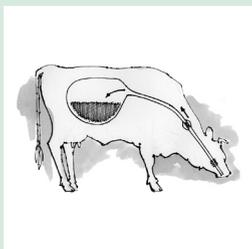


Dairy cattle husbandry

More milk through better management

Agrodok 14 - Dairy cattle husbandry



partageons les connaissances au profit des communautés rurales
sharing knowledge, improving rural livelihoods

Agrodok 14

Dairy cattle husbandry

More milk through better management

Hans Blauw
Gijs den Hertog
Johan Koeslag

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Foreword

This Agrodok provides information about the main aspects of dairy farming in the tropics such as feeding, breeding, health care, reproduction and recording. It is meant for smallholders with some education and some knowledge about dairy cattle. The second target group are technicians like extension and animal production officers, who as advisers can assist smallholders planning to start or improve milk production.

A production of 1500 to 3000 kg milk per cow per year seems feasible for smallholders and this is the assumed level of production in this booklet. A combination of improved management and genetic improvement of the herd can also contribute to increasing milk production. However, farmers who only have a few cows, a long calving interval and high calf mortality, have little scope for selection of replacement heifers. Furthermore, selective breeding may be difficult, especially when the choice of semen or bulls is limited. Seek expert advice from an animal breeding centre, if available.

The booklet is the product of intensive cooperation between the three authors, who together have over 100 years of experience in milk production and dairy development in Africa, Asia, Europe and Latin America. We sincerely thank everyone who helped in its preparation, including the peer readers. Special thanks go to Paul Snijders for his contributions to Chapters 2 and 3, and to Richard Burnie who did the drawings.

While we hope this Agrodok will help farmers make their dairy production more profitable, we will be grateful for any comments, suggestions, additions and criticism.

Deventer, 2008

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1 Introduction

In Latin, the word for money is derived from the word for cattle.

Demand for dairy products is increasing worldwide. Governments encourage the milk production of dairy cattle, and sometimes also of buffaloes, sheep or goats. While some countries have a tradition of milk production and consumption, elsewhere dairy farming and the consumption of dairy products is rather new.

Dairy production can be economically attractive, but the keeping of dairy cows is labour intensive, 365 days of the year! Moreover, cows are expensive and vulnerable animals and milk is a very perishable product.

At national or regional level dairying needs a well-organized infrastructure and the availability of support services: marketing facilities; breeding, health and extension services; and a reliable supply of inputs like concentrates and fertilizers. Farmers need knowledge, skills and management capacities.

In practice, the milk production of dairy cows is often disappointing and far below their genetic potential. The main causes are: (1) late age at first calving; (2) low average production per day; (3) short lactation period; and (4) prolonged calving interval. Moreover, poor reproductive performance and high calf mortality frequently results in insufficient replacement stock.

The management of dairy cows is complicated due to fluctuations of roughage availability and quality throughout the year, and to variations in the animals' nutrient demands during growth and lactation. Health, feeding and reproduction management for efficient milk production requires specific knowledge, skills and good management.

1.1 Keeping dairy cows

The main reasons for farmers to keep dairy cows are:

- Income: dairy cows provide regular cash income from daily milk sales, usually at a known price, plus occasional sales of surplus stock (bull calves, culled cows, breeding stock).
- Resource utilization: crop residues, ‘roadside’ grasses and labour, which would otherwise provide no income.
- Manure: the availability of manure and the opportunity to make compost for the fertilization of fodder and crops.
- Income can be generated even on a small piece of land or for landless farmers.
- Investment: investment in cattle prevents devaluation of your money and is good insurance.

However, one should be aware of the risks:

- Investment security: cows represent a big investment, lost easily through disease or theft.
- The product ‘milk’: milk spoils rapidly if not handled or kept well, in which case it cannot be sold.
- When starting a dairy farm with young stock demands time and considerable investments before the cows start producing milk and income.

1.2 Farming systems

There are many ways of keeping cattle for milk production. The one you choose will depend very much on local conditions, most importantly climate, infrastructure, land availability and local traditions. Two main systems can be distinguished. In Africa dairying is traditionally based on mixed farming with grazing of natural pastures and along roadsides. In Asia the traditional system is ‘cut and carry’, which also offers landless farmers the opportunity to keep dairy cattle.

Extensive systems where cows are only grazing are not very appropriate for dairy production. The two main systems discussed in this booklet are: grazing with supplementary feeding; and the cut and carry sys-

tem or zero grazing. In East Africa, zero grazing is often linked with free-stall housing and the establishment of high yielding grasses like Elephant grass. In reality, overlap and combinations of systems exist all over the world. The systems are defined according to the way the animals are fed or supplied with roughage, because this is the most important aspect of dairy production.

Grazing with supplementary feeding at night

In this system the animals graze during the day in paddocks on natural or improved pasture, are tethered on privately owned or communal land or are herded on communal land or along roadsides. Usually they are stabled at night.



Figure 1: Supplementary feeding after grazing

However, although this system can be used if enough land is available, it frequently comes under pressure due to land fragmentation and management problems for cows grazing on communal land and along roadsides. Danger of traffic accidents, exposure to diseases, undesired breeding and conflicts with neighbours are among the negative aspects of grazing along roadsides and communal land. Supplements such as fodder crops and crop residues can be produced on the farm itself combined with purchased concentrates and minerals. Dairy cattle should always be offered roughage and water during the night. Young stock and cows in early lactation probably need concentrates. Landless farmers can keep dairy cattle on the basis of roadside and communal grazing.

Zero grazing or cut and carry system

Traditionally this is a tie (stall) system. Zero grazing means that the animals are kept day and night in one place and all feed and water is brought to them. Dry cows and young stock are sometimes allowed to graze in a paddock or are tethered in the field. Grass and fodder crops can be cultivated or collected from roadsides, riverbanks and forests. In East Africa zero grazing is closely associated with planting of Elephant grass and free stall housing. Fodder banks of tree legumes, for instance, can be established and farm crop residues utilized, collected or purchased in the neighbourhood. This is a more intensive system of dairy production. The prevalence of tick-borne diseases is an important reason for using a cut and carry system rather than grazing, predominantly in Africa.

Meat, through the sale of bull calves and cull animals, is usually a by-product. To keep the animals clean, manure should be collected and stored properly for use in the fields. A roofed cowshed enables rain-water to be collected, see Figure 2.

The cut and carry system requires considerable investment, labour and knowledge and therefore a reliable market and milk price. Favourable government policy and adequate support services are needed as well. Through intensification of roughage production resulting in higher

yields per unit land, and better management of animals, milk production will increase and less land may be required. The dry matter (DM) yield of one hectare of unimproved natural pasture is about 3000-4000 kg per year, but with good management and the use of manure and fertilizers, the DM yield of Elephant grass can be 8000 to over 15000 kg per year.

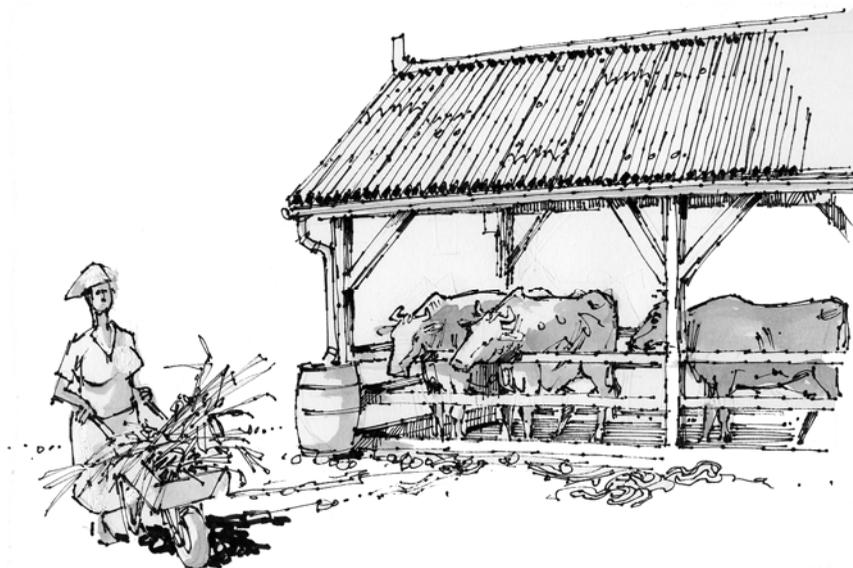


Figure 2: Zero grazing

1.3 Production of more milk

Dairy farming is a long-term investment and requires well-calculated decisions to avoid disappointing results. Take note of what other farmers in the area are doing. Collect information from other dairy farmers in the neighbourhood, paying special attention to reliable marketing of milk and cost of inputs.

Information and advice may also be obtained from local authorities like the extension service, the department of livestock development and the milk collecting organization. A farmer's organization can be

very helpful and may give producers a platform for voicing their opinions and representing their interests.

In order to decide whether to take up dairy cattle farming, or improve the present farm, various aspects should be considered:

- Starting or intensifying dairy production requires serious investment and commitment, only justified if the milk can be marketed at an attractive price.
- Is dairying attractive and profitable now and in the future? Calculate the actual cost price and estimate the future milk price.
- Is there a market for your milk and is it reliable? Is the milk collected and marketed by a well-known cooperative or dairy company, once or twice a day? Or is the market informal, selling directly to customers or middlemen. Milk is a very perishable product and should be sold within a few hours.
- What is the real price the farmer receives? To recover the cost of collection, transport, administration and management, the cooperative or associations often deduct overhead costs. This can be 20% or more of the announced milk price.
- Is the climate suitable for dairy farming and how is the roughage supply throughout the year? What is the duration and severity of the dry season(s)?
- What is the availability and cost of loans, labour, land and inputs like concentrates and fertilizers?
- Intensification always means more labour. Is extra labour with the required qualities and skills available within the family or from hiring? Keeping dairy cows demands attention 365 days of the year and quite a few hours per day, weekends and holidays included. It means that hiring or training skilled and reliable labourers may be essential when expanding the dairy farm.
- Dairy production demands investments, such as animals, roughage production, housing, utensils and concentrates. Moreover, because cash benefits are rarely seen on the short term, special credit facilities may be required.
- Are reliable organizations for veterinary and breeding services available, also during weekends and holidays?

2 Feeding

What fuel is for a car, feed is for a cow. Without it they are useless!

Food is essential for all living beings; they will die without it. If food is inadequate or of the wrong composition, animals will neither produce nor reproduce well and their health will be affected. The milk yield of a lactating dairy cow will drop if she is not fed adequately for some days, and recovery of her milk production will be virtually impossible. A poorly growing calf will never become a good cow. It is really important, therefore, to feed dairy animals well throughout their entire lives.

As it takes time for the rumen to develop, calves become true ruminants only after about 8-10 months. Ruminants can utilize roughage such as grass, hay and straw, which are useless to most non-ruminating animals. Ruminants like cows, sheep and goats are cud-chewing animals with four stomachs.

Feed is partly digested in the first stomach – the rumen – before being regurgitated and then chewed as cud. This activity is called ruminating. The rumen is large and has a capacity of up to 200 litres in a 500 kg cow. It contains microorganisms that break down the cell walls of roughages freeing the cell contents for digestion and they also convert part of the feed into proteins. But, despite its size the rumen's capacity to digest is limited, which restricts the amount of feed the animal can eat.

Fibre breakdown by the microorganisms in the rumen takes time. The more fibres in the ration, the longer it takes to break them down. So the better the quality of the roughage, the more the cow will eat and the more she is able to produce (see Table 1). Thus an increase of roughage quality leads to a higher DM intake but energy intake, total digestible nutrients (TDN) will be much higher, resulting in a considerable improvement in possible milk production.

Table 1: Quality of roughage, intake of dry matter (DM) and total digestible nutrients (TDN) of a cow weighing 500 kg

Quality of roughage	Kg TDN per kg DM of roughage	DM intake per day	TDN intake per day	Possible milk production
Poor	0.45	7.0 kg	3.15 kg	None (weight loss)
Average	0.57	9.5 kg	5.42 kg	5 kg
Good	0.61	11.5 kg	7.02 kg	10 kg

Poor quality roughage contains hardly any protein and only a low amount of energy from 0.40-0.50 kg TDN per kg DM. Examples of poor roughage are rice straw, wheat straw and old yellow grasses with a lot of stems are, which do not even cover maintenance requirements. If not fed supplements animals will lose weight and this may occur during the dry season.

Average quality roughage contains 0.5-0.57 kg TDN per kg DM and a moderate amount of protein. Examples are grasses that are not too old, young grass hay and sugarcane tops. If supplied as the only feed, a low milk production can be expected. Many types of roughage are of an average quality during the rainy season.

Good quality roughage contains over 0.58 kg TDN per kg DM and has a high protein content sufficient for a production of up to 10 kg of milk per day. Examples are young leafy grass, legumes (Leucaena, Desmodium, Alfalfa, Stylosanthus) and cassava leaves.

Grazing alone involves an average of 8-10 hours a day; (selective) grazing on poor quality roughage may take longer. In hot climates animals prefer to graze during the cooler hours of the night. Ruminating takes up another 8 hours, the cow resting for the remainder of time.

Roughages like grass, legumes and crop residues form the basis for feeding dairy cattle. In exceptional circumstances of year-round availability of young green and tender grass or legumes, cows will be able to produce nearly 10 kg of milk per day without any concentrates. If

the roughage is poor, cows will not produce any milk and if no concentrates are fed they even lose weight. In the tropics, dairy cows generally need concentrates to produce milk. Poor roughage quality is barely enough for maintenance during the dry season and just average during the rainy season, covering the requirements for about 5 kg of milk per day.

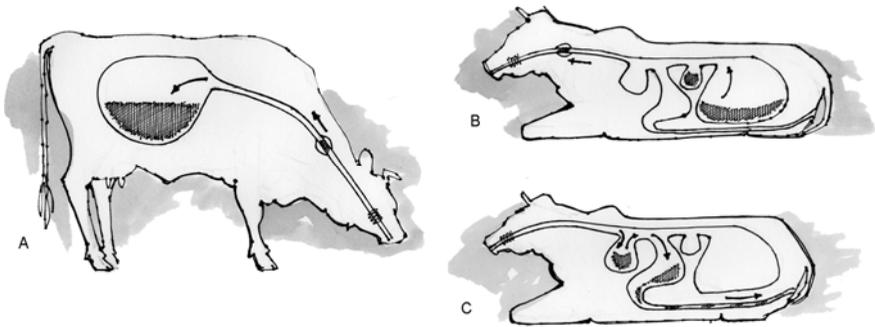


Figure 3: Eating and ruminating

- A: The cow is eating, the grass goes to the first stomach, the rumen
- B: Ruminating, the grass comes back to the mouth and is chewed
- C: Ruminating: the grass goes to the second stomach where it is digested

2.1 What do dairy animals need

Animals need water and feed to live, grow, work and produce milk and calves. Even at rest an animal needs energy and protein to stay alive, breathe, walk and ruminate. These basic needs for maintaining a stable condition are called ‘maintenance requirements’. If an animal’s maintenance requirements are not covered, it will lose weight, not come in heat and might fall ill. Maintenance requirements depend on body weight: a heavy animal needs more energy and protein for its maintenance than a leaner cow. If the farmer wants animals to grow, work, produce milk or calves, they need additional nutrients. These

are called its 'production requirements'. Proportionally more protein is needed for production than for maintenance.

Water

Water is essential. Without water animals may die in a couple of days and if they cannot drink enough water, their feed intake will be reduced as well. Dairy cows need permanent access to clean and cool drinking water. If this is not possible they should be offered drinking water ad lib at least twice a day. A 500 kg cow may drink 60 to 100 litres per day, depending on her production, water content of the roughage and climate.

Energy

Animals need energy to maintain their bodies, to move, to grow, to produce milk and calves. The needs of animals and the energy value of feedstuffs can be expressed in different ways. In this booklet we use the TDN (total digestible nutrients) system. Kilograms (kg) of TDN can be converted into digestible energy (DE) and metabolisable energy (ME), expressed in megajoules (MJ) or megacalories (Mcal). For conversions see box.

TDN (total digestible nutrients) is a common energy unit in cattle feeding. For conversion into other energy units, the following figures can be used:

1 Mcal	=	4.1868 MJ
1 kg TDN	=	18.46 MJ of digestible energy (DE)
1 kg TDN	=	15.14 MJ of metabolisable energy (ME)

Be aware that energy and protein content of a feedstuff can be expressed in the fresh feed, including water, or on a DM basis. For example, if fresh grass with 20% DM contains 10 % TDN (or 0.1 kg TDN per kg of grass), on a DM basis it contains $10 * 100/20 = 50\%$ TDN or 0.5 kg TDN per kg DM. For the composition of feedstuffs we will use the DM basis.

Main sources of energy in feedstuffs are carbohydrates (starch, sugars, digestible fibres) and fats. Feedstuffs rich in energy are concentrates (cereals, oil seeds and their by-products, molasses) and good roughage. Straws and mature grasses have a low energy and protein content and are slowly digested because they contain much indigestible fibre.

Proteins

Proteins are essential building materials for the animal body and they are a vital component of milk and meat. So animals need protein for maintenance of their bodies, for growing and especially for producing milk and calves. When a cow gives more milk it needs proportionally more protein.

Protein needs of animals and content of feedstuffs can be expressed in different ways. Here we use crude protein (CP) in grams per kg DM feed. If a feed contains 18% CP on a fresh base with 90% DM content, then on a DM base it contains $18 * 100/90 = 20\%$ CP or 200 gram CP per kg DM. Important sources of proteins are young grasses, legumes (Alfalfa, Leucaena) and oilseeds and their cakes. Cereals, cassava meal, molasses and mature roughages are low in protein.

Urea is sometimes used as a 'protein' source for ruminants. However, this chemical product, which is also used as fertilizer, is poisonous in high quantities. So be careful.

Minerals

Animals need small amounts of common salt and minerals, calcium and phosphorus being the most important. If cows are fed a variety of feeds, they often get all the minerals they need. However, in many regions of the world feedstuffs do not contain all the necessary minerals, so it is wise to provide cows with a mineral mix. Buy a good quality mix and give your animals free access to it so they can eat as much as they want. But be cautious and introduce the mix gradually if the animals are not accustomed to minerals, otherwise they may overeat and fall ill. It is best to offer the mineral mix and salt separately.

Other needs

Well-balanced dairy cattle rations contain enough vitamins, so it is normally not necessary to pay special attention to vitamins.

As cattle are ruminants, they need a certain amount of fibre (structure) in their ration. But this is seldom a problem in the tropics. On the con-

trary, most roughage contains too much fibre, which restricts the amount the animals will eat because it is digested slowly.

Daily requirements of cows

Table 2 lists daily requirements of cows according to their weight and production.

Table 2: Daily requirements of cows

Animal and weight	Intake Kg DM	Energy kg TDN	CP grams
Calf 3 months 60 kg	1.2 – 1.5	1.1	250
Yearling 12 months 200 kg	4 – 5	2.9	465
Two years 350 kg (400 g growth per day)	7 – 9	3.7	585
Mature Cow 400 kg [#] :	7 – 12*		
Dry		3.1	520
Pregnant		4.0	650
5 kg milk		4.8	910
10 kg milk		6.4	1300
Mature Cow 450 kg:	8 – 13.5		
Dry		3.4	585
Pregnant		4.4	730
5 kg milk		5.1	975
10 kg milk		6.7	1365
Mature Cow 500 kg:	9 – 15*		
Dry		3.7	640
Pregnant		4.8	780
5 kg milk		5.4	1030
10 kg milk		7.0	1420
Mature Cow 550 kg:	10 – 16.5		
Dry		4.0	690
Pregnant		5.2	850
5 kg milk		5.7	1080
10 kg milk		7.3	1470
Per kg milk with 4% fat		0.33	78
* Normal daily intake of roughage varies between 8 to 10 kg for a cow of 400 kg and 10 to 12 kg for a cow of 500 kg; the higher figure is only achieved if the roughage quality is fairly good. Maximum DM intake of 12 and 15 kg per day can only be achieved when concentrates are fed.			
[#] As young cows still need to grow, they need extra energy and protein, otherwise their production and development will be hampered. Young cows of 400 kg daily need 0.6 kg TDN and 105 g protein extra (20%) during first lactation, and half that (10%) during second lactation.			

2.2 Feedstuffs for ruminants

Feedstuffs consist of water and dry matter (DM). Young fresh grass contains about 20 % DM, straws have over 80% and concentrates 90 % DM, the remainder is water. Dry matter contains energy, protein and minerals.

A cow weighing 500 kg and offered good young grass may eat 12 kg of DM or 60 kg of fresh grass per day. That same cow will eat only about 7 kg of dry straw a day. If small amounts of concentrates are offered, the cow will eat these as extra. However, if large amounts of concentrates are given, the animal will eat less roughage.

Roughages

The better the roughage, the more the animal will eat, the more energy and protein it can absorb and the less concentrates it will need. As concentrates are generally more expensive than roughage, trying to provide the best roughage is worthwhile. See Chapter 3 for more information about roughages.

Table 3: Composition of some roughages. Large variations occur due to growth stage, fertilization and season.

Roughages	% DM	Kg TDN per kg DM	CP in g per kg DM
Elephant grass 4 weeks	17	0.62	150
Elephant grass 16 weeks	22	0.51	50
Kikuyu grass	20	0.56	150
Guinea grass, mature	25	0.50	90
Leucaena leaves	31	0.56	240
Stylo hay	87	0.57	130
Rice straw	90	0.38	35
Wheat straw	92	0.45	40
Sugarcane tops	31	0.51	60
Fodder sorghum	20	0.60	90
Roadside grass, old	25	0.48	70
Roadside grass hay	90	0.40	38
Maize silage	28	0.70	50
Maize stover	90	0.48	45
Cow pea stover	90	0.51	150

Concentrates

Concentrates or supplements are given in addition to roughage. Although more expensive than roughage, they are essential when roughage alone cannot satisfy the animal's maintenance and production requirements. Concentrates are especially useful in the following situations:

- During early lactation to stimulate the cows to fully express their genetic potential for milk production. They cannot cover their requirements and reach peak yield on roughage alone.
- For all producing cows during the dry season when roughage is of poor quality.
- For calves up to 10 months because their rumen is not yet fully functioning.

As a general rule for lactating cows one kg of balanced concentrates covers the requirements of 2 to 2.5 kg milk. This implies that it is justified to feed concentrates if they cost less per kg than 2 kg milk, which is nearly always the case.

Balanced concentrates can be bought readymade or can be mixed at the farm. Readymade concentrates are best but also the most expensive. They normally consist of different cereals or their by-products, oilseed cakes, salt and other minerals.

Mixing concentrates

Some of the following ingredients can be combined to make a balanced concentrate mix on the farm. The composition is given on a DM basis.

The ingredients for concentrates can be divided into energy supplements and protein supplements. The first group (Table 4) contains feedstuffs with a lot of energy but little protein; they should be combined with protein rich supplements.

The protein rich supplements are frequently also rich in energy. They are especially used for mixing with the cheaper energy supplements.

Many of these supplements are cakes made from oilseeds after the oil has been pressed out (Table 5).

Table 4: Composition of energy supplements

Energy supplements	% DM	Kg TDN per kg DM	CP in g per kg DM
Maize meal	88	0.90	100
Maize bran	90	0.76	110
Cassava flour	90	0.80	0
Wheat bran	89	0.70	180
Rice bran	89	0.66	150
Rice polishings	90	0.84	80
Sorghum grain	89	0.83	125
Molasses	75	0.91	0

Table 5: Composition of protein supplements

Protein supplements	% DM	Kg TDN per kg DM	CP in g per kg DM
Groundnut cake	92	0.83	500
Coconut cake	93	0.81	220
Cottonseed cake	92	0.74	280
Sunflower cake	93	0.70	400
Soybean cake	90	0.85	480
Meat meal	94	0.72	520
50% maize bran + 50% cottonseed cake	91	0.75	165
50% rice bran + 50% coconut cake	91	0.73	180

The mix of maize bran and cottonseed cake is commonly used in Africa, the mix of rice bran and coconut cake in Asia. Of course other mixes are also used, such as soybean or groundnut cake as protein source plus wheat or maize bran for energy. For 2 kg milk, 0.66 kg TDN and 156 g CP is required, and this is provided by 1 kg of such a mix.

2.3 Body Scores

Body scores can be given to assess the condition of dairy cows. The thinner the animal, the lower its body score (see Figure 4).

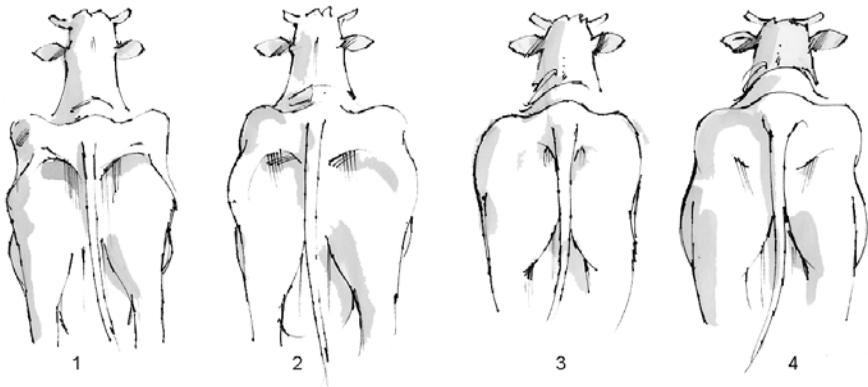


Figure 4: Body scoring of dairy cows from the appearance of the tail head: 1= poor, 2=moderate, 3=good, 4=fat

Details of the body scores:

- 1= Muscles, tail head and lower back vertebrae are shrunken and hollow. No fatty layers can be felt. Skin is supple and freely moveable.
- 2= All bones can easily be felt. Muscles sunken around tail head. Some fatty layers.
- 3= All bones can be felt but are well covered with fat.
- 4= Folds and patches of soft fat under the skin. Hipbones can be felt by firm pressure. Side bones of vertebrae cannot be felt.

At the time of calving, cows should have a body score of 3 to 3.5. A lower score means a lower milk production. Cows with a higher body score are more prone to milk fever and often have difficulties at calving. They reach lower peak yields because their appetite is reduced. Placenta retention occurs more often in fat cows.

When the body score falls below 2, cows may not come in heat and they have less chance of getting pregnant. Their milk production is reduced as well. A body score of 2 or lower is a clear sign to the farmer that something is wrong with the cow's feeding or health. Sometimes body scores 0 (very poor) and 5 (very fat) are used but they have little practical relevance.

2.4 Practical feeding

Roughage is the basic cattle feed; it is generally cheaper than concentrates and it assures proper rumen functioning. Good roughages include young grass, maize silage of the entire plant, leafy hay and tender legumes without too much stems. Straw is low-quality roughage; treatment with urea will do little good. In many cases supplying concentrates to lactating cows is necessary to increase milk production.

Cows should be able to eat as much roughage as possible, so it should be provided at least twice daily, but preferably 4 times. Cows are selective feeders; they like to eat only the best part of the roughage. So if possible offer them plenty, enabling them to select the best parts. Leftovers can be used as bedding or in compost making; they should amount to 10% at least, and 20 to 30% in the case of poor roughage.

The feed intake of cows just after calving is low, which implies that they will lose weight. Milk production increases, peaking at about 50 days after calving. (See figure 5.) Cows losing weight are less likely to get pregnant again. So give the best roughage to the high-yielding cows during the first 100 days of lactation.

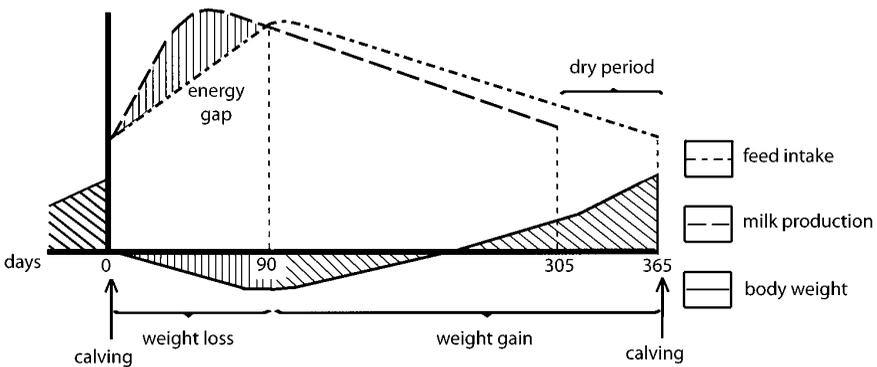


Figure 5: Lactation curve, DM intake and body weight fluctuations

Roughage DM intake of about 2-2.5 % of body weight can only be achieved if animals have access to a permanent supply of quality feed. Provide 1 kg of balanced concentrates for each 2 to 2.5 kg of milk produced. Stimulate peak yield by giving more concentrates than the cow would need for her actual production during the first 60 days of lactation. During the first week after calving concentrates fed should be increased by not more than 0.5 kg per day.

Amount and quality of concentrates fed per day depend on roughage quality and milk yield (see table 6). Concentrate supplement is justified if its price per kg is lower than the price of two kg milk.

Table 6: Kg of concentrates per day in relation to production and roughage quality

Quality of roughage	Not producing cow	Last 2 months of pregnancy	Yield 5 kg of milk per day	Yield 10 kg of milk per day *
Poor	1kg	2 kg	3 kg	5 kg
Average	-	1 kg	-	2 kg
Very good	-	1 kg	-	-
* For each 2 - 2.5 kg of milk above 10 kg, one extra kg of concentrates should be given				

Dairy cows should not be too skinny or too fat. A cow that is too skinny (body score < 2) shows she does not get enough feed or that she is ill, so her production will drop. A cow that is too fat (body score > 3.5) has been given too much (expensive) feed and this often happens at the end of the lactation or during the dry period. Fat cows may present difficulties at calving and are much more susceptible to digestive problems. Start giving some concentrates (1-2 kg per day) to high potential cows during the last 1-2 months of pregnancy but avoid letting them get too fat.

At the end of lactation, cows should be in good condition, not too thin but certainly not too fat. A body score of 3 to 3.5 is correct. This average condition and body score should be maintained during the dry period. Feed about 1-2 kg concentrates daily, as if they were producing about 5 kg milk a day.

Producing cows should be offered cool drinking water ad lib at least twice a day. Animals should have free access to salt and a mineral mix. Cows will consume about 50 grams of salt and minerals per day, young stock about half that.

3 Roughages

Straw is better as bedding than as feed.

Many farms combine dairy production with the cultivation of crops. Crop residues like straw and stover are used as roughage for livestock, while manure is used for the crops. Natural pasture can be an important source of forage if land is not limited. Land restrictions demand intensification through the production of improved forage and better use of crop residues.

3.1 Grasses

Grasses are often the most common roughage fed to cattle. Their feed value varies considerably according to management and growing season, see table.

Table 7: Quality of grass

Good grass	Poor grass
Young	Mature
Rainy season	Dry season
Dark green colour	Light green or yellow colour
Juicy (about 20% DM)	Dry (more than 40% DM)
Mainly leaves	Many stems
Not flowering	Flowering
Very tasty, high intake	Less tasty, low intake
Often fertilized	Not fertilized
High protein and energy	Low protein, average energy
Covers maintenance and requirements for moderate production	Does not cover maintenance requirements
0.58-0.65 kg TDN/kg DM	0.4-0.5 kg TDN/kg DM
120-150 g CP/kg DM	50-70 g CP/kg DM

Natural grasses

Many small farmers use local grasses cut along roadsides. This roughage resource is not very reliable as the neighbours use it as well. Fur-

thermore, traffic exhausts, excrements, parasites and garbage can easily contaminate it. Plots with local grasses are often less productive than land with well-managed improved forage. Once land becomes scarce and milk production more economically rewarding, intensification through planting, sowing and fertilization of improved grasses and forage becomes more attractive.

Improved pasture and forage: choice of species and variety

The choice of which improved pasture or forage best suits your conditions depends on environment, climate, soil and the farming situation. Choosing the right variety from within the species can also be very important. Consult the extension officer and neighbours about their experiences. Table 8 compares some grasses under East African conditions (1 = poor, 10 = excellent).

Table 8: Characteristics of commonly used grasses in East Africa

Grass species	Elephant	Rhodes	Guinea	Kikuyu	Brachiaria
Grass yield	9	8	7	5	7
Dry season performance	9	8	7	7	7
Persistence	6	5	6	8	7
Establishment	planted	sown	sown/planted	natural	planted
Common use	cut	grazed	cut	grazed	grazed

This Agrobook discusses only a limited number of types of roughage. Elephant grass will be described in some detail, with guidelines for the establishment and management of improved pasture.

Elephant (Napier) grass

Elephant grass is recommended for zero grazing because:

- It is high yielding.
- It boosts milk production if cut at the right height and maintained well.
- It remains green during the dry season and withstands drought better than most grasses.
- It is suitable for cutting.

Types

Among the different types of Elephant grass are types with and without hairs, differences in resistance against diseases and different stem thickness. Seek out the experiences in your area.

Where can it grow

Elephant grass requires high, well-distributed rainfall of at least 800 mm annually but preferably more. At altitudes higher than 2100 m, growth is slow because of low temperatures. It thrives best on deep fertile soils supplied well with manure, and prefers well-drained soils, but can grow on almost any soil. Without good nitrogen and potassium fertilization, yield and persistence will decrease after 1-2 years.

How to plant

Plant Elephant grass in well prepared weed-free land at the beginning of the rains. It can be established from root splits, which is more labour intensive, or from cuttings. Root splits from an uprooted plant without leaves establish rapidly if there is enough rain. For cultivation from cuttings cut a well-matured cane into pieces with 3-4 nodes. The leafy top part should not be used. Cuttings can give good results, even if rains are irregular.

Cuttings or splits have to be spaced properly. A row distance of 90 cm and a spacing of 60 cm within the row is commonly used in favourable areas. In drier areas row distance should be wider.

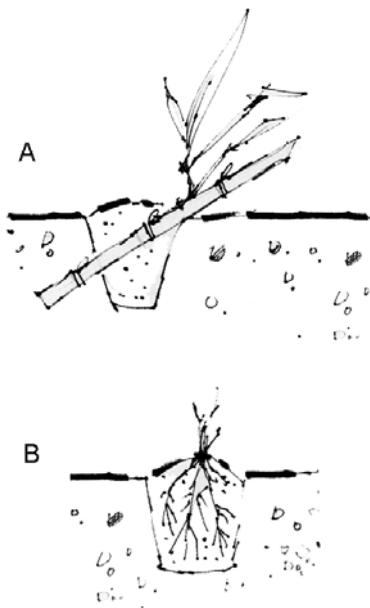


Figure 6: Elephant grass can be established from A: cane cuttings or B: root splits

How to achieve a high yield

Elephant grass grows well on fertile soils, but very poorly in fields full of weeds. Weeding during the dry season will control vigorous weeds like couch grass. Proper weeding combined with manure and fertilizer application should be carried out after every cut.

It is important to return the fresh manure of the cows to the grass to sustain high production. The best way is to dig small ditches in between the rows then put in the fresh manure and cover with soil.

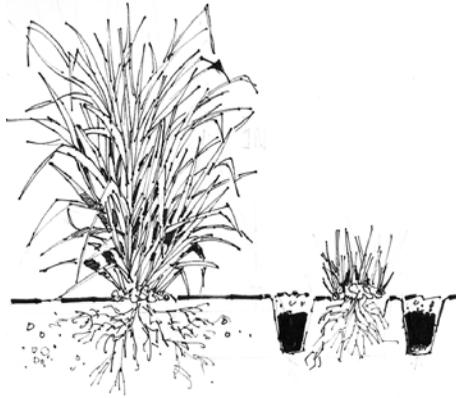


Figure 7: Apply fresh manure after every cut

To obtain high yields, the grass will also need additional fertilizer. How much and when depends on soil, climate, cutting management and the amount of manure. For example, in the case of adequate rainfall in two rainy seasons, 250 kg of NPK fertilizer (20-10-10) can be applied per ha, during the middle of the long rains and at the start of the short rains. In between the long and short rains, a top dressing with 50 kg of CAN (or 25 kg urea) per ha should be applied after each cut.

When to cut

The optimal cutting interval in the rainy season is about 6-8 weeks at a height of 60-90 cm. As it grows taller the quality of Elephant grass (over 1.20 m) declines, so feeding it to the cows may result in lower milk production. If forage is plentiful give only the tops as feed and leave the lower part in the field for mulching, or use it as compost. If there is a real surplus of grass, silage can be made of young leafy grass, preferably after wilting till at least 30 % DM. Due to its thick stem, Elephant grass is not suitable for hay making or grazing.

How to feed and how much milk from Elephant grass

Big cows like Friesians eat about 60 kg of fresh grass per day while smaller breeds like Jerseys and crossbreds eat less. For a high milk production supply the grass liberally to allow cows to eat sufficiently. Fed on grass alone a cow of about 500 kg can produce about 5-7 kg of milk daily. Young Elephant grass will allow a higher milk production (about 10 kg), while old grass may just provide feed for maintenance. Older grass with many stems can be chopped into pieces of 15-20 cm to reduce losses.

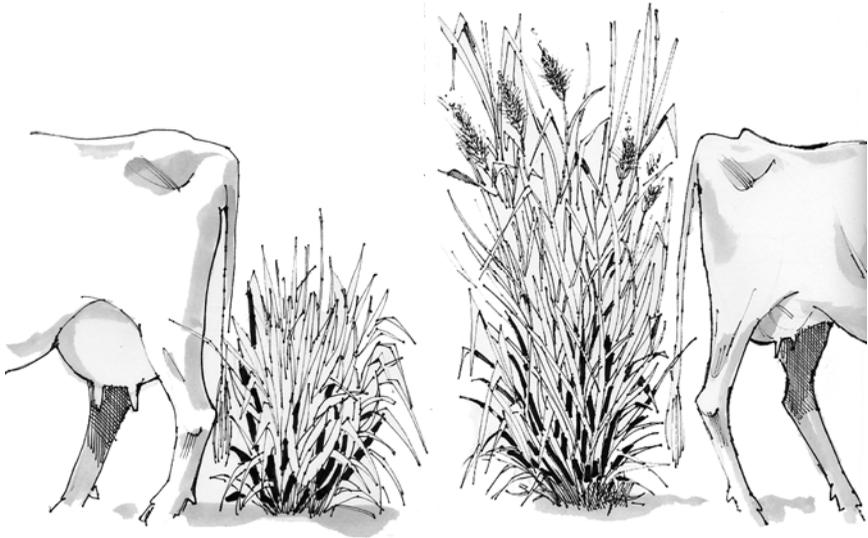


Figure 8: Good quality grass results in high milk yields while tall-stemmed grass causes weight loss if fed without concentrates.

3.2 Leguminous forage

Legumes constitute a common source of good roughage. Moreover, they contain more protein than grasses because their root nodules fix nitrogen from the air. They also improve soil fertility.

Legume seeds often need an application of inoculants before sowing to stimulate nitrogen fixation. It is quite difficult to maintain a good mixture of grass and legumes in the tropics, so legumes are often grown on a separate plot – a so-called ‘protein bank’ – to supply additional roughage and to increase a ration’s protein content when needed. Protein banks are cut for zero grazing or grazed only for a limited time each day by animals needing it most, for example cows in milk, or during the dry season.

Glyricidia, Sesbania and Leucaena are examples of tree/shrub legumes. Desmodium, Alfalfa and clovers are herbal legumes. Multipurpose tree legumes are useful where land is scarce because they can be planted on field and farm borders, providing good dry season fodder. Leguminous crop residues like straw from beans, groundnuts, cowpea and soybeans can be used as feed. Some legumes contain substances that may cause illness or bloating if consumed in excess. Leucaena, for example, should never make up more than 30% of the daily ration. A Desmodium and Elephant grass mixture is an example of a rather successful combination under favourable conditions.

3.3 Crop residues and dry season

Year-round availability of forage is essential for sustained high animal production. On mixed farms, crop residues from grains (maize, cowpea), fruits (banana) or roots (sweet potato) can be important to supplement shortages in the roughage supply.

Residues of many crops can be fed to cows, either fresh or dry, in the field or in the stable. There are, however, large variations in quantity and quality, depending on climate, region, crop species and variety and harvest stage.

Rather good feeds: stems and leaves of legumes like cowpeas and groundnuts, sweet potato vines and green maize leaves.

Acceptable feeds: bean and soybean straw, maize stover if green and leafy sugarcane tops. (Sugarcane tops may be an important resource in

certain areas when huge quantities become available in the dry season).

Low value crop residues: old, brown maize stover, cereal straw.

Very poor feed: rice straw, even if treated with urea. It may help animals survive the dry season, but it is definitely not good feed for lactating cows.

Conclusion: the nutritional value of most crop residues is low with the exception of legumes (see Table 3). Supplementation with protein rich concentrates is necessary to enable your cows to produce.

3.4 Important aspects of forage utilization

- Land has to be prepared well before planting or sowing forage. This includes: weed and bush control, ploughing, harrowing and sometimes ridging. Fast establishment during the rainy season is recommended and helps to control weeds.
- Improved forage only produces well if fertilized with manure and/or fertilizers. Nitrogen is important for grasses, phosphorus for legumes and potassium for both. Without manure or fertilization grass production will decrease rapidly.
- Grazing or cutting management of grass should be adapted to the species. Compromise between quantity (low cutting frequency) and quality (high cutting frequency) (see Table 9). Cutting grass, not too early, will increase yield, stimulate re-growth and help to control weeds. Less frequent cutting results in higher DM yields but decreasing crude protein (CP) content.
- Legumes have a high protein content and can fix nitrogen from the air. They can be used as protein banks or intercropped. Tree legumes like *Leucaena* can be grown as hedgerows and field borders to save land.
- Properly handled and stored crop residues, for example from legumes, stover and sugarcane tops, are good options, particularly during the dry season.
- Seek the extension worker's advice on the best forage for your farm and its management.

Table 9: Effects of cutting frequency on DM yield en CP content of Elephant grass with adequate rainfall and fertilizer application.

Cutting frequency	DM yield kg/ ha	CP %
4 weeks	9000	11.0
6 weeks	15500	8.2
8 weeks	19000	6.4

4 Animal health

Management is prevention of diseases.

Taking good care of an animal does not only mean treating it when it is sick; it means preventing it from becoming ill. Even though treatment may cure the animal, the disease might have affected its body and these effects may last longer than curing the disease itself. Consequently, production losses may continue after the animal has seemingly recovered. Retarded growth in calves and a permanently reduced milk production are examples.

4.1 Disease prevention

It is strongly recommended to call for veterinary assistance for disease prevention as well as when health problems are suspected (veterinarian, veterinary assistant or animal health assistant). Most diseases can be prevented by the same management measures that enhance production. General preventive measures are:

- Hygiene, cleaning and disinfecting. Remember disinfection is useless without proper cleaning beforehand.
- Free access to clean and fresh drinking water.
- Providing good and sufficient feed and water at regular times.
- Protection against predators, parasites and adverse weather conditions like rain, wind, cold, and intensive sunshine.
- A comfortable environment without unrest and stress.
- Avoiding contact with sick animals and game because many diseases are contagious.

Other preventive measures are quarantine, vaccinations and preventive treatments.

Quarantine means isolating sick animals and newcomers from the rest of the herd. This helps to avoid the spread of contagious diseases to

other animals. Take special care of dung, urine, milk, blood and aborted material as these may transmit the disease to other animals. Some diseases, like tuberculosis, brucellosis and rabies, are also dangerous to humans (see Agrodok 46: **Zoonoses: diseases transmitted from animals to humans**). Assure proper cleaning and disinfecting. Dry and clean floors with bedding are important. Sick animals need special care. Provide them with shade, protection against wind, clean water and adequate feed.

Vaccination against a specific disease helps the animal's body withstand an attack by this disease. Sometimes it will protect the animal during its entire life, but many vaccinations have to be repeated. Unfortunately, vaccinations are not available against all diseases.

Preventive treatment can be useful for some seasonal diseases. Examples are treatment of young animals against worms, and tick control.

4.2 Regular observations

To detect health problems in animals, it is necessary to observe them frequently, several times per day. This can be combined with observations for heat detection (see Chapter 6). When observing the animal, check the following:

- Behaviour: does it react normally to its environment and in the group or is it acting strangely?
- Attitude: does it carry its head, ears, body and tail as usual? Does it walk normally?
- Condition: is the animal in good condition and is it well muscled, neither too thin nor too fat?
- Does it eat, drink and ruminate properly?
- Does it urinate and defecate normally?
- If a cow is milked, is the milk normal and is there any sudden drop in production?
- Any other abnormal signs?

General examination

Be very careful with sick animals and pay attention to hygiene while examining the following aspects:

- Breathing frequency. A breathing frequency (breathing in + breathing out) of 10 to 30 times per minute is normal in adult cattle. In calves, 30 to 50 breaths per minute are normal. Breathing can be observed best at the animal's right flank, seen from behind.
- Pulse or heartbeat. The normal rate per minute is 50 to 80 pulse beats in adult cattle, 80 to 110 in animals between 2 months and 1 year of age and 100 to 130 in younger animals. The pulse should be regular. The pulse can best be felt at a blood vessel just below the bottom jawbone (see Figure 9).
- Chewing the cud (rumination). Healthy cattle regurgitate a ball of food (cud) from their rumen stomach and start chewing it. This is called ruminating. If the cow chews the cud less than 40 times per minute, there might be a problem. Rumen activity can be felt by pressing lightly with the fist on the upper part of the left flank. The movement of the expanding rumen can be felt; normal frequency is 2 to 3 times per minute.
- Body temperature. Adult cattle have a normal body temperature of between 38 - 39°C and calves up to 1 year 38.5 - 40.5 °C. A higher temperature does not necessarily mean fever. Fever is usually accompanied by shivering, rapid breathing and an increased pulse rate, and possibly, diarrhoea. Often the ears, horns and legs of the animal are cold to the touch while the body is too warm. Check the temperature of the animal by inserting a thermometer into the anus for one minute; for calves, insert the



Figure 9: The place of the blood vessel to feel the pulse

thermometer one third of its length, and two thirds for adults.

- Coat, skin, hooves and horns. A healthy animal has a shining, smooth and even coat, as well as shiny horns and hooves. Its eyes should be normal, without any discharge or tears, and the muzzle moist.

Health problems can be caused by:

- Infections from internal or external parasites like worms and ticks, or microorganisms such as protozoa, bacteria, rickettsia, viruses and fungi.
- Nutritional deficiencies of energy, protein, minerals or vitamins.
- Digestive disturbances due to improper feeding or lack of water.
- Being too fat at calving, a body score above 3.5.
- Genetics: the animal may inherit abnormalities from its parents.
- Accidents and predators.

5 Diseases and prevention

Hygiene everyday helps to keep the vet away.

There are many cattle diseases, though some are only of significance in certain areas (e.g. Trypanosomiasis) or under specific conditions. Unfortunately describing all the diseases with recommended treatments is clearly impossible within the confines of this Agrodok. Disease identification and proper treatment require specialist knowledge and skills. If your animals are not in good health, you must seek veterinary assistance. A few diseases are described below, with the emphasis on prevention.

5.1 Vaccinations

Vaccinations against the following diseases may be relevant for dairy cattle:

- Rinderpest. Compulsory in many parts of Africa. Can be combined with vaccination against contagious bovine pleuropneumonia once in a lifetime.
- Haemorrhagic septicaemia prevails in humid areas. Quite often a combination of vaccinations is administered annually, which also protects against anthrax and black quarter.
- Foot and mouth disease in areas where this disease is common. Repeated each year.
- Brucellosis. Female animals of about 9 months are vaccinated once.

5.2 Diarrhoea and pneumonia in calves

Diarrhoea, or scouring, is the main cause of death of young calves in the first 2 - 3 weeks of their lives. It is easy to detect: the dung is liquid, white in colour and has a very bad smell. The calf looks ill and does not drink well.

To prevent scouring it is most important to provide the calf with colostrum within 2 hours of its birth; hygiene is essential. Clean buckets for feeding and clean housing are really necessary. A clean and dry floor with bedding or a slatted floor is important too. As treatment, the first step is to give the calf boiled water to prevent dehydration. Add one teaspoon of kitchen salt and two tablespoons of sugar per litre of water. Once the calf has recovered start milk feeding again gradually. If after some days the diarrhoea has not disappeared, treatment with antibiotics will be necessary.

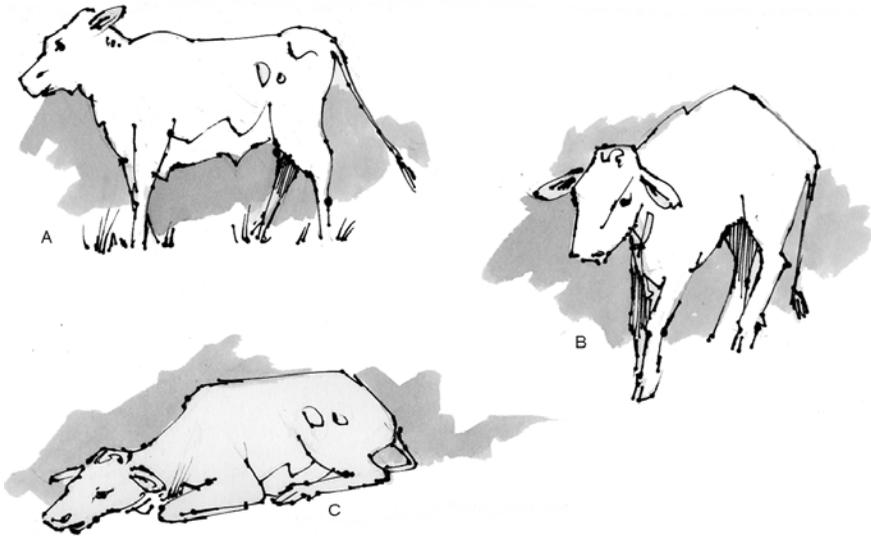


Figure 10: Signs of health and disease in the calf. A: Healthy, alert, clean eyes, shining coat and pricked ears. B: Diarrhoea, dirty hind legs and tail, drooping ears and sunken eyes. C: Pneumonia, Runny eyes and nose, difficult breathing, open mouth and neck stretched out

Pneumonia is an important cause of poor growth and death in the first four months of a calf's life. Symptoms are coughing, high fever, watery eyes and a runny nose. Calves are mainly affected after two months of age.

For prevention, feeding of colostrum immediately after birth and clean open housing, with good ventilation and a dry floor are important. Calves should be protected against large variations in environmental temperature. Vaccination at an age of three months is possible.

If a calf suffers from pneumonia, treatment with a broad-spectrum antibiotic for at least five days will generally be successful.

5.3 Worm prevention

An animal suffering from a worm infection will lose weight and become ill and frequently will also have a “pot-belly”. Young animals are particularly susceptible to gastrointestinal worm infestation from grazing. Worms develop well under humid and hot conditions.

Regular cleaning and keeping the stable floor dry will help prevent infection. Stall-feeding instead of grazing will help reduce the risk of infection. Avoid grazing in humid areas or use mobile pens in clean pasture plots instead. De-worming is common practice for young animals, starting from the age of two months and repeating treatment every 3-4 months until about 2 years of age. As most infections occur during the rainy season, de-worming before and after this season is useful in many areas.

5.4 Tick control

Ticks can be a real problem, especially under grazing conditions. They suck blood and infect cattle with nasty so-called tick-borne diseases. There are many kinds of ticks and although not all of them transmit diseases, they weaken the animal by causing blood loss. They make wounds that allow bacteria to enter the skin resulting in loss of value of hides. Ticks can also attack the udder causing the loss of a teat, thus making the cow less productive.

Farmers should find out which combination of tick and tick-borne disease control measures will be the most suitable. This will depend on

the kinds of ticks in the region, the farm situation (breed of cattle, feeding system), the costs and benefits of the measures and on the veterinary services available.

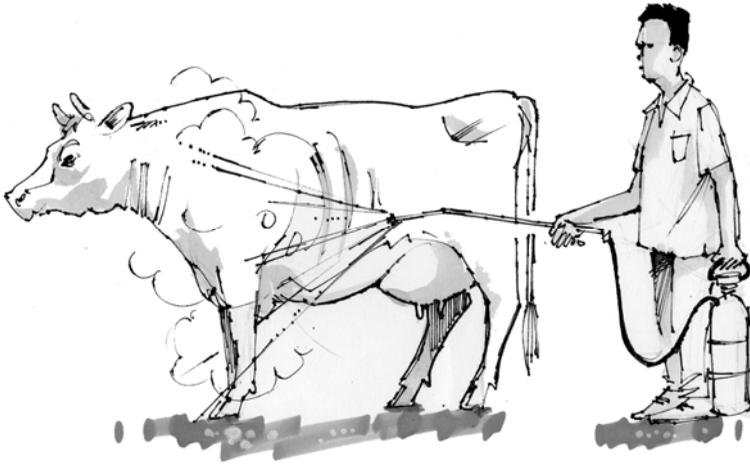


Figure 11: Tick control

If an animal has only a few ticks, they can be removed by hand. Nowadays there is also a drug “pour-on” that can be easily applied to control ticks. In most situations, however, special chemicals called acaricides have to be used. But because acaricides not only kill ticks but also are toxic to humans and cattle, careful handling and following of the provider’s instructions is most important. Acaricides can be used in dip baths or with sprays or sponges. If the animal does not have many ticks, apply acaricides or pye-grease to the parts of the body preferred by ticks, especially the folds of the skin. Use the correct mix of chemical and water for each purpose.

The frequency of treatment depends on the type of ticks, the breed of animal and the season. It varies from twice a week for exotic cattle like Friesians in regions with East Coast Fever to once every three weeks to control *Boophilus* (blue) ticks that transmit babesiosis and anaplasmosis. It also depends on the feeding system and the contacts

of the animals with other cattle in the village. If an animal suffers from a tick-borne disease, seek veterinary assistance.

5.5 Trypanosomiasis control

Trypanosomiasis or sleeping sickness is a disease caused by protozoa transmitted by tsetse flies. It is characterized by anaemia (lack of red blood cells), loss of condition, abortion, infertility and, if left untreated, high mortality.

Trypanosomiasis prevention and control is partly dependent on national measures, including elimination of tsetse flies and limiting contact between cattle, wild animals and the flies. In a region with a risk of trypanosomiasis, a drug can be administered that prevents the animals from becoming ill. Timing and dosing of the drug are very important, so follow the instructions carefully. The same type of drug can be used to treat animals already suffering from trypanosomiasis. If necessary, seek help from an expert.

5.6 Hoof problems

Besides lameness, cows with hoof problems may present a serious drop in milk production. Hoof problems can be caused by infections or by hoofs growing out of shape.

Prevention consists of the following measures:

- Hygienic housing. Clean and dry, well-levelled floors are required. Floors should not be slippery, so the surface should not be too smooth.
- Nutrition. Well-balanced feeding with sufficient roughage and no drastic changes is recommended. Zinc deficiencies may cause hoof problems.
- Hoof trimming. Hoofs grown out of shape need trimming. This job requires special skills and should be done by an experienced person.
- Footbath. When problems occur frequently, a footbath with a disinfectant could be considered.

5.7 Mastitis

Mastitis or infection of the udder is a common problem on dairy farms. It can be chronic or acute. Signs of acute mastitis are: abnormal milk with flakes, different colour, watery appearance and a foul smell. The area of the udder that is affected will be painful and hard, sometimes swollen and reddish. The cow will be difficult to milk and its milk production decreases. Infection most often occurs just after milking when the teat is still open and bacteria can enter easily.

For early detection of chronic mastitis a strip cup with a dark bottom in which the first milk is collected is useful. The first squirts of milk from a cow suffering from chronic mastitis are watery and contain small flakes (see Figure 12).



Figure 12: For early detection of chronic mastitis a strip cup with a dark bottom in which the first milk is collected is useful. The first squirts of milk from a cow suffering with chronic mastitis are watery and contain small flakes.

Try to prevent mastitis by taking the following measures:

- Cleanliness of the milker, building, equipment and cow is of the utmost importance, at all times.

- Milkers should wear clean clothes, wash their hands and have short nails.
- Keep udders as clean as possible by shaving them and providing clean bedding.
- If the udder is not very dirty, just use a dry cloth to wipe off any loose dirt.
- If water is necessary for udder cleaning, add a mild disinfectant, change water and cloths frequently and dry udders well, preferably with paper towels.
- Disinfect teats after milking with a dip or spray.
- Feed the cows after milking so they will not lay down in the first hour.
- A long-lasting antibiotic can be used to treat all quarters at drying off on farms with serious mastitis problems.

If a cow has mastitis:

- Milk and massage the affected part as often as possible, for example every two hours. Washing the udder alternately with warm and cold water and massaging with ointment will also help.
- Consult a veterinary officer and apply antibiotics to the infected area. Milk from treated cows is not suitable for consumption!
- Milk infected cows last and bury the infected milk.
- Clean your hands carefully after milking the affected quarter.
- Check the other cows carefully for signs of mastitis by using a strip cup.
- Cull cows with chronic or incurable mastitis.

5.8 Milk fever

Milk fever is the most common digestive disorder in older cows. It occurs at the time around calving. When a cow has milk fever, it does not eat, it lies down with its head to one side and cannot stand up. It has staring eyes, cold ears and a dry muzzle. If not treated, it may die.

The main cause is improper feeding with relation to the mineral calcium. This occurs when the cow is fed too much concentrate during

the dry period before calving. She should be fed as if producing 5 kg milk per day and not be allowed to become fat. If a cow has a milk fever history, do not milk her out completely at first.

Take immediate action if a cow has milk fever. She will need additional calcium, preferably injected into the bloodstream by an experienced person.

5.9 Retained placenta

Normally the afterbirth or placenta will be expelled within 12 hours after a calf's birth. If not, part of the membranes can be seen hanging from the vulva and this causes a foul smelling discharge. At first, the cow may seem all right but after a few days, she will eat less and her milk production will drop. The cause of placenta retention is not yet known. Infections play a role, but also feeding.

To reduce the incidence, avoid letting the cows get too fat at calving. Be very careful with interventions during calving. Milking or suckling of the calf just after calving helps too. Vaccinations against diseases like brucellosis can be useful. Do not remove the placenta by force. A special pill with antibiotics can be put into the uterus to treat infections.

5.10 Wounds

Accidents occur. Besides treating the wound itself, it is very important to identify the cause and eliminate it. The building, equipment, fences, other animals, predators and parasites, may be the cause of wounds.

Cleanliness and protection against flies are the most important factors in wound treatment. Equipment, clothing, hands and housing should be clean. Hairs around the wound should be clipped and dirt removed. Wash out with a weak disinfectant and try to stop bleeding. Apply iodine tincture, methylene blue or wound spray. If the problem is serious, call in an expert.

6 Reproduction

Without reproduction there is no production.

A cow has to give birth to a calf before she can start a new lactation. Pregnancy only occurs after effective service during heat. The length of the calving interval is determined by the time between calving and the next conception. This affects the length of lactation, which together with the age at first calving has a significant effect on the lifetime production of the cow.

6.1 Heat detection

Signs

A cow in heat indicates that she is ready for breeding and that with an effective service she is ready to become pregnant. Heat signs are:

- The cow becomes restless, bellows and tries to attract attention of other animals.
- She tries to mount other animals, she sniffs them and invites being mounted and sniffed at.
- During standing heat, she will allow mounting and will stand still. This is the most reliable indication of heat and the appropriate moment for (natural) service.
- She may have mud on her flanks from having been mounted before. The hair on her back, the pelvic area and the tail head is ruffled and sometimes bare.
- The lips of the vulva are coloured red and somewhat swollen.
- Discharge of clear thin mucus from the vulva, which may be attached to the tail.
- Often, milk production is less than normal and the cow behaves differently.
- After heat there may be a bit of bloody mucus discharge on the hindquarters and the tail.

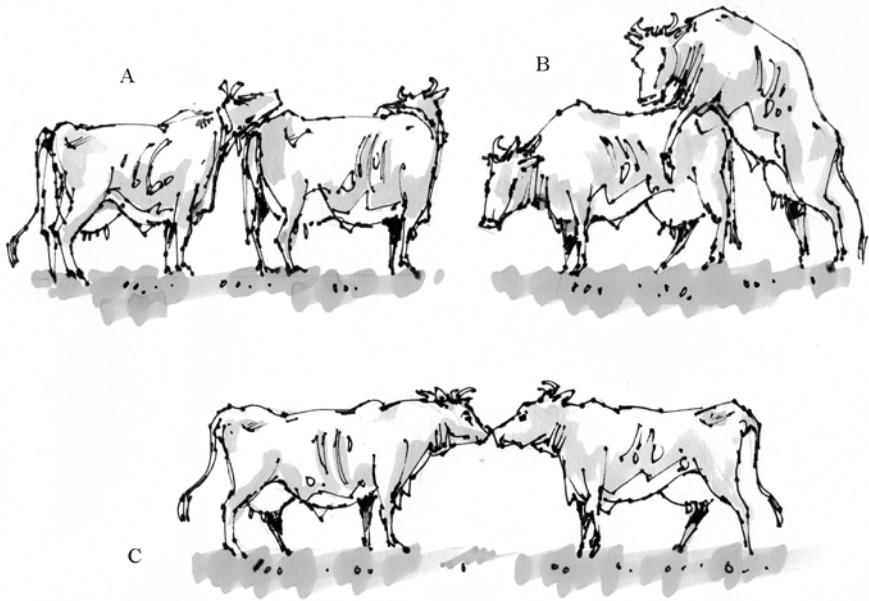


Figure 13: Heat signs

- A: Early heat, sniffing at other cows
- B: Full heat, stand to be mounted
- C: After heat, still sniffing at other cows

Heifers after puberty and non-pregnant cows should come in heat every 3 weeks or 18 to 23 days. So when records are kept of heats detected it is easier to keep an eye on the animal 18 to 23 days later to see if it comes in heat again. If she was inseminated and does not come in heat, it may be assumed that she is pregnant.

Heat detection procedures

Normal heat lasts about 8 to 12 hours. It is therefore advisable to observe cows at least three times a day for some 10 to 20 minutes for signs of heat. A bull will never fail to detect a cow in heat, but mostly bulls are kept apart from the cows, so the farmer has to recognise the heat signs. When cows are grazing in a herd recognising an animal in heat is not difficult, as other cows will mount her. It will be less easy

to detect if cows are housed, but if the animals can walk around, they can still mount one another. Most difficult is when cows are tied in a stable. Then the farmer must be more watchful to detect other signs like restlessness, bellowing and a drop in milk production and check whether the vulva is swollen and red.

Complications in heat detection

Under conditions with high ambient temperatures, cows often show signs of heat during the cooler hours of the day, especially at night. In hot climates, heat is of a shorter duration, 6 to 8 hours, making detection more difficult. Frequent observations, particularly during early morning and late evening will help.

Cows that are not healthy will not come in heat or will not exhibit clear heat signs. The same applies to cows in a poor condition or losing body weight because of inadequate feeding, high milk production in the period after calving, or disease.

6.2 Breeding

Once the animal has been identified as being in heat she may be taken to the bull for service or to be inseminated. If there is a bull among the cows he will take care of the service, but the farmer should record this to establish the dates for drying off and the next calving.

If an artificial insemination (A.I.) programme is available, you may wish to make use of this service for your cows in heat. Be aware that insemination should take place during the second half of the heat, preferably between 6 to 12 hrs after the first heat signs. For natural service, the animal in heat should be presented to the bull during standing heat. As a general rule, cows detected in heat in the morning should be serviced that same afternoon and those that came in heat in the afternoon should be serviced early next morning.

If a cow has to wait for A.I. service, she should preferably be kept in the shade and given water to avoid an increase in body temperature.

Care should be taken to avoid (heat) stress as this reduces the conception rate. To obtain genetic improvement, it is important to carefully select the proper bull or semen. In high potential areas under good management conditions, crossbreeding the local cattle with a dairy bull may be considered. In the hot tropics, crossbreeding with milking zebu breeds like the Sahiwal and Red Sindhi is an option. The choice of bull should be made with care, also within the breeds, taking into account the desired cow to be bred and the specific conditions on the farm. Seeking advice from local specialists is most advisable.

Cows can be served from the second heat after calving onwards, thus after some 45 to 50 days. The first heat is the last part of recovery of the uterus after calving; chances of conception are low at this point in time. If after a service the cow comes back in heat some 3 weeks later, she has obviously not conceived and needs another service

6.3 Calving Interval

The calving interval is the period between a cow's two consecutive calvings. The ideal calving interval is one year (12 months). This period can be divided into the open period, which is the period between calving and conception, and the pregnancy period. As the length of the pregnancy is fixed at 9 months, the calving interval depends entirely on the open period.

The open period should be about 3 months, indicating that a healthy cow coming in heat 50 days after calving should be served then. The open period on many farms is much longer because cows do not come in heat, heat is not detected or the servicing is not successful. The result is a prolonged calving interval, often 15 months or even more.

The shorter the calving interval, the higher the lifetime production of the animal. In any case, calving intervals shorter than 15 months or 450 days should be aimed for. This coincides with a calving percentage of 80 % or higher.

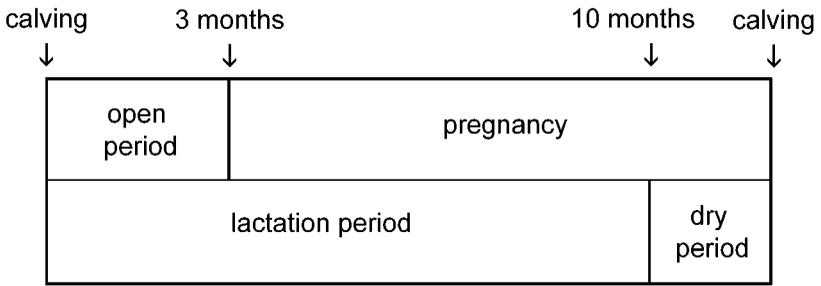


Figure 14: Schematic overview of an ideal 12 months calving interval

Traditionally, the calving % is expressed as a part of a full year or 365 days. A 100 % calving result means that all cows do calf at a year's interval on average. A calving % of 80 implies a calving interval of $(365:80) \times 100 = 456$ days (about 15 months). An average calving interval of 425 days gives a calving percentage of $365 \times 100/425 = 86$ %

Dry period

Ideally, lactation lasts for 305 days. Combined with the 60-day dry period, this provides an ideal calving interval of one year. Many people believe that a new pregnancy will negatively affect the daily production of the cow. This is not the case until about the 6th month of pregnancy.

The shorter the calving interval the more lactations the cow will have in her lifetime. Moreover, if a cow has a longer dry period she may become too fat. This will have a negative carry-over effect on the next lactation, so she will produce less milk. Best is a short calving interval and a standard dry period of 2 months. Moreover a cow producing milk, even a small amount, is more efficient in her feed intake and digestion than a dry cow. Therefore, continue milking her right up to 2 months before calving. This benefits both animal and farmer.

If a cow lives for 6 years after first calving, variations in calving interval will have big consequences for her lifetime production. Meanwhile feed requirements of such cows and other costs vary very little. This shows that calving interval and lactation length are of the utmost importance for the profitability of dairy animals. See table 10.

Table 10: Cows living 6 productive years after first calving and an average yield of 2000kg/lactation

	Calving interval in months	Yield per lactation in kg	Lifetime yield in kg	Yield per day of prod. Life in kg	kg TDN/ kg milk#
Cow A	12	2000	12.000	5.5	1.04
Cow B	15	2000	9.500	4.35	1.22
Cow C	18	2000	8.000	3.65	1.38
Cow D	21	2000	6.850	3.13	1.51
Cow E	24	2000	6.000	2.74	1.71

Lactation

A normal lactation curve of a healthy well-fed cow reaches its peak at about 6 to 8 weeks after calving. Thereafter, milk yield per day levels off and slowly declines until drying off at 60 days before the expected next calving.

It often happens that a lactation curve follows the normal pattern towards the peak, but then milk production sharply declines and after some time rises a bit again (see Figure 15). This is mainly due to inadequate feeding. During peak production, the cow has exhausted her feed and body reserves, gets very thin and her milk production decreases. Once recovered from this feed deficiency, she will again increase production somewhat but far below her capacity, consequently a lot of potential milk is lost. It takes much longer before such a cow conceives again, so she will have a very long calving interval. Therefore it is very important to provide good roughage and liberal amounts of concentrates to cows in early lactation. This will prevent the sharp decline in milk production after peak yield.

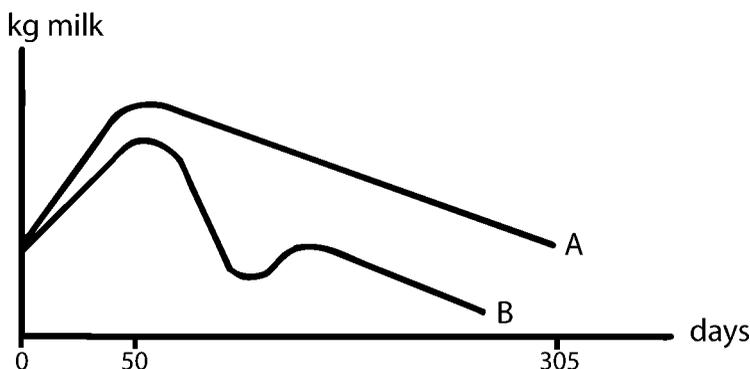


Figure 15: Lactation curves: A = potential lactation, B = lactation of a cow inadequately fed during early lactation.

6.4 Young Animals

Heifers may reach puberty at a very young age of around 12 to 15 months. However, they should have attained at least 70% of their mature weight at the moment of first service. For well-reared heifers this is at an age of around 20 months. Under very intensive conditions this can be achieved at an age of 15 months. On the other hand, when heifers are older than 20 months their live weight at service should be much more because their growth after calving will be much less.

A pregnancy of underdeveloped heifers will hamper their future milk production, so an age of two and a half years at first calving is best on many small farms. As an indication, a Holstein heifer should weigh some 350 kg, a crossbred around 300 and a light breed some 250 kg at the moment of serving at the age of 20 months.

6.5 Partial suckling

Cows that are (partly) suckled by their calves generally do not come in heat during that period. So suckling might increase the calving interval. By restricting suckling, for example, to 15 minutes and only twice

per day or by preventing the calf from suckling for a few days, the cow may come in heat and be served.

6.6 Bulls

Young bulls can be used for controlled mating from the age of 1 to 1.5 years onwards. If mated cows come back in heat frequently, the bull might have a fertility problem. Care should be taken to avoid the spread of contagious diseases, like trichomoniasis, vibriosis and abortion (Brucellosis). Cows for service should be healthy, have calved normally and show no discharge from the vulva. If in doubt contact the veterinarian.

7 Calf and young stock rearing

The calf of today is the dairy cow of tomorrow.

The newborn female calf should become a milk-producing cow in about 2.5 year's time. However, calves may die and this mortality means a loss of money. Far worse is morbidity, the chronic disease status of calves resulting in stunted animals. Morbidity affects all aspects of the animal during its entire life: its growth, the age of first calving, milk production and calving interval.

Proper young stock rearing preventing mortality and morbidity is extremely important for the economic situation of the farm. This starts with the care of the cow around calving. The next step is to help the calf – a monogastric animal at birth – to become a ruminant. A ruminant has four functioning stomachs, while in the recently born calf only the real one, the abomasum, is developed. The other three stomachs, especially the rumen, develop when the young animal eats roughage. This process takes about 8 to 10 months.

7.1 Calving

A pregnant cow will give birth to her calf 9 months after the last successful service. The unborn calf grows fast in the last two months and the milk producing tissues in the udder are renewed. It is why the cow has to be dried off 2 months before the expected calving date.

The cow should be observed regularly a few days before calving and, if possible, be separated from the herd, preferably in a clean, roofed place with dry bedding and without obstacles that might cause injury.

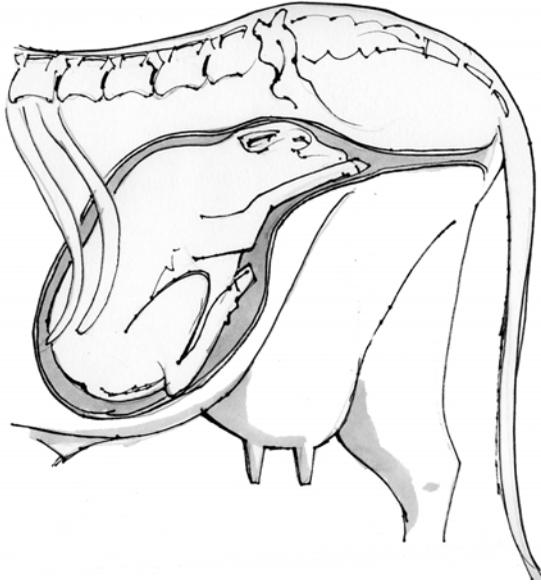


Figure 16: The unborn calf, normal position

At the start of delivery the animal becomes restless, lies down and stands up again, and attempts to urinate. The uterus starts contracting which is not yet visible. The appearance of the water bladder is the first real sign. In a normal delivery the calf's front legs and mouth appear first. Once the head is born the rest of the body will follow, only the hipbones may cause some delay. If it takes too long, pull on the front legs, but only when the cow herself is pushing.

It is best to keep an eye on the cow but let her do the job. If assistance at calving is really unavoidable, make sure that your hands are washed and clean and wash the vulva of the cow before starting. In case of doubt or lack of experience, call the vet or an experienced person.

The afterbirth or placenta should be expelled within 3 to 4 hours. If this does not happen within 12 hours, call for expert help. Do not pull or put a weight on the afterbirth, this may damage the cow's uterus

and cause serious problems. Allowing the calf to suckle directly after birth stimulates the expulsion of the placenta. See Chapter 5.9.

7.2 Calf rearing

A newborn calf needs milk for about 3 to 4 months. After weaning, the calf can do without milk but it still needs high quality feed to stimulate its growth and development. The period after weaning is often the most difficult, especially if high quality feed is not available or is considered too expensive. Calf mortality, however, is highest during the first 3 to 4 months.

The first days

Right after birth the umbilical cord should be disinfected with a solution of iodine. A newborn calf does not have any resistance against diseases or parasites, so it needs good care, proper housing and adequate nutrition to prevent it from becoming ill. Newborn calves should be housed in an individual calf pen. Assure a dry floor with bedding or a slatted floor and no draught of cold air. After 3 weeks, calves can be housed in a group.

The newborn calf needs colostrum as soon and as much as possible, preferably within half an hour but at least within 2 hours after birth. 'Colostrum' is the milk the dam produces during the first 3 days after calving. Colostrum contains a lot of antibodies and it gives the calf so-called 'maternal immunity'. Some farmers allow the calf to stay with its dam for 2 or 3 days to get the maximum amount of colostrum. The problem is that it may be difficult to teach the calf to drink from a bucket thereafter. Other farmers milk the cow 3 to 5 times a day and feed the colostrum immediately to the calf, about 0.75 to 1 kg each time. This is important for building up immunity as soon as possible. Maternal immunity lasts for some 2 to 3 months and within this period the calf has to build up its own immunity. Best is to allow the calf some exposure to pathogenic organisms and parasites. Caution: make sure it is only a light exposure!

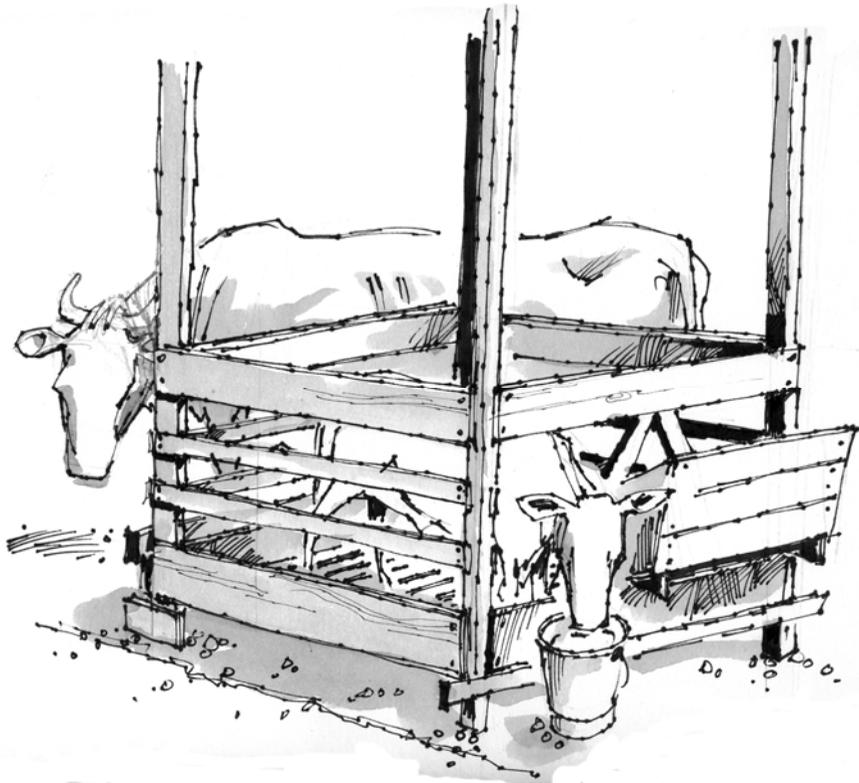


Figure 17: Individual calf pen

Feeding till weaning

Milk is a complete and natural feed for the young calf that needs about 10 % of its body weight per day during the first 3 to 4 months of its life. Too little milk will hamper the development of the calf, too much may cause diarrhoea. Stick to the right amount and the calf will make a good start. To train the calf to drink from a bucket, let the calf suckle on a finger and lead it towards the milk in the bucket; after a few times it will drink all by itself. Clean buckets and strict hygiene are required, otherwise the calf will get diarrhoea.

From the second week onwards a small portion of concentrates and some roughage should be offered. A special calf concentrate is prefer-

able, but any good concentrate will do provided that it does not contain urea and cottonseedcake. At the beginning, the concentrate can be given in the same bucket as the milk. Once the calf starts eating it readily, it should be given in a special feed trough.

Roughage, preferably hay of a good quality, will stimulate rumen development. It can be tied with a piece of rope to the side of the pen when the calf should start eating it suckle-wise. Once the calf begins to really eat the roughage it may be given in a rack and ad libitum. Fresh roughage should be supplied, preferably twice a day. Make sure the calf has water available at all times and, at a later stage, some minerals.

Although very detailed feeding schedules exist, an effective and simple system is to give the calf 2 kg milk in the morning and 2 kg in the afternoon for 12 weeks at least, or about 300 litres in total. This is a minimum, feasible only if the calf consumes an adequate amount of concentrates. If concentrates are not available, more milk per day must be given for a longer period. At weaning, calves of improved breeds (500 kg mature weight) should weigh at least 70 kg and consume 1.5 kg of concentrates per day. After weaning, the calf still needs good quality roughage and concentrates to continue its development. Often concentrates are considered too expensive for calves, but remember that the nutritive value of 1 kg good quality concentrates is equal to that of some 3 to 4 kg milk.

Bull calves

On most dairy farms bull calves are neither used nor needed. Rearing them costs money, so unless needed to stimulate their dams' milk let-down, sell or slaughter them as soon as possible.

Suckling

Many local and crossbred cows will not let down their milk without their calf being present. This does not necessarily mean that the calf has to suckle first, often its close presence will do. If this is the case the cow will stop producing if her calf dies. Therefore try milking the

cow without the calf. Some farmers allow the calf to suckle the last milk for 10 to 15 minutes. This may help to reduce mastitis, but as the last milk contains the most fat, the calf may get too much fat. Better leave (part of) one quarter or teat for the calf, but not always the same teat.

In some areas milk is only collected in the morning in which case the calf can join its dam for suckling after the morning milking till mid-day. From then on until the next morning milking, calf and dam remain separated.

Remember

Points to bear in mind when calf rearing:

- Immediate provision of colostrum to the newborn calf is essential.
- Feed an adequate amount of milk from a clean bucket, right after milking the dam.
- Introduce special or good quality concentrates at about one week of age.
- Start giving roughage during the second week, preferably good quality hay.
- Make sure the calf pen is dry, draught free with a slatted floor or adequate, tick free, bedding.
- Provide the calf with fresh and clean water from early age onwards.

7.3 Young stock rearing

After weaning at an age of 3 to 4 months, many calves are fed on roughage alone, which is not enough for adequate growth because their rumen is not yet fully developed. Generally, roughage needs to be supplemented with calf or young stock concentrates till the age of 1 year at least, though this depends on roughage quality and season. With good quality roughage, a growth of 200 to 300 grams per day is feasible. However, the required growth for a heifer to conceive at about 20 months is 450 to 500 grams per day, necessitating the providing of supplements of at least 1 kg of concentrates per day.

Many farmers give the best quality roughage to their dairy cows and the young stock gets what is left. This hampers their development and they might remain stunted for the rest of their lives. Young animals need adequate nutrition and this investment will be repaid once the animal starts producing milk.

A well-developed heifer can be serviced at about 20 months of age and in this way she will calf-down at about two and a half years or 30 months. The pregnant heifer should grow at least 500 grams a day and this cannot be achieved on the basis of roughage alone, so she needs supplements as well. Any setback in nutrition and health will affect her development, her pregnancy and her future milk production. Such a setback is difficult to compensate later on, the animal will remain a poor producer for the rest of her life.

Once the heifer has calved and started her productive life, rearing is not yet complete. She will continue growing and developing during the first lactation. The extra feed required, the 'youth allowance', is about 20% TDN and CP above the daily maintenance requirements. This youth allowance must be taken into account to enable the cow to develop her production potential. Cows reach full maturity at 4 to 5 years of age, depending on the breed.

8 Clean milk production

Clean milk saves lives; dirty milk may kill people.

Practical reasons for proper and hygienic milking and milk handling in dairying are:

- To produce clean milk of good keeping quality.
- To prevent and control mastitis, a contagious disease that affects the production and the quality of milk.
- To deliver good quality milk to consumers and processors.

Milk is an ideal environment for microorganisms like bacteria to multiply, especially in warm conditions. Microorganisms may cause souring of the milk and hence rejection by the consumer or the milk collector. Filtering the milk after milking removes visible dirt like hairs and larger pieces of soil and dung, but not the very fine dirt particles or the invisible bacteria.

Good standards of hygiene are of the utmost importance for the quality of the milk and its products, as well as for the producer since the milk price often depends on quality; poor quality milk will be rejected. The consumer wants a safe product and the processor needs good quality milk for processing.

The handling of milk strongly affects the quality of the finished product. On leaving the udder milk from a healthy cow contains a negligible quantity of bacteria and no dirt. If good hygiene is practised the contamination outside the udder can be kept to a minimum.

Good quality milk:

- Is produced by healthy cows.
- Is not contaminated with water, dirt, antibiotics, detergents and bacteria during nor after milking.
- Does not smell or taste bad.

- Has not deliberately been adulterated with water, sugar, salt or flour. Addition of water, in particular, may cause contamination by microorganisms and pose a threat to human health.
- Is a healthy food.

8.1 Clean milk

Clean milk production depends on the milker, the cow, the milking utensils and equipment used, the shed including the milking place and the handling of milk.

The milker

The milker should be healthy, clean, have short and clean fingernails and wear clean clothes. He or she should milk the cow paying full attention to the task and not smoke, spit or cough while milking. The cow should be milked as quickly and completely as possible, and preferably always milked by the same person. By calm and gentle handling, touching the cow, talking to her and maintaining routine actions during milking, she will feel at ease. If the cow is fed concentrates, do it during milking.

The cow

To prevent dirt from dropping into the bucket during milking it is advisable to shave the hairs of the udder twice a year, especially around the teats. Brush the hair on the flank of the cow on the milker's side frequently. The tail should also be washed and clipped if necessary to avoid adherence of dirt and dung.

Utensils and equipment

Buckets, milk cans and cloths for cleaning the udder and cloths used for straining the milk are frequently the source of bacterial contamination of the milk. The surface of the milk utensils like buckets and cans should be smooth and without seams and have rounded edges to make them easy to clean. Stainless steel is the best material but is expensive. Good plastic buckets can be used if well taken care of. Aluminium

milk cans are often used for transport. Special care should be given to cleanliness, lid included.

Udder cloths and straining cloth need careful cleaning too. Paper towels for udder cleaning and disposable cotton pads for straining the milk are advisable, but may be expensive or not available. A strip cup for routine mastitis testing can be made from an empty tin and a piece of black inner tube.

It is essential to use clean water for utensil cleaning. The procedure is as follows:

- Immediately after milking, rinse all the utensils with cool water to remove any milk residues. It is rather difficult to clean utensils after the milk has dried and sticks to them. Use cool water, as hot water for rinsing will make the butterfat stick to the utensils. Rinse the milk can with cool and clean water immediately after milk delivery.
- Brush all utensils thoroughly with hot water and detergent or soap. Keep separate brushes for the inside and outside of the utensils.
- Rinse all utensils with clean, cool water to remove dissolved dirt and detergent.
- A second rinsing with a disinfectant may be considered.
- If no disinfectant is used or available, the utensils should be left drying upside down on a rack in the sun. The sun kills bacteria and acts as a disinfectant. Rinse again with cool water before use to remove dust. If a disinfectant is used the utensils can be stored inside, upside down. Never dry utensils with a towel or cloth.
- Cloths should be washed or boiled with hot water and soap, rinsed and left to hang drying outdoors, exposed to the sun.

The shed and milking place

Cleanliness is important within the dairy shed. Special attention should be given to the stand where the animals are resting, to keep animal and udder as clean as possible. Especially tie-stalls with high feed troughs cause very dirty udders as the cow may lay with its udder in the manure. Use clean and dry bedding material in the resting place,

but watch out for tick infestation. The floor in the milk stand is easier to clean if made of concrete. The shed should be built in clean surroundings with proper drainage and a facility for storing manure, in order to prevent muddy and dirty conditions. Maintain high standards of hygiene in and around the place, also important for fly control.

8.2 Milking

Milk let-down

Milking deserves full attention, because it affects the yield, lactation period, butterfat percentage of the milk and the health of the udder. Milking should take place in a quiet place without shouting and yelling so that the cows feel at ease. This is achieved through a routine process with the usual milker who talks and acts quietly. Feeding of roughage or concentrates and rattling of utensils will help. Kicking, beating and twisting of the tail are bad. A good cleaning and massage of the udder is necessary for the cow to feel at ease and stimulate milk let-down. The pressure in the teats is the sign to start milking. Sometimes the presence or even the suckling of a calf is necessary to stimulate milk let-down. Milking should not start before let-down has occurred. The let-down lasts for about 5 to 10 minutes and milking should be completed within that period. If the cow experiences pain or is stressed, this process will be disturbed and milk let-down will not occur.

Preparation

Inspect each quarter for mastitis before milking starts, by squirting the first 2 draws of milk of each teat in a stripcup (see Chapter 5.7). Some watery first milk is normal; the trained eye can recognise abnormal milk, that, may show discoloration, flakes, clots or wateriness. The colostrum may contain some blood or blood clots.

It is best to sit on a stool, preferably on the right side of the cow, to prevent 'hanging' on the teats and to enable the milker to keep the bucket between the legs. This will give the milker a stable position and prevents the cow from kicking the bucket, or dirt falling into it.

Proper milking

Full hand milking is recommended. Stripping is slower than the ‘full-hand’ method and may cause more damage to the teat and udder tissue and hence increase the risk of mastitis.

In ‘full-hand’ milking you close your thumb and index finger around the teat and extract the milk by squeezing progressively with each finger in turn, starting with the index finger and using minimum traction on the teat. In this way the milk is squeezed out of the teat and is prevented from flowing back into the udder.

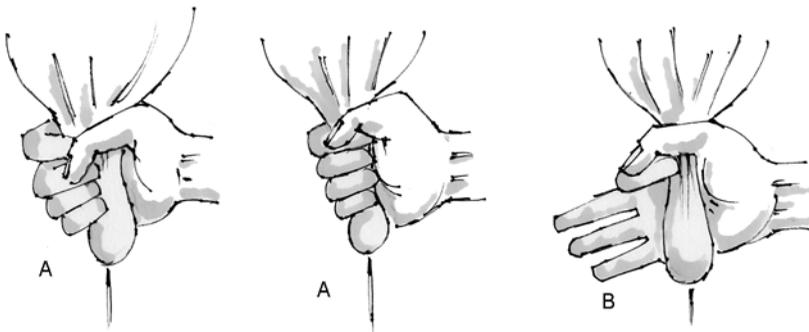


Figure 18: Hand milking. A: full hand milking. B: stripping.

The two front-teats are milked first, then the two hind teats. At the end, the rest milk is milked and massaged out of the forequarters and then the hindquarters. If the udder is not milked out completely, the drying-off process will be accelerated. This means that the milk production of the cow will gradually drop and the length of the lactation will shorten. The cow is thus ‘milked dry’ as she adjusts her production to the amount of milk removed during milking.

It is better to use the dry method when milking. This means that during milking the milker should not dip the fingers in the milk in order to wet the teats. This is unhygienic. Although udder cream is frequently used to make the teats supple, it is better to apply it after milking.

Milking time

Most cows are milked twice a day and the interval should be as regular as possible, for instance, 6 am and 5 pm. Milking times also depend on the time the milk can be delivered or is collected. If there is no afternoon collection you may consider milking as late as possible in the morning, say 7.30 am and as early as possible in the afternoon, say 2 pm. This will increase the amount of saleable milk. The afternoon milk can be used for local sales, home consumption and calf rearing. Usually boiling milk to mix it with the morning milk when delivering to a processing plant is not allowed.

8.3 Milking procedure

- Before milking, rinse the utensils and drain them properly. The noises will already stimulate the cows.
- Offer some tasty concentrates or roughage just before milking. Dry meal concentrates can be mixed with some water to make it easier to eat and to prevent dust.
- If really necessary, tie the hind legs and the tail of the cow. Prevent wounding the hocks by not tying too tight and use soft ropes or a leather strap.
- Wash hands.
- Clean the udder and the teats, preferably by rubbing gently with a dry coarse cloth. Only use water if the udder and teats are very dirty and take care to dry well with a cloth. If available, some udder disinfectant may be added to the water for cleaning. Follow the instructions for dilution carefully.
- Check the first squirts of milk of each teat in the strip cup for mastitis.
- Milk quickly paying full attention.
- Massage udder and extract the last milk.
- After milking, dip teats in a teat dip solution to prevent mastitis.
- Record the milk yield and pour milk into the can.
- Offer some roughage to the cow immediately after milking to keep her standing for about one hour. The opening of the teat will then

dry and close and largely prevent the entry of mastitis-causing bacteria and dirt.

- After milking all the cows, rinse and clean the utensils.
- Clean the dairy shed and milking place.
- Deliver the milk as quickly as possible or cool it.

8.4 Handling of the milk

Keep the milk can in the shade, preferably in the wind, during and after milking. The lid of the can should not be completely closed before transporting it. Stir the milk a couple of times with a metal spoon to let the warmth escape. The lower the temperature, the slower the bacteria will multiply. Deliver the milk as quickly as possible to the receiver or collector, making use of the coolness of the early morning. If necessary, for example, during afternoon delivery, cover the can with a white cloth to protect it against direct sunshine during transport. Do not mix evening and morning milk at the farm until delivery. Never allow milk to stand in the sun! If the evening milk is not collected, cool it down, either by putting the can in cool water, or in the wind, with a moist cloth around it.

9 Records

Records don't lie, recorders do.

Farmers may remember important events and data but often the exact information is easily forgotten. However, information about animals, inputs and prices are very useful management tools.

Recording and administration on the farm are important but should be kept simple and effective. It should provide information on the farm's economic situation, production aspects and cash flow. Technical information, like amount of concentrates fed, gives important management information when combined with prices and costs. Records about fertility, calving interval and disease are the basis for management decisions. Technical and economic records can be combined and provide both the farmer and the extension officer with the required information about the actual situation on the farm and possible developments.

9.1 Diary

In the daily routine of work it is convenient to use a diary to make note of all the events, transferring the information to the proper records at a more appropriate time. Recorded data should include: purchase of inputs and sales, price per unit and total value. Examples are: feeds, fertilizers, equipment, animals, hired labour, veterinary service and A.I. Dates of events should also be recorded. Most important are milk yield, heats, services, births, diseases and treatments of animals as well as harvests and yields of crops. Be as precise as possible with such basic data.

9.2 Animal records

On a dairy farm the animals are the most important so relevant information about them should be collected. This information will help you

with taking action like servicing and drying off and making decisions about keeping the animal or the disposal of it. The best thing is to keep individual records of each animal. A card is usually used to record: births, services, production data, drying off dates, calving intervals, vaccinations and treatments. Table 9.1 shows the front-side of such a card, Table 9.2 the reverse, containing data about health.

Based on the date of the successful service, the moment the animal has to be dried off and expected date of calving can be set.

Table 11: Example of an individual cow record: FERTILITY

Name of cow: Ann		Date of birth: 10 Nov 2003				
Sire: Albert		Dam: Zelda				
		1st calf	2nd calf	3rd calf	4th calf	5th calf
Date of heat	1	13/12/05	1/01/07	1/02/08		
	2	4/01/06	20/01/07	22/02/08		
	3	25/01/06	11/02/07			
	4					
	5					
Date of service and name of bull	1	25/01/06 Sunny	20/01/07 Sunny	1/02/08 Brutus		
	2		11/02/07 Brutus	22/02/08 Brutus		
	3					
	4					
	5					
Expected calving date		1/11/06 7	15/11/0			
Date drying off		-	15/09/08			
True calving date		29/10/06	14/11/07			
Name and sex of calf		Hope female	male			
Calving interval		-	381 days			
Total milk production kg		1805	1972			

Table 12: Example of an individual cow record: HEALTH

HEALTH			
Date	Vaccination	Date	Treatment
20/09/2004	Brucellosis	05/01/07	Mastitis
Remarks			

The frequency of recording the daily milk yield of the individual cows can vary. On most small farms measuring the daily milk yield twice a month will be sufficient.



Figure 19: Recording the milk yield of individual cows

Table 13: Milk production records, measured twice a month

Cow's name	Date calving	MILK YIELD in kg						Monthly total*
		Month : January			Year : 2008			
		First week of the month			Third week of the month			
		AM	PM	DailyTotal 1	AM	PM	DailyTotal 2	
Ann	14/11	8.7	7.5	16.2	9.0	7.6	16.6	502
Flower	06/05	3.1	2.8	5.9	2.5	1.9	4.4	154.5

*: Monthly total = 15 x (daily total 1 + daily total 2)

An incorrect impression about production may be created if no records are kept. Peak yields, lactation lengths and calving intervals can vary a lot. See the example in Table 14.

Table 14: Comparison of two cows

	Peak yield per day	Lactation yield	Days in milk	Calving interval days	Average prod. per day of calving interval
Cow A	12 kg	1590 kg	265	425	3.75kg
Cow B	9 kg	1872 kg	312	390	4.8 kg

Although cow A has a higher peak yield she has also a shorter lactation and a longer calving interval. This results in a much lower production than cow B. Probably cow A consumed more concentrates during the peak period. Cow B is a much better producer, in spite of her lower peak yield.

9.3 Financial records

All activities on a farm are geared to raising an income for the farmer and his family. It is crucial to keep track of the money coming in and going out, so a simple system of income and expenditure will give much insight into the situation and will enable the farmer to make the right decisions.

The information from the diary can best be transferred to the records weekly and analysed at the end of each month. This will often give enough details and missing pieces of the jigsaw may still be remembered. The monthly overview provides good information for a situation analysis. Moreover this can be used later for the yearly records and analysis.

Table 15: Financial records

EXPENSES			RECEIPTS		
Date	Description	Value	Date	Description	Value
02/01	50 kg concentrates	99.00	30/01	540 kg milk	810.00
05/01	Mastitis treatment	20.00	01/02	Male calf	125.00

Herd size

The herd on a farm is always bigger than the number of productive cows and includes young stock, calves and heifers and there may also be a bull. The cost of rearing and maintaining these animals is also borne by the productive animals. The cost of rearing young stock is regarded as an investment for the future, with the hope that these animals will be efficient producers in the future, replacing old and less productive cows. Part of this investment may be recovered by the sale of culled cows. So all the costs and efforts related to young stock, including labour, feed, housing and health care, are part of the farm and should be included in the records and analysis.

Cost price

To be able to calculate the cost price of the milk, all the direct costs have to be taken into account. These include concentrates, fertilizers used for fodder, chemicals, drugs, minerals and hired labour. The cost of calf rearing is often offset against the income from culled cows. The costs of long-term investments, like building and fodder improvement can be estimated. This total cost can be divided by the total amount of milk produced thus arriving at the cost price per kg of the

milk. The difference between the cost price and the received price is the reward for farmer.

9.4 Use of records

Record keeping only makes sense if the information is used to evaluate the performance of the dairy farm and as a basis for decision-making. The local extension officer can help with the analysis of the records and the economics of it. An annual cost-benefit analysis can be obtained by subtracting the total costs from the total income of the dairy. All of this can help plans for further developments of the dairy farm.

Further reading

Animal Breeding, Ruminant Nutrition, Dairying, Animal Health Vol. 1 & 2, Forage production, Livestock production systems. The Tropical Agriculturalist Series. CTA/MacMillan, Netherlands/ UK

Cow Signals, a practical guide for dairy farm management. Jan Hulsen. (2006) Roodbont B.V., Zutphen, the Netherlands. 96 p. ISBN: 978-90-75280-65-4

East Africa's Grasses and Fodders: Their Ecology and Husbandry. Boonman J.G. (1993) Kluwer Academic Publishers, Dordrecht, Netherlands.

Guide to Good Farming Practice, International Dairy Federation and Food & Agriculture Organization of the UN, 2004, Rome. ISBN: 92-5-105094-5

Intensive forage production for smallholder dairying in East Africa. Orodho A.B. (2006)

Intermediate Tropical Agriculture Series. Longman group, U.K.

- **Disease and parasites of livestock in the tropics.** Hall, H.T.B. 1977.
- **Milk production in the Tropics.** Chamberlain, A. 1989.
- **Tropical pastures and fodder crops.** Humphreys, L.R. 1978.

Livestock Research for Rural Development (LRRD) papers:

- **On Farm dairy Cattle feeding experience in eastern zone of Tanzania,** P.Y. Kavana & B.S. Msangi
- **Milk production in Cameroon , A Review;** P.H. Bayemi, M.J. Bryant, B.M.A.O Peira, J.N. Mbanya, D. Caveslany, E.C. Webb.

Available from: www.cipav.org.co/lrrd/lrrdhome.html

The Small Dairy Resource Book, Dunaway Vicky H., 2000, USA.
(www.sare.org)

Tropical Cattle: origins, breeds and breeding policies, W.J.A. Payne; J. Hodges, 1998, ISBN: 0 632 032 04048 3, Blackwell Science, 108 Cowley road, Oxford OX4 1JF, UK

Tropical Forage Plants: Developments and Use. A. Sotomayor-Rios and W.D. Pitman (2000) CRC Press, Boca Raton, Florida, USA.

VEEPRO Manuals (15 topics). www.veepro.nl

Useful addresses

DIO, Veterinary Medicine in Development Co-operation

DIO is a non-profit organization whose objectives include giving support and advice in the field of animal health and production to individuals and organizations in developing countries: healthy animals, healthy people. A participant in the Vétérinaires sans Frontières-Europa-network, DIO specializes in answering questions in the field of veterinary medicine, through the Veterinary Information Service.

DIO foundation, Yalelaan 1, 3584 CL Utrecht, The Netherlands

T: +31(0)30 – 2532032, W: dio@dio.nl

FAO, Food and Agricultural Organization

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

ILEIA

Centre for Information on Low External Input and Sustainable Agriculture. Promotes exchange of information for small-scale farmers in the South through identifying promising technologies. Information about these technologies is exchanged mainly through the LEISA Magazine. All articles accessible online.

ILEIA, Zuidsingel 16, 3811 HA Amersfoort, The Netherlands

T: +31(0)33-4673870, F: +31(0)33-4632410

E: ileia@ileia.nl, W: www.leisa.info

ILRI, International Livestock and Research Institute

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

www.ilri.cgiar.org

Practical Action

Practical Action (the former Intermediate Technology Development Group, ITDG) helps people to use technology in the fight against poverty. Keywords are: practical answers to poverty, sustainable solutions and people focused. Addresses of offices can be found at the website:

www.practicalaction.org

PTC+ is an international training institute that focuses on all the links in the production chain, plant and animal commodities, (agricultural) technology, (food) technology and natural areas. Training programmes are practice-oriented and mix theory with practical classes. PTC+ offers open entry programmes, tailor-made programmes and consultancy. Programmes are offered in the Netherlands and/or on location. It is the policy of PTC+ to search for partnerships and co-operation programmes with national and international institutions abroad. PTC+ Head Office, P.O. Box 64, 3770 AB Barneveld, The Netherlands

T: +31 342 - 40 69 51, F: +31 342 - 40 69 69

E: internationaloffice@ptcplus.com , W: www.ptcplus.com

Veepro

Information centre for Dutch Cattle.

PO Box 454, 6800 AL Arnhem, Netherlands. www.veepro.nl

Websites:

Cattle

www.thecattlesite.com , www.thedairysite.com

Legumes

www.ildis.org

Tropical forages/grasses

www.tropicalgrasslands.asn.au , www.tropicalforages.info

www.internationalgrasslands.org , www.csiro.au

About Heifer Nederland

Stichting Heifer Nederland was established on the 1st of July 1999 as a non-governmental, non-profit organisation. Heifer devotes itself to development cooperation by facilitating sustainable, smallholder animal husbandry projects as an entry point for community development in Africa and Eastern Europe. In practical terms Heifer provides appropriate training, livestock, planting material and other resources to help poor families become self-reliant.

Animals from Heifer provide milk, eggs, plowing power and other benefits that for families across the planet can mean improved nutrition, education for children, health care, improved housing and literally a new way of life.

All Heifer projects are local initiatives, but what makes Heifer unique is the practice known as “passing on the gift.” Families receiving animals agree to pass on the first offspring – or an appropriate equivalent – to another family in need, starting a chain of giving that often touches thousands of lives.

But Heifer’s most striking qualities are its simplicity and effectiveness. In short, Heifer’s common sense approach to sustainable development works – one family at a time.

Heifer Nederland is a member of the Heifer International network. Since the work of Heifer International began in 1944, Heifer has worked directly with 9.2 million families in more than 125 countries world wide.

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Glossary

Abortion	premature expulsion of foetus from 40 days of conception onwards
Acaracide	chemical product used for tick control
Ad libitum (ad lib)	“free access to”, often used in relation to drinking water, roughage and minerals
A.I.	Artificial Insemination. Introduction of semen with a pipette into the vagina by inseminator
Alfalfa	Lucerne
Antibodies	substances in the blood and the colostrum that provide immunity for certain diseases
Bacteria	microscopic one-celled organisms capable of causing diseases
Brucellosis	infectious disease causing abortion 2 months before expected calving
Calving interval	period between two consecutive calvings
CAN	fertilizer containing nitrogen
Colostrum	the first yellow-coloured milk produced by the cow after calving. It is rich in nutrients, vitamins, laxatives and protective antibodies. Essential to the newborn calf
Contagious disease	infectious disease that can spread easily to other animals
Conception	the act of becoming pregnant
CP	crude protein
Dam	mother
Dry cow	cow not producing milk
Dry matter (DM)	part of feed that is not water
Dry period	period at the end of pregnancy when a cow does not produce milk anymore
Dry season	the season with very low or no rainfall
Elephant grass	<i>Pennisetum purpureum</i> , also called Napier grass

Forage/roughage	bulky green or dried/conserved plant materials like grasses, hay, legumes, leaves and crop residues
Heat	the period during which the heifer/cow is fertile
Heifer	young cow, not yet given birth to calf
Heifer calf	female till one year of age
Feed Intake	amount of feed eaten by animal
In lactation	in milk, animal produces milk
Inoculant	substance with specific bacteria that stimulates the growth of legumes
Lactation period	period of milking from the time when the cow gives birth (starts to produce milk) until drying off (stops producing milk). The number of days that the cow produces milk is the lactation length/period
Monogastric	animal with one stomach
Morbidity	harmful delay in development of young animals resulting in stunted growth that affects animals throughout their lives
Mortality	unwanted death of an animal
NPK	compound fertilizer containing nitrogen, phosphate and potassium
Open period	period between calving and start of pregnancy
Protein bank	small piece of land with intensive production of legume fodder
Puberty	period during which young animals reach sexual maturity and become capable of reproduction
Quarantine	isolation of sick or newly purchased animal
Regurgitate	to bring already swallowed feed up again to the mouth
Rumen	the first and largest of the four stomachs of a ruminant where digestion and fermentation of fibrous feed (roughage) by microorganisms takes place
Rumination	chewing the cud after regurgitating feed from the rumen

Scouring	diarrhoea, watery and foul-smelling dung
Semen	the fluid produced by the male/bull containing the male reproductive cells (sperm)
Service period	period between first detected heat and conception
Sire	father, bull
Standing heat	period that the female is ready to accept service by the bull
Stover	residues of maize, sorghum or legumes after the harvest
TDN	total digestible nutrients, measure of energy in feed
Uterus	organ in the female in which the unborn calf (foetus) develops, also called the womb
Virus	extremely small organism that causes diseases
Vulva	external opening of the female genital leading to the vagina
Weaning	end of the period of suckling or feeding milk to the calf