# Dairy cattle herd health management manual for animal health service providers

INITIATIVE ON Sustainable Animal Productivity

## Dairy value chain

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International Livestock Research Institute

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**Cover photo:** Dairy cows at a farm in Nyandarua County (photo credit: Teresia Mwaura/ILRI).



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**About SAPLING:** CGIAR's Sustainable Animal Productivity for Livelihoods, Nutrition and Gender Inclusion (SAPLING) is working in seven countries focusing on livestock value chains to package and scale out tried-and-tested, as well as new, innovations in livestock health, genetics, feed and market systems. SAPLING aims to demonstrate that improvements in livestock productivity can offer a triple win: generating improved livelihoods and nutritional outcomes; contributing to women's empowerment; and reducing impacts on climate and the environment. Its seven focus countries are Ethiopia, Kenya, Mali, Nepal, Tanzania, Uganda and Vietnam.

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# Acknowledgements

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# 1. Introduction

The dairy industry in Kenya is the largest sub-sector in the agricultural sector, contributing up to 14% of the country's gross domestic product (GDP) and about 4% of the nation's GDP. Despite the smallholder dairy farmers making up to 80% of the national dairy cattle herd in Kenya, their total milk production is about 56% of the milk produced in the country (Odero-Waitituh, 2017). Smallholder dairy farming is generally characterized by 1-3 dairy animals per farm with an average daily milk yield of 5-8 litres per cow (Otieno, 2020).

Smallholder dairy farmers in Kenya largely practice subsistence farming, which is usually low input with equally minimal extension support, hence the perpetual poor performance. The low productivity is attributed to: a) constrained feeding practices manifested through under-feeding, poor quality feeds and unstandardized feed rations, b) ineffective breeding practices- due to late maturity of the young stock for breeding, inability to detect heat and late/ delayed service of heifers/cows on heat leading to prolonged inter-calving intervals and use of genetics for phenotypes that are not adapted to the local situation, as well as inefficient breeding services, access to breeding inputs and services, c) inadequate and ineffective extension and advisory services, d) ineffective disease control practices and veterinary services (MoLFD, 2013) and e) generally poor animal husbandry practices. Poor access to output markets also contributes to a low incentive to invest in dairy production.

Infectious disease occurrence on farms can be due to a breach of biosecurity leading to interactions between the disease-causing agent and the host within an environment in which they exist. However, it is essential to recognize that clinical disease is just the tip of the iceberg. Many animals infected will manifest with reduced productivity but no clinical disease (Field Manual 2018).

In a dairy herd, metabolic disorders and mastitis are diseases of major economic importance; mastitis is an ever-present disease-causing loss that includes but is not limited to the culling of cows and generally leads to a decline in milk production, milk contamination and an increase in veterinary expenditure. Poor health and long recovery from disease in dairy animals negatively impact productivity by reducing the reproductive performance of the herd, growth rate, milk yield, and quality of milk, as well as the high cost of treatment. Metabolic diseases are not caused by exposure to infectious agents but are typically a mixture of dietary deficiencies and production stresses, which could include an ongoing infectious disease burden.

To improve the situation on farms, farmers should have the knowledge and skills to manage the health of animals to improve productive performance. Farmers often access unfiltered/unvalidated information from a myriad of sources, which may require analysis and interpretation to make the information a useful resource for the improvement and growth of the dairy enterprise. Traditionally, animal health service providers visit the farms to attend to specific cases of sick animals as reported by the farmer while giving minimal or no attention to the surrounding factors that might have triggered the current state of disease and without aiming to maintain all animals in productive level of health. To address this anomaly, there is a need for a holistic approach by the animal health service provider(s), whereby when they visit the farm, they do not only attend to the sick animal(s) but also, together with the farmer, jointly co-create measures for promotion of the health and productivity of the entire herd.

Therefore, the purpose of this guide is to build the capacity of animal health service professionals to provide relevant solutions and advisories for farmers to help them manage their herds. Solutions and advice should be delivered routinely as part of a herd management service. Data collected on herd performance following the service's delivery forms the basis of a herd health strategy towards an intended goal for the farm. The indicators of success include the overall reduction in disease incidence and burden and the improvement of overall herd productivity.

The herd health plan will be integrated with intervention packages for feeds and forages, breeding, and general husbandry practices to address animal production and productivity goals holistically.

## 1.1. Objective of the guide

The objective of this manual is to equip the animal health (AH) service providers with knowledge and skills on how to implement a herd health approach to prevent and/or control animal health problems at a herd level and improve herd productivity and welfare. The AH service provider, together with the farmer, will be able to identify the issues affecting the herd more holistically and develop a farm-specific herd plan that will see the herd progress towards their potential productivity and profitability.

## 1.2. Target people to be trained using this guide

The manual will be used to equip the animal health service providers with relevant knowledge and skills to undertake Herd Health in a dairy set-up. The provision of animal health services in Kenya is done by trained Veterinarians in both the public and private sectors and Veterinary Paraprofessionals (animal health and production officers).

## 1.3. User's guide

**Livestock extension workers:** This includes government, private and non-government extension workers who provide advisory services to farmers on livestock management. This guide can be used as a resource tool and can equip extension workers with the right information regarding health management.

**Veterinarians and animal health professionals:** Government, private, and non-governmental organizations animal health professionals can benefit from this manual by using it as a guide to implementing herd health programs in dairy farms.

**Government agencies:** The State Department for Livestock, responsible for regulating the livestock sector, can recommend that veterinary and livestock production officers in the field use this guide as a resource tool on herd health management as a means of disease prevention.

**Agricultural learning institutions:** Universities and colleges could use this guide as a resource material for training veterinary specialists and veterinary paraprofessionals in herd health management.

**Livestock Research institutions:** Government and non-government research institutions involved in dairy research can use the guide as reference material in making research decisions, such as designing research questions and operationalizing standard operating procedures.

**Development agencies:** Development agencies responsible for development in the dairy subsector can adopt the manual to equip both livestock officers and farmers with knowledge geared towards improving dairy productivity.

**Dairy cooperatives:** Dairy cooperatives working with farmers to provide input and services and output market, through their extension agents and livestock officers, can use the guide to equip dairy farmers with the right knowledge in herd health management.

## 1.4. Trainer's guide

**Understand the manual:** In preparation for training, go through this guide and internalize the principles of herd health as stipulated herein.

**Plan the training sessions:** Create a training plan allocating sufficient time to all the sessions covered in this guide. Organize participants into sizable training groups for ease of handling. Incorporate group work during the training sessions that allow all trainees to participate. Organize a training venue, teaching aids, writing materials, and enough copies of this training guide.

**Assess learning progress:** Plan to evaluate learning progress by collecting feedback from the participants either during or after training, based on the goals and objectives set at the beginning of training.

At the end of this course:

1. Participants should be able to assess the status of a dairy herd and differentiate an unhealthy or unproductive herd from a healthy one.
2. Participants can identify major health/production challenges affecting a dairy herd, the cause of these challenges, and the routine practices on the dairy farm.
3. Based on the assessment, participants should be able to draw a herd health management plan for a farm together with the farmer.
4. Participants understand the importance of having a vaccination program and proper record-keeping.

# 2. Basic principles of herd health

## 2.1. Understanding herd health

Herd health management (HHM) is an approach used in a population of dairy cows/cattle that optimizes the individual animal health, welfare, and the animal's potential to ensure maximum productivity of the herd. It involves systematic analysis of relevant data and regular objective observations of the cattle/cows and their environment so that informed, timely decisions are made to adjust and improve herd management over time (Green et al., 2012).

A properly designed and effective herd health management program ensures maximum productivity of a dairy enterprise, which is realized by maintaining a healthy and productive herd. The HHM program has both immediate and long-term outcomes depending on the objectives and goals set on the farms. A successful HHM program results in (1) good nutrition and feeding, (2) improved genetics/reproduction, (3) good husbandry and improved husbandry practices, and (4) healthy animals.

Traditionally, the focus of veterinarian/s farm visits is mainly a reactive approach of treating sick animals rather than preventing disease (Lam et al., 2011); however, dairy farmers expect veterinary practitioners to advise on areas that go beyond clinical care, such as nutrition and animal welfare (da Silva et al., 2006). For effective herd health and, hence, improved herd productivity, there is a need to have regularly scheduled HHM farm visits as can be agreed between the farmer and the animal health professional. During these visits, the animal health practitioner/veterinarian spends time on dairy farms, routinely performing tasks related to the treatment of individual animal/s and conducting general herd health assessments, including feeding programs, herd reproduction performance, condition of the different cattle groups in the herd, husbandry and management practices (including effectiveness of disease management and control) and institute measures to correct and improve them (Cipolla and Zecconi, 2015; Luby et al., 2013).

As such, these visits should also provide services other than treatment of sick animals by the veterinarian that involves:

1. Herd assessment, which establishes the status of the herd.
2. Goal setting (herd performance and targets).
3. Planning of intervention activities.
4. Implementation of the agreed plan.
5. Monitor herd performance and review progress, and then, based on the results, go back to the goal. This process is coupled with a generation of evidence through a collection of data, analysis and interpretation of results, which fits into the implementation frame (Figure 1).

Herd health generally constitutes the following:

1. It identifies risk factors for animal health, welfare, and production and appropriate measures to correct the anomaly, as shown in Figure 1.
2. It is a preventative management endeavor to maintain the health of farm animals at the herd level, not individual cow management.

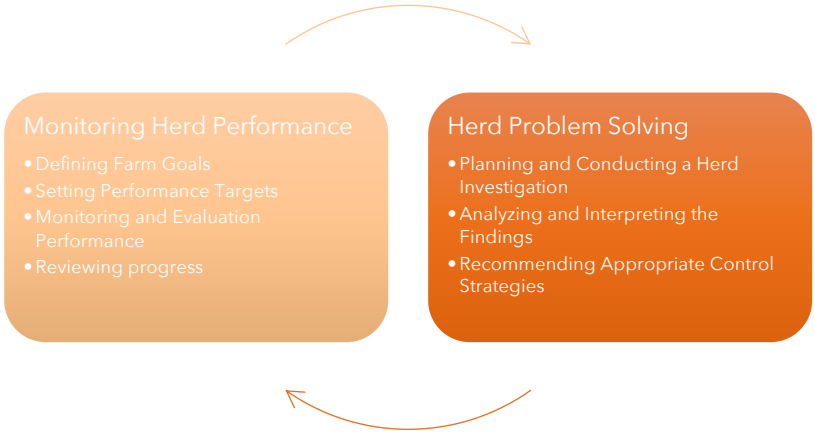



**Figure 1: Pathway for developing and monitoring herd health performance**

*The herd health management (HHM) cycle, modified from Mulligan et al. (2006).*

The HHM is co-developed between the farmer and the veterinary services provider to implement corrective measures on the farm within a specified period. It starts with co-designing and validating the HHM package with the farmer and people involved in the day-to-day management of the farm. The HHM varies from farm to farm, and each farm will present different needs, creating a unique entry point for each farm.

## 2.2. Herd health management program (HHM)

A HHM program follows a general framework comprising (1) animal status and (2) practices around the farm (Figure 2).

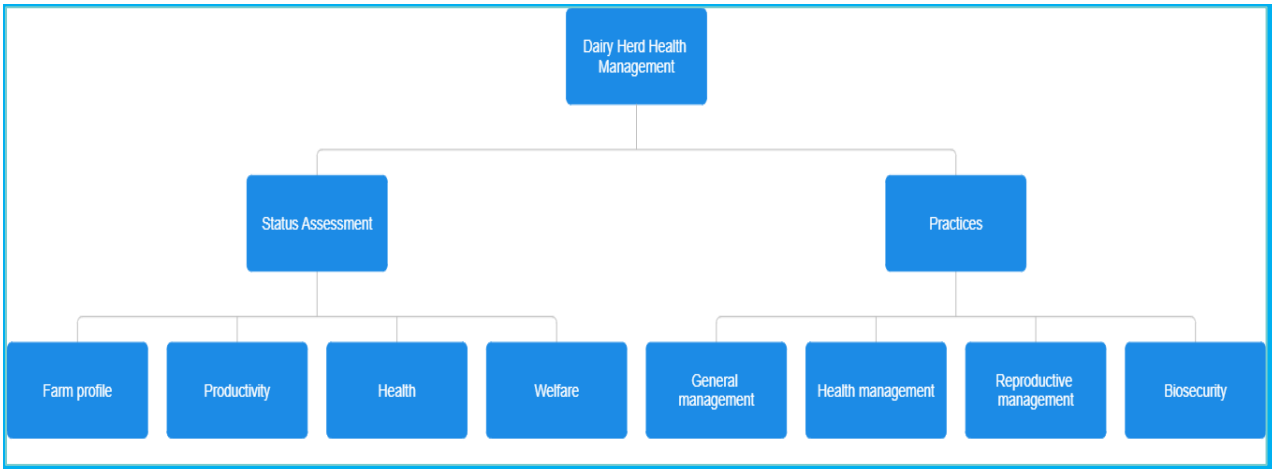



**Figure 2: Herd health management framework for a dairy farm**

### 2.2.1. Status assessment

#### 2.2.1.1 Farm/herd profile

The aim is to assess the herd profile/structure and the animal inventory, including:

1. Herd profile/structure—This includes the number of cattle kept on farms, breed (local, crosses, exotic, and others), animal type (bulls, cows, heifers, and calves), and productivity level.
2. Herd's daily management personnel, whether employed labourers, family members including children and relatives and division of tasks.
3. The main aim of keeping dairy animals (subsistence, selling milk/meat/manure, other)?
4. The future regarding the dairy enterprise and anticipated improvement plan/s of the dairy farm/enterprise.

#### 2.2.1.2 Productivity and production of the dairy animal

Evaluation of production and productivity is needed to provide an overview of the herd and farm dynamics. Table 1 presents the parameters to be assessed and what to quantify and/or measure.

**Table 1: Milk production and productivity**

| Parameter | Assessment |
|---|---|
| **Current herd milk production** | Number of cows milked in a day. |
| | Average milk production per day per cow (litre). |
| | Total milk produced in a day (litres) |
| **Herd milk production during peak period** | Average milk production at calving (morning and evening milk) in litres |
| | Average milk production at peak (if known) (morning and evening milk) in litres |
| | Number of cows milked in a day (d) peak production. |
| **Lactation length** | Number of months cows in the herd are milked (from the day of calving to the day they dry off) (Herd average) |
| **Lactation yield** | Total litre of milk produced/cow in the lactation (first calvers) |
| | Total litre of milk produced/cow in the lactation (mature cows) |
| **Average days open** | The period between calving and the next successful insemination that resulted in the conception of cows in the herd |
| **Average calving interval** | Average number of months between two calvings of the same cow for the cows in the herd |
| **Average age at first service** | What is the average age at first service of cows in the herd (months) |
| **Average age at first calving** | What is the age at first calving of cows in the herd (months) |
| **Number of services per conception** | Number of services (including repeats) before conception |
| **Total herd size** | What is the current total herd size? |
| **Replacement rate per year** | Number of heifers/cows/bulls joining the breeding/milking herd (separate by animal types and function) in a year |
| | Replacement rate per year= Number of animals introduced/ Total herd size multiplied by 100 |
| **What are the reasons for adult cows leaving the herd? (tick)** | Low milk production, Low fertility, selling of heifers, when money is needed, Old Age, Other reasons: Specify |

#### 2.2.1.3 Health status assessment

The aim is to evaluate the health status of the herd for the past 12 months. The information is derived from historical herd health status, mostly from recall by the farm hands/ primary caretaker or farm records if available, and real-time observations made by the health personnel carrying out the HH visit at the farm. During the visit, the veterinary personnel thoroughly examine the entire herd through observations and clinical examinations. Observations are made on the animals' environment, including animal welfare, health status of the herd or individual animals, animal category, and clinical systems affected. Diagnosis is made at the pen side or following confirmatory diagnosis in the laboratory. All the information obtained through observations and further tests then informs management of the herd health issues identified. The parameters to be assessed and what to quantify and measure are presented in Table 2.

**Table 2: General herd assessment**

| Parameter | Factors | Assessment |
|---|---|---|
| **General herd health (assessed through coat appearance and Body Condition Score (BCS 1.5- 5.0)** | Coat appearance. | Is the coat rough or smooth? |
| | | Are there skin lesions or swelling? |
| | | Are there parasites on the skin (ticks, lice, mites, flies)? |
| | | If yes, what type of parasites? |
| | BCS 1.5 | Check the general feeding routine. |
| | | What are the feed constituents? - fodder, concentrates, water check the quantities in the feeding trough and store; mineral supplements (either as salt blocks or powder/granules form) |
| | | Check for general health conditions,<br>Check for external parasites. |
| | | Are the animals dewormed regularly? |
| | | What is the stage of lactation milk yield (early, mid, late or dry) |
| | BCS-2.0, 2.5, 3.0<br>At calving-BCS3-3.5<br>Early lactation-BCS3<br>Mid-lactation-BCS3- 3.5<br>Late lactation-BCS 3.5-4 | What is the lactation stage? |
| | | What is the gestation stage? |
| | | If not pregnant or in lactation, why? |
| | BCS 4.0 and above | Animals are over-conditioned and are prone to metabolic disorders; correctional feeding is recommended |
| **Udder and teats** | Check the functionality of the four quarters/teats. | Are all four quarters and teats functional?<br>What is the consistency of the quarters and teats?<br>If inconsistent, do a CMT test to screen for subclinical mastitis– positive quarters sampled for culture. |
| **Fertility-reproductive failures** | Repeat breeder | Do the animals show consistency in coming on heat during the 18–24-day cycle?<br>If not, how many are inconsistent?<br>How long does it take to come back to cycle? |
| | Early abortions- during the first half of pregnancy | What is the BCS of the animals? |
| | | Are there disease incidences? If yes, which ones? |
| | | What is the BCS of the animals? |

| | | |
|---|---|---|
| | Late abortions and stillbirths | Are there disease incidences? If yes, which ones? |
| **Disease incidences** | Digestive system- Diarrhea | Are animals having diarrhoea? |
| | | What age sets are affected (calves, heifers, adults) |
| | Respiratory conditions | Are there animals showing respiratory problems (nasal discharge, coughing, breathing difficulties, etc.)? |
| | | Have they been treated? |
| | | When were they treated? |
| | | Are there underlying causes/issues? |
| | Lameness<br>(Check for normal posture and gait of the animal) | Assess the hoof score<br>(1 is good, 3 needs a hoof trimming) |
| | | Do the animals show signs of lameness?<br>If yes, inspect the unit to identify causes of injury (if due to injury)<br>If not injury, what is the cause? |
| | | How many animals have been affected? |
| | Metabolic disorders- Feeding | What is the lactation status? (Early, mid, late, dry) |
| | | Have the animals had nutritional deficiencies/metabolic disorders in late pregnancies, at calving or peak production? |
| | | Are they on treatment? What kind of treatment? |
| | | Are the animals supplemented with minerals during pregnancy? / Which minerals are they given? |
| | Tick-borne diseases (TBDs) and external infestation | Do the animals show signs of ectoparasite infestation? |
| | | How often do you apply acaricide? How do you apply (spray/dipping) |
| | | Have the animals suffered from TBDs or any other hemoparasites? |
| | | Are there deaths reported from TBDs/hemoparasites? |
| | | Have the animals ever been vaccinated against East Coast fever (ECF)? |
| **Mortality** | Loss of animals in the last 6 months through death | Number of calves that died (less than 4 months) |
| | | Number of heifers that died (between 4months and before 1st calving) |
| | | Number of cows and bulls that died |
| | | Was the cause of death identified?<br>If yes, what was the cause? |
| | | Are there measures put in place to control these causes of death?<br>If yes, which one? |

#### 2.2.1.4. Assessment of the status of animal welfare

Good animal welfare, as defined by WOAH (2008), is an animal being healthy, comfortable, well fed, safe and can express its innate animal behaviour. The animal should also be free from unpleasant states of pain, fear and distress. Animal welfare is greatly impacted by the animal's environment and its management. Cow comfort is a crucial aspect of herd health management that focuses on minimizing stress in cows' environments to maximize their productivity and well-being (Izabella, 2018; Munksgaard et al., 2005). The aim here is to assess the physical and emotional well-being of the dairy herd.

**Table 3: Animal welfare**

| Parameter | Factors | Assessment |
|---|---|---|
| **General animal and environmental examination** | Provision of feed and water | Provision of fodder, concentrate feeds, minerals and water – are they provided and in the right amounts/ proportions? Type of feeds provided during the dry and wet seasons |
| | | Quantity and quality of forage /stored feeds |
| | | Cleanliness and aeration of the feed storage facility |
| | | Presence or absence of mold on stored feed |
| | | Quantity and quality of water |
| | | Quality and cleanliness of the feeding and drinking troughs |
| | | Rumen fill of the herd |
| | Housing unit comfort | Assess stocking and comfort of housing/unit |
| | | Are the animals shaded from elements of weather? |
| | | Assess the cleanliness of the housing unit |
| | | Assess the floor comfort of the shed |
| | | Assess the quality and hygiene of bedding. |
| | | Assess the cleanliness of the animal. What is the herd cleanliness score? (compared against the cleanliness score chart) |
| | Animal's presentation (check for pain, injury, and disease) | Are there animals with physical injuries or with indicators of pain? |
| | | Are there sick animals? |
| | Cow's comfort (freedom from fear and distress) | Interaction of the animals and surroundings (with other animals and people) |
| | | Are animals aware of the presence of people? |
| | | Are animals aware of the presence of other animals? |
| | Freedom to have normal behaviour patterns | What is the number of animals per given area? |
| | | Is there enough space for the animal(s) to move around and "mate"? |
| | | What proportion of animals shows normal behaviour, i.e., resting and lying down? |
| | | Are the animals ruminating? |

### 2.2.2. Farm practices assessment

Assessing herd health and farm practices is essential for maintaining a productive and sustainable farming operation. Key areas for assessment include general farm management, health, health services and treatment provision, reproductive management, biosecurity measures, nutritional management, and record keeping.

#### 2.2.2.1 General farm management

Evaluation of environmental parameters and management practices on the dairy farm are important for general farm management. The observations made and information retrieved from the farm hand, or the primary caretaker informs herd health management strategies.

1. House premises—Assess the comfort of the resting, milking, watering, and feeding areas, including the space (stocking density—access to watering and feeding points, lying area), flooring and roofing type, bedding, ventilation, and lighting.
2. Water supply—Assess access to water, its source, availability, and quality. Also, assess the cleanliness of the watering containers.
3. Feed supply – Assess the production system (grazing or zero-grazing or combined), availability/access to feed, availability, source and quality of the feed. Assess whether animals receive supplementary feeding – is supplementation by age groups/production level? Does the farm practice feed conservation?
4. Does the farmer keep animal records? What type of records are kept: health and treatment, vaccination, breeding, parasite control, production, sales and purchases, extension visits, expenditures, and revenues?

#### 2.2.2.2 Health management, services, and treatment

The aim is to assess farmers' knowledge of diseases, occurrence, and handling of sick animals.

1. Assess the health monitoring routines in place to identify sick animals. Are there regular disease preventive/control measures, e.g., tick control, deworming, vaccinations, treatment, etc.?
2. Assess the source of prescription and administration of veterinary products, e.g., antimicrobials and drugs for parasite control. Are the products prescribed/used always for the same problem?
3. If self-prescription, how is the diagnosis arrived at? What informs the choice of treatment?
4. Assess the level of knowledge of the persons prescribing or administering the veterinary products. How are the drugs administered?
5. Assess accessibility of animal health and extension service providers. Are they government or private providers?
6. Assess any bio-security control measures put in place, such as fencing, isolation of sick animals or new stock coming in, control measures for people visiting the farm, footbaths, measures of waste management, etc.
7. Assess if animals freely mix with other herds especially when grazing, during vaccination campaigns, dipping etc.

#### 2.2.2.3. Reproductive management (including milking)

This is to evaluate management routines specific to reproduction.

1. How is heat detection done, and by whom? Assess the knowledge of the signs of heat.
2. Assess how standing heat by breeding females is detected and the period it takes to contact the artificial insemination service provider or take the female to a breeding bull.
3. Obtain information on breeding: What method of insemination is used on the breeding females? (Natural mating or artificial insemination). At what age (months) and weight (kg) are heifers inseminated?
4. Where do they get bulls for natural mating (own farm, neighbour or in a communal grazing)
5. How long do cows take before they are ready for mating again after calving? Probe reasons behind prolonged calving intervals.
6. Assess if cows experience breeding-related conditions. Are there cases of abortions? At what stage of gestation did the animal(s) abort? Was the cause of abortion identified? Have there been cases of retained placenta?
7. Access the frequency of the retained placenta in the herd and how it is managed.
8. Are pregnant cows monitored during calving? Have the animals experienced difficulties in calving, and what assistance did they get, if any, and by whom?
9. What care do calves receive immediately after birth (do they receive colostrum)? How long are calves left to suckle?
10. Assess the milking routine/techniques – manual vs machine– and what practices are in place to prevent the development of mastitis. For example, what frequency is the use of teat dips, CMT tests, and test strips?
11. What are the management and control practices of mastitis cases on the farm?

#### 2.2.2.4. Biosecurity management

The aim is to evaluate risk management of disease transmission between and within cattle herds.

1. Assess and establish the health status history of acquired animals before the animals are introduced into the farm.
2. Have the animals had infectious diseases before? Were they treated and recovered? Is there an isolation unit for sick animals?
3. Does the farmer engage any veterinarian when a new animal joins the farm?
4. How long are animals held in isolation before joining the rest of the herd? Is there treatment administered to such animals?
5. Assess if animals encountered other herds at any one time, e.g. while grazing, watering, vaccination, in the sale yard, etc.
6. Assess milking practices, including cleaning hands and cow udders before milking each cow, using teat dip after milking, handling milk, and cleanliness of milking utensils.
7. Assess disposal of aborted foetuses or dead animals and disposal of placenta. Use of protective clothing while handling dead foetuses/animals. Consider "Assess disposal of biological materials and other farm wastes.
8. Assess the cleanness of the farm environment and the existence of rodents and insects.
9. Assess feed storage conditions.
10. Assess the presence of foot and wheel baths or their equivalents.

# 3. Principles of disease prevention

To prevent the herd from suffering from various ailments/diseases that may affect its production and productivity, various measures need to be instituted.

## 3.1. Routine cattle vaccination

Vaccination or immunization is a critical component of herd health management for the prevention of disease entry and spread into a herd of animals. Vaccinated animals mount immune responses that protect animals from diseases, reducing morbidity and mortality, economic losses and adverse animal welfare conditions associated with the diseases. Through vaccination, the animal's immune system recognizes the disease pathogen in future infections (Waldner and Kirkpatrick, 2017) and neutralize it.

The following are factors that necessitate vaccination:

1. It is effective in cases where the likelihood of disease exposure is high and/or the risk of unprotected exposure to a disease is high.
2. The vaccine is effective. The age of the animal and its breed will determine whether to vaccinate or not; vaccine administration is age dependent. Some breeds might be less susceptible to certain diseases compared to others.
3. The cost-effectiveness of the vaccine.

Vaccination is most effective if enough individuals in a population are vaccinated to achieve herd immunity.

Vaccination schedules are usually set to prevent disease outbreaks. Table 4 shows the vaccination schedule of cattle in Kenya.

**Table 4: Cattle vaccination schedule**

| Type of vaccine | Application | Age at first dose | Remarks |
|---|---|---|---|
| **Foot and mouth disease (FMD)** | Sub-cutaneous<br>Every 6 months in endemic areas. | 2 weeks and above | Different strains exist. Consult your veterinarian about the vaccine choice.<br>The disease is endemic in East Africa. |
| **Contagious bovine pleuropneumonia (CBPP)** | Vaccinated through the tail tip<br>Yearly in endemic areas.<br>In other areas, it is only upon warning of an impending outbreak. | 2 weeks and above | Consult your veterinarian.<br>Administered by trained veterinarians.<br>Animals can lose their tails from this vaccination. |
| **Anthrax and Black quarter** | Sub-cutaneous<br>Annual or upon warning of impending outbreak | 3 months to 3 years | Anthrax is deadly for humans and animals. |
| **Brucellosis** | Sub-cutaneous<br>Once in a lifetime | 3-8 months for heifers | During threats of outbreak, the whole breeding herd may be vaccinated.<br>Use vaccine with care; S19 live vaccine can cause brucellosis in humans. |

| | | | |
|---|---|---|---|
| **East Coast fever (ECF)** | Sub-cutaneous close to lymph nodes.<br>Lifetime immunity | 1 month and above | Only used by individuals trained in the infection and treatment method (ITM) and licensed veterinarians.<br>The vaccine is commercialized in Kenya. |
| **Lumpy skin disease (LSD)** | Sub-cutaneous route<br>Annual | Any age | |
| **Bovine pasteurollosis** | Sub-cutaneous route<br>6 months | >3 months | |

*Source: Relevant vaccination protocols in Kenya (National Veterinary Institute, 2016)*

### 3.2. 3.2 Routine deworming and control of ectoparasites

Principals of periodical deworming of animals require that:

1. Younger calves need to be dewormed more frequently than older ones, as they are more susceptible to worms than older animals. The frequency of deworming varies due to worm burden, system of grazing, or age.
2. Deworming of calves starts at weaning (3-4 months of age) when they are introduced to forage feed. Thereafter, deworm after every 3 months.
3. Dairy cattle on pasture during lactation and when grazing is practised have high contamination potential, whereas an extremely low potential exists for cattle confined.
4. One option is to deworm all cows at once and then again six to eight weeks later. In an HHM program, consider synchronizing several animals to manage drug withdrawal periods and related logistics where milk might not be used.
5. Worms may develop resistance to certain drugs, so it is important to alternate the drugs or use a combination of two classes of dewormers (Table 5).
6. Consider other worm management options to reduce overreliance on chemical control. You may need to agree on the frequency of deworming based on regions, choose anthelmintics, and provide what is routine against exceptional cases.

NB: Treatment plans should consider unique factors such as farm location, disease history, current season/weather, and the type and age of stock.

**Table 4: Cattle deworming schedule**

| Drug name | Efficacy | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Roundworms | | Liver fluke | Tapeworm | Mites | Lice | Warbles | Persistence |
| | (Inhibited larvae) | (Active) | | | | | | |
| **Levamisole** | None | Fair | None | None | None | None | None | None |
| **Oxfendazole** | Fair | Good | None | Some | None | None | None | None |
| **Fenbendazole** | Fair | Good | None | Some | None | None | None | None |
| **Albendazole** | Fair | Good | Some | Some | None | None | None | None |
| **Avermentins** | Excellent | Excellent | None | None | Good | Good | Excellent | Good |
| **Milbemycins** | Excellent | Excellent | None | None | Good | Good | Excellent | Good |
| **Clorsulon** | None | None | Good | None | None | None | None | None |

*Source: Yazwinski et. al. (1997).*

There are several control methods which can be used to prevent and/or treat ectoparasites. An 'integrated parasite management' approach that uses cultural, biological, and chemical control methods to suppress insect pests and reduce economic loss and drug resistance is recommended more effectively.

These include:

1. Cultural control focuses on preventing new infestations by minimizing conditions that support insect breeding.
2. Removal and disposal of carcasses as quickly as possible.
3. Clean up and dispose of manure and spilled feed, especially if they are wet.
4. Keep drainage ditches clear by cleaning out weeds.
5. Remove straw or hay that has been defecated and urinated on.
6. Clean and dress all wounds on cattle to exclude blowflies and prevent infection.
7. Biological control: Some insects are harmless to humans and animals and can be used to control pest insects through predation.
8. Periodically dip or spray animals with suitable acaricides to prevent ticks and other ectoparasites (Table 6 lists the acaricide products on the market).

*Picture 1: A cow infested with ticks (photo credit: Laurence Ochieng'/ILRI)*

**Table 6: Acaricide products in the market (populate)**

| Acaricide group | Active ingredient | Trade name | Use | Application method |
|---|---|---|---|---|
| Organophosphates | Chlorofenvinphos<br>Chloropyriphos | Steladone® | Ticks | Spray/dip |
| Formamidines | Amitraz | Actraz® | Ticks | Hand spraying |
| | | Almatix® | Ticks | Hand spraying |
| | | Byebye® | Ticks | Spray |
| | | Norotraz® | Ticks | Spray/dip |
| | | Taktic® | Ticks | Spray/dip |
| | | Tixfix® | Ticks | Spray/dip |
| | | Triatix® | Ectoparasite | Spray/dip |
| | | Twigatraz® | Ticks | Spray |
| | | Tikatraz® | Ticks | Spray/dip |
| Synthetic Pyrethroids | Cypermethrin | Ectomin® | Ticks, fleas, mites | Spray/dip |
| | Alpha-cypermethrin | Alfapor®<br>Sypertix® | Ticks | Spray<br>Spray/dip |
| | Cyhalothrin | Grenade® | Ticks, flies, lice and keds | Spray/dip |
| | Deltamethrin | Delete® | Ticks, flies, lice | Spray/dip |
| Combination | Chlorpyrihos + Cypermethrin | Duodip® | Ticks | Spray |

*Source: Mutavi et.al. (2021).*

## 3.3. Proper animal housing, nutrition and environmental management

### 3.3.1. Animal housing

While designing an animal unit, considerations must be put in place for resting area, ventilation, and spacing, which significantly influence lying time (Reich et al., 2010). It is important to provide dairy cows with good housing as this will help improve milk production by reducing stress and diseases. A properly designed dairy unit will minimize the adverse effects of heat stress, improve cow and farmer comfort, hence cow performance and farm profitability.

- To achieve optimal use of the unit, the following considerations should be borne in mind: Ensure the manure and urine are regularly removed from the animal unit; this is critical for maintaining optimal resting surface conditions.

The unit should be properly ventilated, easy to clean, and have easy access to water and a feeding trough. Ideally, it should have a crush pen that will act as a health facility and a calving area to permit close monitoring during delivery.

- A separate milking parlour is important to aid milking hygiene.
- Good sanitation is also important for both cow cleanliness and effluent disposal.

*Picture 2: Dairy cattle lying down in a comfortable shed (photo credit: Victor Ogeto).*

The following are the key aspects of housing for cow health and well-being:

1. The housing should be simple, economical, and functional for the animal. The housing structure should allow for the comfort of the animals and optimize the space available and farm labour.
2. Comfort does not necessarily mean expensive. Optimizing materials already available on the farm for the housing structure reduces the cost burden.
3. The space should accommodate animal movement around the unit, allow the animal to exhibit natural and social behaviour. The structure should allow for ventilation, lighting and good shading from sunlight and direct heat.
4. The floor should be well compacted, non-slippery, easy to clean, and allow waste to drain. The walls should be steady and safe for the animals to move around.
5. Good-quality and comfortable bedding should be provided; dirty floors and bedding are reservoirs for diseases, pathogens, and parasites.
6. The housing should be well protected from physical danger, allowing animal handlers/visitors to move freely in and out of the structure. It should also be designed to allow for biosecurity measures and easy disposal of animal waste.

### 3.3.2. Waste management

Animal manure consists of animal excrement and can be mixed with leftover feed, litter, bedding material, water, etc. The amount and quality of the manure depends on the animal housing system, the manure collection and storage system, the amount of feed, the method of feeding (pen rearing, night pen, or free range), the quality of the feed, and the efficiency of manure and urine collection.

Sanitation and waste management in a dairy farm are critical; if not well managed, they might cause major problems, such as feed contamination, attract flies, and pose health challenges to both humans and animals. However, if properly managed, the waste can be used in soil improvement as manure. In a day, each cow can produce up to 35 kg of faeces and 12–16 kg of urine, plus shed effluent from washing down floors.

Generally, cows will spend most of their time resting/lying down while chewing the cud. Lying deprivation results in decreased milk production and affects the well-being of the animal (Cooper et al., 2007; Hopster, H. et al., 2002; Metz, 1985). A clean, dry and comfortable lying area will allow the animal to enjoy adequate rest. Wetness

discourages animals from lying down and makes them vulnerable to infections like foot rot, digital dermatitis, mastitis among others.

As the number of animals in the herd increases, so does the challenge in dairy unit waste management; therefore, proper planning is needed to handle the waste before it is disposed of.

The following will cause problems in waste management if they are not handled carefully:

1. The quantity and quality of faeces and urine produced.
2. The adequacy and frequency of waste removal.
3. Storage and processing of waste before disposal or use.
4. Availability and commitment of labour to handle the waste.
5. How the waste is stored and disposed of.
6. The value and use of manure/waste.
7. Public health concerns about smell, groundwater, and watercourse contamination.
8. Human health hazards such as high content of inorganic pollutants and the presence of coliform organisms.

Principals of waste disposal systems:

1. Require that the unit's floors be made from concrete or easily washable material. The floor design should ensure efficient drainage and easy flow of urine and faeces for removal.
2. Require that a manure pit be dug large enough to hold the shed's manure produced over 2 or 3 days. The pit should be covered with a plastic sheet or banana leaves to reduce sunlight, which volatilizes the nitrogen in the manure, reducing its value as fertilizer. A fence around the pit will minimize risks to humans and wandering stock.
3. Recements that the collection of as much urine as possible from the shed is done; use minimum water to wash out the manure drains initially, then direct the main washings from the floor into another pit or directly out to the farm.

For effective waste management, the following are important aspects to consider:

1. The floor design should have the proper slope for easy flow of waste-to-waste collection points.
2. Have a collection pond which can hold the waste.
3. The base of the waste pit should be 1 m above the water table.
4. Have equipment to handle solid effluent for recycling in the forage area.
5. Adhere to local standards on waste management.

### 3.3.3. Feeds and water access and availability

Dairy cows require a well-balanced diet with enough energy, protein, fibre, water, minerals, and vitamins to optimize maintenance, growth, reproduction and production.

Feed intake is influenced by the following:

1. Management factors like stocking density, feeding consistency, feed quality, and access to feed and water.
2. Environmental factors like temperature and humidity, spacing and cow comfort, and
3. Cow factors like stage of lactation, number of lactations, milk yield, body weight, body condition score, and cow grouping.

These factors will influence the management protocols and practices to be adopted at the farm. (Lablanc, 2010).

Cows experience metabolic changes to support pregnancy and lactation. During this transition, the mammary gland demands a high amount of energy, amino acids, and other nutrients to support the production of milk. Most metabolic disorders occur during this period due to depressed feed intake, leading to a negative energy balance.

Heifers may not attain mature body weight during pregnancy, calving, and lactation. Thus, feeding should consider the requirements for growth, pregnancy, and milk production.

The common metabolic disorders are milk fever, fatty liver, ketosis (subclinical or clinical), retained placenta, metritis, mastitis, left abomasum displacement (LDA) and lameness. There is a close interrelation between these disorders, and a cow suffering from one postpartum disorder is at risk of contracting the other. A cow, for instance, developing milk fever, is at risk of developing mastitis, retained placenta, metritis, dystocia, LDA, ketosis and udder edema. Acidosis increases the risk of developing laminitis, LDA, milk fever, fatty liver and mastitis.

Therefore, an adequate supply of a well-balanced diet is critical during the dairy cow's transition stage. Heifers and calves also require good nutrition as the replacement dairy herd.

Water forms the bulk of milk constituent, and it is estimated that a lactating cow needs to consume 1.9 litres of water for every 0.45 kg of milk produced. (David K. Beede, 2005). Generally, water requirements are variable and are related to milk production, dry matter intake, diet composition, environmental temperature, humidity, and water quality. Provide ample water sources, especially after milking and during peak feeding times; the waterers and troughs should be accessible, and cleanliness should be maintained.


*Picture 3: A cow taking water in a clean water trough (photo courtesy of Victor Ogeto).*

### 3.4. Health monitoring through record keeping

A well-designed and executed herd health program will decrease the number of sick animals in the herd and encourage the production of safe, healthy, and wholesome products. A well-managed herd is more likely to remain disease-free and not transmit diseases (zoonoses) to its handlers or people consuming animal-source foods.

Close herd monitoring and proper record keeping are important in tracking herd performance and informing us of timely corrective measures to be undertaken. Some of the important records to keep on the farm include the following:

1. Health records: Record of disease affecting the animals/herd, treatment, medication, service provider/s, recovered/deaths from the disease.
2. Dam records: Dam identification, date of calving, births–born alive, stillbirth, aborted.
3. Breeding /Insemination records: Dam serviced, date of insemination, name of sire, repeats, expected date of calving, service provider.

4. Calving records: Date of calving.
5. Vaccination records: Type of vaccine, vaccination schedules-first vaccination, next vaccination, cost of vaccination.
6. Deworming/Tick control records: Dewormer used/ deworming schedule, who/when; acaricide used, when/who sprayed.
7. Milk record: Milk produced by individual cows and total herd production, amount sold, where/to who sold, and price of milk.
8. Animal sale record: Animal sold, the reason for sale, how many, price.
9. Extension visits records: Who visited, type of information, prospective visits.
10. Financial records (cost of input).

Record keeping is crucial for the success and efficiency of a dairy farm because it helps in:

1. Identifying problems in the dairy herd.
2. Health monitoring.
3. Undertaking good management decisions.
4. Planning for future activities.
5. Financial accounting.
6. Production monitoring and analyzing if targets are met or not.
7. Labour management.

Maintaining comprehensive health records for a dairy herd is essential for effective herd management. The pre-requisite for good records is that:

1. Farmers and service providers are trained on the proper recording.
2. The events are recorded consistently and accurately.
3. The records should be easily understandable, easy to update, summarized easily, easily accessible, updated and include all the latest activities.
4. The records provide useful data for the identification of risks and management.

# 4. Disease identification and management

To reduce and mitigate the incidence of diseases in dairy herds, routine healthcare procedures and control measures need to be implemented and carefully followed. These include identifying health signals by observing the herd and its environment—the behaviour of the animals—and touching and examining individual cows.

## 4.1. Checklist for monitoring Herd health

In conducting general observations, you should assess severity, acuteness, chronicity of the condition, numbers and age affected, among others. The following are usually the parameters observed in a herd and the herd's normal environment (SNV, 2017).

### 4.1.1. Behaviour

Observe the cattle from a distance to see how they are feeding, ruminating, walking, attentive, etc. Animals standing away from the herd, lying most of the time, and being depressed are signs of ill health. However, the system used needs to be considered; for zero-grazed animals, one might miss out on some important issues if they are not keen.

Observing posture and gait notes include:

1. A change from normal gait and posture normally indicates pain and discomfort in the foot, which causes lameness.
2. Most cases of lameness are related to hoof lesions, which could be non-infectious (sole ulcers, white line lesion, injury, laminitis) or infectious (digital dermatitis, interdigital dermatitis, foot rot).
3. Lameness that does not originate from the hoof can be due to trauma, arthritis, muscular ruptures, etc.
4. Factors contributing to lameness that should be considered during corrective management are classified into environmental, management, and animal factors.
5. For posture, a straight back (bending upwards) indicates pain, hoof overgrowth, laminitis, foot rot, injuries, soreness, wounds, and lesions, leading to favouring of limbs (weight bearing) and head movements.

### 4.1.2. Physical examination

Random physical examination and other tools are needed.

Check for the following:

1. Vital signs, including Temperature, Heart rate and Respiration rate.
2. Head and neck to check for discharge, ulcers, abnormalities, teeth wear, and lymph node swellings.
3. Udder and milk, inspect for signs of mastitis and abnormalities in milk quality.
4. Reproductive system: examine for signs of discharge or infection.
5. Heart, lung function, swellings, sampling for diagnosis.

### 4.1.3. Physical assessments

**a) Rumen fill**

The rumen of a healthy cow is full; if not, it is an indicator of ill health or not supplied with enough feed. Rumen fill assessment is a useful technique for monitoring the feed intake and energy balance in dairy cows. It involves

visually evaluating the left flank of the cow to determine how full the rumen is. The scores are reached by observing the Left flank in the area just behind the last rib and in front of the hip bone and scored as follows:

- Score 1: Deep dip in the left flank, more than one hand-width deep. This indicates that the cow has eaten very little in the last 24 hours.
- Score 2: Dip in the left flank, one hand-width deep. This is common in cows in the first week after calving.
- Score 3: There is a slight dip visible in the left flank. This is the desired score for milking cows with sufficient intake.
- Score 4: No dip visible in the left flank. This is typical for cows at the end of lactation and through the dry period.
- Score 5: Skin is flat or slightly bulging. This score is often seen in dry cows.

**b) Hair coat**

The hair coat of a healthy cow is shiny and smooth; observe for parasites or general infestations, skin diseases, hair loss, etc. A rough hair coat indicates poor nutrition, worm infestation and systemic diseases.

**c) Manure score**

Cattle must be in good health for manure scoring to be accurate. Manure scoring is a valuable tool to determine the quality of nutrition the cow has recently consumed. It can be used effectively to adjust supplementation to prevent loss of body condition. Results from manure scoring indicate the health status of the cows' rumen, which is an index for animal feeding. Picture 3, from Left to Right, shows manure scores 1 – 5. Manure scoring aids other Herd Health parameters and should not be viewed in isolation.

The manure can be scored on a scale of 1 to 5, where 1 indicates watery manure while five is extremely dry and segmented indicates a constipated scenario. The consistency of the manure can be checked in the field or housing unit. Additional tools, e.g., faecal analyzers, can be used for further analysis of the manure.

The scores can suggest the following:

Score 1: Very fluid, can indicate a highly digestible ration with excess protein, carbohydrates, or minerals, and low fibre. It may also suggest disease. The addition of hay will slow down the passage rate and thicken the manure. Score 2: Loose indicates a diet that is excess in protein and carbohydrates and low in fibre. The rate of passage is very high; adding hay to this diet will slow it down to allow for more absorption in the intestinal tract Score 3: Ideal consistency, where manure forms a normal part with a slight divot in the middle. This score indicates a balanced diet that meets the cow's nutritional needs. This manure indicates the diet is not nutritionally deficient and is not in excess for the cow and her physiological stage.

Score 4: Thick suggests a lack of degradable rumen protein, excess low-quality fibre, or insufficient carbohydrates in the diet. The manure will indicate a lack of degradable rumen protein, excess low-quality fibre or not enough carbohydrates in the diet. To improve on it, the inclusion of diet rich in rumen-degradable protein such as cotton seed cake or soybean will improve diet digestibility. Score 5: The manure is firm, very dry with clearly defined segments; this manure indicates a poor forage diet that is too high in low quality fibre and low in protein and energy. It is a slow passage in the gut, leading to excess water being reabsorbed in the intestines. To improve it, there will be a need to supplement protein and energy to meet the animals' requirements.

Score 1 Score 2 Score 3 Score 4 Score 5

*Picture 4: Manure scoring in dairy animals*

**d) Body condition score**

Condition scores range from 1 (a very thin cow with no fat reserves) to 5 (a severely over-conditioned cow). Ideal condition scores are 3.0–3.25 at dry off and calving and 2.25–2.75 at peak lactation, with no cows changing condition score class by more than 0.5–0.75 over any lactation period. (Figure 3). A low score may indicate ill health or improper feeding, while a high score may indicate a high probability of pregnancy or metabolic disease.

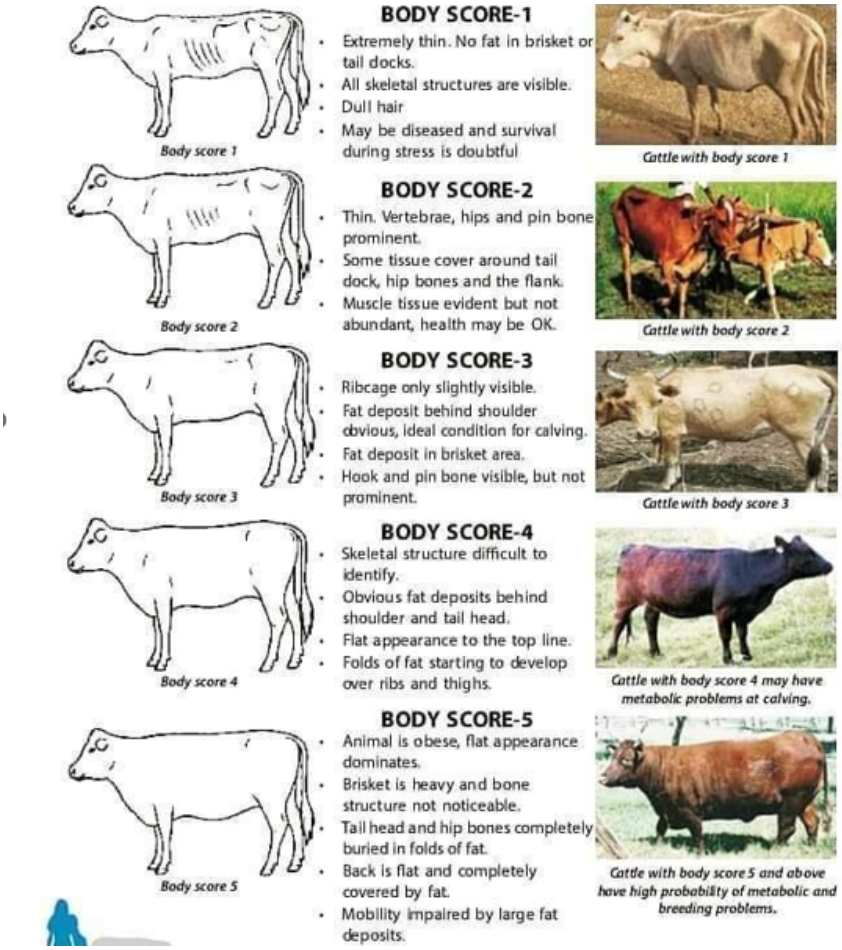



**Figure 3: Body condition scoring**

*(Chandrakiran, 2020)*

**e) Cow cleanliness score**

A clean cow environment helps reduce the risk of infection from environmental pathogens. This is particularly important for zero-grazed animals.

Cow cleanliness is scored based on the cleanliness of the udder/teats, hindlegs and flank area (Figure 4). Each animal zone is scored separately and is rated from 1 = clean to 4 = very dirty

Cow cleanliness score is an indicator of the cleanliness of stalls, bedding, manure level, and consistency. It is also an important indicator of cow comfort. Cows will spend less time lying down when the floor is wet. A cleanliness score above two calls for appropriate action.


**Figure 4: Cow udder and leg cleanliness score chart**

*(Macdonald Campus Farm Cattle Complex, 2018)*

### f) Legs/hoof score

Leg and hoof scoring in dairy cows is essential for assessing their overall health and mobility.

Hoof problems can cause cows great pain and will directly affect production because lame cows visit feeding areas less frequently. Hoof Score typically involves a three-point system to describe the degree of inflammation and

infection of the hoof for various hoof disease conditions. Healthy hooves are crucial for preventing lameness and ensuring the cow's comfort and productivity.

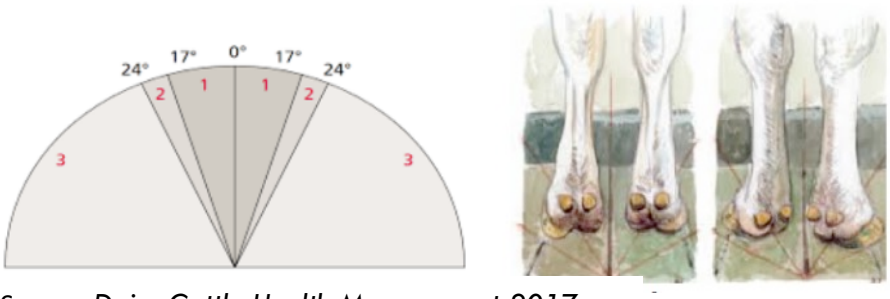
Leg Score also uses a three-point system to assess the stance and structure of the hind legs. Proper leg conformation is important for the cow's ability to move comfortably and efficiently.

Foot Angle and Claw Set are often evaluated on a scale from 1 to 9, with the ideal score being in the middle. Foot angle refers to the steepness of the hoof, while the claw set assesses the symmetry and spacing of the claws.

Rear Feet and Legs are part of the overall physical conformation evaluation, which includes assessing the placement and structure of the hind legs, the depth of the heel, and the foot angle. Normally, the legs should stand straight. If not, cows will likely have a hoof problem.

Regular scoring helps detect issues early, allowing for timely interventions to maintain the herd's health and productivity. (SNV, 2017).

Stand behind the cow when observing for hoof score (score 1 is good; score 3 needs hoof trimming (Figure 5). Consider the effect of overgrown hooves and environmental factors on the farm




*Source: Dairy Cattle Health Management 2017*

**Figure 5: Leg score**

### 4.2. Common livestock diseases

Dairy cattle are affected by various ailments (Table 7)- which can be classified as follows:

**Infectious diseases**: Infectious diseases are illnesses caused by germs such as bacteria, viruses, and fungi that enter the body, multiply, and cause an infection. Some infectious diseases are contagious, meaning they can spread from one animal to another, such as anthrax, foot and mouth disease (FMD) and black quarter. (Hodnik et al., 2021) .

**Metabolic disorders**: When a cow-calf down, there is a very quick change in her metabolic state, where her energy requirements drastically increase to almost twice; at that time, their dry matter intake (DMI) is too low to meet those demands, creating a negative energy balance completely. This period of metabolic stress is associated with several disorders or diseases, which are referred to as disorders. It is estimated that 30-50% of dairy cows are affected by some form of metabolic or infectious disease around the time of calving (Denis-Robichaud et al., 2016). The common metabolic diseases are milk fever, fatty liver, ketosis (subclinical or clinical), retained placenta, metritis, mastitis and lameness.

**Reproductive diseases**: These are conditions that affect the reproductive system and can be caused by infections, genetic abnormalities, hormonal imbalances, or structural issues. Examples include mastitis, cystic ovarian disease, and retained placenta.

**Digestive system diseases**: Digestive system diseases include bloat, rumen acidosis, laminitis, etc.

**Parasites**: Cows, bulls, and young stock are affected differently by internal parasites, and their treatment programs also differ. Internal Parasites affect all ages of animals, but younger calves need to be dewormed more frequently than older ones, as younger calves are more susceptible to worms than older animals. The frequency of

deworming will vary due to worm burden, the system of grazing, or age. High contamination potential exists in dairy cattle on pasture during lactation and when rotational grazing is practised, whereas a low potential exists for confined cattle.

One option is to deworm all cows at once and then again six to eight weeks later. Consider synchronizing some animals to manage drug withdrawal periods when milk might not be used when they are dewormed; other worm management options may be used to reduce overreliance on chemical control.

**NB:** Treatment plans should consider unique factors such as farm location, disease history, current season/weather, and the type and age of stock.

**External parasites**: The infestation of external parasites will vary between individual animals depending on genetic predisposition, age, general health, and nutrition status; the latter will also be affected by season and stage in the reproductive cycle.

Signs of external parasites include:

1. Listless appearance and loss of appetite.
2. Watery and profuse diarrhoea.
3. Sudden weight loss and emaciation.
4. Poor coat condition.
5. Reduced weight gain.
6. Decreased milk production and other production losses.

There are several different control methods which can be used to prevent and/or treat ectoparasites, including:

1. An 'integrated parasite management' approach that uses cultural, biological, and chemical control methods to suppress insect pests and reduce economic loss and drug resistance is recommended more effectively.
2. Cultural control focuses on preventing new infestations by minimizing conditions that support insect breeding.
3. Remove and dispose of carcasses quickly.
4. Clean up and dispose of manure and spilled feed, especially if they are wet.
5. Keep drainage ditches clear by cleaning out weeds.
6. Remove straw or hay that has been defecated and urinated on.
7. Clean and dress all wounds on cattle to exclude blowflies and prevent infection.
8. Biological control: Some insects are harmless to humans and animals and can be used to control pest insects through predation.
9. Chemical control methods are recommended only when pest activity is at its highest.

**Table 7: Common dairy diseases, clinical signs, prevention, and control**

| Name of disease | Causes | Transmission | Symptoms | Prevention |
|---|---|---|---|---|
| **Infectious diseases** | | | | |
| Anthrax | Bacteria | Ingestion of bacteria spores | High fever, tremors, depression, convulsion, respiratory distress, **abdominal oedema, bloody milk, rumen atony**, abortion. | Proper disposal of the carcass, quarantine, cleaning and disinfection.<br>Vaccination- Vaccines commonly combined with Blackleg<br>Treatment of sick animals. |
| Black leg | Bacteria | Ingestion of spores in soil or feed | **Swollen limbs- edematous and crepitating sound on palpation**, fever, lack of appetite, rough coat, lameness and depression. | Vaccination.<br>Treatment of sick animals. |
| Pneumonic pasteurellosis | Bacteria | Direct contact<br>Overcrowding | **Excessive nasal discharge, sudden rise in body temperature**, reduced rumination, **extended head and neck, open mouth breathing and grunting, coughing and sneezing.** | Separate and observe animals from unknown sources before mixing them with the rest of the herd, with proper ventilation.<br>Vaccination.<br>Treatment of sick animals. |
| Foot and mouth disease (FMD) | Virus | Direct contact | Drooling of saliva, Vesicles/blisters on nares/nose, buccal/mouth cavity, dullness, lack of appetite, shaking and kicking of feet, abortion, death of calves. | Supportive treatment.<br>Vaccination.<br>Quarantine. |
| Lumpy skin disease (LSD) | Viral | Direct contact | Fever, lacrimation and nasal discharge, hyper-salivation, lacrimation, nasal discharge, difficulty grazing, **nodules on the skin, swollen lymph nodes**.<br>Secondary infection leads to suppuration and sloughing. | Vaccination.<br>Supportive treatment against secondary infection. |

| Diseases of the reproductive system | | | | |
|---|---|---|---|---|
| Mastitis | Bacteria | Contact | Per-acute form<br>-Redness, swelling, heat and painful teats.<br>Acute form<br>-Lack of appetite, depression.<br>Subclinical form<br>-Milk becomes saltier, and there are changes in the milk, e.g., flakes, lumps, and a change in colour. | Maintain the cleanliness of the milking equipment, housing unit, and hands. Milk the udder empty, using the squeeze-and-release milk technique.<br>Dipping the teats after milking.<br>Keep the cow standing after milking. |
| Cystic ovarian disease | | | **Persistent estrus/heat behaviour in follicular cysts and anestrus in luteal cysts.**<br>Mounting other cows, cows not observed in heat.<br>Decreased milk yield, prolonged intra-estrous interval, anestrous. | Correction of predisposing conditions-nutritional, metabolic disorders and hormonal imbalances.<br>Hormonal therapy. |
| Persistent corpus luteum | | | Complete absence of heat signs. | Rectal examination of anestrus cows and heifers.<br>Hormonal jab to knock off the corpus luteum. |
| Delayed ovulation | Negative energy balance, heat stress, certain infections (IBR, BVD), sub luteal levels of progesterone | | | Proper management of young heifers and postpartum cows, including feeding and disease control.<br>Hormonal therapy to correct the imbalance. |
| Abortion | Infection cause or Non-infectious (heat stress, hypoxia, acidosis) | | | Hygienic and bio-security measures.<br>Isolation of aborting cows.<br>Systematic evaluation of the feed for mycotoxins and other phytotoxins. |

| | | | | |
|---|---|---|---|---|
| | | | | Immunization against infectious diseases causing abortion.<br>Adequate breeding and treatment records.<br>Balanced nutritional program.<br>Genetic selection and a functional record-keeping system. |
| Retained placenta | | | Macerating and discoloured membrane, occasionally foul smelling, discharge, lack of appetite, decreased milk yield. | Gentle Manual removal without causing bleeding. |
| Vibriosis | Bacterial | Venereal | Infertility, abortions, irregular heat, early embryonic death. | Use of semen from non-infected bulls.<br>Screening animals and culling positive.<br>Vaccination. |
| Trichomoniasis | Protozoan | Venereal | Low conception rate, profuse vulva discharge, early abortion, pus in the uterus. | Culling infected animals.<br>Screening animals and culling positive. |
| Leptospirosis | Bacterial | Direct contact, ingestion of contaminated feed and water | Calves - fever, anaemia, inappetence, high mortality<br>Adults - abortion, stillbirth, weak, infected calves, blood in the milk, reduced milk yield, bitter taste of the milk. | Strict sanitary conditions.<br>Avoid contact with rodents.<br>Isolation of new animals.<br>Vaccination. |
| Brucellosis | Bacterial | Ingestion of contaminated feed/water | Arthritis, late abortion, retained placenta, abnormal-vaginal discharge, the birth of weak calves, infertility. | Screening animals and culling positive.<br>Vaccination. |
| Metritis and endometritis | Inflammatory | | Fetid uterine discharge, fever, anorexia, depression, swollen and friable uterus. | Strict sanitary conditions during parturition and artificial insemination. |
| **Diseases of the digestive system** | | | | |
| Simple indigestion | Sudden change of feed | | Lack of appetite, reduced milk yield, reduced rumen motility. | Introduce high grain level rations slowly. |

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|---|---|---|---|---|
| | | | | Increase rumen motility using Epsom salt and magnesium sulphate. |
| Bloat | | | Distension of the rumen, enlarged abdomen, difficulty in breathing, mouth breathing, the extension of the head, loss of rumen motility, protrusion of the tongue. | Wilting of highly leguminous plants before feeding.<br>Feed with hay before leguminous pasture.<br>Introduce a high-performance ration gradually. |
| Grain overload/Rumen Acidosis | | | Shallow and rapid respiration, rumen motility is absent in severe cases, ruminal content is firm and doughy, sudden drop in milk production, drop in fat content. | Introduce a high-performance ration gradually.<br>Feed should contain 10% roughage.<br>Restrict access to grains. |
| Laminitis | | | Painful walking, overgrown hooves. | Regular hoof trimming. |
| Traumatic reticulo-peritonitis (TRP) | Hardware | | Reluctance to move, arched back, careful gait, groaning when stepping over barriers, distended neck. | Housing premise /feeding trough free of sharp objects and nails. |
| **Metabolic diseases** | | | | |
| Milk fever | Calcium deficiency | | Depression, Loss of consciousness, dry muzzle, grinding of teeth, loss of muscle tone, sternal recumbency. | More calcium/low phosphorus in late pregnancy.<br>Balanced diet during pregnancy. |
| Ketosis | | | Weight loss, constipation, Loss of skin elasticity, head pressing, walking in circles, deviation of neck and champing of jaw. | Maintain good body condition at calving.<br>Avoid sudden change of feed.<br>Sufficient protein to the ration. |
| **Parasitic infestation** | | | | |
| Tick-borne diseases (ECF, anaplasmosis, babesiosis) | Tick-borne | Through ticks | Depending on tick and disease. | Confined animals are at lower risk.<br>Pasture management by fencing reduces contact and infestation.<br>Burn dry pastures/cutting bushes. |

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|---|---|---|
| | | Regular control of tick infestation where animals are exposed.<br>Proper choice of acaricide. |
| Internal parasites<br>(Intestinal/stomach, lung worms and liver flukes) | It depends on the species of parasite.<br>Weight loss, rough hair coat, diarrhoea, coughing, emaciation, drop in milk production. | Paddocking/rotational grazing, use dry grass/silage.<br>Control intermediate hosts.<br>Water from boreholes or fast flowing streams.<br>Keep animals away from marshy areas.<br>Separate young stock and adult animal grazing areas.<br>Younger calves dewormed more frequently (susceptibility).<br>Cut down pastures.<br>High contamination potential of pasture exists during lactation and when rotational grazing is practiced; Low potential exists for confined cattle.<br>Deworming at early lactation increases milk yield more consistently than at any other time of treatment.<br>Regular deworming. |

## 4.3. Quarantine procedures

### 4.3.1. Important definitions - Centres for Disease Control (CDC)

**Isolation** is the process of physically separating animals that have been diagnosed with or are showing clinical signs of an infectious disease.

**Quarantine** is a process of physically separating animals exposed to, but not showing signs of, infectious disease to monitor for signs of illness and prevent the spread of disease. It is used to stop the spread of contagious diseases.

**Notifiable diseases** are diseases that, when diagnosed, require health providers (usually by law) to report to state or local public health officials. They are of public interest because of their contagiousness, severity, or frequency. In Kenya, notifiable diseases are contained in the Animal Diseases Act Cap 364. These diseases include rinderpest, anthrax, contagious bovine pleuro-pneumonia (CBPP), tuberculosis, East Coast fever (ECF), epizootic or ulcerative lymphangitis, rabies, and foot and mouth disease (FMD).

### 4.3.2. Importance of isolating/quarantining new animals to prevent the introduction of diseases

Isolation/Quarantine and daily observation of new animals in a herd for any signs of disease are important as they help prevent the new animals from introducing diseases or parasites into the herd. Ideally, the recommended isolation period is at least 4 weeks. This time allows any acute health problems to appear and be treated before the introduced animals are mixed with the rest of the herd.

Any animals that become sick shortly after introduction or during the quarantine period should be inspected by a veterinarian and treated appropriately. Rapid, early detection and prompt treatment of acute diseases can prevent an outbreak of disease from spreading through your herd (Agriculture Victoria, 2023).

During the quarantine period, the introduced cattle should be treated for internal and external parasites; the treatment may involve drenching for worms, application of acaricides for ectoparasites, and vaccination so that their health status matches that of the rest of the herd.

### 4.3.3. Disease outbreak management

During a disease outbreak, it is important to separate apparently healthy animals from sick animals, animals in other age groups, and animals of unknown disease status. Sick animals should be isolated immediately in an area away from other stock.

**Steps in disease containment**

Infectious diseases spread rapidly in a herd. Once a disease is suspected or identified, immediate steps must be taken to contain it, which include:

1. Isolation of the animal shows clinical signs of disease.
2. Implement movement restrictions until the situation is evaluated and the cause established and controlled.
3. Contact the veterinarian to help you decide on the next steps. Based on the size of the outbreak or the type of disease in the herd, the veterinarian will determine whether to contact the public veterinary department.
4. Take inventory of other animals in the herd, identify, and isolate potentially exposed animals, and immediately implement health monitoring such as taking temperature twice daily and observing for clinical signs.
5. Communicate with employees, service providers, visitors and other parties if involved about your biosecurity measures to contain the disease spread.

The typical protocol for the establishment and maintenance of exposed zones by the government uses epidemiological investigation to:

1. Tracing the contacts infected animals had with other animals.
2. Identify the source of infection.
3. Determine the extent of disease spread.
4. Determine the time elapsed since the initial outbreak of the disease.

Implement quarantine restrictions:

Such quarantines should apply to all susceptible species and all conveyances or equipment that may have direct or indirect contact with susceptible species.

Establish biosecurity and movement control checkpoints on avenues of transportation into and out of the exposed zone. At this point, farmers will need to start enforcing more stringent biosecurity measures, including restriction of movement of all animals, humans, and vehicles departing from the exposed zone by implementing the following:

1. Passage is permitted only through bio-secure travel corridors, through established biosecurity perimeters and movement control checkpoints.
2. No animals or animal products can leave the zone.
3. Vehicles, equipment, and people may leave if strict biosecurity procedures are followed:
4. Information concerning their whereabouts and animal contacts is provided.
5. All vehicles, equipment, and people are clean and disinfected.
    a. Personnel shower out.
    b. Human-to-animal contact policies are established and regulated, appropriate for the specific agent.
    c. Official permits and permission are provided.

Further reading: Animal Diseases Act, Chapter 364 (Kenya-Law, 2023)

# 5. Ruminant nutrition and feeding

## 5.1. Nutritional and feeding requirements for cattle

The main nutrients essential for growth, breeding, and production are energy (carbohydrates), fats, minerals, proteins, vitamins, and water. The feed requirement for dairy cattle is meant to meet their reproduction and milk production needs; the feed should provide the energy and nutrients required for the development of the mammary glands and milk formation.

Cattle are ruminants, and their major feed is forage, which plays a key role in ruminant nutrition, animal health and, ultimately, the quality of the animal products. The nutrients in forage are energy, protein, water (moisture in forage only accounts for less than 25% of the water supply, but drinking water accounts for over 75% of water sources to the ruminant), minerals, and vitamins; these are the foundation for all. The productivity of a dairy system is highly dependent on the quality of feeds; the feed quality determines the intake and availability of ingested nutrients for utilization by dairy cattle.

## 5.2. Important feed ingredients in feed formulation

In formulating feeds for animals, the following are important parameters to consider (Gachuiri et al., 2012):

1. Define the purpose of feeding—whether growth, breeding, milk production (Table 8), or meat production; each will require different nutrients.
2. Select the right source of nutrient specifications. This information is usually obtained from feed requirement tables developed by various bodies, and each feed ingredient tends to have its own nutrient specification. This is also based on the plants' stage of harvesting; analysis of the individual ingredients is important and should be done (Table 9a and 9b); book values, however, can at times be misleading, especially for by-products.
3. Cost of the ingredients. Least-cost formulations should be made to obtain the cheapest ration. Select the feed ingredient based on their availability and price; always strive to use locally available materials and consideration of cost.
4. Consider the palatability of the ingredient and any limitations such as toxicity
5. Decide on the maximum and minimum inclusion of each feed ingredient.
6. Use feed formulation software to prepare the formula. Practical feeding of the lactating cow, Table 8 shows the requirements for feed formulation for dairy cows by the Kenya Bureau of Standard

**Table 8: Kenya Bureau of Standards specifications for dairy cattle concentrates**

| Nutrient | Percentage | | |
|---|---|---|---|
| | Dairy Calves | Heifers | Mature cows |
| **Moisture (max)** | 12 | 12 | 12 |
| **Crude protein (min)** | 18 | 14-16 | 14-16 |
| **Non-protein N (max)** | 0 | 2 | 2 |
| **Crude fibre (max)** | 8 | 12 | 12 |
| **Crude fat (max)** | 3-8 | 3-6 | 3-6 |
| **Calcium (min)** | 0.7 | 0.7 | 0.7 |
| **Phosphorus (min)** | 0.5 | 0.5 | 0.5 |
| **Common salt** | 0.5-0.6 | 0.5-0.6 | 0.5-0.6 |

**Table 9a: Quality of some commonly available roughages in Kenya**

| Feed name | DM % | CP g | CF % | Ash % | ME | NE | ME pig | ME rabbit | Na | S | Mg | Mn | Ca | P | Cu | Co | Se |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Acacia, husk | 92 | 110 | 26 | 4.1 | 12.5 | 8.4 | | | 0.1 | | 1.5 | 22 | 3.8 | 1.6 | 5 | | |
| Acacia, leaves | 38 | 151 | 20 | 9.3 | 10.6 | 7.2 | | | 0.4 | | 3.5 | 63 | 17 | 1.8 | 9 | | |
| Acacia, leaves | 92 | 120 | 20 | 10.9 | 10.7 | 7.1 | | | | | | | | | | | |
| African locust bean, pod husks | 93 | 47 | 24 | 8.9 | 11.8 | 7.9 | | | | | | | | | | | |
| African locust bean, pod pulp | 35 | 49 | 14 | 4.6 | 12.4 | 8.3 | | | | | | | 13.2 | 17.6 | | | |
| African locust bean, pods | 93 | 137 | 19 | 6.7 | 13.3 | 8.9 | | | | | | | | | | | |
| Banana aerial parts | 16 | 166 | 26 | 11.1 | 9.9 | 6.6 | | | | | | | | | | | |
| Banana, leaves | 94 | 146 | 27 | 8.9 | 8.69 | 5.8 | | | | | | | 7.5 | 2.4 | | | |
| Banana, shoots | 15 | 77 | 48 | 16.2 | 8.4 | 5.6 | | | | | | | 8.1 | 2.6 | | | |
| Banana, stalks | 7 | 51 | 28 | 15.4 | 7.5 | 5.0 | | | .7 | | 9.2 | | 7.5 | 2.9 | 4 | | |
| Banana, trunk | 6 | 35 | 23 | 11.3 | 7.5 | 5.0 | | | | | 3.7 | | 7 | .9 | | | |
| Barley, straw | 90 | 38 | 40 | 7.1 | 6.5 | 4.3 | 2.2 | | .7 | | 1.1 | 17 | 4.9 | .8 | 17 | | |
| *Calliandra* | 15 | 220 | | | 7.7 | 5.1 | | | | | | | | 1.5 | | | |
| Camel's foot, leaves | 90 | 153 | | | | | | | | | 6.1 | | 8.2 | 3.9 | 7 | | |
| Cassava, foliage fresh | 22 | 249 | 17 | 7.4 | 9.9 | 6.8 | | | .6 | | 7.3 | | 11.9 | 3.7 | 29 | | |
| Cassava, foliage silage | 24 | 238 | 17 | 7.9 | 9.8 | 6.7 | | | | | 8.6 | | 25.1 | 3.3 | 31 | | |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cassava, foliage wilted | 36 | 263 | 10 | 8.2 | 10.2 | 8.5 | | | | | | 14 | 3 | | | |
| Cocoa hulls | 88 | 178 | 20 | 9.3 | 5.4 | 3.6 | 2.9 | 5.2 | .2 | | 4.3 | | 3.7 | 4.4 | 39 | |
| Cocoa pod husks | 91 | 77 | 29 | 11.2 | 7.1 | 4.7 | | | .1 | | 5.4 | 95 | 5.7 | 3.4 | 12 | |
| Coffee hulls | 88 | 94 | 36 | 6.5 | 7.2 | 4.8 | | | .2 | | .9 | 31 | 4.5 | 1.4 | 18 | |
| Coffee leaves, dried | 92 | 167 | 18 | 8.2 | 5.4 | 3.6 | | | .1 | | 2.4 | | 6.2 | 1.2 | | |
| Columbus grass, fresh | 17 | 100 | 33 | 11.7 | 8.7 | 5.8 | | | .5 | | | | 4.5 | 4.1 | | |
| Cotton seed hulls | 91 | 60 | 46 | 3.4 | 7 | 4.6 | | | | | 1.8 | | 1.7 | 1.4 | 7 | |
| Cowpea, aerial parts, fresh | 20 | 181 | 24 | 11.1 | 9.8 | 6.5 | | | | | 3.2 | | 13.2 | 2.4 | 30 | |
| Cowpea, husk | 25 | 110 | | | 8.1 | 5.4 | | | | | | | | 2.5 | | |
| *Desmodium* | 25 | 151 | 32 | 8.5 | 7.4 | 4.9 | | | .4 | | 2.5 | | 8.5 | 2.2 | | |
| Grey love grass | 23 | 153 | 29 | 10.6 | 9.7 | 6.5 | | | | | | | | | | |
| Groundnut haulms, forage | 26 | 175 | 20 | 8.6 | 10.4 | 6.9 | | | | | | | 9.3 | 2 | | |
| Groundnut hulls | 91 | 69 | 64 | 5.3 | 3.4 | 1.8 | | | .1 | | 1.2 | 42 | 2.4 | .7 | 11 | |
| Guinea grass | 22 | 112 | 37 | 10.5 | 8.0 | 5.4 | | | 2.7 | | 3.4 | 127 | 4.9 | 2.4 | 6 | |
| Guinea grass, hay | 92 | 43 | 40 | 12.2 | 7.6 | 5.0 | 11.5 | | 10.1 | | | 16 | 4.7 | 2.6 | | |
| Guinea grass, straw | 89 | 91 | 36 | 11.5 | 7.7 | 5.0 | | | 3.1 | | 3 | 152 | 4.6 | 3 | 6 | |
| Jackfruit, leaves | 40 | 156 | 19 | 10.5 | 7.5 | 5.0 | | | | | 1.9 | | 14.7 | 3.2 | 5 | |
| Kenya sheep grass | 25 | 82 | 31 | 8.7 | 7.6 | 5.1 | | | .5 | | 2.1 | 148 | 3.9 | 2.3 | 4 | |
| Kikuyu grass, aerial parts, fresh | 20 | 151 | 29 | 10 | 9.7 | 6.6 | | | .2 | | 2.9 | 101 | 3.1 | 3.7 | 9 | |
| Kikuyu grass, aerial parts, hay | 90 | 113 | 35 | 9.7 | 8 | 5.5 | | | | | | | | 3.9 | | |
| Leucaena (not Africa) | 29 | 233 | 19 | 8.5 | 11 | 7.4 | | | 0.2 | | 3.9 | 65 | 10.7 | 2.1 | 13 | |
| Lucern, fresh | 19 | 205 | 26 | 11.5 | 9.3 | 6.5 | | | .5 | | 2.8 | 77 | 19.5 | 2.5 | 13 | |
| Lucern, fresh, medium | 20 | 180 | 24 | 8.6 | | | | | 1.4 | 2.8 | 3.3 | 44 | 14.1 | 2.2 | 9 | .31 .36 |
| Lucern, hay | 89 | 182 | 28 | 10.7 | 8.4 | 5.8 | | 7.6 | .3 | | 2.3 | 43 | 16.8 | 2.6 | 9 | |
| Maize stover | 28 | 69 | 30 | 6.7 | 9.3 | 6.2 | | | | 1.4 | 2.6 | | 3.7 | 2 | 18 | |
| Maize, dried stalks | | | | | | | | | | | | | | | | |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Maize, silage | 32 | 70 | 20 | 3.7 | 10.8 | 7.1 | | .1 | | 1.1 | 26 | 1.9 | 1.8 | 4 | |
| Mango, leaves | 33 | 94 | 26 | 9.4 | 11.7 | 7.8 | | | | 2.4 | | 16.9 | 1.5 | 5 | |
| Mango, peels | 15 | 62 | 7 | 2.8 | 11.9 | 8.0 | | | | | | | | | |
| Napier grass, 40cm | 20 | 98 | 29 | 14 | 7.9 | 5.2 | | .3 | 0 | 3 | 100 | 3.6 | 2.9 | 11 | 0.1 |
| Napier grass, 80cm | 20 | 90 | 28 | 14.8 | 7 | 4.6 | | .3 | 0 | 1.4 | 100 | | | 11 | .1 |
| Napier grass, early bloom | 25 | 72 | 36 | 12.4 | 6.2 | 4.0 | | | | | | | | | |
| Napier grass, hay | 93 | 107 | 35 | 10.5 | 8 | 5.3 | | | | 1.6 | | 2.8 | 2.3 | | |
| Napier grass, only tops | 25 | 132 | 32 | 10.3 | 9.5 | 6.3 | | | | | | | | | |
| Napier grass, silage | 27 | 66 | 38 | 13.4 | 7.2 | 4.8 | | | | 2.3 | 36.4 | 2.5 | 3.6 | | |
| Neem tree, leaves | 34 | 166 | 16 | 12.9 | 7.7 | 5.1 | | | | 3.1 | | 20 | 2.5 | 13 | |
| Nile grass, aerial part, fresh | 21 | 140 | 34 | 8.7 | 9.1 | 6.1 | | | | | | | | | |
| Nile grass, aerial parts, hay | 90 | 85 | 31 | 6.1 | 8.8 | 5.9 | | | | | | | | | |
| Nile grass, leaves fresh | 21 | 213 | 30 | 8.4 | 10.3 | 6.9 | | | | | | | | | |
| Nile grass, stems fresh | 30 | 79 | 38 | 9 | 8.2 | 5.6 | | | | | | | | | |
| Oat, straw | 87 | 102 | 34 | 8.5 | 8.3 | 5.5 | | 8 | | 2 | | 4.7 | 2 | | |
| Pawpaw, leaves | 20 | 240 | 12 | 11.4 | 9.9 | 6.6 | | | | 8.5 | | 34.6 | 3.5 | | |
| Pineapple, leaves | 20 | 91 | 23 | 4.9 | 11.5 | 7.7 | | | | | | | | | |
| Pineapple, leaves | 19 | 60 | 22 | 10 | 10.9 | 7.3 | | | | | | | | | |
| Pumpkin, hulls | 89 | 190 | 72 | 2.8 | 4.2 | 2.3 | | | | | | | | | |
| Pyrethrum marc (extracted) | 90 | 130 | 26 | 7 | 8.7 | 5.8 | | | | | | | | | |
| Rhodes grass, hay | 25 | 89 | 37 | 8.9 | 8.4 | 5.6 | | 3.1 | | 1.9 | 72 | 3.8 | 2.9 | 6 | |
| Rhodes grass, medium maturity | 86 | 94 | 35 | 9.8 | 8 | 5.3 | | 4.1 | | 1.4 | 107 | 3.1 | 2.6 | 5 | |
| Rib grass, fresh | 15 | 204 | 13 | 12.4 | 10 | 6.7 | | | | | | 18.2 | 2.8 | 17 | |
| Rice straw | 92 | 42 | 35 | 18.1 | 5.8 | 3.8 | | 2.7 | | 1.9 | 454 | 2.9 | .9 | 6 | |
| Sesbania | 26 | 244 | 12 | 9.7 | 11.5 | 7.7 | | .3 | | 3.5 | | 15.9 | 3.3 | | |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sorghum, aerial parts, fresh | 25 | 173 | 37 | 10.9 | 8.6 | 5.7 | | | .6 | | 2.9 | | 3.5 | 2.8 | | | | |
| Sorghum, straw | 93 | 37 | 39 | 7.5 | 7.3 | 4.8 | | | .2 | 1.4 | 2.5 | 124 | 3.1 | .7 | 5 | .2 | | |
| Soybean, aerial parts | 25 | 137 | 31 | 9.1 | 9.1 | 6.1 | | | | | 6.3 | | 15.3 | 2.8 | 70 | | | |
| Star grass | 30 | 228 | | 10.8 | 6.2 | 4.1 | | | | | | | 1.8 | 1.6 | | | | |
| Sugarcane forage, fresh | 22 | 41 | 34 | 7 | 9.3 | 6.2 | | | .5 | | 1.4 | 37 | 1.9 | 1.1 | 7 | | | |
| Sugarcane leaves, fresh | 42 | 52 | 33 | 5.1 | 2.4 | 1.5 | | | | | | | | | | | | |
| Sunflower, Stover | 75 | 57 | 48 | 8.4 | 6.2 | 4.1 | | | | | 5.4 | | 11.2 | .8 | | | | |
| Wheat, straw | 91 | 42 | 41 | 6.7 | 6.8 | 4.5 | 2 | 3.3 | .1 | 1.1 | 1.2 | 32 | 4.8 | .7 | 3 | | | |

**Table 9b: Quality of some commonly available concentrates and agro-industrial by-products in Kenya**

| Feed name | DM % | CP g/kg | CF % | Ash | ME | NE | ME pig | ME broiler | ME rabbit | Na | S | Mg | Mn | Ca | P | Cu | Co | Se |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Acacia, seeds | 92 | 284 | 9 | 4.3 | 14.2 | 9.5 | | | | | | 2.8 | | 2.8 | 4.2 | | | |
| African locust bean, seeds | 90 | 318 | 9 | 4.4 | 15.9 | 10.7 | | | | | | | | | | | | |
| Barley, grain | 87 | 118 | 5 | 2.6 | 12.4 | 8.3 | | 11.3 | 14.1 | .1 | 1.2 | 1.3 | 19 | .8 | 3.9 | 12 | .35 | .11 |
| Brewers grain, fresh | 25 | 259 | 16 | 4.2 | 9.9 | 6.6 | 12.2 | | | .3 | | 2.3 | 43 | 3 | 5.7 | 14 | | |
| Brewers grain, silage | 25 | 276 | 16 | 5 | 10.2 | 7.0 | | | | | | | | | | | | |
| Cassava, peels dry | 87 | 52 | 14 | 5.8 | 11.5 | 7.7 | | | | | | 1.1 | | 4.5 | .8 | | | |
| Cassava, tubers peeled, fresh | 28 | 22 | 1 | 3.8 | 12.8 | 8.2 | 15.7 | | | | | | | 1 | .4 | | | |
| Cassava, tubers, fresh | 37 | 26 | 3 | 2.8 | 12.4 | 8.3 | 15.4 | 15.2 | | | | 1.1 | | 1.6 | 1.2 | | | |
| Cotton seed meal, high oil, high fibre | 92 | 374 | 17 | 6.5 | 11.9 | 8.0 | | | | .2 | | 6.7 | | 2.2 | 11.9 | | | |
| Cotton seed meal, high oil, low fibre | 92 | 450 | 10 | 7 | 13.2 | 8.8 | 12.3 | | | .3 | | 6.3 | 14 | 2 | 12.4 | 17 | | |
| Cowpea, seeds | 89 | 249 | 6 | 4.3 | 13.4 | 9.0 | 14.1 | 13.4 | | .1 | | 2.3 | 21 | 1.1 | 4.1 | 10 | | |
| Dairy meal | 90 | 156 | 12 | 7 | 9.1 | 6.0 | | | | | | | | 6 | 4.5 | | | |

| | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Fish meal Mbuta | | | | | | | | | | | | | | | | | | | |
| Fish meal Omena | 90 | 500 | | | 9.4 | 6.3 | | | | | | | 1.4 | 3.2 | 9 | .14 | 2 | | |
| Fish meal, high protein | 92 | 754 | | 13.6 | 14.8 | 11.7 | 16 | 16 | | 11 | | 3.1 | 10 | 26.5 | 22.3 | | | | |
| Fish meal, low protein | 92 | 484 | | 35.2 | 14.8 | 9.9 | | 12 | | 28 | | | | 79.3 | 39.8 | | | | |
| Fish meal, medium protein | 92 | 706 | | 18.4 | 13.6 | 10.8 | 16.5 | 14.4 | | 11 | | 2.3 | 16 | 43.4 | 27.9 | 7 | | | |
| Maize bran | 88 | 120 | 12 | 5.9 | 11.3 | 7.5 | 10.9 | | | .8 | | 2.1 | 18 | 4.8 | 3.4 | 6 | | | |
| Maize germ cake | | | | | | | | | | | | | | | | | | | |
| Maize germ meal | | | | | | | | | | | | | | | | | | | |
| Maize grain and cobs | 87 | 88 | 13 | 2.3 | 11.9 | 7.8 | | | | | | 1.3 | 8 | .5 | 2.8 | 3 | | | |
| Mango, pulp | 17 | 42 | 6 | 3.3 | 13.7 | 9.2 | | | | | | 1.5 | | 1.9 | 1.1 | | | | |
| Millet grain | 90 | 142 | 7 | 3.7 | 12.2 | 8.2 | 14.5 | 16.8 | | | | | | .4 | 3 | | | | |
| Millet hulls/husk | 92 | 24 | 46 | 9.2 | 5.4 | 3.6 | | | | 0 | | .3 | | | .5 | | | | |
| Pawpaw, peels | 9 | 90 | 6 | 4.6 | 11.4 | 7.6 | | | | | | | | | | | | | |
| Pineapple, by-product | 88 | 45 | 17 | 8.1 | 10.8 | 7.3 | | | | .2 | | 1.2 | | 4.9 | 1.3 | | | | |
| Pumkin, fruits | 7 | 145 | 13 | 7.9 | 13.6 | 9.1 | | | | | | | | 3.9 | 2.6 | | | | |
| Rice bran | 91 | 88 | 28 | 13.6 | 6.7 | 4.4 | 8.3 | | | .3 | 1.9 | 2.1 | 186 | 4.7 | 7.4 | 10 | | .17 | |
| Rice hulls | 91 | 37 | 42 | 17.5 | 3 | 1.9 | | | | .3 | | 1 | 442 | .9 | 1.1 | 2 | | | |
| Sorghum grain, ground | 87 | 108 | 2 | 2.1 | 13.5 | 9.0 | 15.7 | 15.7 | 14.2 | .2 | 1.1 | 1.8 | 12 | .3 | 3.3 | 5 | | .46 | |
| Sorghum, bran and milling offal | 89 | 117 | 6 | 4.7 | 13.2 | 8.8 | | | | .1 | | 2.4 | 35 | .9 | 4.9 | 9 | | | |
| Soybean, hulls | 89 | 132 | 38 | 5.3 | 11.5 | 7.7 | 8.6 | | | .1 | 1.2 | 2.6 | 25 | 5.5 | 1.6 | 8 | .12 | .21 | |
| Soybean, cake (expeller) | 90 | 493 | 4 | 6.8 | 14.7 | 9.9 | 16.5 | 10.7 | | .2 | 1 | 3.2 | 39 | 4.6 | 7.2 | 17 | | | |
| Sugarcane molasses | 73 | 55 | 0 | 14.6 | 9.6 | 6.4 | 13 | | 13.2 | 2.4 | | 4 | 74 | 9.2 | .7 | 6 | | | |
| Sunflower, cake | 91 | 279 | 26 | 5.7 | 10.9 | 7.3 | 11.1 | | | .1 | 2.1 | 3.6 | 35 | 3.9 | 9.2 | 26 | | .45 | |

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sunflower, heads | 89 | 98 | 19 | 10.4 | 8.6 | 5.7 | | | | | | 2.2 | | 14.7 | 3.7 | 7 | |
| Sweet potato vines | 15 | 132 | 19 | 11.8 | 8.8 | 5.9 | 6.8 | | | 3.7 | | 7 | 131 | 12.4 | 3.1 | 11 | |
| Wheat, bran | 87 | 173 | 10 | 5.6 | 11 | 7.4 | 10.2 | 7.4 | 11.2 | .1 | 2.1 | 4.6 | 113 | 1.4 | 11.1 | 14 | .5 |
| Wheat, grain | 87 | 126 | 2 | 1.8 | 13.1 | 8.8 | 15.5 | 13.8 | 14.3 | 0.1 | 1.5 | 1.2 | 40 | .7 | 3.6 | 6 | .28 |
| Wheat, pollard | 90 | 150 | 7 | | 11.5 | 7.7 | | 9 | | | | | | 1 | 7 | | |

*Courtesy: Infonet Biovision- Animal nutrition and feed rations*

## 5.3. Dairy cattle ration formulation

While formulating rations, it should be ensured that the animal consumes the desired amount of nutrients in a day. The ideal feed management in a dairy operation consists of always having adequate quantities of high-quality feed available on demand (21 hours per day).

The ration may be formulated as a) complete (total mixed ration), b) concentrate mix or c) nutrient supplement of protein, vitamin, or mineral. The diets should preferentially be fed as total mixed rations provided at least twice a day. To stimulate feeding behaviour in dairy cows, the feed should be delivered fresh, and planned milking time should be maintained (Grant and Albright, 2001).

### 5.3.1. Total mixed ration (TMR)

This is a method of feeding cows/cattle that combines feeds formulated to a specific nutrient content into a single mix (Tim Beck et al., 2023).

A dairy cattle ration should contain 70% energy source, 30% protein source and required minerals; a well-formulated TMR should constitute forages, grains and grain by-products, minerals, and vitamins that have been mixed to make a balanced ration in which the weight of each ingredient is known (a M. Amaral-Phillips et al., 2002), which is fed to the cows as a sole source of feed.

Blending all the feedstuff together ensures that each bite of feed a cow consumes contains the same proportion of forages and concentrates. For effective feeding, it is important to ensure the cows eat the expected amount of mixed feed based on their requirements.

The advantages of feeding a TMR include the following:

1. By total mixing, the rations eliminate selective picky by the cows while eating. This ensures they are fed a fixed quantity of forages and concentrates as required.
2. It ensures optimal performance of the rumen microorganisms as they will have a uniform supply of nutrients (protein and carbohydrates) throughout the day. This ensures the maximization of rumen fermentation and the production of rumen microbial protein, which forms the bulk of the ruminant protein source.
3. Through proper mixing, the non-palatable ingredients are eaten by the animals without a problem within the mix.
4. TMR ensures more control and accuracy on the amount of feed given to the animals rather than when the ingredients are fed separately.
5. Through proper planning, TMR mixers will reduce the work of feeding cows and save labour costs.

The disadvantages of feeding a TMR include the following:

1. If not properly grouped, depending on production, all the animals in the herd are fed on the same ration.
2. To ensure a proper mix of TMR, one requires a mixer and equipment to chop feedstuffs such as hay or straw before adding them to the mixer, which might be costly.

### 5.3.2. Grouping of cattle for TMR feeding

It is important to feed cows according to their production and nutrition requirements. Cows may be divided based on their lactation phase/stage and milk production (Figure 6). Cattle naturally tend to compete for feed at the feeding trough even when unlimited access to feed is provided. Therefore, it is important to group the cows so that all the animals in the herd will eat according to their requirements.

Cows may be grouped by 1) parity (first calvers and mature cows), 2) stage of lactation, and 3) milk yield.

1. Grouping by parity: separate first lactation cows from older cows; usually, first calvers are less dominant and will often be pushed off the feed trough, stalls, and water troughs by dominant cows (Grant and Albright 2001). Therefore, by separating them, the first calvers will experience increased feeding time, meals per day, lying time, and improvement in subsequent milk production (Grant and Albright 2001). This way, the different groups of cows can feed and get the required ration, therefore increasing the general herd performance and, consequently, overall farm productivity and profitability.
2. Grouping based on milk production: This is influenced by nutritional requirements. In most instances, high milk yielders may be in negative energy balance (i.e., mobilizing body fat), so they will require a more balanced and nutrient-dense diet. Low yielders, usually at the end of their lactation and soon to be dried off, may require a diet that will support milk production but prevent excessive body conditions.
3. Lactation stage- The period when the cow is being milked (lactation period) can be divided into four phases based on the cow's nutrient requirements (Figure 6); Ideally, a dairy cow should be milked for about 305 days (about 10 months) and then be prepared for the next calving. However, most farmers milk their cows for much longer due to non-conception or delayed breeding. To optimize herd milk production, managing individual cow lactation cycles effectively is crucial in attaining herd milk production potential (Moran, 2015).

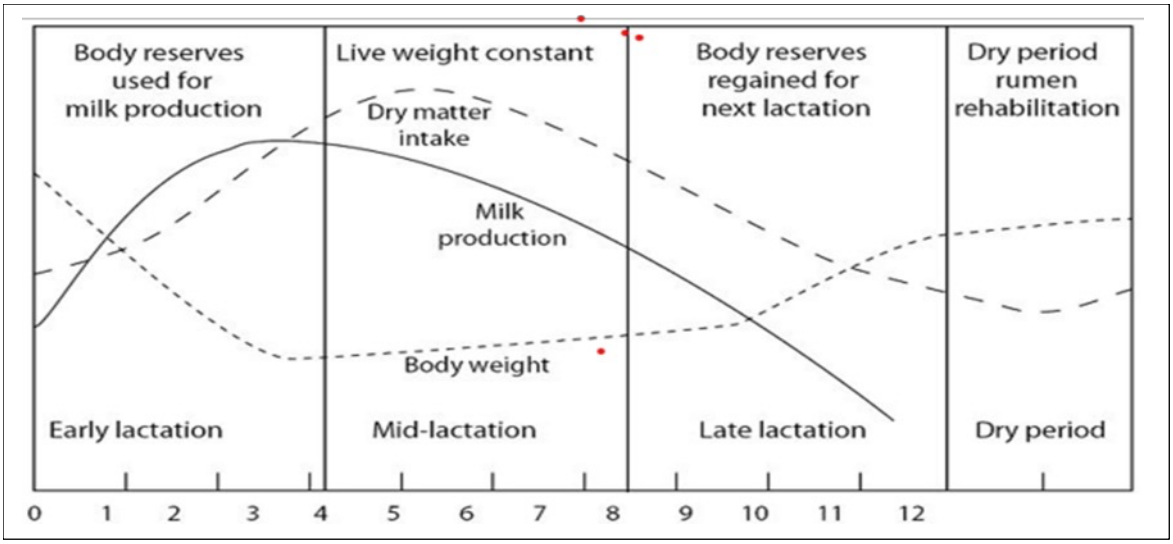


**Figure 6: Dry matter intake, milk yield and live weight changes in a cow during her lactation cycle.**

*Source: Moran, 2015*

To achieve an optimal milk yield, feeding based on the stages of lactation is important; this phase can be divided into:

**1. Transitional feeding close-up dry cows (2- 3 weeks before and after calving)**

During this period, there is rapid growth of the unborn calf, regeneration of the mammary tissue, and colostrum production, and the cow is susceptible to metabolic problems. During this period, the animal tends to have low dry matter (DM) intake; hence, to meet its growing demand, it should be fed on high-energy, highly palatable and digestible feed such as concentrates like commercial dairy meals and maize germ or starchy feeds and molasses. Feeding cows at this time is to prepare them to consume large amounts of feed (for high milk production), accustom the rumen bacteria to high concentrate levels and prevent nutritional disorders such as milk fever and ketosis that are common in early lactation; however, the cow should not be over-conditioned/ over-fattened (Gachuiri et al., 2012; Heinrichs, 1989).

Examples of a good feed ration will include:

- About 3 kilograms of grain and/or grain by-product.
- 2 to 3 kilograms of good quality forage, such as maize silage and hay.
- Protein source.
- Minerals.
- Feed additives- to improve palatability and prevent metabolic disorders.

**2. Newly calved cows (1-21 days after calving)**

The dry matter intake at this stage tends to be low; this is due to the yet-to-be-involuted uterus, which reduces the rumen capacity. However, the nutritional requirement is comparatively high; to mitigate against the low intake, the feed should be of high nutrient quality and palatability to stimulate intake. Feed the cow diet rich in fibre (2 to 3 kilograms of good quality hay); this will help promote good rumen function; inclusion of forages and concentrates in the ration will give a good start towards high milk production and entering the high-production group.

**3. High-producing older cows (2nd lactation onwards and 21- 180 days in milk)**

At this stage, the high-producing older cows attain peak milk production and peak dry matter intake. This group of cows should be fed so that they maintain high milk production and are bred back for the next lactation. During this phase, the cattle are in the reproduction stage for heat detection and breeding; the feed ration should be made and fed to the cows so they can be inseminated.

1. First lactation or first calf heifers

This group is better grouped on their own for social and nutrition reasons. The first calvers reach peak dry matter intake and milk production slower than older cows; they also maintain constant milk production longer than older cows. They can maintain peak production for up to 250 days or more before moving to a late lactation group (Donna M. Amaral-Phillips et al., 2002).

2. Mid lactation cows (180- 250 days in milk)

Ideally, at this stage, the cow should be pregnant, and its milk production should be 75-85% of the peak production. The cows should be fed on a ration rich in forages and less nutrient-dense than when they were in peak production (Donna M. Amaral-Phillips et al., 2002).

3. Late lactation pregnant cow group (250 days in milk to dry off)

The cows should be fed on a high forage ration to maintain milk production and avoid fattening (over-conditioning).

4. Far-off dry cows (220-260 days pregnant)

The goal of the dry period is to prepare the cow for the next lactation. The feed should contain mostly good to medium-quality forages to promote maximum rumen fill and rumination. Cows will need enough protein and proper mineral balance in their ration.

Importance of drying a cow

- Build up body reserves in time for the next lactation period; milk production will be reduced during the next lactation period if the cow does not have sufficient time to build its reserve.
- Allow the cow to regenerate alveolar tissue (milk-synthesizing tissue) that might have degenerated during the lactation period.
- Save nutrients for the fast-growing fetus; feed the cow a ration that caters for maintenance and pregnancy.
- Two weeks before calving, the cow is fed on high-level concentrates (steaming) in preparation for the next lactation. However, avoid over-conditioning by not feeding large amounts of concentrate. The aim is to achieve a body condition score of 3.5–4.0.
- If the diet is rich in energy, limit the intake of concentrate; Feeding bulky roughages helps increase rumen size to accommodate more feed at parturition (birth).

### 5.3.3. Milk from pasture and fodder

Dairy cattle can be fed on forage or pasture with no supplementation, and milk production will depend on the quality and quantity of the pasture. However, it is difficult to realize the full genetic potential of a cow fed in this manner.

i. On Napier grass only, the expected milk production is 7 kg/day.
ii. 9–12 kg/day when the cow is fed on a Napier–legume (desmodium) mixture.
iii. On grass alone (e.g. Rhodes grass or Nandi setaria), an average milk yield of 5–7 kg/day has been obtained.
iv. 7–10 kg/day on a grass–legume mixture.
v. Oats harvested at the milk stage and fed to a dairy animal can enable it to produce up to 12 kg/day.

### 5.3.4. Steaming up

Steaming up is the feeding of the pregnant dairy cow with extra concentrate 6 to 8 weeks before calving (Table 10). For a heifer, this extra concentrate should be fed in the milking parlour if possible, to accustom her to the milking parlour. The diet serves to prepare the animal for lactation and to support the fast growth of the unborn calf. Underfeeding during this time can result in difficult calving (dystocia) and raise chances of metabolic problems (milk fever and ketosis). Over-feeding, on the other hand, may result in a fat animal which may lead to difficulties during calving. The amount of minerals provided should be restricted to minimize the incidences of milk fever.

**Table 10: An example of steaming up schedule**

| **Weeks before calving** | 6 | 5 | 4 | 3 | 2 | 1 |
|---|---|---|---|---|---|---|
| **Concentrates in kg** | 1 | 2 | 2 | 2.5 | 3 | 3 |

Benefits of steaming include:

- High milk yield
- A healthy calf born
- Prevents metabolic diseases such as ketoses
- Provides energy for calving
- The cow takes less time to get back to estrus
- Fastens the development of the mammary glands

### 5.3.5. Challenge feeding

Lactating cows may be challenged with increasing amounts of concentrate until there is no corresponding increase in milk production. This method of feeding is recommended only if the extra milk produced offsets the added cost of the concentrate (Gachuiri et al., 2012). Challenge feeding should take place in the early lactation when there is a risk of underfeeding. Feed each cow the maximum quantity of concentrations that it can consume, without reducing its roughage intake. Continue this until the cow attains peak milk production 4 to 10 weeks after calving.

By using this strategy, each cow is given the possibility to show its production potential.

**Use of body conditioning to assess feeding.**

Body conditioning can be used to assess the appropriateness of a feeding regime for lactating dairy cows. Dairy cattle deposit their energy reserves around the pelvic area, and their condition can be assessed by scoring the amount of deposit using a standard score (Table 11).

Condition scores are normally on a scale of 1–5, with 1 being too thin and 5 being too fat (Figure 3); prior to calving, the animal should be in good condition (3.5–4).

Overweight/over-conditioned cows are more susceptible to metabolic problems (ketosis) and to both infectious (mastitis) and non-infectious (retained placenta and lameness) health problems. They are also more likely to have difficulties at caving.

Under-conditioning can lower milk production as there are insufficient energy and protein reserves for mobilization in early lactation.

An ideal cow has a body condition score of about 3.5, but the system is designed to have cows at certain body conditions at certain stages of lactation.

After calving, cows should lose less than one point before they begin to gain weight; those losing more than one point are more vulnerable to reproductive problems.

**Table 11: Body-conditioning scores and score indicators**

| Body Condition Score | Indications/ Score indicators |
|---|---|
| **1.0** | Skin and bones |
| **2-2.4** | Severe negative energy balance in cows in early lactation; risk of production loss |
| **2.5-2.9** | High producer in early lactation |
| **3.0-3.4** | Milking cows in good nutrient balance |
| **3.5-3.9** | Late lactation and dry cow in good condition |
| **4.0** | Over-conditioned; potential calving problems if dry |
| **5.0** | Severely over-conditioned; risk of fat cow syndrome |

*Source: Feeding and managing dry cows (Heinrichs, 1989).*

**Important points to remember while formulating feeds for cattle**

1. Use the dry matter (DM) intake requirement of the cow to formulate the ration to the desired nutrient amounts. Generally, formulate a ration which is 20% above the milk yield requirement of the cow ration; if the cow produces 20 litres of milk daily, formulate rations for 24 litres of milk daily. The extra portion is expected to yield more milk above 20 litres and aid in growth or improve the body condition, for first calvers/heifers formulate for 30% above milk production of the group to promote growth.
2. Formulate feeds based on dry matter basis; use a moisture tester to check on dry matter content. Changes in dry matter in a feed will be shown by:

3. Changes in the volume of the feed/TMR mixed.
4. Increased quantity of feeds not consumed may mean the feeds have increased dry matter.
5. All the feed consumed may mean the feeds have decreased dry matter content or increased moisture.
6. Formulate feeds based on the number of cattle to be fed and their nutritional requirements.
7. Feed the cows on formulated feeds/TMR at least once or twice a day. Ideally, feeding should be done once in the early morning and once in the evening as it keeps the feed fresher and promotes feed intake.
8. Feed sorting: Cattle use their noses to sort and separate concentrates from forage in a feed mix. They prefer to eat the concentrates first and leave long forages for later. This way, they unbalance the feed mix by eating only the concentrates at one meal, which can lead to acidosis and off-feed problems. Further, the drier the feed, the more the cattle will sort. A mixture of feed should have between 50 and 55 per cent dry matter.
9. Feed refusal should be corrected by ensuring the feed mix is properly mixed. If the cows refuse part of the feed, this should be corrected by either chopping the long forages to ensure proper mixing of the ration or moistening it by adding molasses and other feed additives.

# 6. Management of calves and heifers

## 6.1. Calf management

The management of a calf is important in dairy farming as it ensures a healthy young stock. Feeding management addresses the nutritional requirements while encouraging early rumen development of the calf.

### 6.1.1 Calf feeding

Calf feeding is divided into four phases depending on the development stage of the digestive system (Gachuiri et al., 2012).

1. Colostrum phase (1-3 days) – The calf is born with low immunity and is, therefore, susceptible to infections. Colostrum is rich in antibodies that protect the calf from pathogens and its absorption is maximum within the first 3 days of birth.
2. Pre-ruminant phase (4-30 days) – The calf rumen is still not functional, and a calf relies on liquids. Rumen development starts towards the end of this phase.
3. Transitional phase (2-3 weeks before weaning): The calf is now encouraged to consume dry feeds, especially concentrates (calf starter), which are known to accelerate rumen development.
4. Post-weaning phase – The rumen is now developed and can handle fibrous material. However, the calves should be weaned on high-quality pasture and fodder to maintain a high growth rate.

Between 3 weeks and weaning, the calf's water consumption usually increases, and water should be offered ad libitum.

Weaning- is the withdrawal of milk or milk replacer while the calf becomes fully dependent on other feeds. Dairy calves are weaned at 12 weeks of age but can be weaned earlier if more milk is fed and calves are introduced to pre-starter and starter early (Gachuiri et al., 2012).

### 6.1.1. 6.1.2 Calf nutritional disorders

The common disorders associated with calf feeding are scours and pneumonia.

Scour/diarrhoea may be caused by nutritional disorders and pathogens. They are a major cause of mortality in young calves. To reduce incidences of scours:

- Provide adequate colostrum within the first 6 hours of birth.
- Feed with the right amounts of milk (avoid overfeeding).
- Treat scouring calves early.
- Maintain hygiene and cleanliness of feeding utensils and the environment.
- Isolate sick calves to avoid cross-infection.

To manage scours, give electrolyte replacement to prevent dehydration. Reduce or omit milk one or two feeds but provide fresh water, concentrates and forage.

Blood scours (mostly from coccidia infection) require veterinary treatment and management changes to improve hygiene. The coccidia are ingested, so the unit must be raised or cleaned to ensure the feed is not mixed with the faces.

Aspiration pneumonia is caused by fluids entering the lungs through the windpipe while feeding. To avoid this, ensure the calf takes only what it can swallow in one go.

### 6.1.2. Calf management practices

There are several calf management practices that include:

1. **Disbudding**—Disbud 2-3 months of age by using a caustic potash stick or disbudding iron.
2. **Removal of extra teat**s at 2-3 weeks of age–if a calf is born with extra teats (more than 4), surgically excise and apply the antibiotic spray to prevent infection.
3. **Castration**—This is done in the first week by applying castration rubber to the calf bulls that are not intended for breeding to control inbreeding within the herd.
4. **Identification**- Done immediately after birth for recording purposes – Carry out identification method by use of ear tags or ear notches.
5. **Deworm**- Calves as soon as they start grazing and thereafter every 3 months.
6. **Spray and dip**- Use the correct acaricides to control ticks and other external parasites and prevent the transmission of diseases in animals.

## 6.2. Heifer management

After weaning, a female calf becomes a heifer, which will eventually replace the culled animals, increase the herd size, or be sold to generate income. Heifers should be closely observed and fed correctly to avoid the growth slump that can occur after milk is withdrawn.

### 6.2.1 Heifer feeding

The aim is to achieve a growth rate of 500-700g/day. This ensures that they will come on heat at the right time, as puberty is related to size rather than age (Gachuiri et al., 2012) To increase the number of calvings in a lifetime, reduce the interval between weaning and first calving.

Heifers should be reared in groups of similar age or size—weaners, yearlings, bulling heifers (those ready for breeding) and in-calf heifers to avoid competition across the groups and, hence, delayed growth. Heifers can be reared on good-quality pasture as their nutrient requirements are low (growth and maintenance) with supplementation at 1% body weight. Crude protein is important to ensure adequate frame size and growth.

In heifer feeding programs, it is important to consider:

- Puberty – this is related to calving age and size (a feeding indicator) rather than the age of the heifer. The consequences of poor feeding are, therefore, manifested in delayed first calving.
- Feeding heifers too much energy leads to fat infiltrating the mammary glands, inhibiting the development of secretory tissue, thus reducing milk yield.
- Underfeeding results in small-bodied heifers, which have trouble during calving.
- Overfeeding heifers on feed high in energy but low in protein results in short, fat heifers; high protein and low energy feed results in tall, thin heifers.

# 7. Reproductive health

For a productive dairy herd, reproduction management is a key aspect which needs proper planning to achieve optimal breeding, which determines the number of calves born and the total milk produced throughout a cow's lifetime (Mwai et al., 2020). Successful breeding requires healthy and well-fed animals.

## 7.1. Breeding management

Good breeding management ensures:

1. Higher average daily milk yields are attained– a good dairy cow should calve down every year (every 12-13 months).
2. Higher persistency is achieved- Maintained quantity and quality of milk (high butterfat content, etc.) throughout the lactation period.
3. Longevity- How long a cow remains profitable and highly productive; a cow that combines high milk production and longevity is preferred.
4. High fertility (fewer inseminations/pregnancy or conception)
5. Age at first calving (24-27 months)
6. Good feed conversion efficiency

It is also important to prevent the spread of reproductive diseases and infections. Prompt management of retained placentas and uterine infection will ensure the animal is able to conceive on time as required.

## 7.2. Heat detection and artificial insemination

Efficient heat detection is important as it makes it possible to serve the animal at the right time, reduces calving intervals and overall productivity (Mwai et al., 2020).

Heat detection and timing of insemination (Table 12) are key in breeding cattle.

Key highlights in improving the efficiency of breeding (heat detection and insemination):

1. A heifer may show signs of heat for the first time when she is 9 months of age, but it is advisable to serve animals based on size- bodyweight (Fresian-350 kg, Aryshire-320kg, Guernsey- 300 kilograms, Jersey- 280 kg).
2. A well-nourished cow should show signs of heat at least 45-60 days after calving (the animal should have been served by 90 days post-calving).
3. Observe the cow for heat signs every 18 to 24 days.
4. Heat only lasts for 12-24 hours in exotic and crossbred cows.
5. The AM-PM rule is used in Insemination. When standing heat is seen, AM is served, and PM is served at the same time on the same day.

**Table 12: Heat signs**

| Early heat | Standing heat | After heat |
|---|---|---|
| The cow is nervous/restless, eats less and may bellow.<br>Sniffing, licking, and mounting other cows.<br>Swollen vulva with mucus discharge. | Standing to be mounted.<br>Clear mucus discharge.<br>Sharp decline in milk production.<br>Tail bent away from the vulva.<br>The animal may stop eating. | Dried mucus on the tail.<br>Roughened tail head.<br>The animal refuses to be mounted.<br>Streaks of saliva or signs of leaking may be seen on her flanks. |
| **Early signs: Watch the cow closely** | **Best signs: Take the cow for service as shown in Figure 7** | **Late signs: Keep a record** |

**NB:** Farmers should keep a heat calendar so that they know when to expect the next heat period for each cow.

Signs of clear mucus discharge/ restlessness should be used in smallholder systems where the animals are kept separately to detect heat.

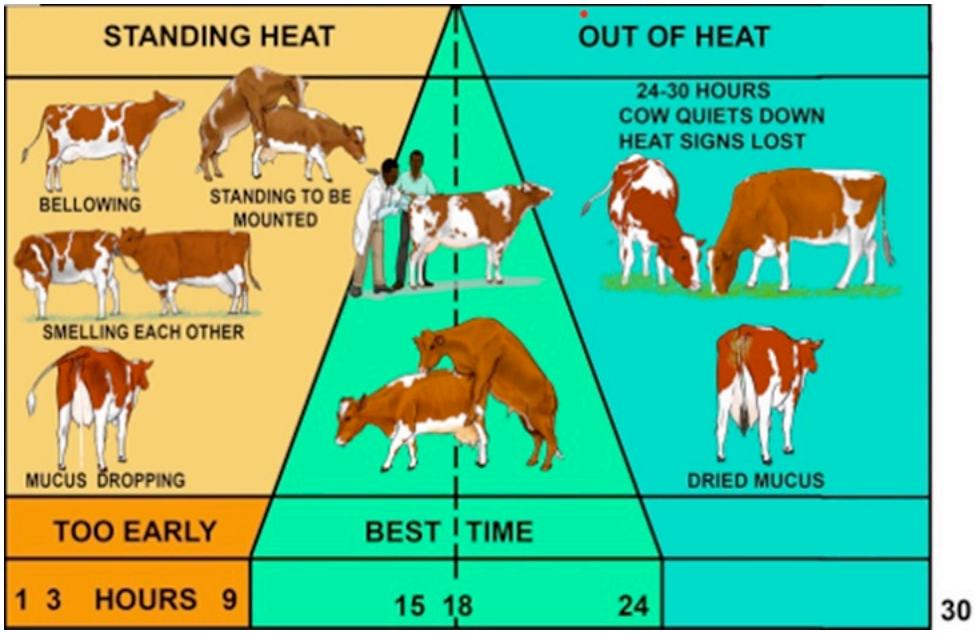


**Figure 7: The best time to present a cow for insemination.**

**Note:**

- If standing heat is observed in the morning serve the animal late afternoon the same day
- If standing heat is observed in the late afternoon, serve the animal the next morning the following day
- Observe for return to heat and report to the animal health practitioner.

## 7.3. Bull selection

Traits to consider when choosing semen for artificial insemination (AI) include:

1. Ease of calving
2. High production quality and quantity
3. High fertility
4. High performance of pedigree

5. Good dairy udder and teats
6. Feet and legs

## 7.4. Pregnancy diagnosis

Pregnancy diagnosis should be done 60-90 days after insemination so that open animals are identified early and a decision made to rebreed them. Call a Vet to make a pregnancy diagnosis.

### 7.4.1. Pregnancy and parturition

A cow is pregnant for an average of 283 days, with the range being from 279 to 287 days. Insemination records should be used to develop a cow calendar, which allows us to estimate the calving period (Mwai et al., 2020).

Loss of calves and/or cows during calving can be minimized by:

- Keeping the calving cow under close observation at the time of calving,
- Providing prompt assistance when difficulty in calving is noted and
- Call for veterinary assistance when you are unable to help.

It is advisable to keep the cow in a small fenced-off area where she will not be disturbed by the other cattle. You can keep a close eye on her and help if necessary. The area should be clean, cool, and/or shaded, near the homestead (for closer observation), well-watered, free from physical objects, and comfortable to lie down in.

### 7.4.2. Signs of calving

Recognizing the signs of calving and the behaviour of the cow or heifer before or during calving is critical in identifying animals that need assistance. There are several signs to watch to tell when an animal is about to calve down:

The udder starts to swell a few weeks before. This may happen earlier in heifers (during the fourth month of pregnancy) and in cows, about 2 to 3 weeks before calving. It is common to see udder edema in heifers that are ready to calve.

1. A few days before calving, the animal often stands alone and away from other animals.
2. The teats become turgid, lose their wrinkles, and may secret colostrum.
3. The vulva often becomes swollen and red, and sometimes, a clear red/brown discharge results.
4. The animal develops a hollow on each side of the tail as the muscles around the pelvis and vagina start to relax.
5. The animal becomes restless. She looks around at her side and often lies down for a short time before getting up again.
6. The vulva is swollen and often produces streams of mucus, particularly when the cow gets up after lying down.
7. The tail head appears to become slightly raised.

### 7.4.3. The process of calving

The behaviours observed during calving are illustrated in Figure 8.

| Calving stage | Illustration |
|---|---|
| **Stage 1: 4 to 24 hours**<br>Signs of discomfort and restlessness<br>Slight arching of the back,<br>Definite straining | Picture 4: Restless pregnant cow (abdomen distended with the enlarged udder, hollow on each side of the tail, tail slightly raised, arched back and swollen vulva)<br>  |
| **Stage 2: 1 to 2 hours** for cows and 3 to 4 hours for heifers<br>Uterine contractions with the result of the first water breaking, during which the first water bag breaks<br>The average interval between the rupture of the first and the second water bag is about 1 hour. | Picture 5: Pregnant cow (abdomen distended) with tail raised, arched back and swollen vulva with water bag broken (content pouring to the ground)<br>  |
| Once the second water bag bursts, regular intermittent straining gradually increases in frequency and duration and becomes nearly continuous during the last few minutes before calving.<br>The legs appear, and after some time, the head (anterior presentation and limbs extended), posterior presentation- extended hind limbs and tail presented).<br>Once the head of the calf has appeared, the rest of the body follows rapidly. | Picture 6: Cow with enlarged udder, tail slightly raised, arched back and swollen vulva and legs and head of the calf protruding.<br>  |

| | |
|---|---|
| Cows can become exhausted and stop straining. Such animals require early assistance while the birth canal is fully dilated | Picture 7: Cow with enlarged udder, the afterbirth hanging and the newborn calf.<br>  |

**Figure 8: Behaviour observed during the calving process -Stage 1 and 2 processes of calving illustrated**

It takes from 2 to 6 hours for the first appearance of the calf in the average cow and from 4 to 10 hours in the average heifer. The actual expulsion of the calf takes from 1 to 4 hours in the cow and from 2 to 6 hours in the heifer.

If a cow has been straining for four hours without making progress or there is no visible progress for two hours after the water bags appear, an investigation should be made to determine the cause of the delay and the type of assistance she may need.

A cow showing any of the following signs may be having calving problems, and you should call the veterinarian:

- Straining for over half an hour without results,
- Fetus to pelvic distortion: Large fetus in a cow with a small pelvis diameter, and there has been straining for 2 hours without delivery, after two hours of straining.
- A calf which is obviously not presenting properly, for example, will show:
    - two front feet and no head, or
    - a head and one or both feet retained, or
    - only one hind foot showing,
    - just the tail and hind quarters of the calf showing

NB: You can assist a cow in calving, but only if there are two front feet and a head or two hind feet presented. However, it is advisable to call a veterinarian whenever a case of difficult calving is detected.

If you must assist /help with calving, these are some useful things to have:

- Clean water.
- Soap and brush for washing hands.
- Soap flakes or other lubricants.
- Clean clothes for drying hands.
- Ropes.

When assisting in calving, ensure

- Hygiene to avoid contamination of the reproductive tract.
- Enough lubrication so that you don't injure the reproductive system of the dam.
- While assisting, only pull out the calf when the animal is straining.

Several good management practices can help to reduce the chances of a difficult calving. These include:

- Choice of bull—Do not breed small cows with big bulls. Select bulls that are easy to calve.
- Size of the cow at breeding –small cows (not required weight) are likely to experience difficult calving. Feed your heifers well to make sure they attain the proper weight at service.
- Timely diagnosis and intervention can affect the amount of assistance needed and, therefore, the amount of stress on calves.
- After calving, the cow should be isolated with her calf for the first day or two to enable the newborn calf to suckle her mother and directly get the colostrum.

**Stage 3: 4 to 12 hours**

1. The placenta or fetal membrane is usually expelled within 8-12 hours after delivery of the calf.
2. Intervene if the placenta is retained after 72 hours. **Do not force manual removal.**
3. Observe the colour of the lochia- it should be brown and non-smelling. Foul-smelling discharge is indicative of infection.

# 8. Biosecurity measures

## 8.1. Biosecurity in herd health management

Biosecurity is defined as a set of management practices or measures implemented to reduce or prevent the introduction and spread of pathogens (disease-causing organisms) within and between farms (Fasina et al., 2012; Gunn et al., 2008). It prevents economic losses and protects public health.
For effectiveness, biosecurity will require the adoption of a set of attitudes and behaviours by people to reduce risk in all activities involving domestic, captive/exotic, and wild animals and their products (Pao et al., 2023).

## 8.2. Important definitions

**Primary biosecurity**: the prevention of pathogens from spreading within a farm.
**Secondary biosecurity**: the prevention of pathogens from spreading between farms.
**Tertiary biosecurity**: measures that increase the resistance or immunity of the animals against pathogens.
Information about the biosecurity level on the farms is important for contingency planning for emerging diseases, when combating endemic diseases in a country, or to see if and where the biosecurity needs to be improved (Sahlström et al., 2014).

## 8.3. Biosecurity practices

Biosecurity practices on the farm include a) sanitation, b) animal management, c) feed management, d) facility maintenance, e) manure handling, and f) disposal of dead animals.

## 8.4. Sanitation

### 8.4.1. Employee sanitation

Employees are an important factor in the spread of disease within the farm or from farm to farm; therefore, their cleanliness is important in preventing infection spread.

The following measures may be put in place to reduce or stop their ability to spread diseases altogether:

- Provide on-the-farm laundry facilities for all employees.
- Consider housing your employees.
- Restrict employees from visiting other farms or owning other animals.
- Encourage employees to wash farm clothing with detergents and bleach.
- Have employees wash their hands before and after milking animals, working with sick animals, and working with young animals.
- Provide gloves when frequent cleaning between animals is necessary.
- Have workers wear protective clothing.
- Order tasks so employees work with younger animals before working with older animals. Young animals are susceptible to diseases carried by older animals.

### 8.4.2. Equipment sanitation

- Clean and disinfect equipment that has been used on sick animals before using on healthy animals.

- Clean and disinfect farm tools (hoof knives, clippers, tattoo pliers, ear taggers, ear notches and dehorners) between uses.
- Use the farm's halters and clippers whenever possible.
- Sanitize nursing bottles and buckets before each feeding.
- Do not use equipment that has handled manure for transporting or delivering feed.

### 8.4.3. Vehicle and transport sanitation

- Make sure visitors and service vehicles do not drive over feed delivery or manure handling routes.
- Locate holding pens for animal pickups near the road and away from the herd and the farm areas.
- Keep visitor vehicles out of areas that are accessible to livestock.
- Have visitors move from younger to older animal groups when touring the farm.
- Ensure that bedding in trucks is clean and ample when moving livestock to prevent both injuries and disease.
- Wash and disinfect the outside, inside, and especially the tyres of vehicles that transport livestock to other farms.

### 8.4.4. Boot cleaning

- Scrub off any visible dirt before thoroughly disinfecting boots.
- Soak boots in a clean solution of disinfectant mixed according to the product's directions.
- Provide disposable booties for visitors and dispose of them on-site.

### 8.4.5. Animal management

- Keep animals that are new to the farm in a separate holding area.
- A quarantine period should be established to facilitate monitoring and testing of the health status of new animals. This will also help to prevent the spread of diseases to the existing herd from animals that might be harbouring a disease without exhibiting any clinical signs.
- Young animals should be kept in a separate area from more mature animals to minimize the exposure of more susceptible animals.
- Keep an isolation area that is intended for only sick animals.
- Meet the standards for pens, stalls, or bedded space per animal in your care.
- Always handle sick animals last.
- Vaccinate farm dogs and cats against rabies to protect humans and animals. Consider vaccinating livestock, too.
- Prevent fence line contact between your livestock and other animals.
- Remove manure and bedding and disinfect pens, especially maternity and sick pens, between animals.

### 8.4.6. Feed management

- Keep food storage areas inaccessible to rodents, birds, dogs, cats, and any wildlife.
- Repeatedly check for and dispose of mouldy or spoiled feed material in storage.
- Place or empty open bags into containers that have tight lids to protect them from pests and water.
- Clean storage areas frequently.
- Remove and dispose of feed refusals if not consumed within 24 hours.
- Store bags of feed off the floor on pallets.
- Rotate feed inventory to reduce the presence of harmful organisms or toxins in stored feeds.
- Clean water once a week.
- Protect all water sources and containers from contamination.

### 8.4.7. Facility maintenance

- Keep away rodents and seal their dens and hiding places. Set baits and traps where necessary.
- Repair holes in buildings to prevent entry of pests.
- Check for weather damage and fix anything that needs to be repaired.
- Remove any standing water that can turn into a breeding ground for mosquitoes.
- Check and maintain fences.
- Place and maintain bird netting if needed.

### 8.4.8. Manure handling

- Ensure the manure handling system prevents environmental contamination and complies with the county/country's accepted agricultural practices.
- Use equipment to handle manure that is not used for feeding.
- Compost or store manure in conditions that destroy disease-causing bacteria.
- Remove manure frequently to prevent the completion of life cycles of flies and intestinal parasites.
- Store manure so that it is inaccessible to livestock, especially young animals.
- Prevent run-off or transfer of manure from older to younger groups of animals.

### 8.4.9. Disposal of dead animals

Dispose of carcasses promptly. This can be through incineration, burial in an approved animal disposal pit, or composting.

Comply with County/Country authorities' regulations on proper disposal.

Call a veterinarian prior to disposal of the carcasses.

### 8.4.10. Vermin control

- Vermin such as dogs, cats, rats, and mice can all spread disease. It is important to keep vermin numbers under tight control.
- Vermin numbers can be effectively reduced by cleaning grain spills, limiting the number of hiding places, disposing of dead stock, and using strategic baiting programs. Flies and mosquitoes should also be controlled to reduce the worry they cause animals, minimize the spread of diseases such as pink eyes, and reduce the transmission of blood-borne diseases.

Consider other biosecurity measures, such as wheel baths, footbaths, hand wash facilities etc.

**Additional information**

USDA-APHIS-Livestock and Poultry Biosecurity Factsheet

Center for Food Security and Public Health-website

National Biosecurity Research Center-website

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# 10. Annexes

## 10.1. Annex 1: General farm herd health assessment

**HERD HEALTH ASSESSMENT TOOL**
**Country:** **Region/ County: _____ Sub County_____(list) Ward _____ (list) Village_____ GPS coordinates: _____**
**Name of the Farm/Farm Owner**: _____
**Farmer/Owner Year of birth**……. .
**Sex of farm owner (1=Male, 2=Female)**: _____
**Highest Education level of farm owner: _____** (1=None, 2=Primary education, 3=Secondary education, 4=Technical education, 5=Diploma, 6=Bachelor's degree, 7=Post graduate degree, -66= Other (Specify)_____
**Which is the nearest dairy co-operative to this farm/farmer? _____**
**Is the farm owner a member of the cooperative?** Yes/No _____
**Mobile Phone Number of farm owner:** _____

**Name of the regular animal health service provider (AHSP): _____**
**Sex of the AHSP: (1=Male, 2=Female)**: _____
**Mobile Phone Number of AHSP**: _____

**Date of Assessment: _____(dd/mm/yyyy)**

**Part A: General Herd Health Assessment**

| **A Herd anagement** | |
|---|---|
| 1.Who manages the dairy farm on a day-to-day basis? | 1.1 Farm manager<br>1= Owner<br>2=Family member<br>3=Hired Farm Manager<br>-66=Other specify _____<br>1.2 If a family member, what is the relationship to the owner? |

| | |
|---|---|
| | 1=Spouse,<br>2=Son,<br>3=Daughter<br>-66=Other (Specify)_____<br><br>1.3 What is the age of the farm manager? [ ]<br>1.3 What is the sex of the farm manager? [ ] 1=Male, 2=Female<br>1.4 What is the education level of the farm manager?<br>1=None<br>2=Primary education<br>3=Secondary education<br>4=Technical education<br>5=Diploma<br>6=Bachelor's degree<br>7=Post graduate degree<br>-66= Other (Specify)_____<br>1.5 How many 'other' family members are working in the farm? [ ]<br>1.6 How many hired workers are working in the farm? [ ]<br>1.7 How many people working in the farm are<br>1.7.1 Male [ ]<br>1.7.2 Female [ ] |
| 2 Reason of keeping the dairy cattle | 2.1 What is the first main reason of keeping the dairy cattle?<br>1= Subsistence [ ] 2= Sale of milk [ ] 3= Sale of animal [ ] -66=Other (Specify)- **pick 1**<br><br>2.2 What is the second main reason of keeping the dairy cattle?<br>1= Subsistence [ ] 2= Sale of milk [ ] 3= Sale of animal [ ] -66=Other (Specify)-**pick 1** |
| 3.Does the farm benefit from clinical and AI services? [ ] 1= Yes; 0= No | a) If yes, what are the services received in the last 12 months? **(multiple select)**<br>1=Treatment of sick animals 2= Vaccination 3**=** Deworming 4= Artificial Insemination<br>-66= Others (Specify)<br><br>b) Specify cost charged and the frequency of service in the last 12 months for each of the service |
| 4 Does the farm benefit from extension services [ ] 1= Yes; 0= No | If yes, what are the extension/advisory services received in the last 12 months?<br>1= Feeding 2 =Disease control 3= Housing 4= Acaricide application and use -66= Others (Specify) (**multiple select)**<br><br>b) If the extension service was charged what is the cost charged to the farmer for each visit and frequency |
| 5.Is the farmer content with the current productivity? [ ] 1= Yes; 0= No | If No, score level of satisfaction/dissatisfaction on the likert scale for the productivity indicator |

| | | | | | |
|---|---|---|---|---|---|
| | Productivity indicator | Very dissatisfied | Dissatisfied | Neutral | Satisfied | Not satisfied |
| | Disease control | | | | | |
| | Herd size | | | | | |
| | Current breed | | | | | |
| | Calving interval | | | | | |
| | Herd structure | | | | | |
| | Internal parasite control | | | | | |
| | External parasite control | | | | | |

| | | | | |
|---|---|---|---|---|
| **B. Herd Structure** | | | | |
| 6. Herd Size and Structure | **Enter number based on category below; if there are different breed in any category separate accordingly (eg if Male calves less than 3 months are 5 in number- say Ayrshire 2 and Jersey 3 at the breed level** | | | |
| | Animal type | Breed<br>1=Cross Friesian<br>2=Cross Ayrshire<br>3=Cross Guernsey 4=Cross Jersey<br>5=Cross Fleckvieh<br>6=Exotic Friesian<br>7=Exotic Ayrshire<br>8=Exotic Guernsey<br>9=Exotic Jersey<br>10= Exotic Fleckvieh<br>11= Exotic Guernsey<br>12 =Exotic Sahiwal<br>13 =Cross Sahiwal<br>-66= Others (Specify)__ | # in herd | % in Herd (auto generated) |
| | Male calves (under 3 months) | | | |
| | Immature males (3-8 months) | | | |
| | Bulls (above 8 months?)<br>Specify use: 1= Breeding, 2= traction, 3= Steers/fattening -66=other (specify)_____ | | | |
| | Female calves (under 3 months) | | | |
| | Heifers (4-12 months) | | | |
| | Bullying heifers (ready to be served >12 months) | | | |
| | In- calf heifers | | | |

| | | | | | |
|---|---|---|---|---|---|
| | Non-Pregnant cows | Lactating | | | |
| | | Dry | | | |
| | Pregnant cows | Lactating | | | |
| | | Dry | | | |
| | **Total (Automatically generated)** | | | | |
| **C. Herd Dynamic** | | | | | |
| 7. Did any cattle join or leave the herd in the last 12 months.?<br><br>**(multiple select)** | If (a) **joined**, how and how many?<br>1=Births [number] 2= Purchased [number]3= Gift [number] 4= Agistment [number] -66= Other (specify) [ number]<br><br>Purpose for joining the herd.<br>1=Breeding; How many [ ] 2= Milking; How many [ ] -66= Others (Specify)_____ how many [ ] | | | | |
| | If **left**, why and how many left?<br>1= Death [number] 2= Culling-not meeting farm standard[number] 3= Sold other reasons [number]<br>4= Stolen [number] -66 Other (specify) [ number] | | | | |
| 8. Replacement rate per year | Replacement rate= (Number of animals joining the dairy herd/ Total dairy herd) multiplied by 100<br>**Autogenerate= (Total 7a/Total 6) 100** | | | | |
| **D. Milk Production and Breeding** | | | | | |
| 9. Current Herd Milk Production (litres) | Do you have any cows being milked currently? [ ] 1=Yes 2=No<br>If **Yes**, enter all the details below;<br>If < 3 cows milking, record all three<br>If>3 cows, record for each category of lactation (early (0-4months), mid (>4-8months) and late (>8months) lactation)<br>If Not, enter the details on the bold area | | | | |
| | **Description** | | Cow 1 | Cow 2 | Cow 3 |
| | **Breed of cow** | | | | |
| | **Current age of the cows (years) (Age using records/dentition)** | | | | |
| | **Age at first calving (MM/yyyy) (min 24 months)** | | | | |
| | **Number of months since the last calving (If Not being milked)** | | | | |
| | Number of months since the last calving (Months in milk if being milked) | | | | |

| | | | | |
|---|---|---|---|---|
| | Frequency of milking in a day- 1,2,3,4 | | | |
| | Average milk produced yesterday in litres (total) | | | |
| | Average milk produced at calving in litres (total) | | | |
| | **Average milk produced per day in the previous peak lactation (3-4 months after calving) (total)** | | | |
| | **Average milk produced per day at late lactation (7.5 months - calving) (total)** | | | |
| 10. Reason for mature cows not being in lactation (dry) | Why is the cow dry? _____<br>1= Dried off (steaming)2= Dried off (Sickness) 3= Being culled -66=Others (Specify)_____ | | | |
| 11. Lactation length (Months) | Number of months the cow was milked in the previous lactation<br>(not more than 10 months) | | | |
| | Herd Average (auto-generate) | | | |
| 12. Cow Open days (months) | Period between last calving and next the conception (if not conceived since the last calving, consider the previous calving)<br>(max 4 months) | | | |
| | Average Herd Open days (auto-generate) | | | |
| 13. Calving Interval (months) | Calving interval<br>(Number of months between last calving and the previous one)<br>(max 13 months) | | | |
| | Average Herd Calving Interval-auto-generate | | | |
| 14. Successful Services | Which method did you use to serve/inseminate the cow?; 1=Use Bull 2=AI | | | |
| | If bull service,<br>Where do you source the bull:<br>Own/Borrowed/Hire/Communal | | | |
| | Average number of Inseminations done before Conception if using AI | | | |
| | Herd Average Inseminations (AI) before Conception | | | |
| **E. Routine Management Activities.** | | | | |
| 15. Disease prevention through vaccination | 1. Has there been any disease incidence on the farm in the last 3 months? Yes/No<br>2. If Yes, which disease/s in the last 12 months | | | |

<table>
<tr><td></td><td>0=I don’t know<br>1= Tick-borne disease (East Coast Fever, Anaplasmosis, Babesiosis etc.)<br>2= Other vector-borne disease (Trypanosomosis)<br>3= Notifiable diseases (Foot & mouth disease, Lumpy skin disease, Anthrax, Black quarter, Rabies, Rift Valley Fever, etc.)<br>4= Routine management-related and controllable diseases (Foot rot, Mastitis, worms, bloat etc.)<br>5= Nutrition diseases and complications (e.g. Milk fever, Acidosis, Ketosis)<br>6= Reproductive related disorders (Retained Placenta, Abortions)<br>7= General frequent infections (e.g. Respiratory/ Pneumonia, Diarrhoea)<br>8= Skin problems (e.g. Mange, warts etc.)<br>9= Injury/physical trauma-related conditions (lameness etc.)<br>10= Mastitis<br>-66= Other (specify)_____-<br>3. Have you vaccinated your cattle in the last 12 months? [ ] 1=Yes, 0=No<br>If yes, enter the following details
<table>
<tr><td></td><td>Date when last vaccination was done (mm/yyyy)</td><td>Planned next vaccination date (mm/yyyy)</td></tr>
<tr><td>Anthrax/Black quarter</td><td></td><td></td></tr>
<tr><td>Bovine Pasteurollosis</td><td></td><td></td></tr>
<tr><td>LSD</td><td></td><td></td></tr>
<tr><td>ECF</td><td></td><td></td></tr>
<tr><td>FMD</td><td></td><td></td></tr>
<tr><td>Rabies</td><td></td><td></td></tr>
<tr><td>Brucellosis</td><td></td><td></td></tr>
<tr><td>CBPP</td><td></td><td></td></tr>
<tr><td>Mastitis</td><td></td><td></td></tr>
<tr><td>Enterotoxemia</td><td></td><td></td></tr>
<tr><td>RVF</td><td></td><td></td></tr>
<tr><td>Others (Specify)</td><td></td><td></td></tr>
</table>
4 If Not, What is the reason?<br>1=Not aware of the vaccine's existence 2= Aware but cannot afford 3= Cultural and religious norms. 4= No vaccination campaign by county govt. -66= Others (Specify)</td></tr>
<tr><td>16. Internal Parasite Control</td><td>1. Have you dewormed your cattle in the last 6 months? [ ] 1=Yes, 0=No<br>2. Do you deworm the following: 1. Calves 2. Heifers 3. Cows 4. Bulls multiple select<br>If yes, enter the following details<br>3. Enter intervals between deworming in 2 above</td></tr>
</table>

| | | | | | |
|---|---|---|---|---|---|
| | Date when last deworming was done (mm/yyyy) | | Class of dewormer Used e.g. Albendazole, Levamisole, Oxyclozanide, Ivermectin, Nitroxinil, etc. | Planned next deworming date (mm/yyyy) | |
| | 4 If Not dewormed, what is the reason?<br>1=Not aware of the deworming 2= Aware but cannot afford 3= Cultural and religious norms -66= Others (Specify)_____ | | | | |
| 17. External Parasite Control | 1. Have you encountered tick-borne disease/s in your farm in the last 12 months? Yes/No<br>If Yes, which one? 1= Anaplasmosis, 2=East Coast Fever, 3=Babesiosis, 4= Heart water -66=Other (specify)_____<br>2. Do you face challenges of ticks, flies and other external parasites in the farm? _____<br>3. If Yes, how do you control them? 1= Use chemicals 2= Hand pick 3= Ethnoveterinary 4= -66=Others (Specify) (multiple select)<br>4. If using chemicals, which groups do you use chemicals on? 1= Calves 2= Heifers 3= Cows 4= Bulls (multiple select) | | | | |
| | Date when last applied (mm/yyyy) | Class of Acaricide used e.g. pyrethroids, Formamidines/Amitraz, Organophosphates, Combination of organophosphate and synthetic pyrethroids, Ivermectin, Carbamates, etc. | Method of application<br>1=Spray<br>2=Plunge dip<br>3=Pour on<br>4= Injection<br>5=Dusting<br>-66=Others (Specify) | Frequency of acaricide application (weekly/monthly/etc.) | After acaricide application how long does it take to see ticks again on the animals? |
| **F. Herd Examination Assessment** | | | | | |
| 18. General animal and environmental examination | **Factors** | **Description** | | | |
| | **Provision of feed and water** | 18.1 What is the feeding system used on farm? 1= Intensive (Zero-grazing), 2= Extensive (Grazing) 3=Semi intensive (Both zero-grazing and grazing)<br>18.2. List the feeds/forage/ minerals/concentrates that are fed to the cattle? (last one week)<br>1=Napier 2=Silage 3=Hay 4= Maize stover 5=Sweet potato vines 6=Banana Stems 7=Natural grass 8=Planted grass=-66 Other (specify)_____18.3 Is this the usual feeding trend in the year? Yes/No<br>18.4 If no; how is the trend different?<br>18.3. List the type of concentrates and mineral salts that are fed to the cattle? (last one week)<br>1= Dairy meal, 2= Maize germ, 3=Maize bran, 4=Wheat bran, 5=Sunflower cake 6=Fish meal 7=Mineral block/lick, 8= Mineral salt -66=Other (specify)_____<br>18.4. Is this the usual feeding trend in the year? [ ] 1=Yes 2=No<br>18.5. If no; how is the trend different? …….<br><br>18.6. Amount fed in kg of each portion: Give Consideration of the past 1-week trend. (If grazing only skip to 5)<br>5. Observe status of feeding and drinking troughs (clean and ease of cleaning, size, accessibility, covered/open to the sky, safety, check on mold) _____ | | | |

| | | |
|---|---|---|
| | | 6. Observe the herd rumen fill- 1) Full 2) Not full–<br>(Time dependent)<br>7.Observe herd body condition score (BCS) and rank (Calves/Heifers/Bulls/Cows)<br>(See the body condition score chart)<br>8.Observe and score manure (See the **manure score chart) (this is influenced by feeding materials)**<br>1=Too watery-feeding on finely chopped feeds or more concentrates,<br>2= More formed- improvement in forage<br>3= Well-formed<br>4= Too hard- more hard forage<br>5= Harder than 4- poor quality forage- not well digested |
| | **Housing unit comfort**<br><br>Score according to the checklist (1-3)<br><br>1-Poor<br>2. Meets condition<br>3. Ideal situation<br>1. | • Stocking and comfort of housing/unit<br>• Provision of shade?<br>• Cleanliness of the housing unit<br>• Floor comfort<br>• Quality of bedding?<br>• Hygiene of the bedding?<br>• Hygiene of the floor?<br>• Cleanliness of the animal?<br>• (Herd cleanliness score)<br>• Ventilation<br>• Lighting<br>• Waste management<br>• Isolation units<br>• Calf pens- age separations<br>• Biosecurity measures in place- waste management, footbaths etc. |
| | **Animal's presentation- pain, injury, and disease** | • Do the animals show signs of physical injury or indicators of pain? ) [ ] 1= Yes; 0= No<br>• Are there sick animals in the herd? [ ] 1= Yes; 0= No<br>• What is the condition of the hooves? (1=Good condition, 2=Poor condition)<br>• What proportion of the animals in the herd are resting? _____ |
| | **Cow's comfort (freedom from fear and distress)**<br><br>Score according to the checklist (1-3) | • Interaction of the animals and their surroundings (people and other animals)<br>• Are animals aware of the presence of people? Awareness of the presence of other animals? |

| | | |
|---|---|---|
| | 1-Not bothered by the presence of people or animals<br>2. Friendly<br>3.Scared/agitated | |
| | **Freedom to have normal behaviour patterns** | • What is the number of animals per given area? (what is enough space)<br>• Is the enough space for the animal(s) to move around and "mate"?<br>• What proportion of animals are showing normal behaviour, i.e., resting and lying down?<br>• Are the animals ruminating? |
| 19. Coat appearance. | 19.1 What is the appearance of the hair coat? 1=Rough 2=Smooth<br>19.2 Are there external parasites on the skin of the animal? [ ] 1= Yes; 0= No | |
| 20. Udder and teats | **Check the functionality of the four quarters/teats**<br>20.1 Are there changes in the udder/teat? (e.g. swelling, pain, redness, etc.) [ ] 1= Yes; 0=No<br>20.2 If yes, check the consistency of the 4 quarters<br>1= Hard<br>2= Soft<br>3= Normal<br><br>20.3 If lactating, express milk from the 4 quarters<br>(Check for uniformity of colour of expressed milk, presence of flakes, blood, pus, watery, etc.) _____<br>20.4 Have you (enumerator) done a CMT test? [ ] 1= Yes; 0= No<br>20.5 If yes, record the result of CMT if conducted the test (note appearance of milk) _____<br>4. Type of milking (1=hand milking or 2=machine milking) _____ | |
| 21. Fertility-reproductive failures | **Repeat breeder**<br>Uniformity of cycle (Deviation of 18-24 days heat sign) -If there is deviation of this means there is a problem)<br>21.1 Do you have cows coming on heat in less than 18 days after the last heat signs? [ ] 1=Yes; 0=No<br><br>21.2. If yes, how many cows show this deviation | |
| | **Abortion**<br>21.3 Have there been abortion(s) reported in the farm [ ] 1=Yes; 0=No<br>21.4 If yes, when was the last abortion reported in the farm(mm/yyyy)<br>21.5 At what stage of pregnancy was the abortion reported?<br>1=1-3 months of pregnancy (Early abortions)<br>2=4-7 months of pregnancy (Mid-term abortion)<br>3=8-9 months of pregnancy (Late abortions/Stillbirths)<br>21.6 Cause of abortion if known _____<br>(If not known-set to understand the cause) | |
| 22. Disease Incidences | GIT- Diarrhea | |

| | | |
|---|---|---|
| | **From observation, is the faecal material normal? Yes/No**<br>**If No, what was observed?**<br>1=Too watery2= Mucoid3= Bloody4= Smelly5= Hard<br>6= Other, specify_____<br>3. Age sets affected. (Calves, heifers, adult) _____ | |
| | Respiratory conditions-<br>1. Is there any animal showing respiratory signs (nasal discharge/coughing/ laboured breathing)<br>2. Have they been treated?<br>3.Possible cause(s) from observation _____ | |
| | Lameness<br>1. Are there animals showing signs of lameness/abnormal gait? [ ] 1=Yes, 0=No<br>If yes, and from observation what is the cause of abnormal gait?<br>If injury, inspect the unit to identify causes of injury _____<br><br>2. Assess the hoof score (use the hoof score chart): _____<br>(1 is good, 3 needs a hoof trimming) | |
| | | |
| 24. Mortality | Has there been loss of animals through death in the last 12-months? [ ] 1=Yes; 0=No<br>If yes, how many (by animal type)<br>Calves (< 3 months) [__]<br>Heifers [____]<br>Cows [_____]<br>Bulls [____]<br>3. What was the cause of death? 1= Disease, 2=Accident/Injury, 3=Not known, 4= Other (specify)<br>4. How were the carcasses disposed? _____<br>If no deaths in last 12 months, when was the last reported death? [ ] mm/yyyy<br>If no deaths ever reported in the farm, make this part inapplicable | |
| 25. Records | | |
| | Animal identification | 25.1 How are animals identified on farm<br>0= No identification used, 1=Names; 2=Tags; 3=Notching; -66=Other (specify)_____ |
| | Production Records | 25.2a Are there production records in the farm? [ ] 1=Yes, 0=No<br>25.2b If yes, which ones?<br>1=Weight records<br>2=Growth rate of calves<br>3 = Milk records (amount milk, sold, given to calves etc)<br>-66= Other (specify)_____ |
| | Reproduction records | Are there breeding records in the farm? [ ] 1=Yes, 0=No<br>If yes, which ones? |

| | | |
|---|---|---|
| | | 1=Insemination method (AI/Bull)<br>2=Date of Insemination<br>3=Date of calving<br>-66=Other (specify)_____ |
| | Health records | 25.3a Are there records for disease and treatment of animals? [ ] 1=Yes, 0=No<br>25.3b If yes, which ones?<br>1= Animal type affected by disease<br>2= Diseases, treatment administered, service provider etc.)<br>-66= Other (specify)_____ |
| | Vaccination records | 25.4. Are there records for animal vaccination? [ ] 1=Yes, 0=No |

Key findings from the herd assessment:

## 10.2. Annex 2. Health plan and actions

Name of the Farm: **[_____]**
Plan determined in agreement between (write the names):
**Name of service provider**: [_____]
**Name of farmer: [_____]**

What are the agreed focus areas, based on the herd assessment?
Focus area 1:
Focus area 2:

Herd Health Time plan

| FOCUS AREA 1 | Aim | Action | Goal Date | Inputs required | Who is responsible | Comment |
|---|---|---|---|---|---|---|
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| FOCUS AREA 2 | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| **Follow up** | | | | | | |
| Follow up | Observable changes Intended | Observable changes Not intended (Positive/Negative) | Progress towards achieving intended goal | Input used- list (Quantity used/ Unit Price/ Total Cost) | General Herd Observation | What needs to be done to achieve the goal |
| 1 | | | | | | |
| 2 | | | | | | |
| 3 | | | | | | |

Important conditions or causalities for success: Economic potential of set goals:
Date and signatures:

**Annexes**

These annexes arose during the co-creation workshop with the National and County Veterinary directorate team.

**Economic/Business model**

1. There are several economic factors used to address herd health programmes as motivation factors for farmers (Annex 2).
2. The advisory tool to be developed under SAPLING (Analysis of Animal Health Economics (AAHE) will be based on the simulation model for individual animals in a dairy herd in weekly time-steps.
3. The model will mimic the production-related and economic effects of management changes in a herd based on the individual herd's own data.

Annex 1: Sustainability of the HHMP

The willingness of the farmers to demand and pay for the services will determine the sustainability of HH package at the end of the project. Assess if the farmer would demand for the HH services and how much the farmer would be willing to pay for the service.

1. Are Herd health services beneficial to your farm? _____
2. Would you reach out to a health service provider for HH health services? _____

If not, why? _____
If yes, when would you consider reaching out to the service provider for the HH service?
Only when the animals are sick [_____]
Only when milk production drops [_____]
Regularly/ Routinely [_____] monthly, quarterly, bi-annually, annually
Other, specify [_____]
3. How much would you be willing to pay for the herd health service? Kshs. [_____]

## 10.3. Annex 3: Important economic factors in herd health program

| Management area | Parameter change in the scenario (suggested improvements) |
|---|---|
| 1. Incidence of clinical mastitis | Risk reduced by 50% |
| 2. Somatic cell count | Reduced by 50,000 |
| 3. Incidence of lameness causing diseases that are hoof related | Risk reduced by 50% |
| 4. Incidence of lameness causing diseases with an infection's origin | Risk reduced by 50% |
| 5. Incidence of metabolic diseases | Risk reduced by 50% |
| 6. Incidence of reproductive disorders | Risk reduced by 50% |
| 7. Cows' heat detection | Increase by 10% point |
| 8. Cows' conception rate | Increase by 10% point |
| 9. Voluntary waiting period for breeding all cows | Reduced by 21 days |
| 10. Voluntary waiting period for primiparous cows | Increased by 42 days |
| 11. Energy balance | Risk of clinical ketosis reduced by 50%, risk of sub-clinical ketosis reduced by 100% |
| 12. Calf health | Risk of mortality after a livebirth reduced by 50%, improved growth rate, higher yield in first lactation |
| 13. Longevity | Milder cases of lameness and milk fever representing a lower treatment threshold, resulting in fewer culling and a less severe milk loss |
| 14. Stillbirth | Risk for stillbirth and associated problems in the start of lactation reduced by 50% |
| 15. Improved cow comfort | Milk production increased by 0.5 kg per cow per day |

Annex 3 provides a summary of the herd health innovations co-created during a stakeholder's workshop. The proposed components were packaged into a herd health plan which will be bundled and implemented together with the breeding, feed and forage innovations.

## 10.4. Annex 4: Herd health package plan co-created with stakeholders

| Basic components of the herd health package | Feasibility (cost, labour, etc.): High-Medium-Low | Key value proposition/benefit to actors | | | Likelihood of sustainability after the project: High-Medium-Low | Potential challenges to adoption: High-Medium-Low | Likelihood to overcome the challenges High-Medium-Low | Impact on animal welfare High-Medium-Low |
|---|---|---|---|---|---|---|---|---|
| | | What? | To whom? | Potential: High-Medium - Low | | | | |
| 1. Advisory Service (extension services /consultancy services) | Medium | Increased milk<br>Increased revenues | Farmer/Consumer nutrition /Agro-dealers/Service provider | High | High | Medium | High | High |
| 2. Breeding and reproduction | High | Improved genetics<br>Increased Productivity<br>Reduced per unit GHG emission | Farmer/Agro-dealers/Service provider | High | High | Medium | High | High |
| 3. Bio Security (preventive service) | Medium | Reduced disease incidence<br>Reduced cost of veterinary service | Farmer/Environment/Agro-dealers | High | Medium | High | Low | High |
| 4. Routine practices (dehorning, deworming) | High | Improved animal welfare<br>Improved production/revenue | Farmer/Agro-dealer/Service provider | High | High | Low | High | High |
| 5. Disease control | High | Improved production/revenue<br>Improved animal welfare | Farmer/Agro - dealer/Service provider | High | High | Low | High | High |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 6. Calf/heifer management | High | Improved replacement stock | Farmer/Service provider | High | High | Medium | High | High |
| 7. Reliable Digital APP platform (Review and Contextualize to Desired Audience of the AADGG App) | High | A robust database - unique Animal Identifier – Ability of the platform to cross talk | Farmers/Service Providers/Cooperatives/ GoK /Financiers (Banks)/Insurance providers | High | High | Medium | Medium | High |
| 8. Sensitization, Recruitment & Registration (of Farmers) | Medium | Access to Market, Information and Data that will inform decisions | Farmers/Service Providers/Cooperatives/ GoK /Financiers (Banks)/Insurance providers | High | High | Medium | Medium | High |
| 9. Sensitization, Recruitment & Registration (of Data Collectors) | Medium | A robust database (accurate/validated) | Farmers/Service Providers/Cooperatives/ GoK /Financiers (Banks)/Insurance providers | High | High | Medium | Medium | High |
| 10. Sensitization, Recruitment & Registration (of Service providers) | Medium | A robust database (accurate/validated) | Farmers/Service Providers/Cooperatives/ GoK /Financiers (Banks)/Insurance providers | High | High | High | Medium | High |
| 11. Registration of Animals (Herd Composition & Body Condition Scoring) | Medium | A robust database (accurate/validated) | Farmers/Service Providers/Cooperatives/ GoK /Financiers (Banks)/Insurance providers | High | High | High | Medium | High |
| 12. Structured Farm Visit to Record Events (to generate frequency of visits/generate visit calendar) | Medium | A robust dataset (accurate/validated) | Farmers/Service Providers/Cooperatives/ GoK /Financiers (Banks)/Insurance providers | Medium | Medium | Medium | Medium | High |
| 13. Structured Farm Visit to Review Status Report (Known and Others) | Medium | A robust database. Matrices that farmers will visually appreciate | Farmers/Service Providers/Cooperatives/ GoK /Financiers (Banks)/Insurance providers | Medium | Medium | Medium | Medium | High |

## 10.5. Annex 5: Exhibit A

# EXHIBIT A

1. **Scope of Services (Section 1)**.

The University of Florida is the Management Entity for the Feed the Future Innovation Lab for Livestock Systems. Innovation Labs are USAID-funded long-term, multi-disciplinary, applied research and capacity-building projects that conduct research for development to address poverty and malnutrition in Feed the Future countries. The Livestock Systems Innovation Lab program works globally: East Africa (Ethiopia, Rwanda), West Africa (Burkina Faso and Niger), Asia (Nepal), and Haiti.

The VENDOR will work with the Management Entity of the Feed the Future Innovation Lab for Livestock Systems at the University of Florida, as part of the Scaling Co-Investment initiative.

As part of the "Scaling the Rice Straw Plus model in Nepal", the VENDOR will:

1. Upgrade its production capacity for the production of Rice Straw Plus
2. Build capacity of cooperative's board members in governance, financial management and business development to support RSP business
3. Production of different composition of RSP for the selection of best composition
4. Participate in local and national agricultural/livestock shows to promote the product

The detailed scope of work for this contract of services can be accessed here:
NEP_Scaling project description_RSP_2024_10_18.docx

**Communication:**
The VENDOR will maintain regular communications with and report to the LSIL Project Manager, Andrea Bohn (livestock-lab@ufl.edu) as representative of / point of contact for the Management Entity.

2. **Term (Section 2)**.
The term of this Contract shall begin on **October 25, 2024** and terminate on **September 15, 2025**. The term of this Contract may be extended by University for additional days. If the University desires to exercise this extension right, it shall so notify Vendor in writing.

3. **Compensation and Payment Schedule (Section 3)**.

| | Milestone Description | Verification of milestone | Anticipated in | Value |
|---|---|---|---|---|
| Milestone 1 | Agreement signed and returned to the University of Florida | Signed agreement | October 2024 | $43,396 |
| Milestone 2 | Tractor Operated Straw Baler Machine delivered and operational | Proof of delivery of the baler | December 2024 | $7,750 |
| Milestone 3 | Capacity development program completed | Report on training activities including location and list of participants for all training courses conducted. | February 2025 | $9,750 |
| Milestone 4 | Promotional / awareness creation events conducted | Report on activities including a list of places visited and pictures of events. | May 2025 | $6,250 |
| Milestone 5 | Completion of all activities | Final approved project report | August/ September 2025 | $3,000 |
| **Total** | | | | **$70,146** |

The total contract amounts to USD 70,146

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We would like to thank all funders who support this research through their contributions to the CGIAR Trust Fund: www.cgiar.org/funders.

To learn more about this Initiative, please visit this webpage.

To learn more about this and other Initiatives in the CGIAR Research Portfolio, please visit www.cgiar.org/cgiar-portfolio



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Sustainable Animal Productivity