the rope tight.

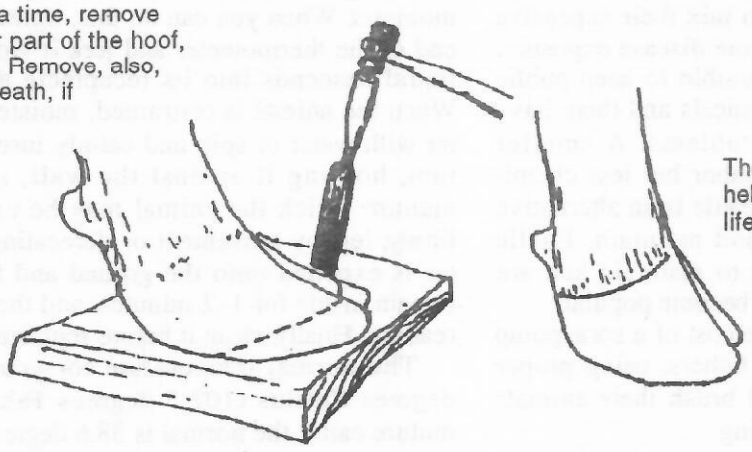
Hooves needing trimming.





Place the restrained cow's hoof on a board to reduce the shock.

Cutting a little at a time, remove the upper, harder part of the hoof, especially in front. Remove, also, the softer underneath, if necessary.



The well-trimmed hoof will help increase the cow's lifetime and comfort.

How should I spray cattle against ticks?

In order to effectively control ticks, it is necessary when spraying that every part of the body be reached, and not only the hair but the skin be moistened. The illustration shows where ticks are most commonly found and special care should be taken to adequately spray these areas. The cattle should first be adequately restrained, the spraypump cleaned and functional, and the acaricide (spray) be mixed according to direction. It is advisable to spray cattle at a place separate from the shed where the chemical cannot contaminate feed or water and where others are not likely to become contaminated by the chemical from normal traffic.

Old and new methods, which are alternatives to spraying, are also recommended and effective if used with appropriate care. These include the following:

Manual removal of ticks is used in some countries, as a task for the farmers' family each day while grooming the cattle. It is cheaper, and there are no contaminants, but there is more risk if ticks are not observed.

New chemicals are available and are becoming more economical which may merely be applied along the backbone of cattle from the head to the tailhead. These control not only ticks but tsetse fly, and other external parasites, and may be applied every two weeks instead of weekly or bi-weekly, depending on the tick prevalence. These chemicals will likely grow in popularity if they become comparatively economical.

Some farmers use a pyrethrum grease compound which repels or kills ticks when applied to certain areas where ticks are commonly seen, around ears, legs, and tail-head. However, there is more risk that the ticks can attach where the compound has not been applied, and should not be used as a method where ticks are very prevalent.

Use of public cattle dips used to be more common, because they are easy for large numbers of cattle, do not require each farmer to invest in a spraypump, conserve the chemicals more efficiently, and have few repairs compared to automatic sprayraces. However, their popularity has lessened as they require a large investment in chemicals for replenishment so must be well used to be efficient, and as more cattle are kept indoors farmers are less willing to mix their expensive dairy cattle with others and risk more disease exposure. In some areas it has not been possible to keep public dips supplied constantly with chemicals and there have been various organizational problems. A smaller 'Machakos' dip which uses more labor but less chemicals and can accommodate 30–50 cattle is an alternative which some groups have built and maintain. Public spray races have also been hard to maintain and are more costly than dips, so have not become popular.

Some farmers have reduced the cost of a spraypump by sharing with their neighbors. Others, using proper protective rubber gear, wash and brush their animals with the chemical instead of spraying.

Some farmers successfully avoid the cost of spraying, depending on early treatment of animals which come down with tickborne diseases. This method will likely become more popular as vaccines are developed at affordable prices for farmers, but at present puts a high dependence upon supportive veterinary staff and can be expensive in drugs and losses.

How do I give a drench?

The way to give oral medicines to cattle is normally done by drenching the liquid preparations, or giving water together with pills or ground boluses (large pills). Care must be taken that the one drenching is not bitten in the process, and that the animal drenched swallows the liquid, without inhaling it or spitting it back out.

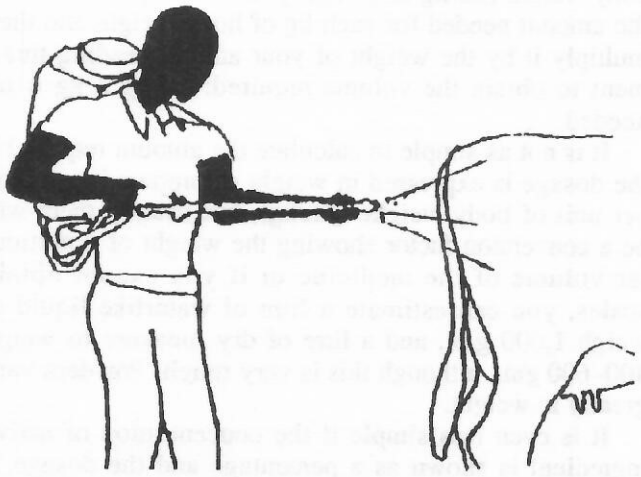
After the preparation is measured and put into a bottle, the animal should be well restrained. The head should be lifted so that it is level with the line of the back, preferably by an assistant who restrains the animal's nose. Insert two fingers into the mouth from the side where no molar or incisor teeth can easily bite. Squeeze the animal's tongue down to open the mouth and then insert the bottle from the same or opposite side onto the middle of the tongue. While pouring the medicine at the speed that the animal can swallow, listen. If the animal coughs or bellows discontinue pouring and adjust the tongue and bottle. It sometimes helps to pull the tongue outward slightly. If necessary you can release the head to let the animal cough, and then resume. Make sure the animal has made a good swallow before releasing the head so that the full measure of the medicine will have been swallowed and not spilled over the ground/floor.

Boluses and pills can be given without pre-grinding them by simple placing them far back on the tongue and drenching with water. Special bolus guns are also available for this purpose as well.

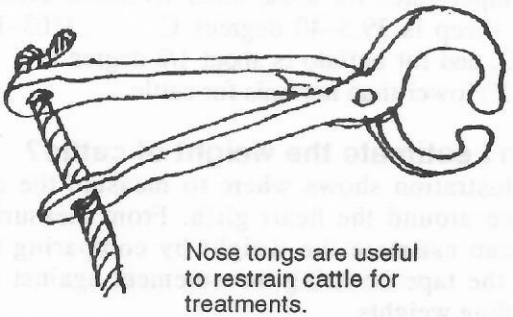
How do I take the temperature of cattle?

This requires that you first become familiar with a rectal thermometer. Turn it around, and ask for help if you cannot see a reading from the fine, thin line which travels up and down the numbered gradient of the thermometer. When you can do this, tightly grasp the upper end of the thermometer and jerk it violently so that the liquid descends into its receptacle at the lower end. When the animal is restrained, moisten the thermometer with water or spit, and calmly insert it into the rectum, holding it against the wall, not within some manure which the animal may be expelling. Hold it firmly, lest by movement or defecating, the thermometer is expelled onto the ground and broken. It should remain inside for 1–2 minutes, and then be removed for reading. Finally, clean it before replacing it in its case.

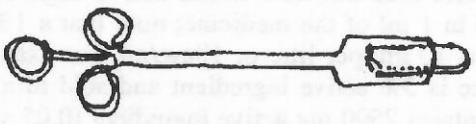
The normal temperature for young cattle is 39.2 degrees Celsius (102.5 degrees Fahrenheit), and for mature cattle the normal is 38.6 degrees C . (101.5



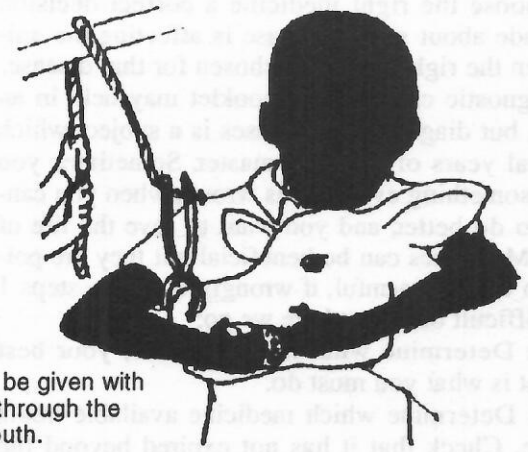
Hand spraying against ticks.



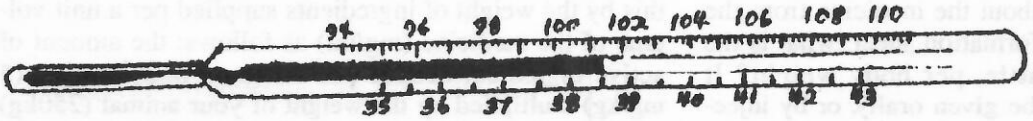
Nose tongs are useful to restrain cattle for treatments.



A bolus gun



A drench may be given with a soda bottle through the side of the mouth.



A cattle thermometer showing the normal tempature of healthy cattle, which is 39º Centigrade or 102º Fahrenheit. Rotate the thermometer in order to observe the thin line which indicates the temperature. Always shake the thermometer to make the liquid go back down before inserting in the rectum for use.

degrees F.). There may be very slight variation, but generally you should consider an increase of 1 degree C . above the normal as a slight fever, and an increase of 2 degrees C . above normal is a high fever which should receive consideration for treatment. However, some increase in temperature results from exertion or from very high outside temperatures. The normal temperatures for some other livestock such as goats and sheep is 39.5–40 degrees C . (103–104 degrees F.), and for buffalo is about 1/2 degree C . (1 degree F.) lower than normals for cattle.

How can I estimate the weight of cattle?

The illustration shows where to measure the circumference around the heart girth. From measuring this you can estimate the weight by comparing the length of the tape or string measurement against the corresponding weights.

How can I estimate the right amount of medicine needed?

Please note that it will not help to measure the right amount of the wrong medicine for any treatment! In order to choose the right medicine a correct decision must be made about which disease is affecting the animal and then the right medicine chosen for that disease.

The diagnostic chart in this booklet may help in an emergency, but diagnosis of diseases is a subject which takes several years of study to master. Sometimes you have to do something even if it is wrong, when you cannot know to do better, and you want to save the life of an animal. Medicines can be beneficial but they are poisons, which can be harmful, if wrongly used. So steps 1 and 2 are difficult ones, but here we go:

Step 1: Determine what the disease is; your best guess if that is what you must do.

Step 2: Determine which medicine available treats this disease. Check that it has not expired beyond the validity date.

Step 3: Find out more about the medicine from the box or bottle or enclosed information sheet: what is the recommended dose for cattle, per body weight? It should tell whether it is to be given orally, or by injection under the skin (S.C .-subcutaneous), in the muscle (I.M.–intramuscular) or in the vein (I.V.–intravenous). It will say how often to give it. It should say if there are any special warnings, such as that meat or milk should not be used for 72 hours, for example, or that there is a toxic dose.

Step 4: Estimate the body weight of the animal needing treatment. You can use the heart girth measurement to compute this, although after you gain experience you become able to estimate weight accurately enough without measuring.

Step 5: Determine how much medicine is required for your animal needing treatment. If the dosage is expressed in volume of prepared medicine per unit of body weight (ml/kg or cc/kg), you can simply determine the amount needed for each kg of body weight and then multiply it by the weight of your animal needing treatment to obtain the volume required: ml/kg x kg = ml needed.

It is not as simple to calculate the amount required if the dosage is expressed in weight of prepared medicine per unit of body weight (gm/kg), but usually there will be a conversion factor showing the weight of a particular volume of the medicine or if you cannot obtain scales, you can estimate a litre of waterlike liquid to weigh 1,000 gm., and a litre of dry measure to weigh 400–600 gm., although this is very rough! Powders vary greatly in weight.

It is even less simple if the concentration of active ingredient is shown as a percentage and the dosage is expressed as weight of active ingredient required per unit of body weight (mg/kg). However, a surprising number of veterinary drugs are thus indicated, so you should learn to make these conversions to a volume of prepared medicine per unit of body weight or seek help from others in order to be able to use these medicines when it becomes necessary.

You must find out how much active ingredient is contained in 1 ml of the medicine; note that a 1% solution means 10 gm per litre or 10mg/ml. For example, if a medicine is 5% active ingredient and sold in a 50 ml vial, it contains 2500 mg active ingredient (0.05 x 50 ml = 2.5 g/50 ml = 2500 mg/50 ml = 50 mg/ml).

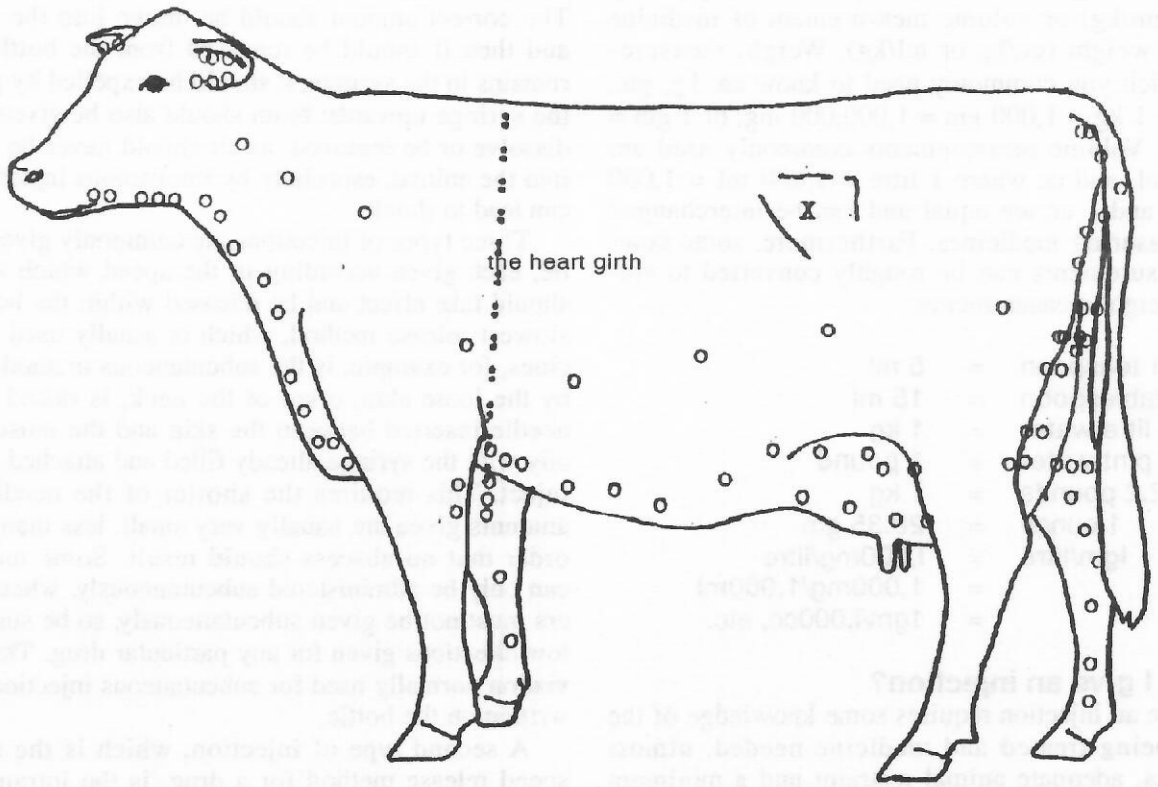
Then you must find out the weight of medicine required per kg of body weight. For example, the information may say 5 mg. active ingredient required per 1 kg body weight.

For our example let us say your animal needing treatment weighs 250 kg.

Multiply the weight of active ingredient needed per kilogram body weight (mg/kg) times the body weight of the animal (kg) which gives you the total weight of active ingredients required by the animal. Then divide this by the weight of ingredients supplied per a unit volume of the medicine (mg/ml) as follows: the amount of active ingredient needed per kilogram body weight (5 mg/kg) multiplied by the weight of your animal (250kg) or 250 x 5 = 1,250 mg, reveals the weight of active ingredient needed for your animal.

Divide this by the concentration level of the active ingredient by volume: since a 5% solution contains 50 mg/ml in the bottle, divide 1,250mg by 50mg/ml = 25 ml or 25 cc are needed for your animal. (It may be helpful for some to recap that certain measurements are by weight and others by volume.)

Body weights are usually expressed in kilograms (kg). Most medicine strengths are indicated by a certain weight measurement per certain volume measurement (mg/ml). However, dosage rates are written three ways: sometimes given as a weight measurement of active ingredient of a medicine per body weight measure



Key:

O — areas on cattle where ticks are often found. Be sure to spray these areas well.

X — the area on the LEFT side of cattle where, if necessary, it may be punctured to release air or foam in the case of acute bloat.

: — the heart girth where the measuring tape should be drawn around a cow/calf in order to estimate weight of cattle.

Length		Approximate weight	
If it is	65cm (25")	the weight is	35 kg
"	70cm (28")	"	35 kg
"	75cm(30")	"	40 kg
"	80cm (32")	"	45 kg
"	85cm (34")	"	55 kg
"	90cm (36")	"	65 kg
"	95cm (38")	"	75 kg
"	100cm (40")	"	90 kg
"	105cm (42")	"	105kg
"	110cm (44")	"	120kg
"	115cm (46")	"	135kg
"	120cm (48")	"	150kg
"	125cm (50")	"	170kg
"	130cm (52")	"	190kg

Length		Approximate weight	
If it is	135cm (54")	the weight is	215kg
"	140cm (56")	"	240kg
"	145cm (58")	"	265kg
"	150cm (60")	"	295kg
"	155cm (62")	"	325kg
"	160cm (64")	"	355kg
"	165cm (66")	"	385kg
"	170cm (68")	"	415kg
"	175cm (50")	"	455kg
"	180cm (50")	"	500kg
"	185cm (50")	"	550kg
"	190cm (50")	"	600kg
"	195cm (50")	"	655kg

(mg/kg), or weight measure of actual medicine per body weight (gm/kg) or volume measurement of medicine per body weight (cc/kg or ml/kg). Weight measurements which you commonly need to know are kg, gm, mg where 1 kg = 1,000 gm = 1,000,000 mg, or 1 gm = 1,000 mg. Volume measurements commonly used are litres(l), ml, and cc where 1 litre = 1,000 ml = 1,000 cc.; 1 ml and 1 cc are equal and can be interchanged when measuring medicines. Furthermore, some common measurements can be roughly converted to volume or weight measurements:

1 teaspoon	=	5 ml
1 tablespoon	=	15 ml
1 litre water	=	1 kg
1 pint water	=	1 pound
2.2 pounds	=	1 kg
1 ounce	=	28.35 gm
1gm/litre	=	1,000mg/litre
	=	1,000mg/1,000ml
	=	1gm/1,000cc, etc.

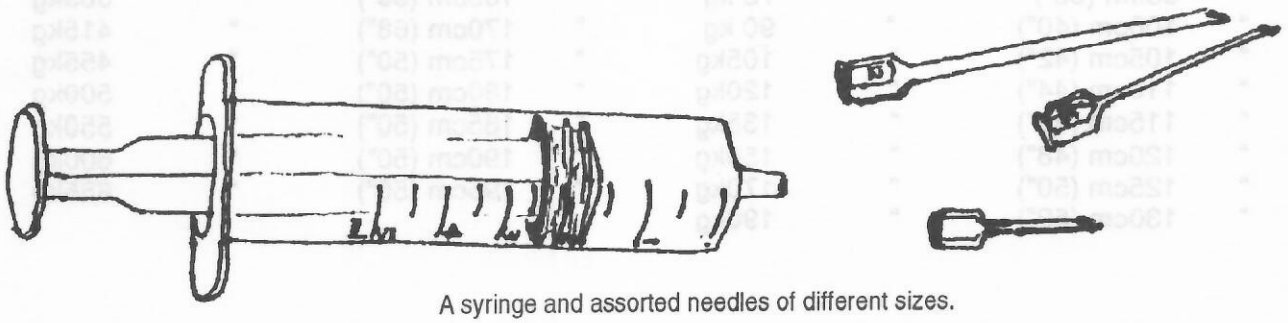
How do I give an injection?

To give an injection requires some knowledge of the disease being treated and medicine needed, utmost cleanliness, adequate animal restraint and a minimum amount of equipment. Plastic, reusable syringes of 12 cc or 20 cc are usually preferred because they are the right capacity for most treatments, can be sterilized after each use and then reused, and yet are less prone to breakage from being dropped or mishandled. New, sharp needles of 12 to 16 gauge of 2.5–3.5 cm length (one to one and a half inches) for adult animals and 18–20 gauge of 2.5 cm length (one inch) for calves should be used. For slow, intravenous injections of large amounts of medicine, you may also require a special intravenous tube adapted for the purpose of slow release of the medicine from the bottle to the vein.

The correct medicine, which should not have expired, is usually drawn into the clean syringe by first puncturing the rubber stopper in the bottle, injecting a small amount of air into the bottle, then inverting the bottle and drawing the medicine down into the syringe by pulling down the plunger. It may be beneficial to inject it back into the bottle, and then draw it anew into the syringe, in order to emit any air from the syringe. The correct amount should be drawn into the syringe, and then it should be removed from the bottle. If air remains in the syringe, it should be expelled by pointing the syringe upwards; foam should also be given time to dissolve or be removed, as air should never be injected into the animal, especially by intravenous injection as it can lead to shock.

Three types of injections are commonly given to cattle, each given according to the speed which the drug should take effect and be released within the body. The slowest release method, which is usually used for vaccines, for example, is the subcutaneous method, whereby the loose skin, often of the neck, is raised and the needle inserted between the skin and the muscle, usually with the syringe already filled and attached ready to inject. This requires the shorter of the needles, and amounts given are usually very small, less than 5 cc. in order that no abscess should result. Some medicines can only be administered subcutaneously, whereas others must not be given subcutaneously, so be sure to follow directions given for any particular drug. The abbreviation normally used for subcutaneous injection is s.c., written on the bottle.

A second type of injection, which is the medium speed release method for a drug, is the intramuscular injection, whereby the medium length needle is poked into one of the muscled areas as shown in the drawing, usually prior to attaching the filled syringe, ready for injecting. It is best not to push the needle in slowly but to seize the needle between your thumb and fore finger tightly as a fist, and poke it in as if it were a nail being pounded by your fist acting like a hammer. If blood oozes out of the needle, remove it and poke it in again so that the medicine will not enter the blood vessel directly. The syringe should then be attached and the medicine given, with no more than 10 cc. per injection site for mature cattle, and no more than 5 cc. per injection site for calves. The abbreviation normally used for intramuscular injections is i.m., written on the bottle. A third type of injection which releases the medicine into the bloodstream directly in the shortest time is the intravenous injection which perhaps requires the most skill. A longer needle is required, and the vein, usually the jugular vein on the neck, must be found by restrict-



A syringe and assorted needles of different sizes.

ing the flow of blood using one of various methods such as pressure of your fingers on the vein, or tightening a string around the neck. It is usually found more easily if you wet the skin. The needle then must be inserted, and blood should flow through the needle prior to attaching the syringe, to ensure that you have found the vein. As the medicine can quickly travel to the heart or brain to cause shock, it is important that it be injected slowly into the vein. If the animal has disturbed the process so that the injection begins to produce a swelling beside the vein, it is obviously no longer going into the vein. At this point you must find the vein again before proceeding. Again, certain drugs should be administered by this method, whereas others must not be given this way. The abbreviation normally used for intravenous injections is i.v., written on the bottle.

How do I use a canula/knife to puncture the rumen for bloat?

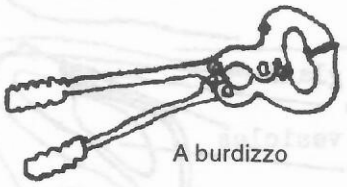
In severe cases of bloat when other steps are no longer possible to save the animal, it may become necessary to puncture the rumen of a cow in order to save it. The illustration shows where, as a last resort, the rumen may be punctured on the left side of seriously bloated cattle, using a trocar and canula or a knife. When using a trocar, the canula should be left in the puncture opening to help gases to escape until the critical period is over. When using a knife, puncture the rumen and then give the knife a quarter turn in order to create an opening for gas or foam to escape. The advantage of a canula is that it can be easily left in the cow until the condition stabilizes, although it may require unclogging when rumen contents block the air passage. Usually healing of the puncture wound takes place without any therapy, although antibiotics may be occasionally required.

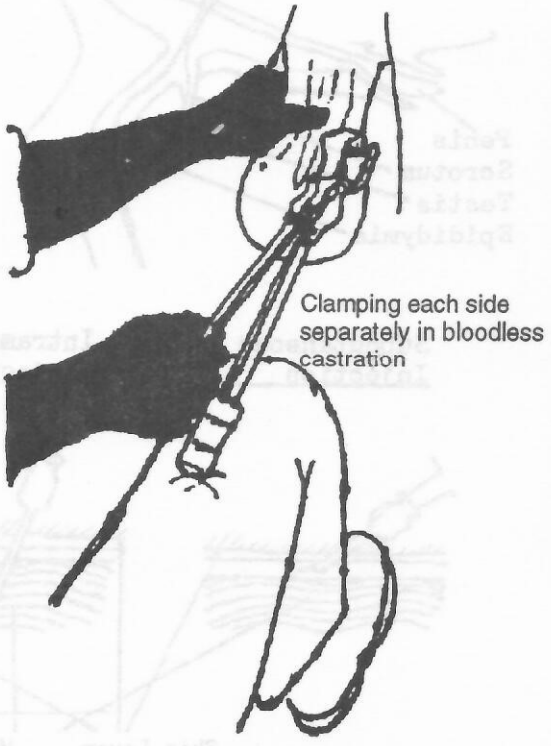
There are other measures to take prior to stabbing cattle; it may be possible to prevent or treat bloat by many less drastic methods which are described in the section on health care under 'Bloat'.

How are bulls castrated?

Bulls which are kept but not wanted for breeding purposes are usually castrated by one of two methods: bloodless castration, done at any age beyond 8 months, using a burdizzo which severs the blood vessels to the testicles causing them to atrophy; or surgical removal of the testicles, usually best done at a younger age of between 4–6 months. Both operations are best done by qualified livestock staff or under their direction to avoid post-operative infections or incomplete castrations caused by improper procedures.

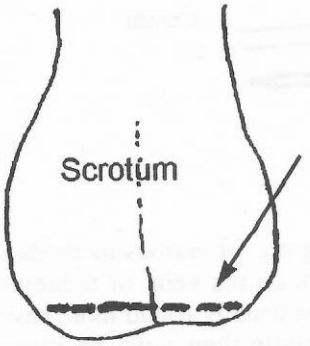
In bloodless castration, the testicles degenerate by the restricted blood flow caused by crushing the arteries in the spermatic cords attached to the testicles without damaging the scrotum. The bull must be adequately restrained so as not to harm either himself or the attendant. This process is more easily performed on young bulls than mature bulls, although larger sized burdizzos are available for larger animals. Working on one side at a time so as not to damage the blood supply to the scrotum in the center, pull the testicle down and work the cord to the outside of the scrotum as you spread the burdizzo over the cord on one side only. Close the burdizzo just below the bull's false teats until it clicks shut and wait for three seconds, open it slightly and adjust its position down the scrotum slightly before closing it again in order to ensure adequate pinching of the cord has been done. Care should be taken not to pinch the center part of the scrotum which can lead to infection of the whole scrotum.


A burdizzo

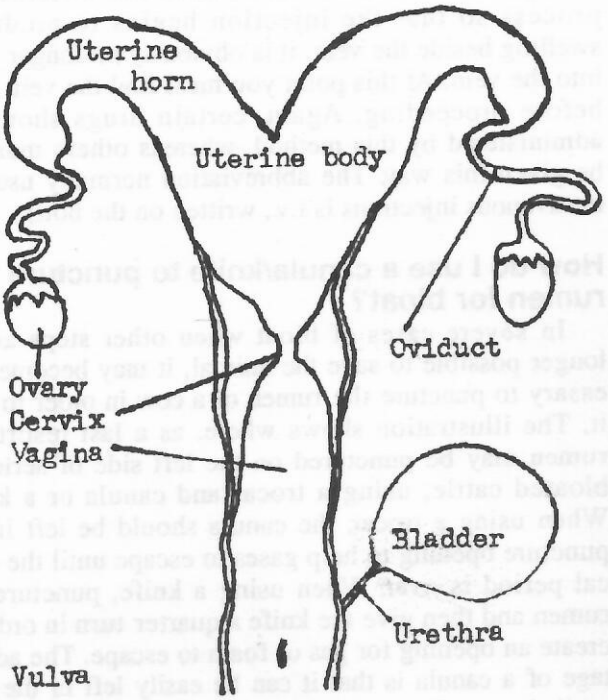

Clamping each side separately in bloodless castration

A similar operation should be done on the other side of the scrotum. Finally, the testicles can be squeezed upward above the place which was squeezed and the bull released without further care.

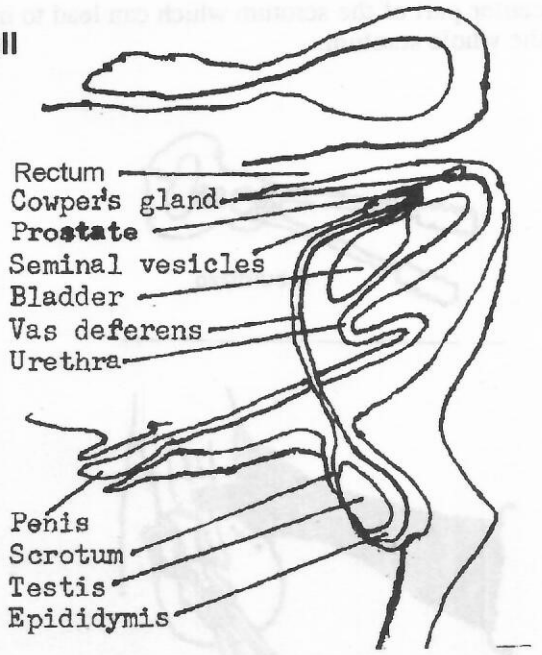
In surgical removal of the testicles, the scrotum is first washed together with the surrounding area using water and disinfectant. The skin of the scrotum is stretched by squeezing the testicle downward and is slit with an unused razorblade or surgical knife, large enough only for the testicle to be pressed out; they are removed together with the spermatic cords which are merely pulled out until they break. No suturing (sewing of the cuts) is required; it will normally heal within two weeks. To prevent subsequent infection it is good to apply iodine solution, and flies must not be allowed to lay their eggs in the wound; a fly repellent such as pygrease or pine tar must be applied near to the wounds if flies are present. If this method is used for older bulls, it may be necessary to suture the spermatic cords to stop bleeding.

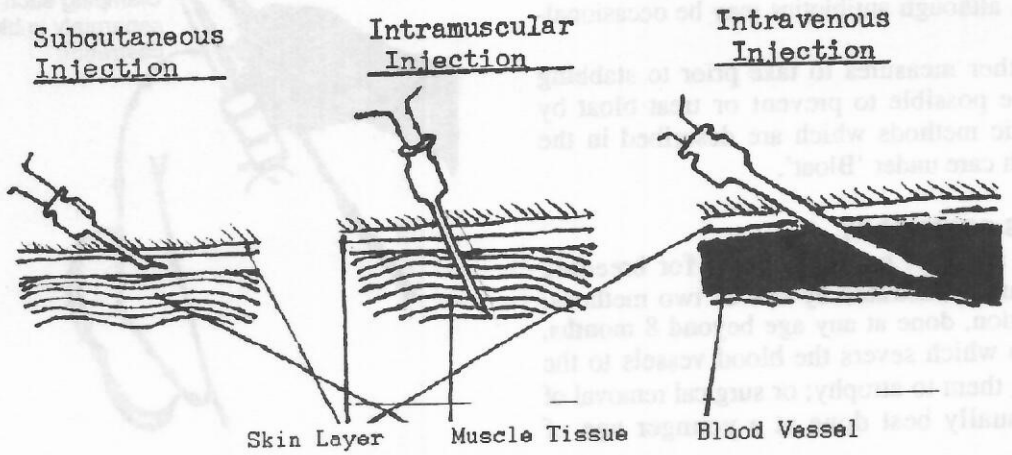


A cow



A bull

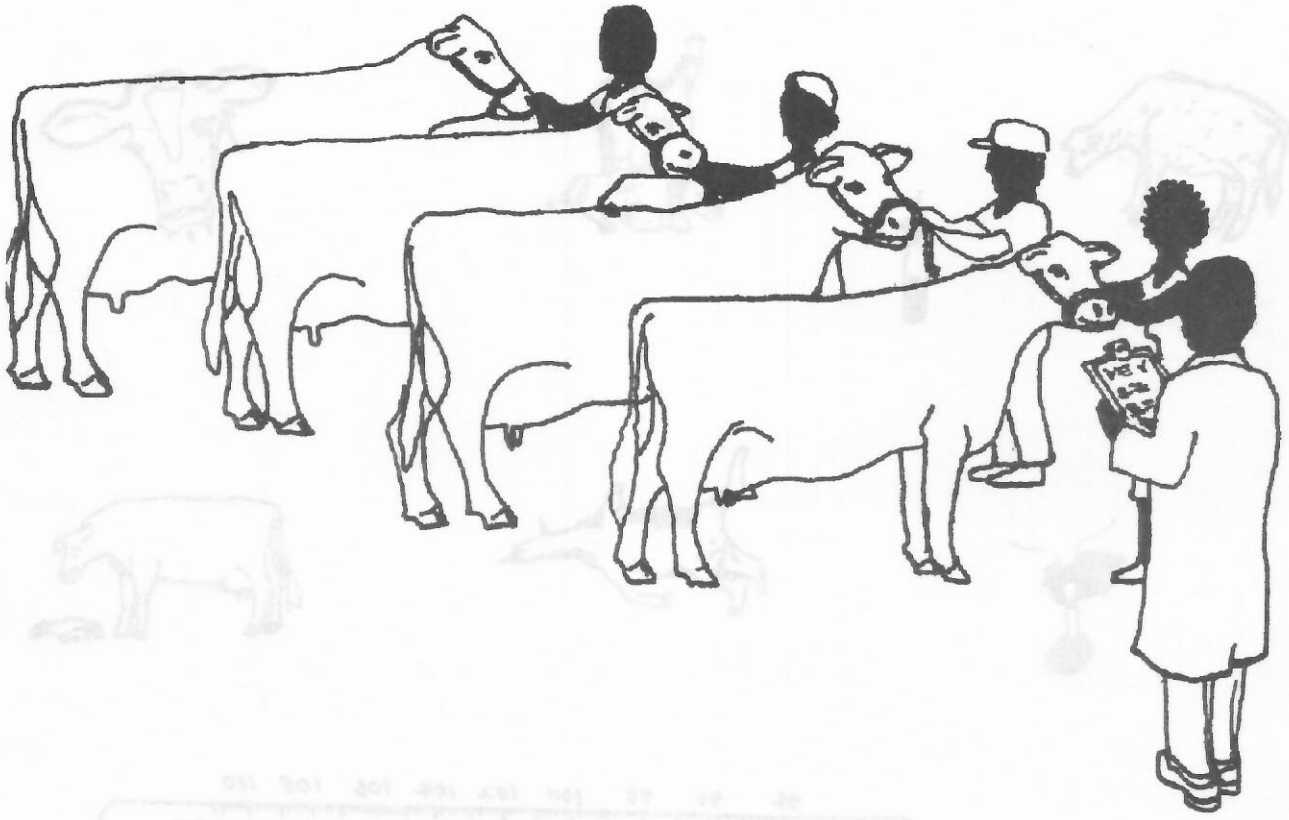




How are cattle prepared for show competitions?

Several key ingredients make up proper showing of cattle, and attention to detail in the supply of each ingredient makes the difference in successful or unsuccessful showing. The ingredients are as follows:

- Cattle are judged in four main areas: dairy character (milk-producing attributes), body capacity (ability to consume and convert much forage into milk , general appearance (no defects, conformation to the ideal type), and udder quality. Select a quality animal which conforms to the ideal type of that particular breed. Biggest is not always best, although it often is given preference if other matters are not lacking. A cow should show a capacity for eating much, have a large, well formed udder, and not be too fat or thin. Notice the shape of the ideal which increases as you progress from the shoulders toward the rear end. It should be wide at the rear, with a high udder attachment, and a straight backline. It should have a feminine appearance, with strong legs and hooves widely spaced on the ground. Teats should be of medium length and evenly spaced, preferably pointing inwards or straight downwards rather than forwards or sideways. To succeed in showing cattle, one must become a successful judge, and this comes through practice.
- Accustom the cow to handling, by first teaching her to be led by a halter as is described above. Brush her often which will endear her to you, and finally, starting a few days prior to the show, shampoo the animal several times to make it shine. Be sure the hooves and tail are trimmed if needed. Ensure that the cow will be in a clean, well bedded place with adequate feed and water, and milked on time. Show people usually are reluctant to milk out a show animal completely prior to the judging time, so as to give the cow that great appearance of a full udder of milk. Take care that you do not start a mastitis case by failing to milk your cow! Make sure that the cow is used to you and is obedient to the pull of the halter. As a showperson of animals it is always wise to take care for your own appearance as well, not to excess, but not to shame the cow either!



HEALTH CARE:

What are common health problems of dairy cattle?

Before beginning this discussion it is wise to mention that healthy livestock are not merely those free of disease, but those which are in healthy enough condition to produce as much benefit as their potential makes possible. Thus, disease is defined as any condition preventing an animal from being productive. Therefore, we shall include malnutrition, which is not only the most common 'disease' condition found on small holder farms but is the major cause of other diseases which attack their livestock. From this brief discussion it can be concluded that if we can prevent malnutrition, we can thereby prevent a number of other diseases from affecting our livestock.

Why is prevention better than cure?

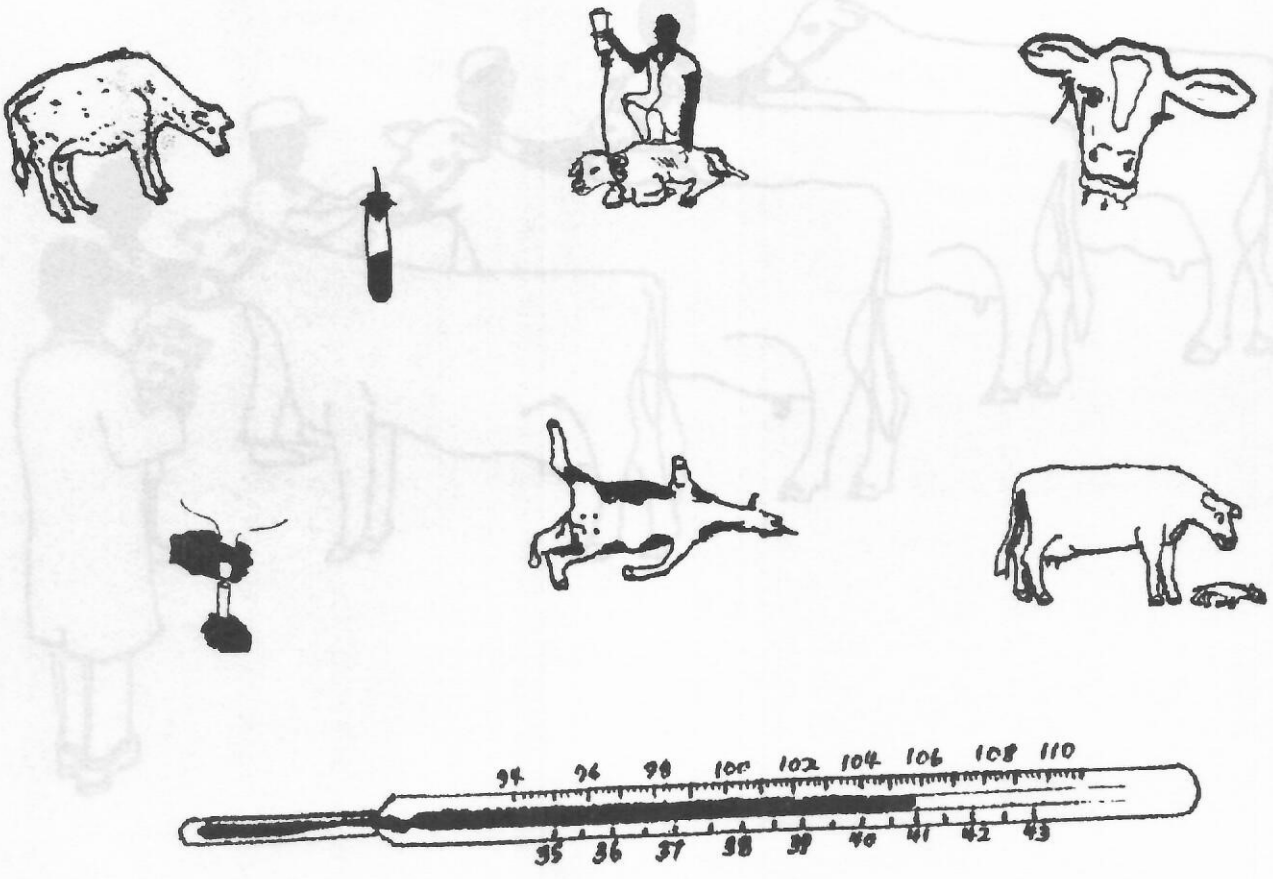
If we can prevent disease, we can reduce the costs of treatments and the losses of productivity and livestock deaths which diseases cause. Preventive measures are virtually all cheaper than cures, and cures are not always successful. However well we try to prevent diseases, they sometimes cannot be avoided; the successful livestock keeper is not the one whose livestock never get sick, so much as being the one who reduces the incidence of disease, the losses which they cause, and recovers from those losses, learning along the way preventive measures to ensure a better future.

What are the signs of illness?

An important part of knowing what the signs of illness are is to learn to observe signs. Often a farmer knows something is wrong before s/he knows what exactly is different, as if there is an intuition which can be developed to feel when something is wrong even when the animal cannot communicate anything such as where it hurts. In order to help the one giving the treatment to know what is wrong, it is helpful if the farmer can learn to make observations of what is wrong. This can be learned if the farmer learns the signs of good health.

A description of healthy cattle should include the following:

The farmer can observe whether the general appearance of the animal shows it to be in good flesh or body weight, calm but able to react to stimuli such as noise or rousing, able to get up, to walk, to breathe quietly and effortlessly, to move without pain and to mingle



Class of Cattle	Normal temperature degrees F.	degrees C.	Heartbeats per minute	Breaths per minute
Young calf	102.5	39.2	110	50
Weaned calf	102.5	39.2	95	30
Yearling	102.0	38.9	90	25
Mature cow	101.5	38.6	50	15

normally with other animals. There should not be obvious wounds or rashes on the skin, and the haircoat normally should be smooth and shiny. The cow should be eating or ruminating normally. Its ears should be alert, and its nose moist with small droplets. It should be evident if the animal is in advanced pregnancy.

By physical exam, it should have a normal temperature (measure with a thermometer inside the rectum—see the section under using a thermometer). It should have a normal heartbeat (grasp the tail near the rectum and sense the pulse beat of the blood vessel in the groove).

It should have a normal respiration rate.

There should be no mucous or puss being emitted from eyes, ears, nose, mouth, vulva or other body orifice. There should be no unusual odor from these orifices. The rumen should show some movement two or three times per minute; if it cannot be seen, it can be felt by compressing the fist into the area on the left flank where the trocar would be used in the case of bloat. The udder should not be swollen irregularly, hot or off-color, and the teats should be intact, not swollen, cracked or wounded. The milk should be able to be extracted easily without discomfort to the cow, and should be a normal white color and of a fairly constant amount each day. The animal should be able to freely urinate a clear, yellowish urine and the faeces (manure) should be neither too loose, too hard, of unusual color, bloody or of a peculiar smell. The animal should not show dehydration, which can be tested by grabbing a fist fold of the skin on the neck and observing if it returns rapidly to its original place or remains in a pinched position indicating dehydration. A physical examination may include a pregnancy examination. The description of a healthy cow can include a brief examination of the animals' surroundings to note that there are no abnormalities, pests or dangers which could cause disease or injury, and that adequate feed and water, shelter, exercise and rest area are avail able.

What is a recommended vaccination regime?

Vaccination regimes vary from place to place depending on the diseases which are prevalent in particular areas. Common diseases can be prevented and are worth the expense to vaccinate against if vaccina tions are available. It is best to consult with the local livestock office to obtain appropriate information on the needs and availability of vaccines for your particular area. Once you have learned what those diseases are it

The most common diseases for which immunizations regularly should be done for cattle are the following:

Disease	Class of cattle/age	Frequency
Foot & Mouth Disease	All cattle	Every 6 months
Haemorrhagic Septicaemia	All cattle	Every 6 months
Blackquarter	All cattle	Once per year
Anthrax	All cattle	Once per year
Brucellosis	Calves @ 6 months	Once, then again... @ 2 years if there is outbreak
Lumpy Skin Disease	All cattle & calves	Once per year
Rinderpest	All cattle	Once at 6 months age Once again at maturity
Trypanosomiasis	All cattle (not a vaccine)	Depending on the area

is best to keep close contact with the livestock office to alert them to your interest to maintain vaccinations up to date. This will help you to keep abreast of the schedules for vaccination campaigns and ensure that you are included. It will also encourage the livestock office to maintain the necessary vaccines in stock, as occasionally they are available but unused due to lack of general interest, and thus they expire in storage.

Vaccines are developed or being developed for many other diseases such as the tickborne diseases Babesiosis and East Coast Fever, or other diseases such as Bovine Pleuropneumonia, Johannes Disease, certain kinds of Mastitis, Coccidiosis in calves, and Rabies, but the effectiveness of some vaccines is still being improved whereas others are only used in special cases, and in general, they are not readily available for routine use.

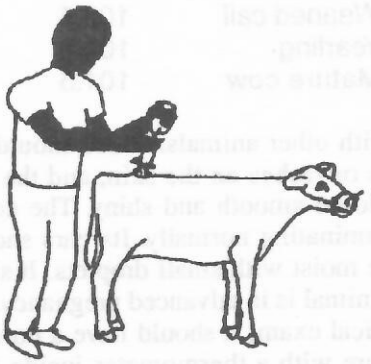
What are other helpful disease prevention measures?

Deworming: Internal parasites, especially the liver flukes and round worms, are the most frequent debilitators of young calves, and the cause of general weakness, unthriftiness, poor growth rates and eventual death of thousands of smallholders' livestock each year. This is unfortunate because by simple, regular treatment of cattle, particularly young calves, with dewormers appropriate to the area, this can be controlled. In addition, it is important to feed clean fodder in troughs whereby the calves/cattle cannot trample and defecate on their feed. This will help to break the worm cycle. For those cattle which are allowed to graze, it is best to rotate pastures frequently, with rest periods of at least 6 weeks for pastures, to decrease the worms in the pastures. It helps to carry water to the cattle rather than drive them to water where they ingest worm eggs, especially of liver flukes. But the only way to control worms effectively is by regular deworming. Several new compounds are now produced, some injectable, others which are broad-spectrum and able to kill a wide variety of worms, others which are specific to a particular type of worm. See the diagnostic chart for more specific description of dewormers against the various kinds of worms.

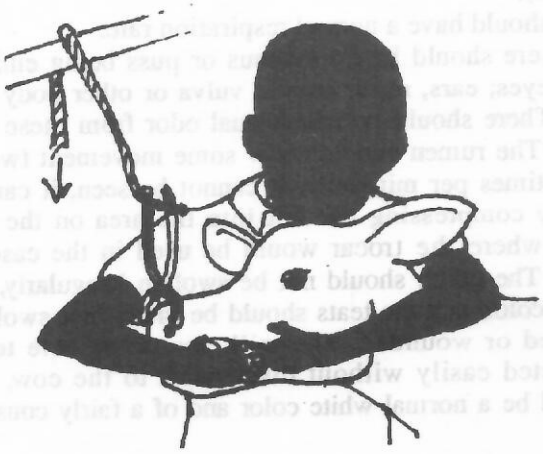
Tick and tsetse control: External parasites are many, but by far the most losses in cattle in East Africa are caused by diseases transmitted by various kinds of ticks and the tsetse fly. There are various methods to counter these, one of which is the adherence to strict zero-grazing/stall-feeding which reduces the opportunity for ticks to come in contact with cattle. There are various chemicals being used to control , some of which are effective against both ticks and tsetse fly, and are mentioned under the section on how to spray against ticks. In the next section, the diseases are highlighted, and a review of chemicals being used against them is given.

We have already highlighted many disease preven-

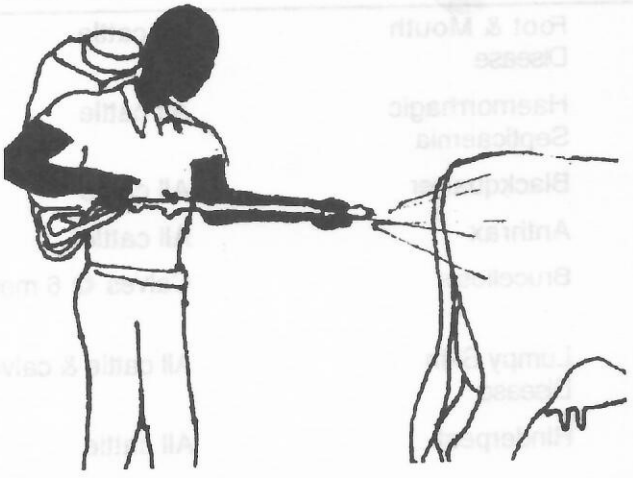
Important Preventive Health:



Vaccination programs help control and eradicate disease.



Deworming should be done periodically on all stock, especially young stock at greater frequency.



Tick control measures are usually cheaper than cures.

tion measures in various sections of this booklet: the importance of clean, well-designed housing and environment, proper milking techniques, care during calving time and afterwards, care for the calf in its early life and beyond, the importance of adequate, balanced feeding, artificial insemination, methods to reduce stress on animals and still increase their production, and early awareness of diseases. These are all summed up as tender, loving care of animals which will pay off, in that as you care for your cattle, so will they be able to take care of you.

What are some common diseases, with symptoms, treatments?

Disease	Symptoms	Prevention	Treatment
Malnutrition	Thin, sickly, dull haircoat; little energy; swollen stomach; anaemia; low milk	Balanced feeding and deworming	Balanced feed; deworming
Liver flukes (*)	Weight loss; low apetite; diarrhea; anaemia	Regular deworming; do not drive to river but carry water to cattle	Regular deworming (e.g.: NILZAN)
Lung worms (*)	Coughing; no fever; slow growth	Regular deworming	Regular deworming (e.g.: NILVERM)
Roundworms (Large) (*)	Only in calves; slow growth & unhealthy, blocked intestine or scours	Regular deworming	Regular deworming (e.g: PIPERAZINE)
(Small) (*)	Anaemia; diarrhea; poor apetite; swollen stomach	Regular deworming; keep from trampling feed; cleanliness	Regular deworming (e.g.: NILVERM)
East Coast Fever (E.C.F.) (*)	High fever; swollen glands; muccous from mouth constipation	Tick control & vaccination being developed (e.g.: BACKDIP)	Early treatment (e.g.: CLEXON and TETRACYCLINE)
Heartwater (*)	Runs circles & falls down; high fever; off feed	Tick control (e.g.: BAYTICOL)	Early treatment (e.g.: TETRACYCLINE)
Babesiosis (Redwater) (*)	High fever; Bloody urine; off feed	Tick control (e.g.:SUPONA)	Early treatment (e.g.: BERENIL & TETRACYCLINE)
Anaplasmosis (*)	High fever; off feed	Tick control (e.g.: DELNAV)	Early treatment (e.g.: TETRACYCLINE)

Disease	Symptoms	Prevention	Treatment
Trypanosomiasis (Trypse) (*)	Wasting away; anaemia; frequent fever	3 to 6 month injection with (e.g.: SAMORIN) if endemic	Inject with (e.g.: BERENIL or NOVIDIUM or others)
Foot & Mouth Disease (F.M.D.) (*)	Mucous from the mouth; wounds on mouth hooves, teats; off feed	Regular vaccination at 6 months intervals	None, treat the wounds & fever, if any, w/ antibiotics
Footrot (*)	Sores on feet; lameness with swelling & pus	Avoid possible foot injuries; trim hooves; dry feet, no mud	Clean & trim hooves; treat with (e.g.: PENSTREP)
Haemorrhagic Septicaemia (H.S.) (*)	High fever; difficult breathing; salivating; cannot swallow	Regular vaccination at 6 month intervals; isolate from healthy cattle	Treat with (e.g.: TETRACYCLINE)
Tuberculosis (**)	Varies; maybe coughing or wasting; diarrhea or abscesses	None, slaughter of infected animal; burial; testing of animals	None
Pneumonia (*)	Similar to H.S. above	Keep out of wet & cold draughts	Treat with(eg: TETRACYCLINE)
Lumpy Skin Disease (*)	Small bumps or abscesses all over body; high fever; off feed	Regular vaccination at 6 month intervals	None, treat wounds and (e.g.: TETRACYCLINE)
Anthrax (**)	High fever; difficult breathing; sudden death & black blood from mouth & anus	Regular vaccination yearly, treat other exposed animals with TETRACYCLINE or PENNICILIN in high doses; DO NOT DO POST-MORTEM; BURIAL with care	None unless detected and treated very early
Blackquarter (*)	Lameness; high fever; swollen leg with air pockets under skin; difficult breathing	Regular vaccination yearly; treat other exposed animals with TETRACYCLINE or PENNICILIN in high doses; DO NO POST-MORTEM; BURIAL with care	None unless detected and treated very early
Tetanus (**)	Stiffness in jaw, neck, tail and unable to open mouth	Dip navels of newborne calves; good sanitation; BURIAL	Treat with (e.g.: PENNICILIN)

Disease	Symptoms	Prevention	Treatment
Malignant edema (*)	Same as for Blackquarter but swellings are filled with fluid	Regular vaccination yearly, and preventively treat exposed animals as with Blackquarter; BURIAL	None unless detected and treated very early
Rinderpest (*)	Fever; discharge from mouth & eyes; off feed; cough and diarrhea; sores on mouth, nose & tongue	Vaccination at 6 months age & again at maturity	None; no response to treatment
Brucellosis (Contagious abortion) (**)	Abortions at 5-8 months gestation and retained placenta, or no obvious signs	Vaccination at 6 months, and again at maturity; Bury dead fetus and slaughter of infected cattle is advisable; pasteurize milk	None; humans can be treated with Tetracycline in high doses
Infertility (*)	Silent heats or no signs of heat or frequent heat periods of short duration; repeat breedings	Improved feeding of balanced rations, careful attention to heat detection and the dates/times of heats; early treatment of infections of reproductive tract	Together with preventive steps, put cow with bull, or manual stimulation of ovaries, or hormone injections; treat infections with antibiotics or antiseptic cleansing
Retained Placenta (Retained aftebirth) (*)	Afterbirth remains inside the cow; foul smell & wasting shortly after calving	Adequate nutrition; sanitation at time of calving when being helped; let calves suckle until it comes out	Treat with antibiotics (e.g.: SULFA, TETRACYCLINE); Manual removal of placenta if necessary
Infection of the uterus (*)	Discharge of pus or other material from vulva; smell from vulva	Use disease-free bulls; sanitation at time of calving if being helped	Uterine irrigation (washing); treat with antibiotics (e.g.: TETRACYCLINE)

Disease	Symptoms	Prevention	Treatment
Prolapsed Uterus or Vulva	After calving, cow continues to strain & pushes reproductive organs out also	Calving on level floor; cow to stand up after calving or lying facing downhill; good supervision at time of calving water solution	Immediately getting replaced by washing with cold water and pushing it carefully back inside; soak in sugar- to reduce swelling if necessary
'Milk fever'	(See earlier section in this book on CALVINGS: What do I do if the cow cannot stand?)		
Ketosis	(See earlier section in this book on CALVINGS: What do I do if the cow cannot stand?)		
Obturator nerve	(See earlier section in this book on CALVINGS: What do I do if the cow cannot stand?)		
Calving paralysis	(See earlier section in this book on CALVINGS: What do I do if the cow cannot stand?)		
General weakness	(See earlier section in this book on CALVINGS: What do I do if the cow cannot stand?)		
Mastitis (*)	Inflamed udder; off-color milk; clots in milk; fever; off feed; red/painful udder	Clean housing; proper milking technique; milk out completely or let calf suckle; wash udder with anticeptic solution after each milking; good	Clean udder; repeated milking of affected teats every 2–3 hours; wash udder with warm then cold water; treat either with intramammary infusion or injection of (e.g.: PENSTREP or TETRACYCLINE)
Calf scours (*)	Diarrhea with mucous or abnormality; dehydration; often compounded with pneumonia	Clean calf housing; clean milk feeding; regular deworming; clean feeds & water; not feed too much milk	Stop feeding milk until it recovers; orally give water & salt/glucose or intravenous; treat with antibiotic (e.g.: SULFADIMIDINE)
Coccidiosis (*)	Bloody diarrhea	Same as for calf scours above	Same as for calf scours above

Disease	Symptoms	Prevention	Treatment
Naval ill (*)	Off feed; pain at urination; pus and swelling at naval	Dipping naval in iodine at birth; observation of naval often	Cleaning with antiseptic; removal of maggots; use ointment (e.g.: SULFA)
Wounds	Fresh cuts	Clean wound with disinfectant (e.g.: SALVON) or clean, boiled water. Shave hair around cut. Decide whether to stitch or tape. If tape, apply antibiotic ointment or powder and then put on bandage if it can stay dry. If not, it is best to leave open. Protect from flies by putting repellents (PYGREASE) near to but NOT ON the wound.	
Wounds	Punctures	If the wound is deep (puncture), treat as above but leave open. Then treat with antibiotic injections (e.g.: PENNICILIN)	
Abscesses (*)	Lumps or swellings under the skin or in the muscle; open wounds oozing fluids or pus	Use of clean needles for injections; tender,loving handling of cattle remove any dangerous nails, obstacles from the shed; vaccinate against Lumpy Skin Disease if prevalent in the area; if LSD infects cattle, prevent abscesses by treating with antibiotics, and give good feed & water	Give animal IM antibiotic; do not puncture abscess early until it has become soft & ready; when it is open(ed), clean out pus; any other dead skin or maggots; treat with (e.g.: PENNICILIN); keep wound open, to heal from within
Ringworm (*)	Round, dry area on skin; hair loss; grayness	Clean, dry cattle sheds; isolate affected animals	Treat with IODINE or any FUNGICIDE
Pinkeye (*)	Tears; eye inflamed, red	Clean cattle sheds; reduce flies, dust; if neglected, it may turn pink or blind	Cleanse eye with saltwater and eye ointment (OPHTHALMIC)antibiotic

Disease	Symptoms	Prevention	Treatment
Poisonings	If the animal has apparently eaten a poison, and is undergoing pain, with symptoms of not ruminating, try to induce diarrhea or vomiting. If you suspect it to be nitrite (urea) poisoning (difficult breathing, blood a brown color):		If swallowed, give MAGNESIUM SULFATE with WATER; Give intravenous injection of solution of NEW METHYLENE BLUE
	If you suspect organophosphate poisoning (will show tears, salivating, urinating and defecating):		Give ATROPINE SULFATE injection
	If you suspect snakebite (swollen wound, difficult breathing, shock, salivating, sweating):		Give STEROIDS and Antibiotics. Antivenoms & tourniquet if limbs are bitten to slow venom movement within the body
Allergies	If the allergy has affected the breathing or there is swelling in the throat, try to determine the cause and remove it from the cow:		Treat with ANTIHISTIMINES or STEROIDS
Bloat	Off feed; rumen swollen hard; no rumination; animal may lie down and swell up; die quickly	Prevent animal from eating too lush feed (fresh legumes can be dangerous); feed dry feed prior to giving fresh feed	Give mineral oils; make it run if it can; puncture rumen with a trocar or knife if necessary
Rumen Impaction	Off feed; rumen packed, hard; no rumination; animal in pain; fermented grains	Prevent animal from over-eating dry feeds without water; avoid half-lots of water	Force feed with water and magnesium sulfate or oil
Wooden tongue (*)	Cow cannot chew due to swollen tongue; saliva runs non-stop	Hard to prevent; sanitation; treat mouth wounds (?)	Treat with (e.g.: PEN-STREP or SODIUM IODIDE)
Shock	Weak pulse; inactivity; cold body temperature; vomiting; rapid breathing	Prevent blood loss; keep it warm; keep the animal calm; do not give water until recovered	Open air passageways; give STEROIDS & rehydration by intravenous injection

Disease	Symptoms	Prevention	Treatment
Johne's Disease (*)	Smelly diarrhea which does not respond to any treatment; cow wastes away	Isolation of sick cattle; quarrantine affected farms and slaughter affected animals	No treatment
Rabies (**)	Wildness, aggression; progressive paralysis; death	Control of rabies carriers; slaughter; vaccination if there is an outbreak	No treatment

(*)—infectious diseases which can readily pass from cow to cow, and require care to prevent passing through the herd or to neighbors' cattle; includes those passed by internal or external parasites and infections which can be passed by contaminated environment or dirty needles

(**)—infectious diseases which are dangerous also to man, and require extreme care to prevent them from passing to humans

NOTES: The treatments recommended are only given as examples, and for many diseases, there are many medicines which are effective. The author thinks it is beyond the scope of this manual to train on the forms and uses of all the common medicines for cattle, but that it would be helpful to farmers to know an example of a medicine (at least the generic, not brand, name) in order to aid them to seek help or treat their own cattle in the event it becomes necessary. No intentional slighting of certain drugs or companies has been intended. Farmers are encouraged to continue to utilize qualified veterinary care when available.

FARM RECORDS:

What Farm Records are Important to Keep?

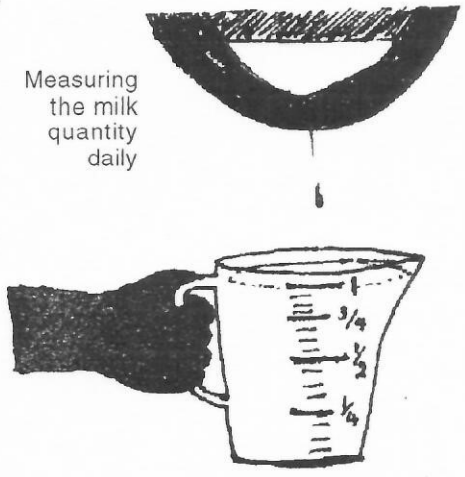
Record keeping is the oft-neglected task of the busy farmer who measures profits by intuition, losses by hunch and may often fail to recognize the actual situation without outside help. Record keeping should become a natural thing for a successful farmer who wants to know exactly the profitability of each enterprise and each animal, the pedigree information which warrants a higher price for certain offspring, the action to be taken in a timely way with regard to cattle breeding, calvings, disease immunizations, crop planting and care, and the advice which was given by the extensionist on the last visit. The following records should be kept by the successful farmer in order to remain successful:

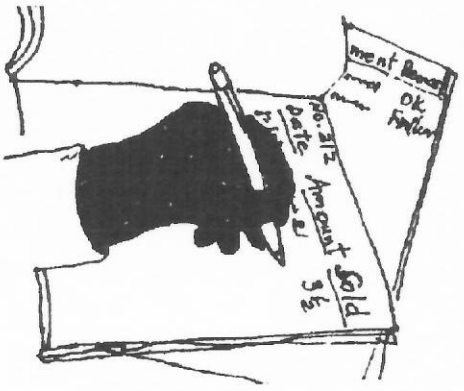
- Advice given by the extensionists/veterinarians who visit, kept in a small ledger. These will indicate to the farmer whether innovations recommended were followed and whether they worked.
- Dates of deworming, vaccinations, immunizations and treatments against diseases, kept on each animal's health card. These will aid in keeping up with the calendar for immunizations, and help to show which drugs were effective for any disease.
- Dates of heat periods, breedings, pregnancy checks, and bulls used, kept on each animal's breeding card. These are very important in order to reduce the calving intervals for more profitable dairying, and to prevent in-breeding or reuse of a poor bull.
- Dates of calvings, pedigree and numbers given to calves born, kept on each cow's record card. The pedigree proves the value of salable offspring, thus increasing the value considerably. This information also helps in keeping up with immunizations.
- Milk yields, dry off dates, lactation lengths, purchased feeds fed, and costs incurred, kept in a ledger or individual cattle card.

These will help to determine profitability and make plans.

- Milk sales and income received, milk used at home, kept in the milk yield ledger or a separate income ledger. These may be kept in confidence, but are essential to the farmer who wants to evaluate accurately the profitability of any operation of the farm or any particular animal. A key indicator for evaluation of a particular animal is milk produced per year or profit per year.
- Income and expenses of other farming enterprises, kept in the income ledger. This information will also help the farmer to know where priorities should be given.
- Action plan for yearly farming calendar and record of actual implementation. This might include a map of the farm with a design for land use now and in the future. This will enable the farmer to actively plan for the future rather than to merely react to the vague changes of the times and seasons.

Cattle records should not be locked away but put in an accessible place for the view of the extensionist/veterinarian on any unanticipated visit.





Important records: Milk records, breeding dates, sires, pregnancy checks, calving dates, identification, income and expenses, health records and advice given by specialists.

	Time	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	Total Milk	Av./ Day	Comment
JAN	am																																		
	pm																																		
FEB	am																																		
	pm																																		
MAR	am																																		
	pm																																		
APRIL	am																																		
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MAY	am																																		
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SEPT	am																																		
	pm																																		
OCT	am																																		
	pm																																		
NOV	am																																		
	pm																																		
DEC	am																																		
	pm																																		

	Milk	Number of Days
Year Total		
Lactation Total		

Cow Identification

Cow Name :	Dam : .....
Number :	Number : .....
Breed :	Breed : .....
Birth Date :...../...../.....	Sire Name : .....
Date Animal Received : ...../...../.....	Number : .....
Source :	Breed : .....

Health Record

Date	Illness/Event	Outcome

Breeding / Reproductive Information

Lactation No.: . . . . . Date Last Calving: . . . . . .

Dates on Heat				
Service Dates				
Bull / A.I.				
Breed and Owner				
Preg Check: Date & Result				
Date to Dry				
Date to Calve				

Calving Record

(ID)				Birth		Weaning 12 Mnths				
Number	Name	Sex	ID	Date	Weight	Date	Wt	Date	Wt	Remarks

Vaccinations - (When done / Due)

	TRYPS	BQ\ANTHRAX	FMD	CBPP	RINDERPEST	BRUCELLOSIS	LSD
DATE VAC'D							
DATE DUE							
DATE VAC'D							
DATE DUE							
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MARKETING:

What are some tips to profitable dairy farming?

When few people are involved in dairying and the demand for milk in a particular area is not supplied, it is unlikely that the farmer will experience any marketing problems unless the buying power of the populace is just too low. As more and more people get involved in supply, unless a corresponding growth in the demand has occurred, problems begin to occur such as costs of production not remaining in constant relation to the price; often costs go up faster than the price, and milk sales become less lucrative. In the interests of the general welfare I do not advise farmers to get the maximum price for their milk if it means making it unavailable to their immediate neighbors. However, in the interests of sustainable dairy enterprises, it becomes necessary for the milk producer to examine now and then the costs of production per litre of milk and if the margin of profit, price of milk produced minus costs, is unfavorable, some adjustments have to be made.

Three main alternatives exist, although for some desperate farmers, these do not seem like alternatives at all. Farmers are often put between a 'rock and a hard place' with little room to move. These alternatives are:

- Ask more for your milk: this implies either remaining with the same clientele but convincing them to pay more, or changing your clientele, if the law allows, by means of finding a different market, or milk product which you can sell for additional income, such as cheeses, butter, soured milk, clarified butter or other milk products. It might involve doing a bit of marketing promotion of your milk, like inviting people who do not use it to taste it, advertizing your milk availability by word of mouth or in various public/private circles, etc. It might involve working together with other milk producers to transport/market your milk in bulk rather than each producer individually.
- Reduce your costs: this implies that there may be some practices you do which are not paying off, like keeping unproductive cattle, purchasing expensive feed, suffering high health costs or cattle losses, or neglecting some key feed ingredients which would boost productivity of your cattle, such as minerals. For whatever reasons there may be which cause dairying to be unprofitable, it is less profitable for some, and still profitable for others based on attention to detail, innovations used, and degree of self- reliance/lack of indebtedness.
- Get out of dairy farming: this may not seem like a good alternative, but is a wise choice at times if conditions do not change for the better and the above two alternatives are not options.

In general, the successful dairy farmer is as self-reliant as possible with feeds because of being a good caretaker of the soil using highly productive fodders, adequately managing each aspect of the dairy so as not to incur health problems or unnecessary losses, minimizing the calving intervals of the cattle by careful attention to breeding, paying attention to sanitation and good calf care so as not to require purchase of replacement stock or incur complaints about the quality of the milk, and keeping good records as recommended in this booklet. The farmer who does all this, and still has problems with selling milk can look further for more help as indicated below:

A village group can start a milk marketing strategy.

Group efforts may be required to overcome obstacles which an individual alone cannot surmount.

MORE HELP:

What help can be found to solve problems?

Is extension or veterinary assistance required?

"Be not forgetful to entertain [extensionists], for thereby some have entertained angels unawares."—Hebrews 13:2

Agricultural extensionists and veterinarians have been trained to promote improved, relevant practices which will bring about more profitable agricultural enterprises. Although some may lack experience or may unfortunately discredit the soundness of some wise, traditional agricultural methods to the point of being offensive, they usually have good ideas which should be considered and explored so as to know whether they are likely to lead to improvements. However, farmers in some places have lost confidence in them for various reasons.

Agricultural technicians and veterinarians often are placed by the government in rural or village centres close to the people to provide services to farmers. The farmers who take advantage of these services are often fewer than would be expected, and tend to be those who can better afford to pay, or to take risks, whereas the subsistence farmer often is not able to obtain access to these services, either because of their cost, the influence needed to obtain services, and the large number of farmers compared to extensionists.

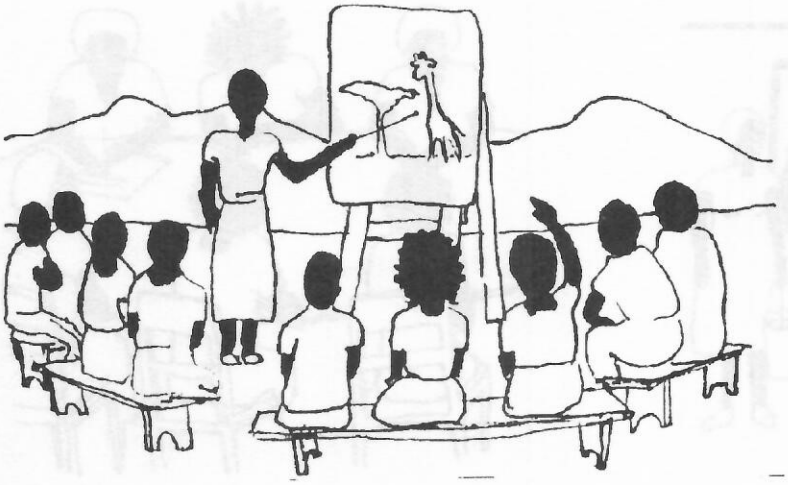
Ways which some farmers have used to obtain more assistance from qualified livestock personnel are the following:

- Becoming innovative, risk-taker farmers who follow the suggestions of these technicians or veterinarians when they visit. Most technicians will be gratified to see their advice followed, and will not hesitate to visit again. Usually a reluctance of a technician to visit again occurs not because the farmer did not give a gift to the technician, but because the farmer has not been willing to follow the advice of the technician. Have dialogue with the extensionist to show that you are willing to make changes, but that you must minimize your risk of failure.
- Forming a farmers' group to which the technician or veterinarian is invited to give a presentation. Often technicians become frustrated by their inability to find a listening ear or to make an impact when they see so many individuals requiring assistance. A farmers' group existing in a certain place indicates a general interest to advance and adopt changes/improvements. Technicians normally look for these types of opportunities to spread their message among people who will value it, and will prefer to meet with an existing group rather than try to organize a new group.
- Being willing to receive visitors to your farm will encourage your technician to bring them, and as a result, the technician will want to show that you are making progress as a result of your relationship.

How useful is on-farm training?

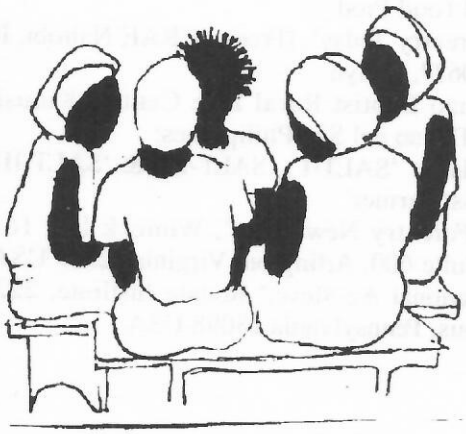
"Without counsel purposes are disappointed; but in the multitude of counsellors, they are established." Prov. 15:22

The best training that can be obtained for the farmer

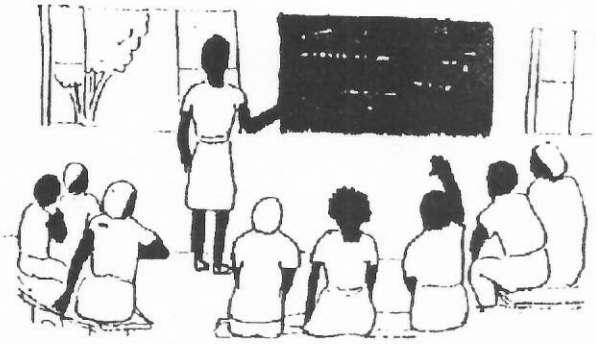


Village-based trainings allow more people to attend, concentrate on fewer topics and often bring excellent results.

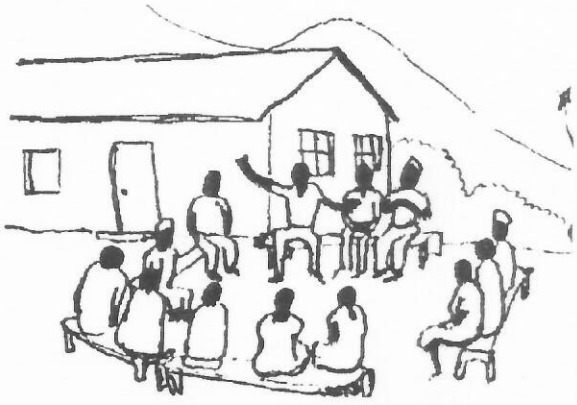
Discussion groups can motivate farmers to adopt innovations.



Discussion groups help farmers to share problems and find joint solutions.



Formal trainings allow introduction of more complex technologies.



Farmers learn most often from their neighbors by informal exchanges.

is the training given on the farmer's own farm, using direct application of the recommended innovations to the local conditions of the farm. On-farm training occurs when the farmer is visited by an extensionist, veterinarian, group of neighboring farmers or other visitors. Farmers who want to improve their production should encourage visits to their farms and take advantage of any opportunities to attend trainings within the village, as these will almost always be the most appropriate to the local conditions. Many good trainers are 'just' fellow farmers! One needs to keep an open ear and mind.

Why form a farmers' discussion group?

"Iron sharpeneth iron; so a [farmer] sharpeneth the countenance of [his/her] friend" Prov. 27:17

As mentioned above, the farmers' discussion group which meets regularly (monthly) for exchange of ideas, experiences, and plans action toward improvements to be taken jointly, has many advantages over the isolated farmer working alone. The group can better succeed to obtain visits from experts to teach on useful topics. The group can benefit from visiting members' farms to give group critiques/evaluations of members' efforts. The group can pool resources to send one member for further training, or to purchase bulk inputs. If the group pools resources, however small, they become closely knit as they learn successfully how to manage them for helping a needy member, or different members on a rotation, or for joint services.

Of what use is a farmers' association/cooperative?

"Unity is strength." A Tanzanian motto

Where farmers have learned to work together in harmony and have formed grassroots organizations to address their problems, these organizations have been able to be sustained, and successful to increase members' incomes and access to credit facilities, to improve locally available services, and to diversify into new ventures for income or service generation within their communities. Where members' individual resources are limited, these have been the only way for farmers to break out of some vicious cycles, and enter into viable enterprises and livelihoods.

In general, associations which are imposed upon farmers, or in which there is disharmony, especially with poor financial management, have no success and farmers in these circumstances are better off to go it alone. However, the benefits of group unity are so significant, it is worth it to try to reconcile differences, solve problems, and start again, for going it alone for some will only mean a spiral downwards.

Although it is beyond the scope of this book to teach

cooperative development, many forms of cooperative development assistance are given to groups to help them to start to function. It is important to formalize group by-laws which indicate purpose, rules of member ship, leadership, meetings, contributions, distribution of benefits, and even how to dissolve. Group discipline is important and democratic functioning will bring harmony. If you are not yet a member of a farmers' group, or are a member of one which does not function, consider forming a group or joining another group.

Is formal training available?

In many places farmers' trainings are conducted for various durations during various times of the year. These are often very valuable to make farmers aware of new innovations and intensive techniques which cannot be easily taught at the village level. The interested farmer should try to obtain information on the training institutions in the vicinity, and procedures for enrollment. Husbands and wives should both attend where possible, or they should agree as to who would best benefit from the training. Often the one who is closest to the day-to-day operation is the one most appropriate to attend the course, and many times that means the wives should attend.

What other resources are available?

Periodicals are often helpful to keep abreast of new findings and innovations which can improve the productivity and livelihood of the smallholder farmer, and increase the integration of other activities which benefit also the environment. Some English language periodicals and materials which the author considers useful are listed below:

'The Exchange Newsletter, (Free), Heifer Project International newsletter, P.O Box 808, Little Rock, Arkansas 72203, USA

'The ECHO Development Notes, (Free), 17430 Durrance Rd, North Ft Myers, Florida 33917 USA

'World Neighbors in Action', 5116 N. Portland Ave., Oklahoma City, OK 73112 USA

'Small Farm Newsletter', CUSO, 17 Phaholyothin Golf Village, Bangkhen, Bangkok 10900, Thailand

'Sustainable Agriculture Newsletter' (same as above)

'ILEIA Newsletter', P.O Box 64, 3830 AB Leusden, The Netherlands.

'Footsteps', (Free), Tearfund, 100 Church Road, Teddington TW 11 8QE. UK

'NFTA Resource Kit', NFTA, 1010 Holomua Rd, Paia, Maui, Hawaii 96779-9744 USA

International Institute of Rural Reconstruction, Silang, Cavite, Philippines 4118 (IIRR) Resource Kits:
'Sustainable Agriculture for the Uplands'
'Agroforestry Technology Information Kit'
'Low-input Lowland Rice-based Technologies'
'The Biointensive Approach to Smallscale Household Food Prod.'

'Agroforestry Today', (Free), ICRAF, Nairobi, ICRAF, P.O Box 30677, Kenya

Mindanao Baptist Rural Life Centre, Kinuskusan, Bansalan, Davao del Sur, Philippines:
Manuals on 'SALT-I', 'SALT-II', & 'SALT-III', and 'The Baptist Farmer'

'Farm-Forestry Newsletter', Winrock Int., 1611 No. Kent St., Suite 600, Arlington, Virginia 22209 USA

'International Ag-Sieve,' Rodale Institute, 222 Main St., Emmaus, Pennsylvania 18098 USA

SUMMARY / REFERENCE:

What are some useful things to remember?

1. Age when it is possible for a heifer to conceive:...12 to 14 months
2. Recommended age for first service of a heifer (depending on weight and breed):...18 to 24 months
3. Time to breed or inseminate after first signs of heat:...12 hours
4. Time for heat period to come again if the cow has not conceived:...18 to 21 days
5. Best time to do a pregnancy test:...not later than 60 to 90 days after the last service in order to know soon whether cow should be rebred
6. Gestation period (time calf is in the womb):...275 to 285 days or nine months and ten days
7. Recommended dry period (rest from milking prior to the next calving):...2 to 3 months, depending on the condition of the cow
8. Recommended goals for lengths of the calving cycle periods:...lactation period-10 months (305 days), dry period-2 months (60 days), total calving interval-12 months (365 days)
9. Normal period after calving before signs of heat (estrous) begin:...4 to 8 weeks (30–55 days)
10. Recommended time to serve a cow after calving:...2 to 3 months (60–90 days)
11. Recommended time after calving by which, if the cow has not shown signs of heat, that help should be sought:...3 months (90 days)
12. How many times can a cow calve in a lifetime:...as many as 15 times (Do not discontinue to breed cattle because of old age; when they no longer conceive, their productive life is over, not before.)
13. Period of time to 'steam-up' (feed concentrates prior to calving):...2 to 4 weeks (up to a month, depending on the condition of the cow)
14. Time between which the appearance of the 'waterbag' occurs and when help should be sought for calving down a cow if the calf has not been born:...2 hours (Do not assist too early or too late.)
15. Age when calves can begin to eat solid feeds and water:...2 to 3 weeks
16. Age at weaning (by which time the calf should have received 350 litres of milk prior to weaning):...between 2 and 4 months (depending on whether concentrate feeds have been introduced early on)
17. Frequency of deworming of calves:...after every 2 months until 6 months age, then at 3 month intervals until 12 months age
18. Frequency of deworming mature cattle:...1 to 2 times per year (best at beginning of wet season and again at end of wet season)
19. Frequency of the most common vaccinations/immunizations:
    - Foot and Mouth Disease:.....2 times per year
    - Anthrax:.....1 time per year
    - Blackquarter:.....1 time per year
    - Haemorrhagic septicaemia:.....2 times per year
    - Brucellosis:.....as a calf at 6 months age,
    - Lumpy Skin:.....3 vaccines, 1 time per year
    - Rinderpest:.....2 times in lifetime of an animal
20. How often to spray against ticks:...1 or 2 times per week, or as directed by the indications for the chemical used
21. Best age to castrate bull calves:.....3 to 6 months
22. Age when bulls can safely begin serving cattle:...16 to 18 months (although they begin to mount long before then)
23. Ideal age to dehorn/disbud calves:.....1 to 2 months

24. Average levels of amounts of feed (green feed, or dry matter) and water required for various classes of cattle per day:

Cattle age or class	Body weight (kgs)	Green feed or Dry Matter Daily Requirements (kgs) (as fed)	or (dried)	Concen-trates (kgs)	Water (lts)
Calf to 12mo.	50-100	15–25 kgs	2–3 kgs	1-2kgs	>10 lts
12–18 mo.	100-200	30–40 kgs	4–5 kgs	0-2kgs	>25 lts
Small cow*	250-300	45–75 kgs	6 -10 kgs	2-3kgs	>50 lts
Large cow*	350-500+	80 -110 kgs	10 -13 kgs	3-4kgs	>80 lts

*plus an additional kilo of dry matter/concentrates for every five litres of milk produced.

Thus it becomes evident that whereas a cow producing less than 10 litres of milk/day can consume enough green, quality fodder to meet her requirements, a cow producing 20 litres/day cannot, no matter how high its quality; she would need to be able to consume 18 kgs of dry matter which means more than 150 kgs of fresh fodder (80–90% water) per day which is physically impossible. This emphasizes the necessity of concentrate feeds for high producing dairy cattle.

It is recommended to feed concentrates at the rates recommended on page, or higher if the fodder is of lesser quality, in order to obtain optimum milk production and growth. Feeding of high quality forages and concentrates should be a priority for the following classes of livestock: calves being weaned; cattle one month away from calving; cows for the first 3 months minimum after they calve; those giving more than 10 litres of milk per day; and those recovering from illness.

Glossary:

Abortion—immature, dead birth before gestation time is complete

Acaricide—chemical used for external parasite (tick) control

Acute—condition which is sudden and critical of short duration

Afterbirth—placenta and other membranes expelled after birth

Allergy—reaction when animal is unable to tolerate presence of something else

Alleycrop—permanent crop interplanted in rows with other crops between the rows; usually a leguminous tree used for green manure and soil erosion control from wind or water

Anaemia—lack of healthy, red blood cells in the blood

Antibiotic—drug used to kill organisms which cause disease

Antiseptic—chemical used to kill bacteria and cleanse

Artificially inseminate—manually breed using collected semen

Ayrshire—red and white breed of dairy cattle originally from Scotland; medium size, good milk producer

Bacteria—microscopic organisms

Biogas—gas (fuel) obtained from anaerobic manure fermentation

Bladder—the organ which is reservoir for urine, or gall, in body

Brown Swiss—large brown dairy cattle originally from Switzerland; high producer

Bunds—hillrows of soil dug along contours on which crops are planted for soil erosion control

Calliandra—popular leguminous fodder tree

Carbohydrates—important nutrients providing energy to body

Castrate—remove testicles or cause them to be non-functional

Centrosema—a popular herbaceous, companion, leguminous fodder

Chronic—condition which is recurring and of long duration

Colostrum—the important first milk of newly calved cows high in immunizing factors needed by the calf

Compost—decomposed crop residues/manure ideal as a fertilizer

Concentrate—feed low in fiber and high in digestible nutrients

Contagious—diseases which are readily passed on to others

Contour—line along a slope which is of same vertical level/altitude, on which soil erosion control measures are used

Cover-crop—a crop which covers the soil, reducing loss of nutrients and water from the soil from solarization

Crop rotation—alternating crops from one season/year to another

Crossbreeding—mixing of two different breeds, a simple method of obtaining offspring with more desired characteristics of both breeds

Crush—a narrow chute which is used to confine cattle for treatments

Cultivation—digging or turning under undesired plant growth

Dairy meal—a concentrate especially mixed for milking cows

Desmodium—a popular herbaceous, companion, leguminous fodder

Digestible—able to be absorbed (digested) by the animal

Disinfectant—chemical which helps cleanse undesirable bacteria

Drench—force feed/give orally (through the mouth)

Estrous—heat, the condition of being receptive to breeding

Fertility—ability to produce (soil) or reproduce (animals)

Fetus—immature calf, normally still within the womb

Flemingia—popular leguminous fodder tree

Fodder—crop or feed which is normally cultured for animals

Free-stall—design of cowshed which allows freedom of movement and clean environment for zero-grazed cattle

Friesian—black (or red) and white breed of dairy cattle originally from the Netherlands; large size, highest milk producer of low-fat milk

Gestation—period of pregnancy; term of life of calf within womb

Gir—smaller breed of dairy cattle originally from India; *Bos indicus* type which is hardier, heat tolerant, medium milk production of high-fat milk

Gliricidia—popular leguminous fodder tree

Green manure—crop, usually legume, planted for soil improvement by cutting it for mulch or turning under the soil, to increase humus, ground cover, soil nitrogen and soil structure

Guatemala grass—popular high-producing fodder grass

Guernsey—fawn and white breed of dairy cattle originally from British Isles; medium size; medium producer of high-fat milk

Guinea grass—popular high-producing fodder grass

Hay—dried fodder, stored for later use

Hedgerow—(see Alleycrop)

Holistic—integrating the 'whole' picture or including

the 'holy'; concerned with spiritual, physical, social, and any other aspects; truly 'integrated'

Hormone—substance produced naturally within the body which regulates body functions

Immunity—the body's defense against disease; can be passed on to offspring through colostrum, or through exposure and naturally developed defenses (vaccinations/innoculations)

Indigenous—native, occurring locally; originally inhabiting

Infectious—disease conditions which can be passed on to others (see Contagious)

Integrated—combining many dissimilar aspects/disciplines

Intercrop—planting of different crops between each other

Intramammary—infused into the udder through the teat canal

Intramuscular—injected into the muscle

Intravenous—injected through the vein

Isolation—kept separate from others

Jersey—fawn colored breed of dairy cattle originally from British Isles; relatively lower producer of high-fat milk; small body size; ideal for low-resource farmer

Kikuyu grass—popular pasture/fodder grass; low-growing

Kudzu—a popular, herbaceous, companion, leguminous fodder

Lactation—time period when cow produces milk until drying off

Legumes—nitrogen-fixing, pod-producing plants, many of which are high-protein feeds and plants which ameliorate the soil

Let-down—the occurance of the cow releasing the milk from the udder, usually after stimulation prior to milking or suckling

Liver flukes—common internal parasites which damage the liver

Leucaena—the most commonly used leguminous, fodder tree

Lucerne—popular herbaceous, leguminous fodder

Lungworms—common internal parasites which damage the lungs

Mastitis—any inflamation or abnormal condition of the udder or milk

Milk fever—critical condition after calving when cow cannot stand and may quickly die unless given calcium therapy

Minerals—nutrients required by animals for body structure, growth and functions

Mulch—slowly decomposing, usually organic, residues which are spread over the surface of soil to maintain moisture, increase surface microbial activity, aeration and eventual soil improvement in fertility and structure; weed control

Napier—a popular, high-producing fodder grass ('elephant grass')

Nitrogen fixing—plants which are able to capture nitrogen from the atmosphere and soil, retaining it in the roots (nodules) for the benefit of the plant and subsequent crops if the nodules remain in the soil; the ability of certain plants, especially legumes; to do this enables them to ameliorate the soil by providing a needed plant nutrient, and reducing the need for other fertilizers

NPK—an abbreviation for a balanced chemical fertilizer containing nitrogen, phosphorus and potassium, the three most commonly deficient 'macro'-nutrients to plants

Nutrients—the essential requirements for life and growth of plants and animals

Oxytocin—a hormone which is necessary for milk let-down, and which also induces birth (and abortions), cleansing of the reproductive tract after calving, and other functions

Palatable—'tasty'; readily acceptable to animals for feed

Paralysis—condition of being unable to move muscles

Parasites—any organisms which have a harmful effect or cause a diseased condition; usually refers to worms, ticks, fleas, mites, lice, leeches, etc.

Parturition—the act of giving birth; calving

Placenta—the sac inside which the fetus grows and is attached to the mother's womb through which it is nourished

Pneumonia—disease condition evidenced by fluid in the lungs causing coughing, difficult breathing

Progeny—offspring

Prolapsed uterus/vagina—a condition which commonly follows calving, whereby the cow continues to strain, pushing out part or the entire reproductive tract. It requires immediate treatment by sanitary replacement within the cow

Protein—essential nutrient required by animals for body growth, muscling, milk production and reproductive functions

Purebred—offspring of a single, recognized breed of livestock

Quarrantine—imposed restriction on movement or introduction of new animals or plants into or out of an area until disease outbreak or danger is past

Regenerative—causing improvement; ameliorative; sustainable by being able to recycle again and again; this is the type of agriculture needed for the future

Resistance—refers to the natural ability (of an animal) to prevent disease; immunity whether natural or acquired

Retained placenta—a common disease condition whereby the placenta is not expelled after calving, requiring treatment

Rhodes grass—a popular, highly productive pasture grass

Roundworms—common internal parasites of cattle, both large and small types, requiring frequent deworming

Roughage—high-fibre types of feeds including fodder grasses/legumes, fodder trees, silage, hay, and stovers/crop residues

Ruminant—animals with four stomach compartments which chew a cud; they are uniquely able to convert a wide assortment of crops/residues and non-protein nitrogen, unusable to humans and other monogastric animals, into usable human food (meat and milk)

Sahiwal—a larger breed of dairy cattle originally from India; a *bos indicus* type of cattle; high producers of high-fat milk with good heat tolerance although less hardy than Gir cattle

Sanitation—systematic, habitual cleanliness, a requirement of successful dairy farming

Scours—calfhood diarrhea, a major cause of death of calves usually due to dehydration

Sesbania—a popular leguminous, fodder tree

Setaria—a highly productive, fodder grass

Silage—roughage conserved through an anaerobic process by which the nutrients and water are preserved

Siratro—a popular herbaceous, companion, leguminous fodder

Slurry—the manure and urine mixture which may be mixed for feeding the biogas digestor prior to subsequent use as a fertilizer in the fields

Stall-feeding—the intensive system by which animals are not allowed to graze, but their feeds are brought to them in an enclosed structure; the benefits are highlighted in this book

Sterile—unable to produce offspring

Stillborn—offspring dead at birth

Stylo—a popular herbaceous, companion, leguminous fodder

Subcutaneous—injection given immediately under the skin

Sustainable—able to last; (see Holistic, Integrated, Regenerative)

Syringe—apparatus used to give injections

Tether—to tie an animal with a rope and thus restrict grazing area available to the animal

Tolerance—ability to withstand, such as disease or stress of heat, work, etc.; a term usually used to describe indigenous animals ability to thrive in the natural environment compared to introduced animals

TSP—an abbreviation for the phosphate fertilizer, triple super-phosphate

Udder—the milk producing 'bag' of the cow attached between the rear legs

Upgraded—offspring of breedings using bulls of breeds with desirable traits

Urea—a nitrogen fertilizer

Uterus—the portion of the cow's reproductive tract in which the fetus develops into a calf

Vaccination—deliberate introduction of inactive or inadequately potent disease organism in a healthy animal in order to create artificial immunity to the disease

Vajina—the portion of the cow's reproductive tract through which the calf must pass, which is separated from the uterus by the cervix

Velvet bean—a popular green manure/cover crop/annual, herbaceous, leguminous fodder

Virus—a minute organism which causes disease

Vitamins—essential nutrients required for health and body functions

Vulva—the opening below the tailhead to which the urinary and reproductive tracts are attached, which swells at time of estrous and more so at calving time

Zebu—a large group of sub-breeds of *bos indicus* type cattle found throughout the world, and common in East Africa, which includes Boran, East African Short-horned Zebu, and others

Zero-grazing—(see Stall-feeding)

Zero-tillage—a system of planting which does not require any cultivation and reduces erosion and labor: seeds are planted either in holes poked in the ground or trampled in heavily by livestock moving over the ground; this system is gaining acceptance compared to traditional or 'modern' hi-tech methods which fail to conserve or improve the soil; when done together with use of green manures, mulching and contour farming it can produce a consistently adequate harvest yet requires one fourth the fertilizer and less weeding

Zygote—the joining of the sperm of the male to the ovum (egg) of the female to form a new, growing offspring; a fertilized ovum