Livestock Production

FARMER EXTENSION GUIDE

to improve cattle, sheep, goat and poultry practices for smallholder farmers in South Sudan

SECOND EDITION

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Foreword

I present to you the first revision of the livestock husbandry guide first published by the Ministry of Livestock and Fisheries. In 2016 we produced the first harmonised guide for livestock husbandry for the use of extension workers and farmers in South Sudan. The guide provides information on cattle, sheep, goats, and poultry husbandry practices. Since the launch of the guides as part of the activities marking the 2016 Agriculture Extension Day event, many of our extension staff and smallholder farmers across the country have been trained using this guide as a resource. However, following the feedback we received, the Ministry along with our development partners has revised the content and layout of the guide to improve its readability and align with recent scientific findings.

I am very pleased with the level of information in this second edition of the guide, and it is my hope that this will motivate other activities, documentation and research in livestock sector. It is also my hope that the information presented here will be used to improve both livestock production and productivity. As we have seen, this resource will continue to support the implementation of the National Agriculture and Livestock Extension Policy (NALEP) and the Comprehensive Agriculture Master Plan (CAMP) of the Ministry of Agriculture and Food Security and the Ministry of Livestock and Fisheries.

I want to use this opportunity to thank the European Union for providing most of the resources for this publication. Thank you also to the staff of my Ministry for their contribution to the guide and to our development partners. We appreciate your continued support and strong collaboration in our effort to ensure food security in South Sudan.

Hon. Onyoti Adigo Nyikwec
Minister
Ministry of Livestock and Fisheries
The Republic of South Sudan

Preface

This manual is for the use of extension workers as a resource material from which simplified content can be developed and adapted.

The manual originated in 2014 when practitioners in livestock production and extension observed that there were a variety of training materials used by extension workers from the ministries and NGOs at the state and national levels. Many were materials brought back from neighbouring countries where South Sudanese once lived during the struggle leading to the country's independence. Practitioners observed that unverified information and unfamiliar examples from other countries could mislead farmers in South Sudan, hence the need to harmonise the materials.

The first edition of the livestock husbandry guide for farmers and extension workers in South Sudan was published in 2016 and has since been widely used across the country. This second edition of the manual builds on the initial publication with additional technical information provided, more illustrations and improved layout for ease of use.

As with the previous manual, the process of revising this guide was participatory and built upon consensus. The process involved bringing together practitioners from the Ministry of Livestock and Fisheries, Ministries of Agriculture and Food Security, non-governmental organizations, ICRC, UN agencies (FAO and UNIDO), academia (University of Juba, University of Upper Nile and Catholic University) and private sector practitioners represented by the South Sudan Forum for Agricultural Advisory Services (SoSFAAS). An expanded Agriculture and Livestock Technical Working Group of the Food Security Cluster, which includes specialists from NGOs, the Ministry of Agriculture and Food Security and the Ministry of Livestock and Fisheries, played a pivotal role in validating the information presented in this guide.

Measurements used

1 hectare	=	2.47105 acres
1 feddan	=	0.42 hectares which is equivalent to 1 038 acres
1 malwa	=	3.5 kg
1 mug	=	0.5 kg
1 whawal	=	50 kg
1 kg	=	1000 g
1 matchbox	=	35 g
1 tablespoon	=	26 g
1 teaspoon	=	9 g

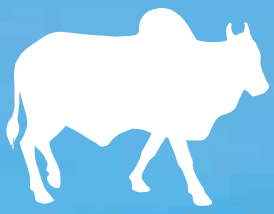
Cattle

Kingdom: Animalia
Phylum: Chordata
Class: Mammalia
Order: Artiodactyla
Family:Bovidae
Subfamily: Bovinae
Genus: *Bos*
Species: *B. taurus*

estimated
11.7 million cattle

Dominant Breeds

Ankole
Sanga cattle is the collective name for indigenous cattle of sub-Saharan Africa. They are sometimes identified as a subspecies with the scientific name Bos taurus africanus.



Zebu
one of a domesticated form of cattle, Bos taurus indicus, of India, having a large hump over the shoulders and a large dewlap.

Introduction

South Sudan is a livestock-rearing country. It is estimated that there are about 11.7 million heads of cattle nationally (FAO report of 2009). Livestock keeping prevails in all states of the country with variations based on climate, topography and socio-economic factors.

Livestock are a very important source of livelihoods. They are an important asset to households and to the cultures of most tribes. They could also make an important contribution to the country's gross domestic product (GDP). Daily consumption of red meat is very popular across South Sudan, and it is estimated that cattle supply about 65% of the red meat consumed. In 2013, it was estimated that the average consumption of cattle meat (beef) per person in South Sudan is 8.52kg, sheep meat (mutton) is 1.13kg and goat meat is 1.1kg per person. In the same year, red meat which is a combination of meat from cattle, sheep and goat consumption per capita was 10.75kg per person while milk consumption averaged 51.72 litres per person (IGAD, 2015).

Many households rear cattle as an important source of income, food (both beef and milk), social security, social status, manure production (for soil fertility), draught power for tillage and transportation. Horns can be used to make glue, and bones are used to make animal feed and buttons. Cattle dung is also a good source of biogas.

Environmental, social and gender-related factors in rearing cattle in South Sudan

Environmental factors: Cattle contribute to the build-up of organic matter and soil fertility, which can improve vegetation and help cultivated crops thrive. However, cattle rearing also causes overgrazing, putting pressure on land that may lead to degradation. Uncontrolled cattle herding can cause damage to crops and pollute common water points, especially during migration. This can lead to conflict. In addition, cattle that are kept together in small spaces for long periods can also cause damage to vegetation.

Social factors: Most cultural practices (including weddings, religious festivities and use of cattle as a financial safety net) are densely intertwined with rearing cattle. Cattle play a predominant part in the social and ritual life of the people, and are essential to the continuation of the present social system as the currency of the "bride wealth". There is also the practice of castrating exceptionally well-grown young bulls between 1 and 3 years of age so that they may become the pet "song bulls" of the young warriors. Unfortunately, cattle raiding and cattle rustling have become part of the practice that fuels conflict.

Gender-related factors: Most cattle are owned by men, to the exclusion of women who actually play a very important role in livestock management including duties such as milking, disease identification, collection of manure and milk marketing. Other duties of women also include cleaning of the kraal and lighting a fire to warm livestock during cold seasons or when animals are sick.

Internal organs of cattle

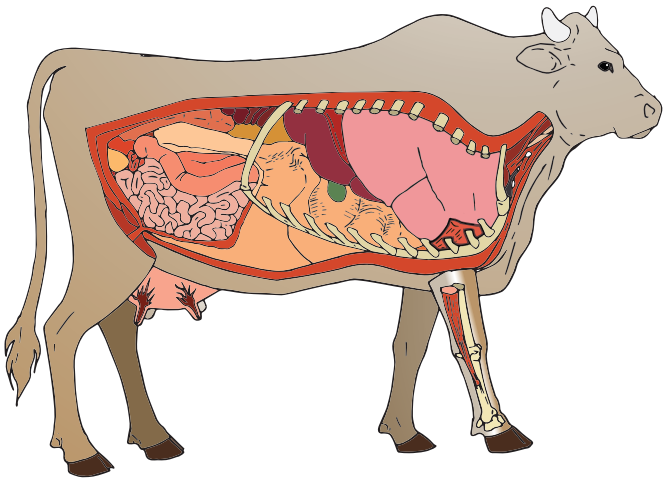


Figure 1: Section Showing internal organs of cattle

Common cattle breeds in South Sudan and their characteristics

A livestock breed is defined as an established group of animals or birds having similar general body shape, colour, structure and characters which produced offspring with the same characters. They are classified depending on their origin as indigenous or exotic.

There are numerous breeds of cattle around the world. Cattle are generally bred for beef, dairy or a combination (hybrid). All modern domestic cattle are believed to belong to the species *Bos taurus* (mainly shorthorned) or *Bos indicus* (zebu breeds originally from India) or to be crosses of these two. There has been an appreciative effort to crossbreed these species. The mixed breed has the ability to increase milk production or beef.

The types of cattle breeds kept by herders in South Sudan

The livestock breeds of South Sudan are generally classified as non-descript (no specific breed maintained) with unique adaptive and production characteristics. Livestock breeds are specifically named on the basis of their ethnic groups, habitat or location to which they have adapted well. The four most common breeds of South Sudan are sanga (usually humped and a cross between Bos taurus and Bos indicus), large East African zebu, small East African zebu and the small South Sudan hill zebu. These breeds are popular among different tribes in South Sudan.

The table below describes the breed, their ecotype (tribal affinity), major characteristics and their common names.

Table 1: Livestock Breeds, their Ecotype and Characteristics

Breed	Ecotype	Major Characteristics	Common name
Sanga	Dinka Nuer Shulluk Anuak Mundari	Crosses of *Bos indicus* and *Bos taurus* Cervico-thoracic humped Long horn, varied colours, large size Adapted to harsh environments Low productivity (milk and meat) Dual purpose	Nilotic
Large East Africa Zebu	Murle Toposa	Fatty thoracic hump Large dewlap, medium horn Adapted to poor environments with little water Good walking ability High longevity	Zebu cattle
Small East African zebu Small South Sudan hill zebu	Mangalla Kuku/Lugware Latuka Bari	Thoracic hump Short dewlap, short horn zebu Short, small size and well-fleshed Tolerant to tse tse fly, adapted to browsing during dry periods	Hilly zebu

There are also improved cattle breeds crossed with well-known breeds such as Holstein-Friesian (CAMP 2015 report) or to improve milk production capacity. The Holstein-Friesian breed is originally from Netherlands and is now in North and South America, Australia and South Africa. It is thought to have originated in the northern area of Kenya, on the Somali border but the genetic makeup consist of 64% Bos indicus, 24% European Bos taurus and 12% African Bos taurus.

Improved Cattle Breeds

Boran cattle breed for meat

Holstein-Friesian breed for milk

Crossed breed between Improved and indigenous

Figure 2: Pictures showing improved cattle breeds

External parts of cattle

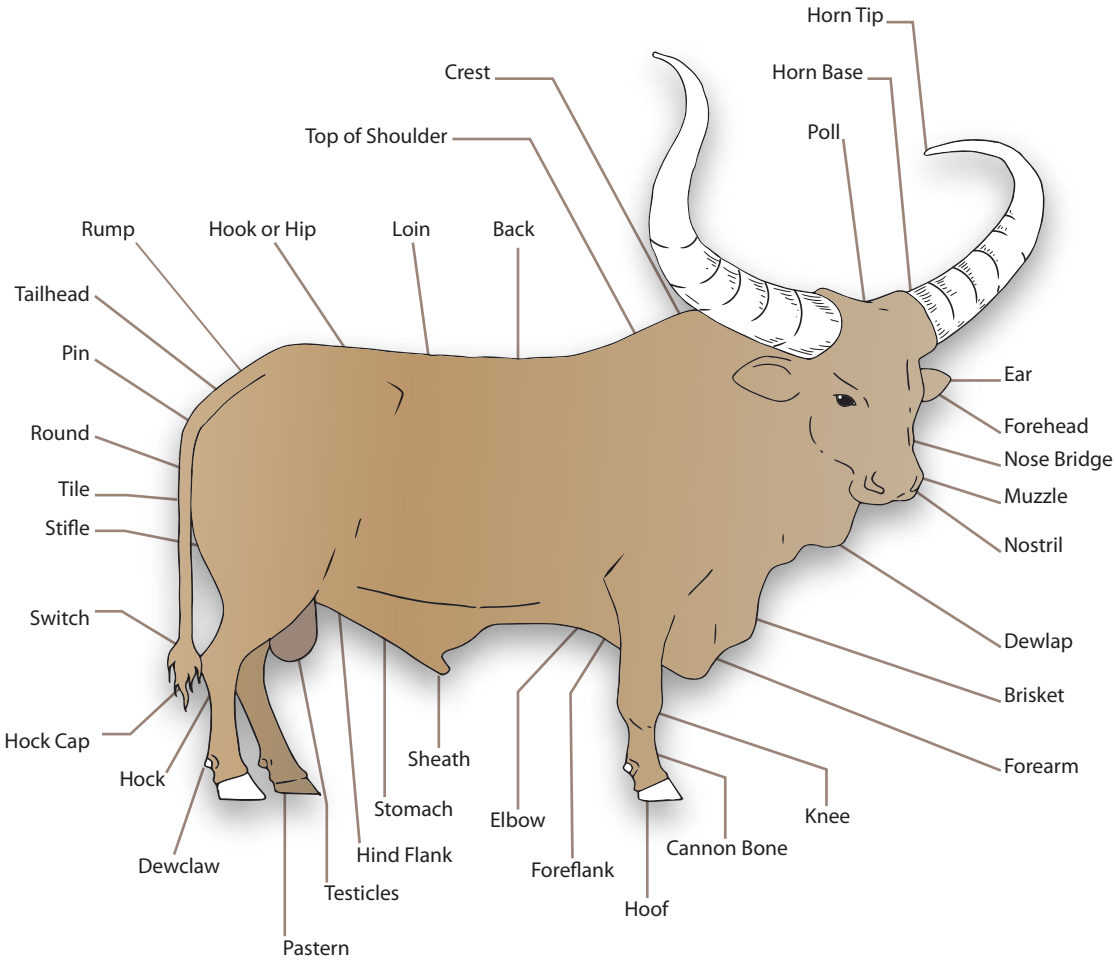


Figure 3: External parts of cattle

How to determine the age of cattle through their horns

In horned breeds of cattle a rough estimate of age can usually be made by counting the number of rings around the bases of the horns. The first ring appears at about 2 years, and thereafter one ring is added annually.

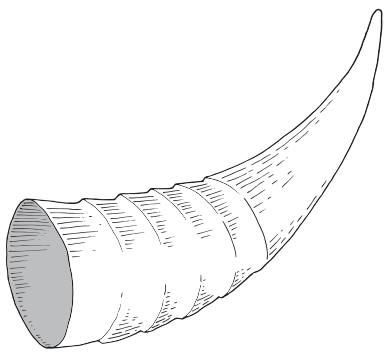


Figure 4: Horn method

How to determine the age of cattle through their teeth set (dentition)

Figure 4: Teeth of cattle

Table 2: Age and dentition of cattle

Age of cattle	Description	
At birth:	Calves are usually found to have their 8 incisors and 3 pre molars of the temporary dentition easily palpable below the gums.	
At 1 month:	8 temporary incisors have their crowns free from the gums and the teeth are quite prominent and well defined. The three temporary molars are well up and wearing.	
At 6 months:	The teeth are well placed in the jaw and are no longer overlapping.	
At 1 year:	The most marked change between this time and 6 months of age is the wear of the temporary incisors.	
At 2 years:	The first pair of permanent central incisors replace the corresponding temporaries and the first and second molars push out the temporaries and cut through the gums.	
At 2 1/2 - 3 years:	The second pair of permanent medial incisors replace the corresponding temporaries.	
At 3 - 3 1/2 years:	The third pair of permanent lateral incisors replace the corresponding temporaries.	
At 4 years:	The last pair of permanent corner incisors replace the corresponding temporaries.	
At 4-5 years:	The teeth are slightly worn along their cutting edges, and they occupy a less crowded position.	
At about 6 years:	The surface of wear has reached practically half-way across the upper surface of the teeth, and a portion of the root is exposed.	
At 10 years:	The greater parts of the crowns have worn from the teeth and only a little cup-shaped piece of enamel remains.	
At about 12 to 14 years:	Only the stumps of the teeth remain.	

Selection criteria for dairy, beef and for breeding cows

There are many factors to consider and characteristics to look for depending on the purpose for which a farmer rears cattle. The following characteristics should be considered when selecting cattle for dairy, breeding and meat.
Dairy cattle should:

- Have well-developed hindquarters;
- Have a wedge shape;
- Have a well-developed udder, which should be well-attached to the abdomen with a good network of blood vessels;
- Have evenly placed teats;
- Be of good temperament, docile and easy to handle;
- Have a deep, long body with wide, well-sprung ribs;
- Have a long lactation period;
- Be free of disease.

Selection of cattle for meat production

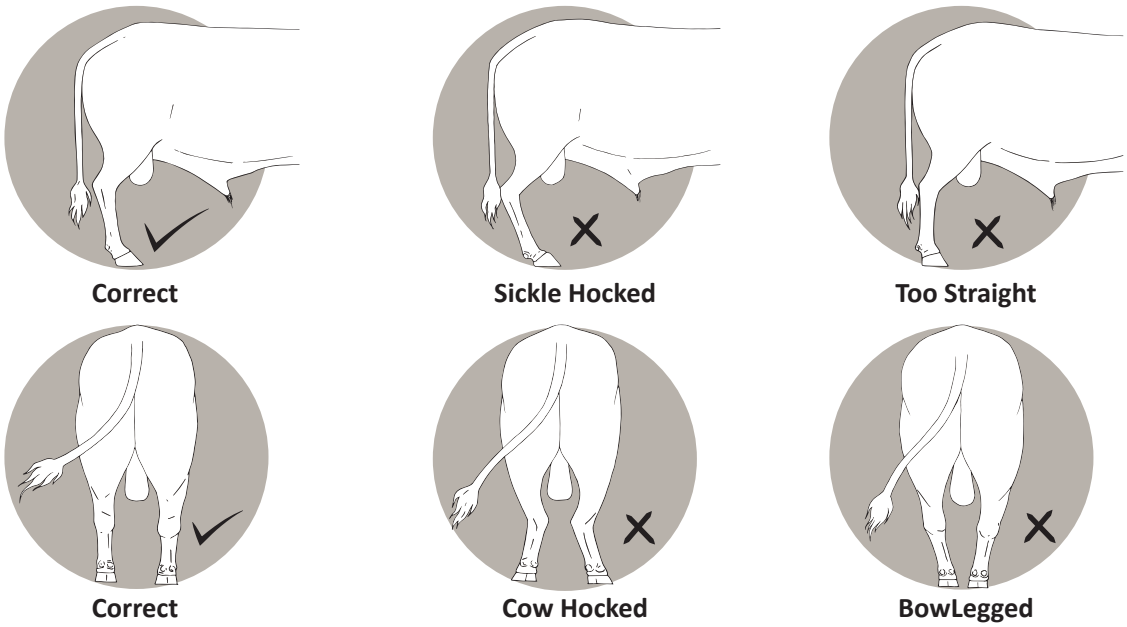


Figure 5: Selection of cattle for meat

Both in South Sudan and across the sub-region, one of the primary reasons for keeping cattle is that of meat production. While the slaughtering of cattle for household consumption is not a common practice in South Sudan, cattle meat is very well accepted by all religions, customs and cultures.

A good meat-producing bull should:

Be from a good dam and sire;
Have dangling testicles;
Be unrelated to cows in the herd to avoid in-breeding;
Have good conformation for beef production (blocked shape).
Please note that the selection of bulls should be based on the objective of the farmer. If the aim of selection is beef production, the bulls selected should be from a relevant ancestral line. If the aim is milk production, the farmer should select bulls from a milk-producing line.

Cattle Production systems
Broadly, there are two types of livestock production systems: extensive and intensive. A semi-intensive system represents a stage and level that are between the two, often determined by the geographical condition of the area or by the capacity of the farmer to afford the equipment for intensive production. This is very visible in the type and nature of housing provided for livestock. They are extensive, semi intensive and intensive systems.

Management of Cattle

Housing

In South Sudan most cattle are kept in cattle camps under an extensive system and the intensive and semi-intensive systems of rearing cattle are not currently common. This is seen as a drawback by dairy enterprises. In the extensive system of cattle rearing, cattle are commonly kept by each family in a large hut known as a luak (often the biggest in a compound).
It is equally common to keep the animals in camps (often called “cattle camps”) in which they are tethered by a rope around their necks to a peg. It is not unusual to combine herds belonging to various owners into one larger group where a set of youths secure them. Under this system, food and water are provided regularly and since many small herds are kept together, it is easier for veterinary extension officers to provide advice and treat animals as requested. However, no buildings are constructed to protect the cattle from the sun or rain.
After a while, the camp, which will have become littered with heavy layers of dung, is rotated to enable the owner of the land to cultivate crops on it. For the well-to-do who also own a herd, the rotation of fields used as cattle camps for a few weeks at a time allows for the build-up of manure. This is one of the benefits of collaboration. It is also common to keep a number of dogs in the camp to scare away wild animals and thieves.

Factors to consider when constructing shelter for cattle under the extensive, intensive and semi-intensive systems are as follows:

Extensive or traditional system:

Under the extensive system, the producers are generally scattered among rural communities at some considerable distance from the urban centres. The cows are not selected for high milk production or any of the other characters desirable in a good dairy animal. Milking is not carried out at regular intervals and very often there is no record for milk produced by each cow. There are no cultivated pastures on which to feed the animals. The animals rely on grazing on open range grounds with the change of seasons. In most cases, this development results in a very low level of production. The milk produced is not usually processed and the system requires thousands of milking cows to satisfy the requirement of the market.

Intensive system:

This system involves the use of dairy animals specialized for milk production. This involves the investment of considerable capital. The size of the dairy herd could vary from 50-100 cows for small scale operations and up to 500-1000 cows for a medium size operation. The milk is regularly tested for quality and Artificial Insemination is used to improve the milk producing ability of the animal. The animals are fed regularly on cultivated pastures, usually green soiled or zero-grazed. They are also supplemented with concentrates usually rationed according to production. The animals are housed and milking is usually done in a dairy parlour under hygienic conditions. There is a considerable degree of mechanization in most of the operations. The animals are subjected to regular veterinary inspection to prevent and cure diseases. Under this system of production, the farmer is concerned with making as much profit as possible.

Specialised dairy breeds include Friesian, brown Swiss, Jersey, Ayrshire and guernsey (all of temperate origin). Friesian, brown Swiss and Jersey were imported to Nigeria for crossbreeding with indigenous cattle in order to raise the level of production.

- Should be built on well-drained ground and easy to clean;
- Should face the direction of the wind;
- Should be located near a water point;
- Should have a concrete surface;
- Should use locally available materials;
- Should include access to pasture;
- Should offer protection from thieves and raiders.

Semi-intensive system:

The semi-intensive system is a compromise between intensive and extensive systems. Under this system, cattle are allowed to graze for some time during the day and in the evening they feed on supplements like Napier grass, hay or silage.

- Should be built on well-drained ground;
- Should be located near a water point;
- Should include access to pasture;
- Should offer protection from thieves and raiders.

DAIRY PRODUCTION SYSTEMS

A cow's productivity could be gauged as high or low depending on the following: high reproductive wastage, low calving rate and low milk yield per lactation.

The generation interval of the cow is 4 years. Conception rate is low and lactation period is 6 months. The cow dries up when she losses her calf, usually at 3 months. However, when this happen, the pastoralists in South Sudan are often reluctant to cull sick animals except when he needs money. In that case, he sells off the sick and the old ones in the herd. Milk production is higher in the rains than in the dry season.

Milking is done twice daily. In the rains, the average yield of a cow per day is 1.5 litres (3 star beer bottles) while in the dry season, the yield is reduced by half. Thus, the average yield per cow per day under pastoralist management is 1 litre while the same breed can produce 4 litres under improved management.

A good milk-producing cow should:

- Have well-developed hindquarters;
- Have a wedged conformation;
- Have a well-developed udder;
- Be docile and easy to handle;
- Have a deep, long body with wide, well-sprung ribs;
- Be from a known ancestral line.

Breeding and techniques of cattle improvement

Under natural conditions bulls and heifers would mate to produce offspring (calves). Since most cattle kept are of pure stock, reproduction occurs naturally within the herd. Selection is done through the observation of qualities exhibited by the cattle, based on the experience of herders. The choice of cattle to breed depends very much on whether the cattle are used for meat or for milk production.

Breeding is the production of offspring or young ones. Animal breeding involves the selective breeding of domestic animals with the intention to improve desirable and heritable qualities in the next generation. This could be for better performance in livestock, improved milk production, meat quality, wool production or egg production.

In livestock breeding heifers, cows and bulls play active roles.

Heifers

A heifer is a young female cow which has not yet calved. It is important to select heifers on the basis of the dam's milk production and the potential of the sires (bulls kept for breeding). The heifer should be properly grown and free of genetic abnormalities. Those that conceive before 24 months of age should be retained. If the aim is to use the heifer as dowry in the future, it is important to consider its colour (e.g. in Warrap State, black-and-white heifers are usually preferred).

Cows

A cow is a mature female of cattle that is kept on farms for its milk. The most important economic trait to look for in a cow is its milk production rate. The current average daily milk production of a cross-bred cow is around 1-7 litres in lowland areas of Kenya, but among the pure traditional breeds commonly kept by agro-pastoralists in South Sudan, farmers rarely get more than 2 litres per day.

Bull

A bull is a sexually mature male that has not been castrated. A young male calf is typically under 20 months of age.

Types of Breeding

There are two types of breeding: inbreeding and outbreeding, both of which are described below.

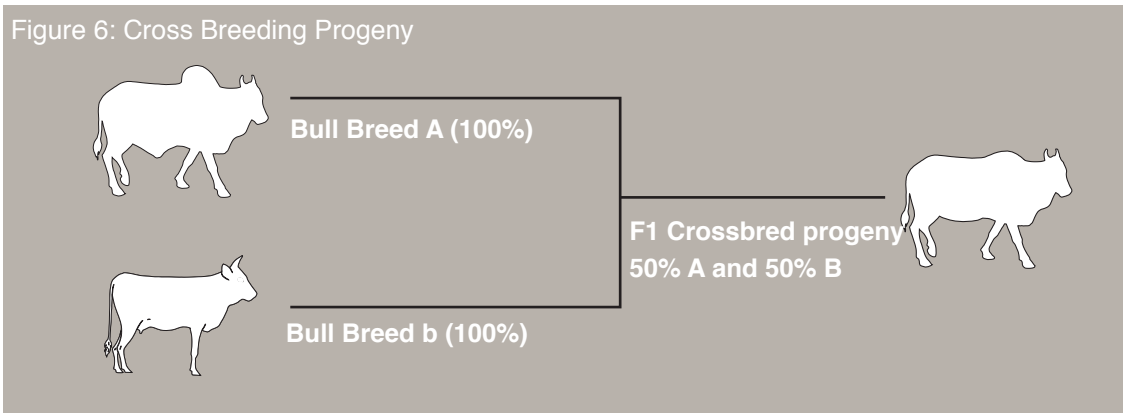
Inbreeding: This is the mating of closely related animals in the same breed such as brother-sister mating or parent and offspring mating (when the mates have common ancestors). Within four generations this results in inbreeding.

Advantage of inbreeding: A pure line of a particular breed can be maintained.
Disadvantage of inbreeding: Loss of vigour, size, production fertility problems.

Outbreeding: This is the breeding between the unrelated animals which may be between individuals of the same breed (but having no common ancestors for 4-6 generations) or between different breeds (crossbreeding) or different species (interspecific hybridization).

Crossbreeding: This is a form of outbreeding involving the mating of animals from two different established breeds. The cross bred animals will exhibit the mixture of qualities of both the parents' breeds. The progeny will improve in production performance and will exhibit marked disease resistance characteristics of the native breed and is well adapted to withstand local climatic conditions. The ideal combination is 62.5% of exotic blood and 37.5% local blood.

Figure 6: Cross Breeding Progeny



Grading: Grading is a form of out crossing, where bulls of a distinct breed are bred on non-descript cows from generation to generation, so that in the course of time a populations essentially resembling the breed from which the Bulls are used.

Non descript (ND) cow x Jersey Bull
F1 50% ND + 50% Jersey x Jersey Bull
F2 25% ND + 75% Jersey x Jersey Bull
F3 12.5% ND + 87.5% Jersey x Jersey Bull

After 5-6 generations the offspring will have 96.9% and 98.3% of the hereditary characters of the "pure breed". So grading is a process by which a few pure bred sires can rather quickly transform a local variety of animals into a group resembling the pure breed.

Heifers and breeding cows

Depending on the breed, the first service is usually between 15-24 months of age. Between 3-6 months of age all replacement heifers should be vaccinated against brucellosis or contagious abortion. Most heifers in the tropics are too small to be bred at 15-24 months and the size or the degree of body maturity is a better guide of fitness for bulling than actual age. Undersized heifers should not be mated until growth is up to average unless their ration is to be generously supplemented with concentrate. Even when supplementation occurs it should be recognized that heifers that have reached sexual but not physical maturity are less likely to withstand the stresses and strains of pregnancy and the subsequent lactation and maintenance of a reasonable level of milk production.

After the first conception, the heifer not only has to continue to grow but also to bear a viable calf and produce milk, so she needs to be well fed particularly during the pre-calving period. Very heavy feeding results in fat deposition and subsequent milk production is less than that of normally fed heifers. Underfed animals also produce less milk and cause calving difficulties, but they achieve rapid growth during the first lactation and catch up with normally fed animals during the 2nd and 3rd lactation. Underfeeding delays the onset of puberty but does not significantly affect conception rate.

Housing of heifers need not be elaborate and varies with climate. Protection should, however, be provided from rain and wind. Open sheds that allow 40-50 sq. ft. per heifer are considered adequate. The gestation period varies between 275 and 287 days with an average of 281 days. The heat period occurs on average at 21 day intervals with a normal variation between 16 and 26 days. If calving is at 12 months intervals, the cow should be bred between 75 and 110 days after calving and the cow should be milked for 10 months (305 days) and rested for 2 months. The dry period allows the mammary glands to rest and the cow to build up body reserves for the next lactation.

Heifers and cows in poor condition should be allowed longer dry periods when they are not be milked. The dry cow can be fed on pasture alone until just prior to the next lactation. After calving, the cow should be fed a little more concentrate than her milk production justifies during the first part of lactation. A lactation period is the period between parturition and final drying off or cessation of milking.

Signs of oestrus (heat) in cows

A cow is in oestrus (heat) when she shows signs that she is ready to be mated. During this period it is important that herders are observant since oestrum is short in cows (lasting only 16-24 hours). Cows are most likely to show they are in heat between 6pm and 12 midday. It is thus important that cows and bulls be left together overnight.
Usually, the main sign of oestrus is that the cow will stand and allow herself to be mounted by another animal (rather than moving away). Other signs include eating when other cows are resting, urinating more frequently and moving around more than other cattle. The vulva of the cow will turn reddish. Appetite may be reduced and milk production will drop significantly. Bloody mucus may leak from the vulva for 1-3 days after heat.

Figure 7: Optimum time for crossing

Proestrum: (2 days). This marks the animal coming into heat. The graffian follicle helps the nourishment of ovum fluid that contains the hormone called oestrogen. It causes changes in uterus and blood supply.

Oestrum: (1 day). This is the period of desire, during which the female is ready to receive a male. The vulva becomes swollen and the vulva and vagina are congested.
Metoestrum: (4 days) Implantation of the embryo takes place, and it prevents the growth of graffian follicle thereby arresting the oestrus cycle. This is the period when the organ returns to normal in a non-congested condition.

Diestrum: (14 days). Longest part of estrus cycle. Further development of uterus takes place. If the animal has not conceived involution of the uterus takes place.

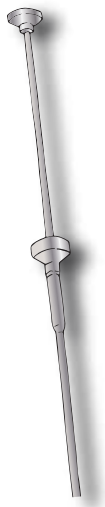
Symptoms of Heat:

1. Goes off feed. No appetite for feeding
2. Drop in milk yield
3. Restless and excited
4. Bellowing
5. Oedema/swelling of genitalia
6. Frequent urination
7. Transparent mucous discharge
8. Cow which is in heat will mount other animals and allows mounting by other animals.

ARTIFICIAL INSEMINATION

Artificial insemination is the deposition of male reproductive cells (sperm) in the female tract by mechanical means rather than natural service.

Advantages:
It increases the usefulness of superior sires to an extraordinary degree. Services of superior sires are greatly extended. If the sires are used for natural service the animal can serve only 50-60 animals/year but under artificial insemination the amount of semen secreted by the animal can be used to satisfy the requirements of 1000 animals per year. The dilution of semen has an average of 1000 million sperm/ml. The total volume of semen per 2 ejaculations is 6 ml resulting in 6000 million sperms.



Disadvantages
1. Some bulls' semen may not freeze well.
2. If inferior bull semen is frozen and used, extensive damage is caused.
3. Maintenance of a frozen semen bank is not economical for a small area of operation.
4. Requires well trained technical personnel and special equipment and hygienic measures are required in preparation.
5. Improper cleaning of instruments and unsanitary conditions may lead to lower fertility and may be the nucleus for the spreading of diseases.

Figure 8: Artificial Insermination gun

Management of dairy cattle

Sanitation and general cleanliness

Sanitation and general cleanliness are important to prevent digestive upsets and diarrhoea. The pens and stores as well as management equipment must be thoroughly cleaned. Disinfect pens after one calf is removed and before another calf enters. Calves should be housed in a warm environment to prevent pneumonia. Stalls 1.5 x 2 m with solid partitions between them are suitable to prevent calves from sucking each other after milk feeding and minimise spread of disease. Group housing saves labour, but provisions must be made for individual milk feeding and tying up of the calf for a short period after milking to prevent them from sucking one another. Diseases of one calf are easily spread to other calves.

Dehorning

Horns in animals can possibility inflict injuries of one another. The presence of horns also necessitates the provision of an extra shed and feeding space and makes the animal more difficult to handle. Disbudding is the process of removing horn bud in young calves before its attachment to the skull within 3-5 days after birth. On the other hand dehorning is the removal of horn after it has attached to the skull in older calves. It is therefore desirable that calves should be dehorned at 2-4 weeks old. Several methods are in use:

Use of chemicals, e.g. potassium hydroxide (KOH) or sodium hydroxide (NaOH)

They come in the form of sticks, pastes or liquids. The hair around the horn buds is clipped closely. A ring of heavy grease or petroleum jelly is smeared on surrounding skin to prevent skin burn and keeps the liquid caustic from running into the calf's eyes. If a stick is used, then slightly moisten one end of the stick with water and rub it firmly over the horn buds with a rotator motion until blood appears. The effect is to deaden the horn root. In a few days a scab appears over each horn bud which soon drops off leaving a smooth spot of skin devoid of hair. Calves treated should be protected from rain for a day following the application since the chemical may wash down and injure the side of the face and the eyes of the calf. It is also best not to turn calves back to their dam for a few hours after the application of the caustic.

Use of saws, shears and clippers

Saws of various forms, shears and clippers are used for dehorning. This is, however, less desirable method which applies only to older calves. Whatever the instrument used, it is necessary to remove the horn with 0.5 to 1.0 cm of the skin around its base to be certain that the horn forming cells are destroyed.

The electric dehorner or hot iron dehorner

This method consists of the application of a specially designed electrically heated hot iron to the horn buds of young calves. The cup-like end of the hot iron is firmly pressed on the horn bud for a few seconds to destroy horn forming cells. While the method is bloodless, it is much more painful than the use of chemicals. It can only be used for calves under 5 months of age.

The elastrator

This is an instrument used in stretching a specially made rubber over the horn well down into the hair line. This is aimed at cutting off the blood circulation to the bud. This system may be used on cattle with horns from 6-15 cm long. Small horns drop off in 3-6weeks. Large horns stay up to 2 months.

Treatment after dehorning

It is essential that a good fly repellent be applied to the wound to remove the danger of flies. The danger of infection is generally reduced if there is extreme care and cleanliness. Instruments should always be disinfected.

Castration of bull calves

Castration of bull calves makes the animal quieter and easier to handle. The bull is not prone to get excited due to decreased libido. Bull calves can be castrated from a few weeks to 8 months, but it is best done at 4 months old. The older the animal, the greater the shock and risks of castration will be.

Branding and marking

It is highly desirable that all animals in the herd bear some mark or tag whereby each can be positively identified. This is necessary for the establishment of pedigree or ancestry as in case of a purebred herd. The method of marking employed will depend primarily on the objective. When the objective is to establish ownership, branding with a hot iron is probably the best method. Although much has been said against branding because of the pain inflicted and the damage it causes to the hide, the hot iron is still the common method. In advanced countries, before cattle can be legally branded, the brand being used must be properly registered with the Livestock Identification Office to avoid duplication, especially at state boundaries. Other methods include ear marking, ear tags, neck chains or straps and tattoo.

Cattle feeds and feeding

Cattle are ruminants who feed mainly on roughage (grasses and legumes). Cattle feed should be sufficient in both quantity and quality. It should contain a good mixture of carbohydrates, proteins, vitamins, minerals and roughage. Cattle will naturally graze on green pasture, but they will also do very well on supplementary concentrate feeds. Dairy cattle require more concentrate than beef cattle.
The goal of a feeding program is to: meet the cow's nutritional needs while maintaining health; to optimize milk production, milk fat and milk protein; and for economic gain.

An example of a good ration which can be given to animals not on pasture is 3 parts of maize, 1 part sunflower seeds and 1 part unshelled groundnuts. The ration is fed at the rate of 2-3% of body weight each day.

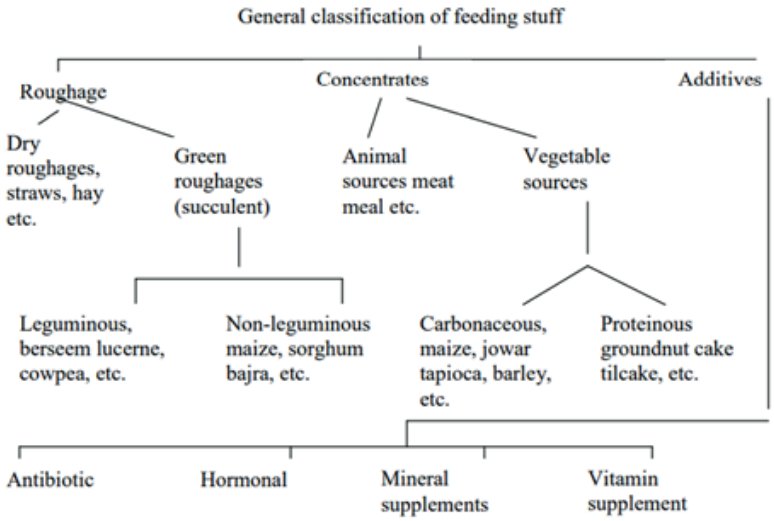


Figure 9: Classification of feeding stuff

The ruminant feed pyramid provides the basis for formulating rations.
High-quality forages and grains are the base of all diets and will support good milk production.
Added fats, rumen, un-degradable protein and other feed additives are needed by higher producing cows.
Feeding rations

A daily ration is the amount of feed an animal needs every day. A good ration will contain all of the nutrients. Carbohydrates, protein and fats are three very important nutrients in animal feed. It is the feed allowed for a given animal during a day of 24 Hours. All rations should contain at least 1 feed from each category: 1) forage, 2) grains, 3) protein supplements, 4) mineral and 5) salt.
Some nutrients are found in large amounts in some plants as listed in the table below:

Table 4: Nutrients and Plants

Nutrient	Plants
Carbohydrates	Maize, sorghum, wheat, oats, rice, grass
Protein	Lucerne (alfalfa), clover, beans, grass, nuts
Fats	Cotton seed, sunflower seeds, grass, groundnuts

Feed Stuff

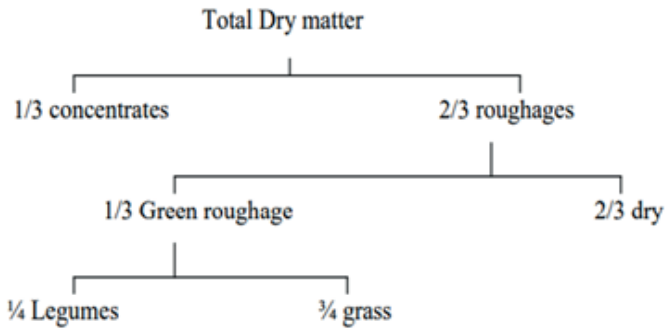


Figure 10: Sketch for feedstuff

Green growing grass contains all the nutrients required by cows, but in the dry season grass contains little protein and vitamins. It is necessary to give additional feeds at this time in order to prevent weight loss and to maintain high milk production, growth and reproduction. It may also become necessary to give minerals to the animal. Broad recommended ratios when feeding on green grass are as follows:
Dry cows (this is a stage of lactation cycle where milk production ceases while preparing for the next calving and lactation): 25-30 kg/day
Milking cows: 30 kg/day
Pregnant cows: 25-30 kg/day
This recommendation is only a guide. Your cattle may require more or less.

The commonly available animal feeds are:

Green forage: These include established natural pastures (toich), fodder crops (e.g. sorghum), legumes, vegetables (such as pumpkins and sweet potato) and moringa, which is becoming increasingly popular.
Farm by-products: These include crop residue and dry grasses. Others are moringa and vegetables such as okra, pumpkins and sweet potato.
Preserved animal feeds: These include hay (dry grass) and silage.
Agro-industrial by-products: These include brewers' waste and blood meal for increased protein and bone meal for minerals.

Mineral (or salt) licks that provide important minerals such as calcium and phosphorus. The most common method of feeding cattle in South Sudan is free-range grazing, with many of the cattle-owning communities being nomadic, transhumance or agro-pastoral. This method is relatively cheap where green grass is available, but it can create conflict between crop farmers and livestock keepers. It also places a lot of stress on the cattle, thereby reducing their milk production capacity. Milk production in cows can be improved through:
Use of cereal and legume crop residue as feed;
Feeding of hay and silage during the dry season;
Improving feeds with additives such as molasses and mineral licks;
Supplementary feeding with concentrates, minerals, etc.

Commonly used grasses and legumes on which cattle graze are:

Appach grasses (Panicum virgatum) in swampy areas
Sorghum Sudanese grass
Jaragua grass (Hyparrhenia species H.hirta, H.rufa, H.filipedula)
Legume plants such as Centrosema spp. and Calopogonium spp.

Balanced Ration

Balanced ration is that ration which provides essential nutrients to the animals in such proportion and amount that are required for the proper nourishment of the particular animal.

Desirable characteristics of a ration:
This is about feeding that satisfies all the physiological requirements. Avoid waste in preparation and feeding. Do not over feed as doing so is doubly wasteful.
Individual feeding that should only be adequate. Avoiding competition is always better.
Properly balance between concentrate and roughage including green fodder, both legumunious and non-leguminous.

Dry fodder

Palatable and varied to provide a better balance of protein, vitamins and other nutrients. Good and sound. Low quality, unwholesome ingredients may contain toxic components leading to poor quality and reduced feed value.
Mineral mixture should be included.
A laxative should be added, otherwise food will be incompletely digested causing constipation and digestive disorder utilisation. The absorbed nutrients will be decrease and production will be reduced.

Bulky enough in volume and ability to satisfy the animal.
Green fodder which is a source of vitamin A and is bulky, acts as a laxative, is economical and easily digestible.
Avoid sudden change in the diet.
Maintain regularity in feeding times which enable glandular secretion that is essential for digestion.
Properly prepared such that hard grains are coarsely ground, cottonseed is soaked, fodder is coarsely chopped and the feed is sprinkled salt and molasses. This will increase consumption.
Labour and cost should aim at having 70% of production costs attributed to feeding of animals.

Feeding dairy cattle

The major emphasis on the management of dairy cattle is the provision of good grazing pastures and minerals with calcium, phosphorus, salt lick and clean water during the wet and dry seasons. In the dry season, browsing plus additional dry grass, groundnut hay, cowpea hay, rice bran, guinea corn hay or stalks, various kinds of concentrates such as cottonseed, groundnut cake, guinea corn and millet should be provided. Disease prevention and vaccination should be carried out. A herd of 5-30 cows will need one bull for servicing. The non-producing females and castrated malea should be herded in a separate group and disposed of to save grass and feed for the producing animals. For feeding purposes, cattle should be divided into the following herds: 0-3 months, 4-6 months, young heifers/breeders, pregnant and lactating herds.

0-3 months calves

After calving, the calves are left with their dam to receive colostrum. The colostrum contains antibodies which protect calves from disease. However, if calves are removed at birth, they are transferred to calf pens. It is essential to bucket feed the calves with 2-3 litres of milk per day at the temperature of 37.5-38°C. If the dam dies at calving or for other reasons fails to produce colostrum, then an effort should be made to obtain either surplus colostrum from another dam or feed a colostrum substitute. A well-known recipe is to whip up a fresh raw egg in 1 litre of milk and add half boiled water and 1 teaspoon of castor oil. This will be sufficient for one feed and should be fed at body temperature 3 times a day for the first 3 days or ad libitum. Once the black, jelly-like foetal dung passes along the feaces, the castor oil can be omitted. The milk should be supplemented with a mixture of soyabean cake and maize. The calves should be confined in another pen and allowed to graze during the wet season.

4-6 months calves

These are calves that have been weaned. Shortly after weaning, calves are usually placed in a group of 8-10. At 4 months of age, the calves should be introduced to the concentrate feeds of the cows. When calves are 10 months old, grain can be discontinued if good quality roughage is fed. They should receive salt as well as Ca and P supplements. Rotational grazing should be adopted and heifers should not be grazed on any one paddock for more than 5 days at a time, to minimize disease infestation and destruction of vegetation.

Pregnant and lactating herd

During pregnancy, the cows will need to be monitored until they calve. They should be allowed to graze at least 6 hours during the wet season and 9-10 hours during the dry season. The cow will need to graze, rest and graze a second time. Water will need to be given during the resting period. Each cow will need 28g of combined minerals containing calcium and phosphorus and trace elements plus 28g of salt lick per day. Cows should be served by bulls so that calves can be born in the early wet season where there is adequate amount of grass at the time the cow is producing milk for the calf. If a cow or heifer is to be fit for heavy and sustained milk production, adequate nutrition (in quantity and quality) before calving is essential. This feeding will provide for the building up of the unborn calf and body reserves of the dam. The growth and development of the udder tissue is also dependent on the adequate pre-calving feeding. To meet the objectives, a feeding practice known as ‘’steaming up’’ is generally employed especially where high yield is the aim.

Steaming up

Steaming up cows to boost milk production. This is the practice of providing extra rations of carbohydrates, proteins and minerals to cows in the late stages of pregnancy in an attempt to promote maximum production of milk from the very beginning of lactation. Feeding usually begins about four weeks before the due date. It should begin 6-8 weeks before calving. The heifer should be given a steaming up ration meant to further supplement her normal ration. The amount of such ration to be fed is determined by the condition of the cow or heifer and her probable milk producing capacity. Attempt to steam up cows or heifers on roughages or succulent feed (good quality hay, silage or dried grass) are much less effective than the use of concentrate. This is because the animal does not have the appetite to consume enough of these feeds apart from the facts that the feeds themselves do not have the same body building power as concentrate. Steaming up also has the effect of stimulating the secretory activities of the udder.

Utensils in which whole milk or a milk replacer is fed to calves must be clean and should be cleaned after each feeding. Severe digestive upsets can result from such contamination of the feeding utensils. Either the nipple pail or the open type buckets are satisfactory for feeding milk or the milk replacer. It may take less effort to teach a calf to nurse from a nipple pail than to drink from an open pail. Also, rapid consumption of milk from an open pail may at times cause digestive upsets.

To teach a calf to drink from an open pail, place your fingers in its mouth and after it starts to nurse lower its head into a pail of warm milk or milk replacer. It may be necessary to repeat the process several times. A stubborn calf may need to be backed into a corner and restricted by standing astride its neck. Maintaining the temperature of the milk as removed from the cow is not necessary, but it should be the aim when possible. However, cold milk may cause calves to shiver and chill. At any rate, calves should not be overfed.

CARE AND MANAGEMENT OF HEIFERS

Identify pregnancy
Provide gentle treatment.
The first quarter of the gestation period is critical.
In early stages of pregnancy disturbances can cause abortion.
Provide concentrate feed at 3.5 kg per day.
Provide 25-35 kg of green fodder per day and 5 kg of paddy straws.
Minimum 45-60 days of dry period is essential.
Avoid long distance travel.
Avoid slippery conditions in the shed.
Avoid chasing by dogs, bulls or children.
Avoid infighting between pregnant animals.
Separate pregnant animals from recently aborted animals or carriers of diseases like brucellosis.
Provide adequate clean drinking water.
Protect against the extremes of climate.

The improvement of dairy cattle feeding systems should start with a reduction in the distance over which dairy cattle are walked. Stall feeding should be introduced by confining the cattle in feeding paddocks where grazing is controlled.

Local dairy animals should naturally adapt to feeding on natural pasture;
The pasture should be free of any larvae which may eventually cause an infestation of worms, such as liver fluke and a number of other internal parasites;

Feeding troughs must be cleaned on a regular basis;
Supplementary feeding is recommended in the form of concentrates;
Mineral licks should be provided.

Other methods of improvement are:
Rotational grazing where cows are moved from one field to another in rotation.
Strip grazing where animals are confined to one area, fed sufficient grass for one day then moved to another section.
Set stocking in which cows are kept in a single paddock using a semi-intensive system. A one-hectare plot on a large farm is preferred. Animals should be rotated (different cattle in the paddock each week) to avoid the infestation of worms. One quarter to 1.3 acres of good pasture should be provided per cow.

Making pit silage for cattle

Silage is made from high-quality pasture or crops such as napier grass (Pennisetum sp.), sorghum and maize preserved through tightly controlled fermentation, which is fed to cattle along with good management. Grain sorghum should be ensiled when the top seeds are in the dough stage and the bottom ones in the milky stage. Sweet sorghum used for silage should be cut before the seeds mature; otherwise a large portion of the small hard seeds will be wasted as they are not easily digested. Forage sorghum silage ferments similarly to maize, with a pH below 4.0.

A grade cow may eat up to 30kg of silage per day. To make good quality silage which can be fed to cattle during the dry season, it is important to plan far ahead and to pay attention to detail. The steps involved in making silage are described below.

Steps involved in making pit silage

Dig a shallow pit on slightly sloping ground (*See Figure 11*). The depth of the pit should decrease from the higher end of the slope to the lower end, giving a wedge-like shape. The dimensions of the pit depend on the amount of forage to be stored. In order to store 20 bags of fresh forage, you need to dig a pit approximately 2 cubic metres in volume. Additionally, you will need to buy 10 metres of polythene and about 30 litres of molasses.
Using a chaff cutter, chop the forage to be preserved into pieces of about 1 inch in length.
Place polythene sheeting over the sides and floor of the pit so that the forage will not make contact with the soil.

Empty the chopped forage into the plastic-lined pit and spread it into a thin layer. Repeat this until the pit is filled to a third of its capacity (6 bags).

Dilute 1 litre of molasses with 3 litres of water. Sprinkle this mixture over the layer of chopped forage. Use a garden sprayer to distribute the solution evenly. This helps to feed the micro-organisms that will make the silage ferment quickly, thus preventing rotting.

Press the forage down with your feet to force out as much air as possible. This will prevent fungi from attacking and destroying the forage.

Add more bags of the chopped feed, sprinkle diluted molasses and compact the forage again. Repeat this process of adding forage, diluted molasses and compacting until the pit is filled in a dome shape.

Cover the pit (after a final pressing) with polythene sheeting to keep water from seeping into the silage and dig a small trench around the edges of the pit.

Then cover the pit with soil. A layer of 24 inches is required for wet, fresh fodder and a layer of up to 36 inches is needed for drier forage. This should keep the air out and prevent damage to the polythene by rain, birds and rodents.

Conservation through fermentation takes several weeks. Wait until there is a shortage of feed to start using the silage. When prepared well with good sheeting and sufficient soil cover, silage can last up to 2 years;

To remove feed, open the pit at the lower end of the slope. Remove enough silage for a day’s feeding and put the cover back.

Making Pit Silage for cattle

chop the forage to be preserved into pieces of about 1 inch in length

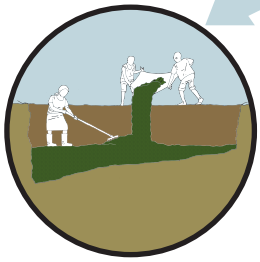
1

Dig a shallow pit on slightly sloping ground. The depth of the pit should decrease from the higher end of the slope to the lower end, giving a wedge-like shape.

2

Place polythene sheeting over the sides and floor of the pit so that the forage won't make contact with the soil

Dilute **1 litre of molasses** with **3 litres of water**. Sprinkle this mixture over the layer of chopped forage. Use a garden sprayer to distribute the solution evenly. This helps to feed the micro-organisms that will make the silage ferment quickly, thus preventing rotting



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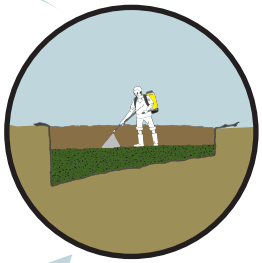

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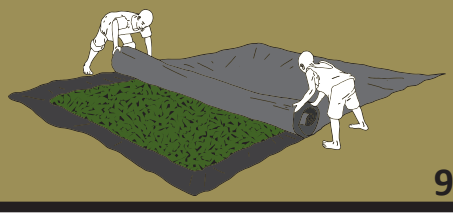
Cover the pit (after a final pressing) with polythene sheeting to keep water from seeping into the silage and dig a small trench around the edges of the pit



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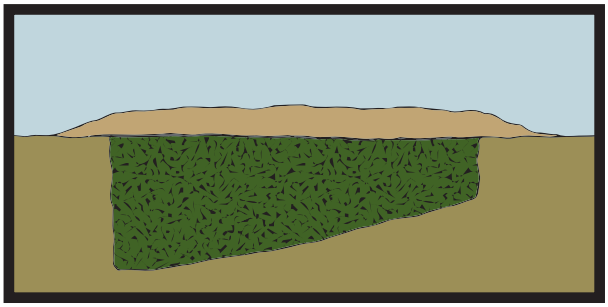


Then, cover the pit with soil. A layer of 24 inches is required for wet, fresh fodder and a layer of up to 36 inches is needed for drier forage. This should keep the air out and prevent damage to the polythene by rain, birds and rodents

Figure 11: Making of Pit Silage for Cattle

Water should be constantly available to cattle to quench their thirst and improve their digestion. When using a free-range system access to water can often be a challenge, especially during the dry season in most parts of South Sudan. This is one of the reasons why cattle are herded to areas that are rich in rivers and fresh grass. It is important to ensure that the water given to cattle is clean and fit for animal consumption. Water in troughs must be changed on a daily basis and the trough itself kept clean to avoid contamination. It is important to use separate troughs for different age groups.

Figure 12: Watering trough for cattle

Routine practices in cattle management

The following are some of the essential practices that should be carried out by cattle keeping farmers. Some of them are daily tasks and others are occasional activities, depending on the age of the cattle, the season and the purpose for keeping them.

Identify your stock. Livestock identification is essential for good management, especially in breeding farms. The best method of permanent identification is by tattooing the inside of the ear with indelible ink. Metal ear tags or buttons with letters and numbers may be inserted in the ear as a means of identification. A neck strap or neck chain with a number plate attached make an easy method of identification. Identification helps farmers to spot cattle with problems quickly, isolate them and treat them. Identification is also important in South Sudan because group herding is a common practice. Farmers should normally mark their animals. Use different methods for easier identification. Methods include branding and ear notching, cutting and tagging. Do this as early as possible as and no later than when a calf is one year old.

Removal of supernumerary teats is also important, and this has to be carried out before development begins. This is usually done in the first month of age with the help of a short pair of sterile scissors. If the extra teat is at the base of the normal teat, veterinary help may be required to remove it.

Dehorning or disbudding. Disbudding is carried out either by the use of hot iron, caustic sticks and electrical dehorning cone. Both the buds are destroyed at an early age (within 3 to 10 days). Remove the young male calves to reduce the risk of injury. Large horns are removed by cutting using surgical or dehorning wire. Dehorning is done to reduce the risk of injury to human beings and other animals. It should be carried out 1-2 months after calving. Disbudding is the removal of the horn tissues of young male calves to stop the horns from growing. This is done using a dehorning rod. Nurturing horns for shows, prestige and social reasons is popular among some tribes in South Sudan. Care must be taken to avoid inflicting injuries on other cattle in the herd.

Isolate sick animals. Observe your cattle regularly to spot sick animals so that you can keep them from infecting other cattle on the farm. Isolation is the practice of spotting and keeping sick animals away from healthy animals to avoid spreading diseases. It is important to create an isolating shelter from the start when establishing a farm. If a separate shed is not available, the animals for isolation should be tied at one end of the shed as far away as possible from the apparently healthy stock.

Give treatment promptly. Treat sick animals promptly and without delay. It is a good practice to conduct regular deworming to control internal parasites and to spray the bodies of cattle to control external pests. Timely vaccination is a prerequisite. Sanitation is required to control pests and diseases and to ensure that milk is safe for human consumption. Therefore, general cleaning and maintenance of animal housing is important.

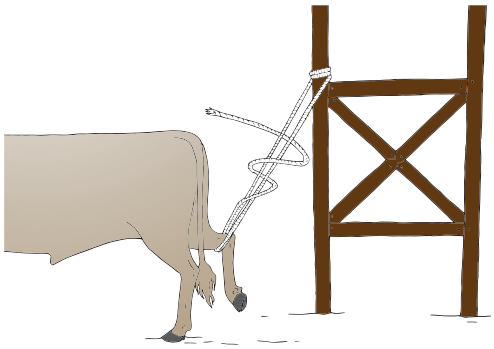


Figure 13: Isolating a cattle by Tying

This can be difficult to enforce due to current husbandry practices in South Sudan and to the nomadic nature of herders. It is, however, important that the person who tends the animals be neat, clean and in full working attire (coats, overalls, gumboots, gloves, etc.).

Quarantine new or sick animals. Keep aside new animals you intend to introduce to your herd for the first time or when reintroducing them after they have been taken to another farm. This is a process known as quarantine. It is the process of segregating apparently healthy animals (especially animals being introduced into a herd or into the country for the first time) which have been exposed to the risk of infection. The quarantine period depends on the incubation period of diseases. In practice, a minimum period of 30 to 40 days has been generally accepted as the reasonable period.

Practice flushing. The objective of flushing is to boost ovulation, conception and embryo implantation rates. Flushing is the provision of high-quality feed in sufficient quantities prior to the start of breeding (in order to improve reproduction) and immediately after gestation. Practice flushing in goats and sheep to increase the chances of producing twins. By doing so, there is a 10-20% chance of increase in the number of lambs or kids, meaning more money to the farmers. The rule of thumb is to flush for 30 days before and 30 days immediately after parturition. The purpose of flushing in cows is to obtain an optimal ovulation rate and better implantation, leading to an increase in calving percentage (percentage of multiples).

Deworm regularly. Accumulation of worms in the rumen of cattle is usually very inconveniencing for cattle. As a result it will limit their production and productivity if not treated. This is a routine practice implemented to reduce the build-up of internal parasites. It is commonly carried out in the rainy season due to the high numbers of insect eggs in the pasture. Deworming medication can be administered in both solid (bolus) and liquid (drench) form. The simple equipment used is a bolus gun or drenching gun/syringe. Bottles can also be used for improvisation.

Cull unproductive cattle. Remove old or non-productive stock from your herd for slaughter or sale. Otherwise you continue to feed them without an appreciable weight gain or milk production. This is an essential practice often overlooked by farmers sometime because of attachment to their stock.

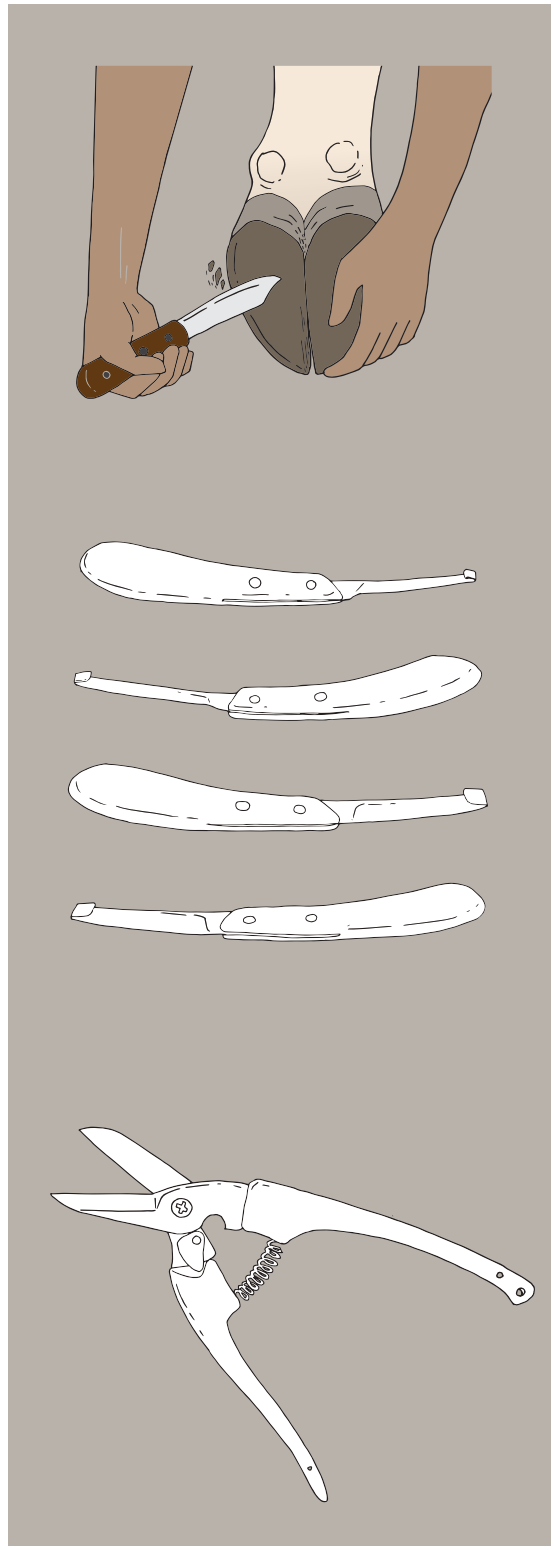


Figure 14: Hoof trimming tools

Castrate cattle when necessary. Castration is carried out to prevent inbreeding, unwanted and achieve better distribution of fats, resulting in better quality beef. This is done by the removal or destruction of the testicles of a male animal. The commonly used tool for castration is the burdizzo. Castration of a calf is best done about 2 months old rather than later (i.e. when bulls are young).

(i) The bloodless castrator (Burdizzo pincers)

It is used in animals with pendulous testes. The spermatic cords and associated blood vessels are crushed or severe so completely that the testicles waste away from lack of blood circulation. Young calves can be castrated while standing but those over 3 months are best castrated while lying down. The operator's assistant should sit on the calf's head and keep the upper most hind leg of the calf pulled well forward. Two independent closures about 1/4 inch apart should be made for each cord. If done properly, it is a satisfactory means of castration as there is no external bleeding and the chances of infection are reduced.

(ii) Open incision

An incision is made on the scrotal sac. The testes are removed by pulling them away from the spermatic cord. It is not advisable to cut the spermatic cord since excessive bleeding may result. The cord is gradually scrapped with a sharp knife until it snaps off.

(iii) The rubber ring elastrator

This involves stretching a specially made rubber ring over the scrotum. It is a useful method for castrating young calves under 2 months old. The ring cuts off the scrotal and testicular blood circulation so that they finally drop off. As a rule the hands of the operator and instrument should be kept clean and as sterile as possible by dipping them in disinfectant solution between operations. The wounds of the calf should also be disinfected.

A burdizzo helps to ensure bloodless castration.

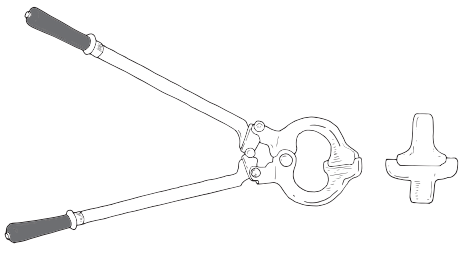


Figure 15: Burdizzo Emasculator

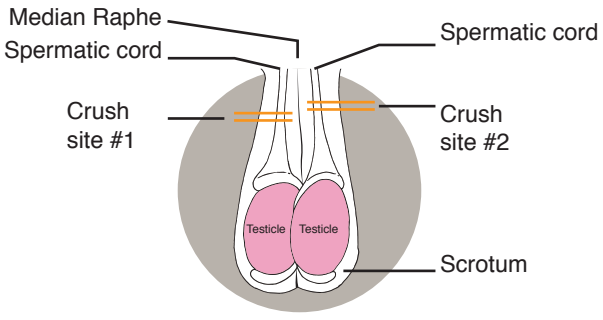


Figure 16: Illustration showing position to castrate

What to consider when castrating a calf

Restrain the calf properly and use a crush to guide the calf and to be humane. There is a danger of infecting the calf being castrated when you use an unclean burdizzo emasculator. Clamp one side then the other. Do not clamp across the whole of scrotum (see illustration above). Make sure that the clamp lines do not go across the scrotum in a single line. Follow these steps:

Stand behind the calf, grasp the scrotum and check that there are two testes.

If there are, push the left spermatic cord to the outside of the scrotum

Open the emasculator and hold it so that the C-shaped side of the jaw is facing up.

Place the emasculator so that the left spermatic cord runs between the jaws. Get the cord as near to the right-hand side of the jaws as possible. The aim is to crush as little of the scrotum as possible.

Close the jaws and hold them for 5 seconds.

Repeat on the right-hand side, below the first crush.

Milking and milk hygiene

Cows are reared and exclusively maintained for milk production. Though the primary objective is to produce milk, the amount of milk produced by the indigenous breeds is very low compared to the amount of milk secreted by exotic breeds which is very high and exceeds the requirement of a calf.

Milk is the lacteal secretion of the mammary glands of animals. It is obtained generally from the cow or the goat during the period following at least 72 hours after calving/kidding or until the milk is colostrum free. Milk is a white opaque fluid in which fat is present as an emulsion; protein and some minerals are in a colloidal suspension; and lactose, some minerals and soluble proteins are in true solution.

Clean milk production

Milk is defined as whole, fresh, clean lacteal secretion. Milk once secreted becomes the target for transformation by a variety of host organisms at the farm itself. Hence, proper care must be taken regarding preservation of milk, protection of milk constituents, protection against high temperatures and natural calamity. Strict protocols are to be observed and implemented both in hand and machine milking. The microbiological quality deserves special attention for stringent export requirements for milk products in the global market. The custodian of milk should never compromise on quality.

Rural milk collection

Milk procurement models in western countries, such as bulk cooling, bulk transportation, etc. are not applicable in South Sudan due to tropical climatic and techno-economic conditions prevailing in the country. Collection of small amounts of milk scattered over long distances, therefore, poses a formidable challenge in maintaining the quality attributes and keeping costs down.

A suitable systematic approach to rural milk collection is that milk brought by individual livestock producer should first be tested for quality. As soon as the milk supply reaches collection centres, it is weighed and a representative sample is drawn for quality grading. The common tests that can be carried out at the point of milk collection are taste and smell, sediment, fat, solids not fat (SNF) contents and acidity test. These quick tests generally form the basis for accepting or rejecting milk supplied. All milk collected should generally be filled in cans to enable transportation to the chilling centre or directly to the milk plant. Care should be exercised to bring the milk for chilling or processing within 3 hours of milking otherwise serious deterioration of milk takes place, which affects the quality of products.

Preservation of raw milk

In order to produce milk products conforming to international quality standards, it is important that the milk is collected, transported and cooled immediately under strict hygienic conditions. Ideally, all the milk reaching to the dairies should be bulk cooled.

Under South Sudan conditions, it would be beneficial to have access to methods, other than refrigeration, for retarding the bacterial growth in raw milk during collection and transportation to the dairy plants or centre. One of the methods, which has some merit and is worth considering, is LP system (lactoperoxidase/thiocynate/hydrogen peroxide system). The LP system is an indigenous antibacterial system in milk and human saliva. The enzyme lactoperoxidase is present in cow milk in relatively high concentrations. The antibacterial effect of the LP system is mediated by short-lived oxidation products of thiocynate. To activate the LP system in milk, adequate concentrations of thiocynate and hydrogen peroxide are added. It is very important that preservation of raw milk by LP system is controlled at the society level and that the individual farmers do not have direct access to such chemicals.

Adulteration

Adulterants in milk are the addition or removal of legally prohibited substances from the milk with the view to increase quantity and reduce the quality to make extra profit. Others additives, such as preservatives like formalin, extend milk shelf life.

Common adulterants:
1. Addition of water is a most common adulterant
2. Removal of fat
3. Addition of starch
4. Addition of milk powder
5. Addition of carbonate and bicarbonate

Clean milk production

Complete milking of healthy milch animals to obtain milk containing the prescribed percentage of fat and SNF (solids not fat). Exclude milk from cows that have calved in the previous five days or less.

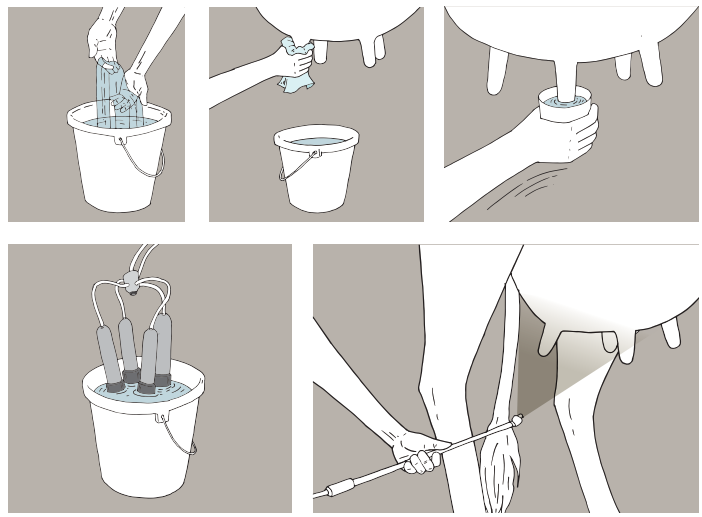


Figure 17: Cleaning in preparation for milking

Clean milk

Advantages of clean milk:
1. Protects the health of calves
2. Protects the health of consumers, especially infants, growing children and aged people.
3. The cleaner the milk the longer it can keep its quality and flavour.
4. Consumer will demand milk when confidence is developed on its wholesomeness.
5. Fresh, clean milk is readily marketable.

Disadvantages of unclean milk:
1. Keeping quality of milk is poor.
2. It is a nucleus for spreading of diseases such as sore throat and brucellosis.
3. Health of the calves are affected, increasing chances for calf mortality.
4. Sour and off-flavoured milk are not readily marketable.

PRINCIPLES OF MILKING

Milking is critical and laborious process which involves a hormonal reflex. The art of milking is performed within 5-8 minutes. Normally milking is done twice a day. Although the primary objective of keeping a cow is to produce milk, the amount of milk produced by the indigenous breeds is very low compared to the amount of milk secreted by exotic cows which is very high and which exceeds the requirement of calf. If the calf is allowed to suckle the complete quantity of milk it leads to digestive disturbances, enteritis, etc. Usually milk is fed to calves depending upon the body weight of the calf ate the rate of 1/10 of the body weight during first week and 1/15 the body weight during the second week. Milking methods could be manual (hand) or mechanical. The use of proper milking procedure is critical to ensure food safety, milk quality and cow health. The method used could influence the quality and quantity of milk produced at the dairy farm.

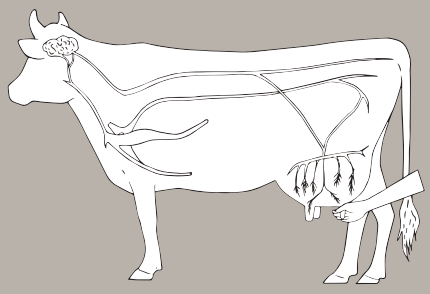


Figure 17(b):
Mammary glands of a cow

Techniques of letting down (removing) milk

A dairy enterprise's main output for human consumption is milk. Farmers must ensure that milk is produced in clean and hygienic conditions because milk is an ideal medium for the development of bacteria and other microorganisms that could be harmful to health.

As a result, diseases can easily be transmitted during the production, handling and marketing of milk, leading to serious public health risks. The milking herd should therefore be free of diseases such as mastitis, brucellosis, etc. Animals under treatment days should be observed. The general practice is 14 days of observation. Until a cow is observed to be healthy, she should not be milked.

The commonly used milking method in South Sudan is the stripping/pulling of teats also call hand milking. In other cases when the herd is mainly cross-bred, the preferred method is squeezing. The farmer needs to check for mastitis using a strip cup or an improvised container with a black surface. If a cow is affected by mastitis, it should be milked last and the milk should be disposed off.

1. Natural technique (calf suckling)
2. Manual technique (hand milking)
3. Mechanical technique (machine milking)

Natural technique: is the method in which the calf is able to draw the milk from the udder. To extract the milk the calf presses the teat between its tongue and pallet on opposite sides of the teat. The tongue encircles the teat and a vacuum is created in the mouth by separating the jaws and retracting the tongue. Nearly 100-200 alternating cycles may be observed per minute. A calf's suckling is the best method of evacuating the milk with the least damage to the delicate tissue of the mammary gland.

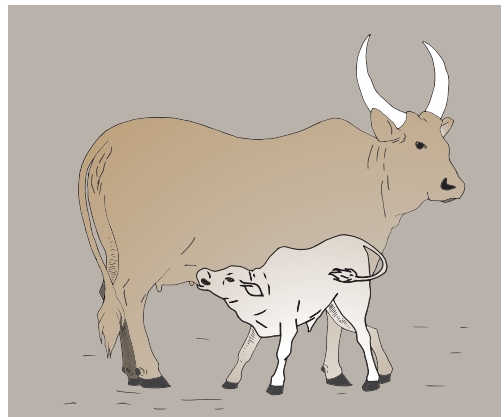


Figure 18: Natural technique

Milking cows with full hands in South Sudan

Manual milking: is commonly practiced in the harvesting of milk by hand. The milk should only be squeezed and not drawn. The three most common manual milking methods used are:

1. Fisting
2. Knuckling
3. Stripping

Figure 19: Milking cow

Fisting: This method is also referred to as hand milking. It requires that the whole teat is held first with the thumb and the index finger encircling the base of the teat. The base of the teat is closed by the ring formed by the finger, so that the milk that is trapped in the teat canal cannot slip back into the gland cistern. Simultaneously the teat is squeezed between the hollow of the palm and with the middle, ring and index finger. The process is repeated in succession.

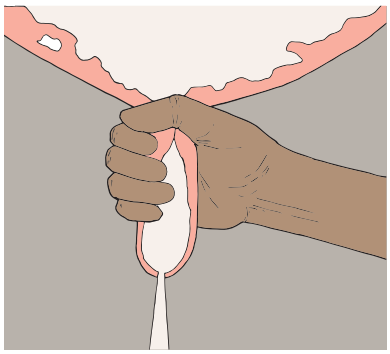


Figure 20 (a): Fisting with one hand

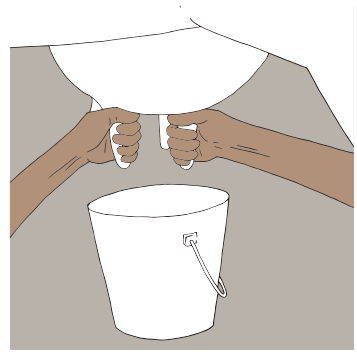


Figure 20 (b): Fisting with two hands

Knuckling: Knuckling is a term used to describe hand milking when the milker bends his/her thumb against the teat. It involves pressing the thumb against the teats while the teats are in between the thumb and fingers. The method can hurt the teats and udder so it is not advisable.

Figure 21: Knuckling

Stripping: Stripping is done by firmly holding the teat between the thumb and fore finger and drawing it down the length of the teat and at the same time pressing it to cause the milk to flow down in a stream. This method is also very useful where the length of the teat is short; it is normally practiced towards the end of milking in order to evacuate the milk completely. The last drawn milk is called stripping which is rich in fat content.

Figure 22: Stripping

Mechanical milking: This refers to the use of a machine or devices for milking. When using the mechanical method, apply the milking machine gently within 30 to 60 seconds after washing the udder. The milking machine performs two basic functions: 1. It opens the streak canal through the use of a partial vacuum, allowing the milk to flow out of the teat cistern through a line to a receiving container. 2. It massages the teat, which prevents congestion of blood and lymph in the teat.

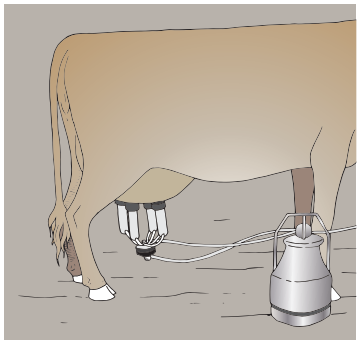


Figure 23: Mechanical Milking

Advantage of mechanical milking

It is easy to operate and saves time as it could milk form 1.5 litre to 2 litres per minute.
It is also very hygienic and energy-conserving as electricity is not required.
All the milk from the udder can be removed.
The machine is also easily adaptable and gives a suckling feeling to the cow and avoids pain in the udder as well as leakage of milk.

Disadvantages of mechanical milking

It can be expensive and often unaffordable to subsistence farmers.

High possibility of transmission of diseases if not properly washed and disinfected because they are often used on many cows at a time.

Frequency of milking

Under normal conditions cows are milked twice a day: early morning and late afternoon. Milk obtained at the morning milking is much lower in fat (3%) than at the afternoon milking (5%).

The factors to be considered during milking

Avoid excitement of the animal during and prior to milking. If the animal is excited then there is release of adrenaline and it will cause vasoconstriction.

Prepare and collect all the milking equipment prior to milking.

The milking operation should be a continuous one.

As far as possible, the milking should be done at the exact same time each day.

Prepare the cow for milking.

Complete the milking within 5-7 minutes.

Use both hands for milking.

Use the correct method and type of milking.

Weaned animals should not be milked with the calves nearby.

Provide concentrate mixture at the time of milking.

Remove the first few strippings for any possible abnormalities of milk.

Group the animals 2 hours prior to milking.

More than one milkman should milk a cow during the lactation so that any change in milkman will not affect or cause any problem in milking especially in the letting down process of lactating animals.

Milk contamination

There is a strong possibility for intruding unwanted particles into milk before, during and after milking. It is important to consider the following ways in which contamination could take place.

Milk contamination may occur as a result of:

- Cow faeces coming into direct contact with the milk;
- Infection of the cow's udder (mastitis);
- Bovine diseases (e.g. bovine tuberculosis);
- Bacteria that live on the skin of cows;
- Environment (e.g. faeces, dirt and processing equipment);
- Insects, rodents and other animal vectors;
- Human activity (e.g. via cross-contamination from soiled clothing and boots).

The following practices should be observed during milking:

- Milking containers must be sterilised or properly washed before and after use;
- All milking containers must be made of stainless steel or plastics;
- The teats must be washed before milking;
- Milking salve (ointment/oil) must be applied to the teats if they are too dry.

In order to ensure that there is reduction in the level of milk contamination, milkers should consider the following preparations:

Pre-milking preparation

The following steps should be taken in preparation for milking:

- Ensure the milking utensils are clean. They should be washed with warm, clean water and detergent. The use of seamless, stainless steel utensils is encouraged. Where steel materials are unavailable, clean traditional containers can be used such as guards and calabashes.
- The milk handler should wear protective clothes (preferably white) and maintain good personal hygiene. The milker should wash his/her hands properly.
- The milking area should be clean and the floor should be concrete or rough.
- The cow should be calmly prepared for the milking process at a fixed time each day. The udders should be cleaned using a warm, clean towel to stimulate the descent of the milk. The cow should also have been well fed and watered prior to milking.
- The cows should be given special feed to stimulate milk descent (e.g. concentrates, licks, fresh sorghum or maize stalks or moringa leaves).

Post-milking practices

Weigh the milk immediately after milking.
Check for foreign materials in the milk and sieve.
Pour the milk into a special container. The container should be lidded, seamless and made of stainless steel. The milk can be preserved using a cold system (refrigeration), fermentation (to make yoghurt) or processing to create other end products like cheese. Milk should be pasteurised before consumption.

Figure 24: Need for hygiene when milking

Consuming raw milk is dangerous and may cause diseases in humans. This is because it is likely to contain harmful bacteria such as Brucella, Campylobacter, Listeria, Mycobacterium bovis, Salmonella, E.coli, Shigella, Streptococcus pyogenes and Yersinia enterocolitica.

Consuming raw milk is dangerous and may cause diseases in humans. This is because it is likely to contain harmful bacteria such as Brucella spp., Campylo bacter, Listeria spp., Mycobacterium bovis, Salmonella spp., E.coli, Shigella spp., Streptococcus pyogenes and Yersinia enterocolitica. Bacteria that live in raw milk can cause vomiting, diarrhoea (sometimes even bloody), pain and cramps in the abdomen, kidney failure and miscarriage. It is therefore essential to pasteurise milk to make it safe for human consumption.
When you pasteurise, products become safe to eat or drink. Pasteurisation also increases shelf life (how long milk can stay without going bad) and reduces spoilage.

The following pasteurisation steps are common among cattle herders:

- Collect the milk in the morning in a clean, preferably steel container;
- Strain the milk with a sieve to remove all large particles;
- Place the milk in a clean pot and heat in a water bath until the milk is hot (75°C) but not boiled;
- Set the pot to cool (40°C);
- Store the milk in a cool, dry place in a clean bottle or container that is securely covered or sealed;
- Refrigerate the milk or drink it on the same day.

Processing raw milk

Milk is a very popular product of cows and one that is loved by many. Unfortunately, it has a short shelf-life meaning it is highly perishable in the raw form and requires careful handling. Because it is a very good medium for the growth of microorganisms, bacterial pathogens that are harmful to human health are very commonly found in it. The short shelf life also causes significant economic losses to pastoralists and dairy farmers. Processing therefore allows the preservation of milk for days, weeks or months and helps to reduce food-borne illness. There several forms of processing milk, ranging from simple to highly complex.

Below are examples of the ways milk can be processed:

- Cooling (use of refrigeration)
- Thermal processes (heating boiling)
- Pasteurization
- Changing its forms by adding value (butter, cheese, yoghurt, ghee, etc.)

Thermal Processing

Thermal processing is an integral part of all operations/processes of milk and milk products. The main purpose of heat treatment of milk is to render it safe for human consumption and to enhance its shelf life. Common pathogenic organisms likely to occur in milk are killed by relatively mild heat treatment. The most resistant organism is the Bacillus tuberculosis, and thus it has been made as index organism to achieve the complete safety of milk. Any heat treatment that may destroy this organism can be relied upon to destroy all other pathogens in milk. The thermal death of pathogenic organisms like Tubercle bacilli, Typhus spp. and coliform bacteria form the basis for time-temperature combinations where the effect on microbes and the quality factors of the milk must be balanced and optimized. Heating milk to 88.33°C (191°F) for one second works to kill most of the disease-causing pathogens.

Pasteurization of Milk

Pasteurization is the processing of exposing the milk to a controlled temperature for a specific time with the object of destroying all the pathogenic bacteria and cooling the milk immediately to a temperature low enough to retard the growth of the surviving bacteria. Pasteurisation is a quick process, in which milk is heated to 71.67°C (161°F) and rapidly cooled to 50°F. This is sufficient to kill the most common disease-producing bacteria and reduce enzymatic activity.

Take the following steps to pasteurise your milk at home:

Take the following steps to pasteurise your milk at home:

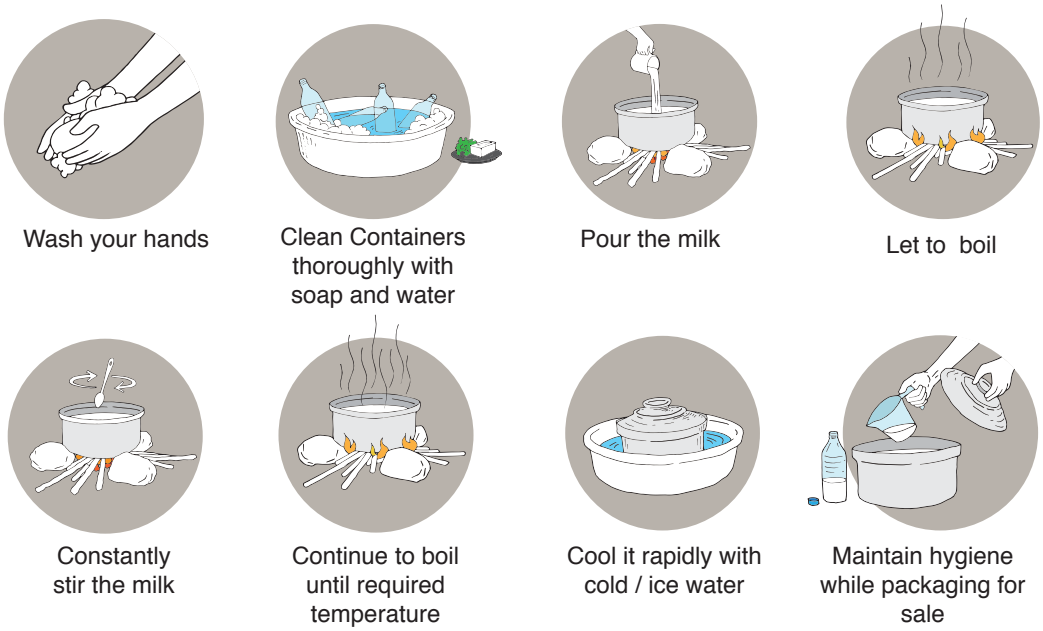


Figure 25: Steps to pasteurisation milk at home

Healthcare management for cattle

Be on the alert for signs of illness such as reduced feed intake, fever, abnormal discharge or unusual behaviour. Whenever the incidence of disease is reduced, productivity and profitability in both beef and dairy farming will improve. For the control of all diseases and pests affecting cattle, it is vital to contact your local veterinary officer. Drugs should never be administered without the advice of a vet.

Health is the condition in which all the organs and tissues in the system functions normally and harmoniously. Any change from a normal state to either a small or large extent is called a disease stage. Health is fundamental for a sound enterprise. Most diseases can be avoided by proper attention, sanitation, hygiene, nutrition and management practices. Once an outbreak of disease occurs it causes complications in cattle operations such as financial loss, logistical complication and additional expenses of medications. So the farmer must be vigilant in day to day activities to avoid or prevent spreading of disease and to minimize financial loss.

Diseases are broadly described as either (1) infectious (also called contagious) or (2) non-infectious (non contagious).

Control of disease

- Provide well-ventilated and proper housing.
- Provide a balanced, nutritious diet.
- Observe strict hygiene and sanitation of animal houses.
- Adhere to regular and routine vaccination schedules.
- Avoid entry of outsiders within the farm-premises.
- Be informed of the latest scientific information and management practices. Quarantine
- Remember that prevention is better than cure.

Diseases

Diseases may generally be classified as viral, bacterial and metabolic. The following table lists diseases in these categories.

Table 5: Infectious and Non Infectious Diseases of cattle

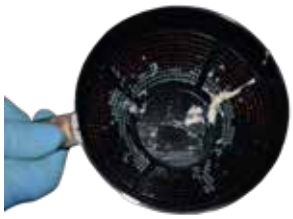
Infectious or contagious	Non-infectious or non- contagious
Bacterial a) Anthrax b) Black quarters c) Halmorrhagic septicalmia d) Tuberculosis e) Brucellosis	Metabolic Milk fever or hypocalcaemia Acetonemia or hypoglycaemia Ketosis
Viral a) Rinderpest b) Foot and mouth	Dietary Tympanites or bloat impaction Non-specific enteritis
Parasitic Ectoparasite Endoparasite	Parasitic Tick, lice and mite Tape worm, round worm
Fungal Aflatoxicosis	

How to detect mastitis in milk using a strip cup

The strip cup is a device with four circular plates for each quarter. The first few strips of milk are drawn in the respective circles to assess the physiological status of the udder. If there is any change in colour, consistency and appearance, the milk should be drawn at the end so as to prevent spreading the disease from one quarter to other. The photos below show how to use the strip cup for detecting mastitis in milk.

A clean strip cup

Fore stripping before milking



Clots in milk confirming mastitis

Figure 26: Detecting mastitis

Signs of healthy cattle

An animal is normally active and stays in a group. It shows good appetite and when offered feed it takes it happily. Chewing the cud is a sign of good digestion. Ruminating 40 to 70 times on a cud is normal. A cow should ruminate for seven to ten hours per day. Its nose is usually wet and bright. The skin is usually a good indicator of health. If you pinch the skin it should return to normal (flattened) in no more than 1-2 seconds. It should be glossy and bright without the eggs of ticks, lice or mites.

The eyes should be clear, bright and without excessive tears. Its ears are usually warm but not too hot. The udder should be of normal size and colour, and it should be soft. Excessive redness or hardness of the udder is a bad sign. Urine should be clear and without smell. It is usually pale yellow in colour and the pH is alkaline (7.4). Vaginal discharge in a healthy animal is indicative of the oestrous cycle, but it should be odourless and should occur only once in 21 days. Faeces (cow dung) should be semi-solid. Watery stool is a sign of diarrhoea. Movement of the animal should be normal and straight.

Signs that identify sick cattle

Any deviation in the features of a healthy cow as mentioned above should be regarded as a sign of bad health. Loss of appetite and stopping rumination are the first signs of bad health. Other signs of bad health include:
Temperature: High temperature shows fever. Cold ears indicate milk fever or blood circulation problems.

Limping: If an animal is not putting weight equally on all four legs it may be suffering with injuries to one or more of the limbs.

Examination of rumen and rumination: Examine the rumen. It is on the left side. It should be filled with feed. On pressing the rumen with your fist you should feel contractive movement around 10-12 times in five minutes. If an animal is not ruminating it is a sign of illness.

Neck: The neck should not be swollen. If it is swollen it means the manger is situated too low, forcing the animal to keep its head low during feeding which causes fluid accumulation.

Hooves: Healthy cows stand straight and still while eating. Tipping or walking with a lame gait are signs of poor hoof health from bad rations, poor floors or lack of hoof treatment.

Udder: The udder is examined for signs of engorgement, injury, redness, warmth, etc. Inflammation of udder is indicated by four signs: heat, redness, swelling and pain. To assess udder health, look carefully at the teats after milking. Good teats are flexible and naturally coloured. Poor udder health is caused by hygiene problems, poor milking equipment installation or inadequate feed rations. Mastitis is a very common problem in dairy animals. It is inflammation of the udder.

Manure: the fresh dung should be neither too solid nor too watery. Undigested food particles should not be present in the faeces.

Breathing: Faster breathing indicates heat stress, pain or fever.

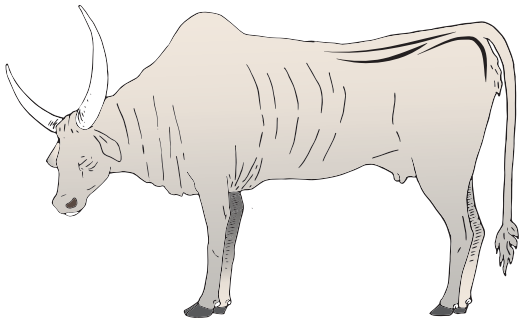


Figure 27: Sick looking cattle

Common cattle diseases and their control

Disease is an alteration of the body or body organs which interrupts or disturbs the body's function. Direct causes of disease are: (1) bacteria, (2) viruses, (3) parasites, (4) fungi, (5) nutritional deficiencies, (6) chemical poisons and (7) unknown causes.

Common animal diseases in South Sudan include anthrax, black quarter(BQ), haemorrhagic septicaemia (HS), contagious bovine pleuro-pneumonia(CBPP), contagious caprine pleuro- pneumonia (CCPP), trypanosomiasis (sleeping sickness), East Coast fever (ECF), brucellosis, and foot and mouth disease (FMD).

Diseases are broadly classified as either notifiable or non-notifiable.
Notifiable diseases are diseases that are required by law to be reported immediately to the authorities in case of an outbreak.

Non-notifiable diseases are those that can be dealt with by community animal health workers (CAHWs) if they pose no threat. Transboundary animal diseases (TADs) are those epidemic diseases which are highly transmissible and have the potential for very rapid spread, irrespective of national borders, causing serious socio-economic and possibly public health consequences.

Common diseases of cattle

Table 5: Common diseases of cattle and symptoms

Name of disease	Clinical signs and symptoms	Treatment and control	Prevention
Contagious bovine pleuro-pneumonia (CBPP)	In milking cows, there will be a drop in milk yield. Sick cattle tend to isolate themselves from the herd and stop eating. Pregnant cows and heifers may abort. Sufferers will experience diarrhoea, difficulty breathing and a cough. They will stand with their front legs apart facing the wind.	Use of Tylosine, or Penicillin Streptomycin (also commonly called Penstrep) for three days or Oxytetracycline (OTC) antibiotics vaccination.	Isolation and treatment of sick animals, culling of the animals if CBPP is chronic.
Anthrax	Caused by the spore-forming bacteria *Bacillus anthracis.* Sporulation occurs outside the body, and spores are highly resistant to heat, light and disinfectant. Infected animals will experience difficulty in breathing, extreme weakness and oedema of the tongue and throat. Diagnosis: sudden death, acute bloating, exudation of blood.	Antibiotics such as penicillin are effective treatment, but must be applied at a very early stage. Anthrax can affect humans so do not open affected animals. Bury or burn carcasses and apply lime.	Hygiene and sanitation. Vaccination one month before the disease period. Annual vaccination such as application of Anthracis dose 1ml. Report any anthrax case immediately to the veterinary office in your area.
Haemorrhagic septicaemia (HS)	An infected animal will experience sudden high fever (40-42.5°C), depression and a hot, painful swollen throat. There may be bloody faeces, diarrhoea, lack of appetite and excess salivation, with the tongue lolling out and being dark red. Sudden death may occur. The causative organism is the bacterial *Pasteurella multocida.*	Treatment: injection of sulphadimidine. Or Oxytetracycline, Penicillin Streptomycin and Tylosine Control: isolation, routine hygiene and sanitation.	Vaccinate once a year, one month before the disease period (rainy season).
Black Quarter (BQ)	Infected cattle will experience high fever, depression, lack of appetite severe lameness and swelling of the shoulder or upper leg. Breathing may be accelerated and the skin of the affected becomes dry, hard and dark. Death could occur within 24 to 36 hours. Diagnosis: affected part is black or dark red with a characteristic rancid smell.	Antibiotics during early diagnosis (OTC or penicillin); destruction of carcasses, hygiene and prophylaxis control.	Annual vaccination before the onset of rainy season with 5ml of polyvalent s/c (*Clostridium* sp.). Antibiotics like penicillin and tetracycline may be given.

Foot and mouth disease (FMD)	Highly communicable disease. Infected cattle will experience a lack of appetite. Temperature 40^0 C. The coat may be rough with long hair, panting and the forefeet lame due to painful foot lesions. There will be blisters on the tongue, udder and above the hooves that break and ulcerate. Cows may experience abortion. The animal looses appetite. Body weight and milk production are reduced.	There is no treatment for this viral disease. Provision of broad antibiotics such as alamycin and Pen Strep will help to treat secondary infections. Provision of plenty of water, shading of the animal and cleaning of wounds. Apply an oil adjuvant: IVPM (20 ml for calves and 40ml for adults).	Thorough disinfection of shed, utensils, clothes of attendants. Isolate sick animals. Restrain movement of animals in that area. Vaccination with poly valent . Specific vaccine volume and timing varies with type of vaccine.
East Coast fever	Infected cattle will experience high fever (41-42^{0}C), inactive deep unresponsiveness and sleepiness (lethargy), swollen lymph nodes (neck area), difficulty breathing, cough and a clear discharge. Watery diarrhoea sometimes with blood. Death occurs in 18-30 days after infection.	Give Parvaquone. Give Oxytetracyline OTC injection together with Parvaquone or Pupavaquone.	Transmission is by brown ear tick. Therefore controlling ticks is the first form of prevention control. Move away from ECF-prevalent areas.
Trypanosomiasis (sleeping sickness)	Infected cattle will often experience high fever (On and off) loss of appetite, generally poor physical condition (emaciation) and an aversion to the sun. They may have sunken, watery eyes and swollen lymph nodes, strange smelling urine and diarrhoea. Animal lags behind the herd.	Homidium chloride (no Vidium and Ethidium), Samarine, Diminazene.	Control animal movement; burn or compost cow dung to keep tsetse flies away.
Foot rot	Infected cattle will experience lesions in the centre of their hooves, bad smell of hooves, lameness and swollen joints. Hooves can be detached from the fingers.	Wash and remove the affected area, avoid walking cattle too far around muddy areas. Apply Pen strep for 3 days in a row.	No effective form of prevention but it helps to keep animals in a dry place. Maintain a good level of hygiene by removing dung from the sleeping area.
Brucellosis	Transmission is from an infected male to a female. Signs and symptoms in female are late-term abortion, infertility, retention of the placenta and enlarged joints and arthritis. Male is known to have swollen testicles. Swollen joints and fever are common to both.	It is advisable to cull the animal. Antibiotics should be given at a very early stage especially after mating and immediately after abortion. Administer Pen strep for three days in a row.	No effective form of prevention. Slaughter bulls with swollen testicles and swollen joints. Cows with repeated abortion should be slaughtered. Administer penicillin during complicated parturition.

Bovine Mastitis	Cause: bacterial origin mainly *Str.agalactiae*, *Staphylococcus*, *Coryne* bacterium, *E. coli.* Transmission: Infection accurs via the teat canal from a contaminated environment such as skin of udder, milking equipment, milker, etc. Mastitis is an inflammation of one or more quarters of the udder usually caused by a bacterial infection. Most common types of bacterial mastitis originate in the udders of infected cows and in sores on teats. The signs include one part or whole udder swollen, hot and painful. Change in milk consistency or colour with purulent yellow secretion. Cow will be difficult to milk. Rise in body temperature enlargement of udder and cessation of milk secretion. Milk secretion becomes blood stained and may contain pus. Quarters may be completed affected. In some severe cashes animals may die of toxaemia.	Diagnosis: early detection is important by physical examination of the udder. Many kits are available for diagnosing the disease. Treatment: Effective drugs are available for treatment. Apply antibiotics to treat the infections. Mastitis is easily spread during hand milking. It therefore important to maintain hygiene at all times	Mastitis cannot be eradicated nor controlled by vaccination or the use of antibiotics alone. Hygenic measures are important. a. Animals diagnosed positive should be milked at last. b. Milkers should wash their hands before milking and should use well washed white overalls. c. A separate clean cloth for each cow is used for washing the udder with a disinfectant. d. The first stream of milk from each quarter should not be allowed to drop on the floor but is collected in a separate container. Milkers should not wet their hands with first stream of milk. e. Normal milk room hygiene including washing of milk containers and equipment should be practised.

General disease control measures

National quarantine procedures must be followed in order to avoid disease transmission;

Animals must be vaccinated regularly (i.e. a vaccination calendar and treatment procedures must be clearly followed);

A proper feeding regime is very important since it boosts the immunity of an animal;

Pasture should be well managed in order to avoid infection by disease-causing organisms;

Regular and timely dipping/spraying is recommended;

Animals should not be grazed in tsetse fly-infested areas.

Common communicable diseases from cattle to humans (zoonosis)

Ringworm (dermatophytosis)

Ringworm is a skin infection caused by fungi. Animals catch ringworm through direct contact with an infected animal or through being in an infected environment. Ring worm is a contagious disease of cattle, goat, sheep and wild animals and can also affect humans.

Brucellosis

Humans become infected by eating or drinking contaminated, unpasteurised milk products. The milk of infected sheep, goats and cows is contaminated with bacteria. If the milk is not pasteurised, the bacteria can be transmitted to people who drink it or eat cheese or other dairy products made from it. Humans can also contract the disease when slaughtering infected animals or during the processing of contaminated organs from freshly-killed, brucellosis-infected livestock or wildlife.

Anthrax

Anthrax is a bacterial disease. The bacteria form spores that can survive for years in the environment. Cattle, sheep and goats are at particular risk. People develop anthrax when the organism enters a wound in the skin, is inhaled via contaminated dust or is consumed through eating the undercooked meat of infected animals. The disease can be prevented in humans by making sure not to open the carcass of an animal that is suspected to have died from anthrax. It is recommended that the carcass be disposed of by deep burial.

Tuberculosis

In cattle, bovine tuberculosis is caused by the bacterium Mycobacterium bovis which is present in the respiratory secretions, faeces and milk of infected animals.

Humans may acquire tuberculosis from unpasteurised dairy products, drinking milk from infected cattle or by inhaling infected droplets which are expelled from the lungs by coughing. The clinical signs for bovine tuberculosis include:

- Weakness
- Loss of appetite
- Weight-loss
- Fluctuating fever
- Intermittent hacking cough
- Diarrhoea
- Large, prominent lymph nodes

Livestock vaccination calendar for South Sudan

Vaccinating your animals before they contact deadly diseases is a very important measure farmer's must take. Vaccination is the practice of using vaccines to prevent disease. Vaccines are inactive organisms that are introduced into the body of an organism to build its resistance to specific diseases. Timely vaccination of cattle (both dairy and beef) is very important. In order for the vaccines to be effective, it is important to vaccinate animals before they are infected by the target disease. Any sick animals should undergo close daily monitoring. Examples of common diseases that can be controlled by vaccination are:

Haemorrhagic septicaemia (HS)
Black quarter (BQ)
Anthrax
Contagious bovine pleuro-pneumonia (CBPP)

Table 6: Vaccination calendar for South Sudan

Vaccine	Seasonal events / Application period											
	Wet season						Early dry season			Late dry season		
	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr
				Typical flood season								
							Flooding recedes					
CBPP												
Anthrax												
HS												
FMD*												
BQ												
CCPP												
PPR												
S&G Pox												
NCD												
Rabies	Disease of public health interest											

* Based on the FMD strategy - zoning, ring vaccination, etc. Vaccine to be introduced in 2020.

Depending on the region or geographical location, the vaccination calendar will broadly be as follows:

Wet season vaccination should start from May to July/August.
October to December (before livestock migration) vaccination continuing through March in areas of high livestock concentration (toiches) with good pasture and water such as Terekeka, Wunlit triangle, riverine areas (e.g. Nile river basin, etc.)
Small ruminant vaccination is best in dry season - December to March.
It is essential to map cross border migration routes.
It is not recommended to vaccinate animals during periods of high stress (late dry season).

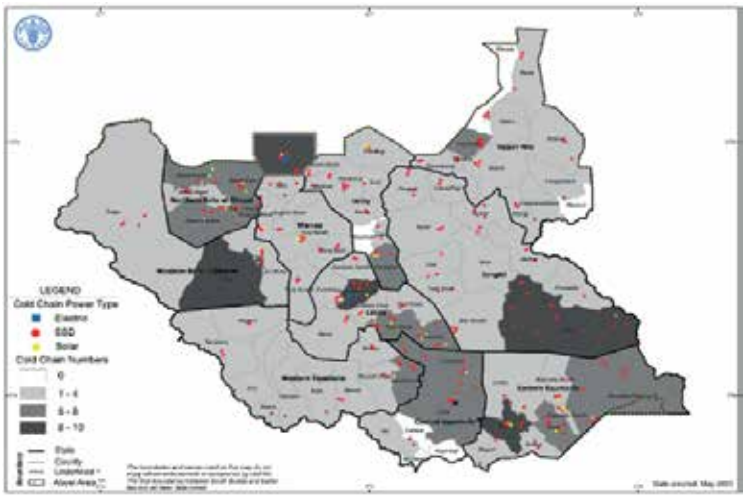
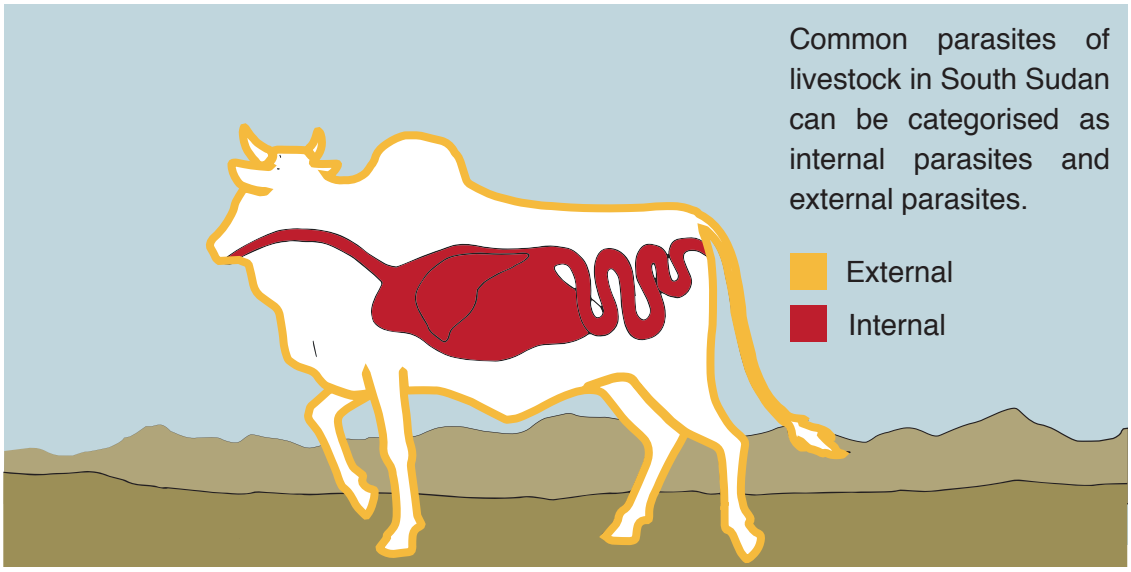


Figure 25: Livestock sector cold chain mapping (2020)

Common parasites of cattle and their control



Internal parasites (endo-parasites) include liver flukes, tape worms and cysts. Signs of the presence of gastrointestinal worms include emaciation, loss of weight or appetite, blocked or damaged organs, diarrhoea and coughing. Internal parasitic infestation can be controlled by applying deworming treatments before animals are moved to grazing areas and at the beginning, middle and end of the wet season.

Table 8: Internal Parasites of cattle

Internal parasite	Symptoms	Prevention	Treatment
Liver fluke (*Fasciola hepatica)*	The life cycle involves a snail host. After growing inside the animal, the fluke invades the liver capsule, reaching the bile duct after 6-8 weeks. In dairy cattle, cows show reduced milk production, poor fertility, chronic diarrhoea and general emaciation.	Avoid grazing cattle in swamps, creeks, lakes or streams that harbour snails. Controlled grazing should help prevent the ingestion of snails. Avoid areas that might have been frequented by infected animals.	The most effective method is to kill the fluke when it is young. Triclabendazole clorsulon is effective against adult flukes of all ages.
Tapeworm (*Taenia saginata*)	Stomach and intestinal worms cause diarrhoea and a loss of appetite and weight.	No known method of prevention.	Albendazole (Valbazen) deworming
Roundworm (*Ostertagiaostertagi* and *Cooperiaoncophora*)	Stomach and intestinal worms cause diarrhoea and loss of appetite and weight. Young animals show stunted growth and development, swollen bellies and poor coat condition.	Clean pens and ensure animals are well fed and healthy.	Deworming with ivermectin (Ivomec) has been found to be effective.

External Parasites of Cattle

The major external parasites that can infest dairy cattle are insects. External parasites (also called ecto-parasites) comprise a variety of pests, including stable flies, fleas, house flies, horn flies, face flies, mosquitoes, horse flies, deer flies, cattle grubs, and lice. Other arthropods such as ticks and mites also cause serious problems.

Figure 28: Diagram of Flies, Ticks, Lice and Mites

FLIES

Biting insects that suck blood

Cause miasis
Vectors of encephalomyelitis
hatches into maggots which feed on dead tissue

Lifecycle stages are :
egg, larva, pupa , adult

Best way to control is to remove manure and decaying vegetable material

TICKS

Cause Piroplasmosis, African horse fever

Lifecycle stages are:
egg, 6 legged larva or seed tick, 8 legged nymth, adult

Treat by dipping entire animals

Breathe by spiracles or holes on their abdomen
There are both biting and sucking kind

LICE

Cause irritation & loss of blood

Attach eggs, called nits, to the hair, close to the skin
Eggs hatch in 11-20 days
Females lay eggs 11-12 days of age

Can only exist about 3 days when off the host animal

Treat by spraying, sponging or dusting and repeat in 2-3 weeks

---

MITES

Cause Mange

So small must be viewed under microscope
Chorioptic type may cause foot mange resembling scratches
Females lay 10 to 25 eggs during laying period which lasts 12- 15 days

Eggs hatch in 3-10 days

Dust is not effective, must spray or use a wet brush wash,
repeat every 7 days

Control of livestock parasites

- National quarantine procedures must be followed in order to avoid disease infestation;
- Animals should be regularly de-wormed and dipped or sprayed according to a strict calendar;
- Livestock housing should be kept clean as this boosts the immunity of animals;
- Pasture should be well managed in order to avoid cysts or pest infestation;
- Animals should not be grazed in tsetse fly infested areas.

Warble Flies:

The warble fly also called the cattle grub is an important external parasite of cattle. It mostly affects the skin and has a serious effect on the quality and pricing of hides resulting in huge economic loss to leather industry. The fly's larvae travel through the animal itself before erupting through the skin, leaving holes in the flesh behind.

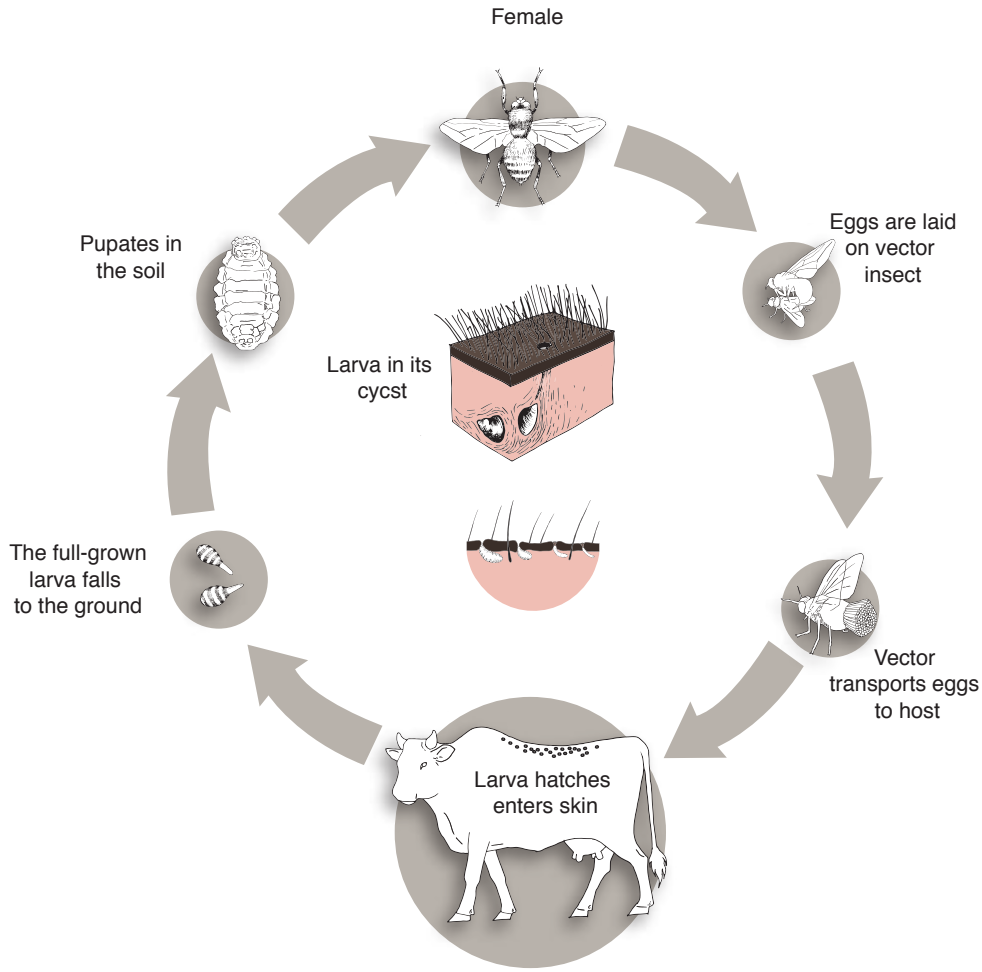


Figure 29: Life cycle of Warble flies

Symptoms: Cattle that are being bothered by warble flies will show unusual behaviour such as gadding or running across the pastures.

Treatment: Use available systemic insecticides containing macrocyclic lactones for treatment. Doramectin, eprinomectin or ivermectin poured evenly along the midline of the back has been found to be effective.

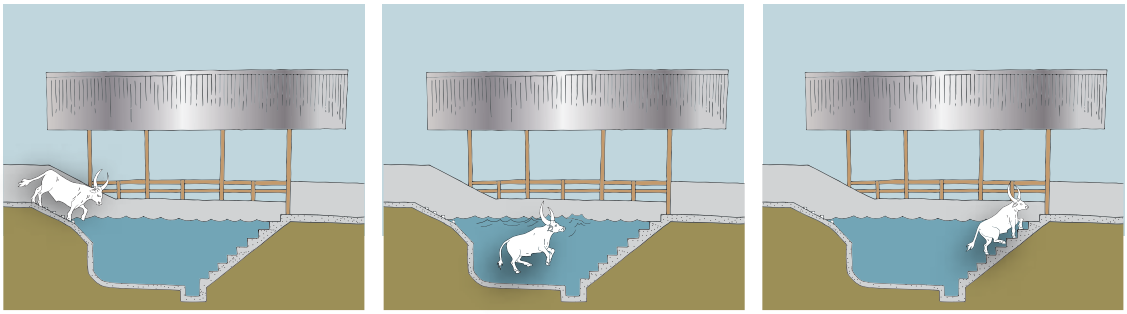


Figure 30: Dipping of Cattle

Dipping cattle to control ectoparasites

Control external parasites by dipping. Control external parasites on livestock using a dip. Dipping is the practice of immersing animals in a pool (dip) or container to control ticks, flies, mites, lice and other external parasites. It can also be done by direct application of a diluted acaricide or parasiticide chemical to the skin through spraying. It is important to follow the manufacturer's instruction on the dilution rate of chemicals. Dips can either be fixed, in which case they are constructed with concrete or movable drums for smaller stock. It is important that a dip allows for complete immersion of the stock for it to be effective. The frequency of dipping could vary from two to four weeks. Typical cattle dips have a volume of 10,000 litres or more, and sheep dips have about 2,000 litres.

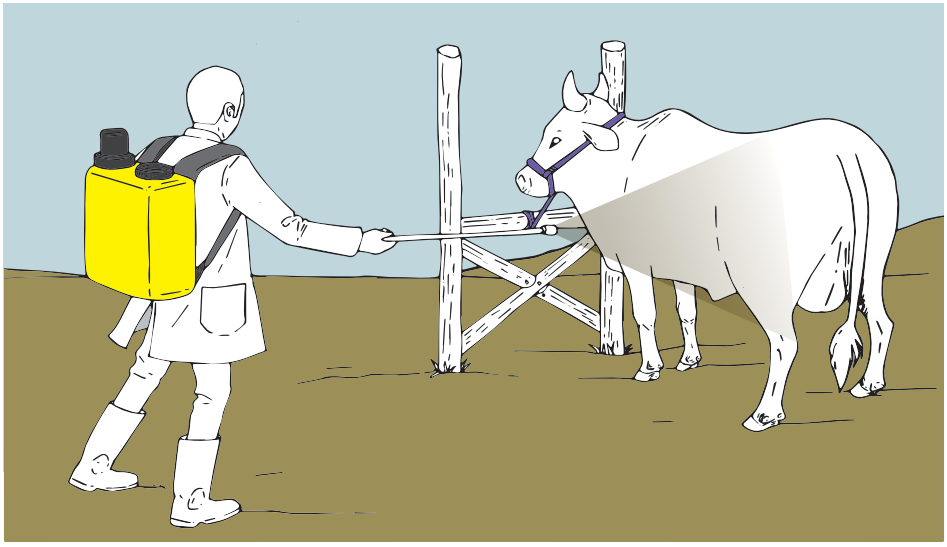


Figure 31: Spraying the body of Cattle

Spraying to control parasites. Using pesticides to kill ectoparasites (mites, lice and ticks) is more popular among cattle owners. It requires that you have the right type of pesticide and that you dilute it according manufacturer's instruction or as guided by the veterinary office nearest to you. To spray, use a knap sac sprayer with the right nozzels directed to the body surface of the cattle.

Pour on or spot on. Pour-ons or backliners are ready-to-use liquid formulations containing one or more parasiticidal active ingredients that are applied to cattle, sheep, pigs or horses by pouring it along the backline, roughly from the neck to the tail. Sometimes they are also called "backline drenches". If the liquid is not poured but sprayed along the backline, they are called spray-ons.

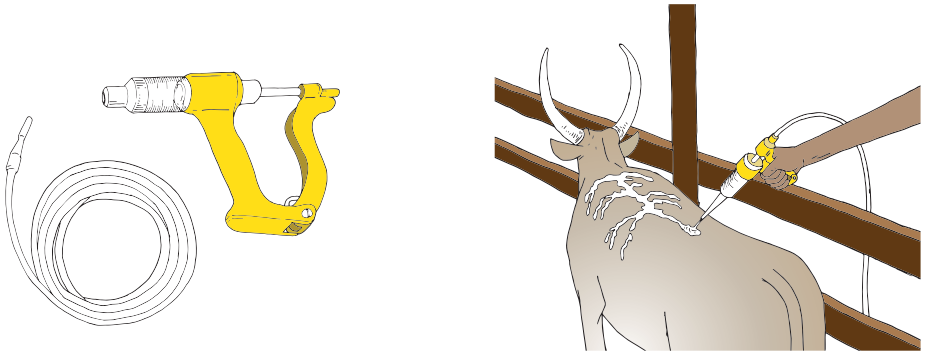


Figure 32: Pour on or spot on application

Livestock slaughter and slaughterhouses

Slaughter refers to any procedure which causes the death of an animal by bleeding. The age to slaughter animals varies depending on many things. The highest quality beef comes from animals that are under 36 months of age. Old cows produce highly acceptable beef if properly fattened and processed. Depending on the calf and the feeding regime, calves are best slaughtered between 3 and 16 weeks of age. Sheep and goats may be killed any time after 6 weeks, but the more desirable age is from 6 to 12 months.

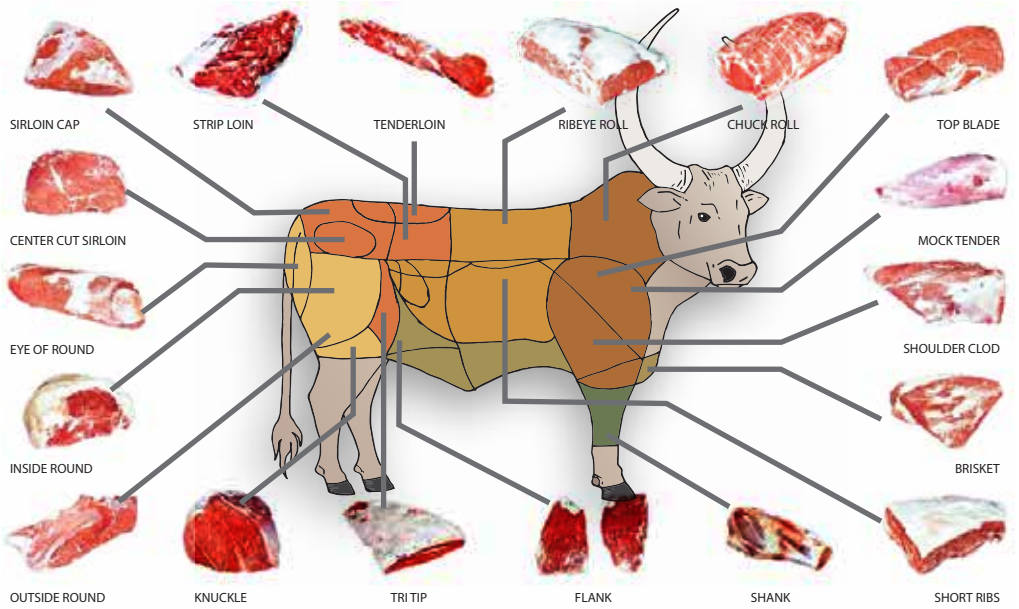


Figure 33: Beef cuts

All livestock should be slaughtered in a healthy and hygienic environment. A well-built and managed slaughterhouse with meat inspection officials in place is required. A slaughterhouse is a premise, including facilities for moving or lairaging animals (a lairage is a place where sheep or cattle may be rested during transit to a market or abattoir). It is used for the slaughter of animals for human consumption or animal feeding that is approved by the national and state Ministry of Livestock and Fisheries.

General hygiene principles for meat handling

It is recommended to keep all meat products clean, cold and covered in order to maintain quality and protect against food poisoning and disease. Generally, contamination occurs when the product comes into contact with dirty hands, clothing, equipment or facilities. If the product is kept clean there will be little or no contamination by microorganisms.

Animal welfare - treatment of livestock before slaughter and its impact on meat quality

Stress in its many forms, e.g. deprivation of water or food, rough handling, exhaustion due to transporting over long distances or mixing of animals reared separately resulting in fighting, is unacceptable from an animal welfare viewpoint and should also be avoided because of its deleterious effects on meat quality. From loading on the farm to the stunning pen, animals must be treated kindly, and the lorries, lairages and equipment for livestock handling must be designed to facilitate humane treatment.

Inside and outside of a slaughterhouse in Kuajok, Warrap State

Slaughter slabs

Figure 34: Slaughter house and slaughter slabs

Slaughtering equipment

Slaughtering equipment, particularly for smaller-scale operations, need not be elaborate and expensive. If possible, all equipment should be made of stainless steel or plastic, be rust resistant and be easily cleaned and sanitized. Equipment which does not come in contact with the meat (e.g. overhead rails, working platforms, knocking pen, and stunner) is usually made of galvanized steel.

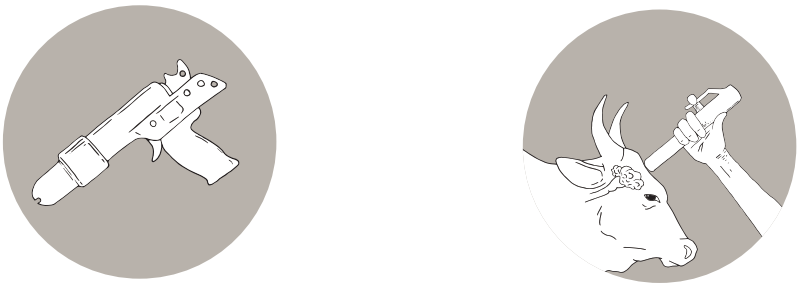
There are many slaughterhouses and slabs across South Sudan. The Government of South Sudan regulations and FAO guidelines recommend that:

The condition of the animals should be assessed upon their arrival to check for any animal welfare problems.
Injured or sick animals requiring immediate slaughter should be killed humanely at the site where they are found.
At the time of slaughter, animals should be healthy and physiologically normal.
Slaughter animals should be adequately rested.
They should be rested, preferably overnight, particularly if they have travelled for some time over long distances.
When ready for slaughter, animals should be driven to the stunning area in a quiet and orderly manner without undue fuss and noise. For humane slaughtering, it is required that stunning must render animals immediately insensible to pain on the first attempt.
Stunning must ensure animals remain insensible to pain until the animal dies due to slaughter or blood loss. Stunning is any mechanical, electrical, chemical or other procedure which causes immediate loss of consciousness which lasts until either the animal is killed or it recovers.

Persons carrying out stunning should be properly trained and competent, and should ensure that:
The animal is adequately restrained.
Animals in restraints are stunned as soon as possible.
The equipment used for stunning is maintained and operated properly in accordance with the manufacturer's recommendations, in particular with regard to the species and size of the animal.
The instrument is applied correctly.
Stunned animals are bled out (slaughtered) as soon as possible.
Animals are not stunned when slaughter is likely to be delayed.

In addition, when an animal is not properly stunned, a backup procedure must be used immediately.

Stunning gun



Correct Positioning of Stunner

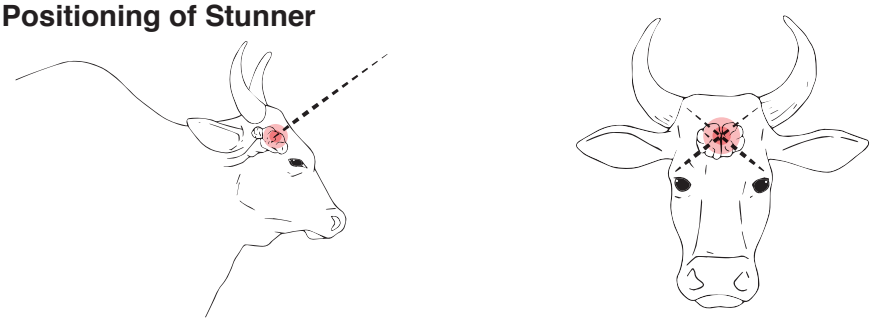


Figure 35: Stunning gun and position for stunning

Signs of an effective captive bolt stun:

Animal should collapse immediately
Eyes fixed
No corneal reflex (no blinking when eye ball is touched)
No rhythmic breathing, even though the heart does not stop for some time

Signs of an ineffective captive bolt stun:
Attempts to raise head and stand up requiring repeat stuns
Eyes rolled down
Positive corneal reflex
Rhythmic breathing

How to restrain cattle

Restraining cattle humanely is the process of bringing the cattle into a position where it is not able to move and is under the least stress possible.

Basic types of restraint

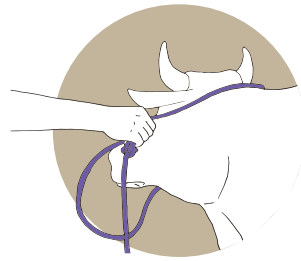
- Halters
- Mechanical restraints (e.g., crushes or chutes, stocks, stanchions)
- Chemical restraint

Halters

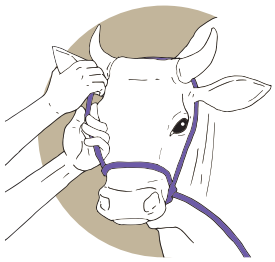
Halters and crushes are very commonly used in South Sudan. A cattle crush or squeeze chute is a strongly built stall for holding cattle safely. It is used to enable easy access for examination of different size animals. Crushes are used to minimise the risk of injury.

Halters are strong ropes used for restraining cattle. Before putting on a halter; stroke the cattle on its head continuously without hesitating as cattle can sense the fear of a human. Putting on a halter will only be hard if the animal senses your fear. Hold the halter with the knot at a water drop position which indicates that the top part goes over the head and the lower hole is the nose piece. Walk toward the cattle but be sure to stand outside the flight zone of the cattle to prevent the cow from panicking. Place the rope of the head piece behind the ears of the cattle and the rope of the nose piece under the mouth; adjust the rope to fit the animal. Pull the long string attached to tighten the halter. Tie the rope onto a pole. To prevent the cattle from moving its head when checking the eyes or ears pull the rope until the cattle faces one direction. Tie the rope to the crush tightly to prevent the animal from pulling free.

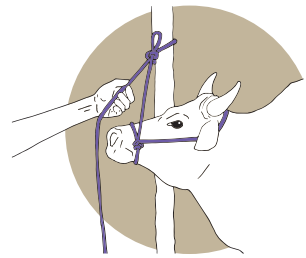
(1) Livestock Rope Halter



(2) Place Head Stall over Poll and behind ears



(3) Adjust slip lead to proper fit



(4) Secure lead with Quick release knot

Figure 36: Securing a halter

There are different types of cattle crushes with different features. Typical features of the cattle crush include: push-pull lever, dual locking system, side gates (with slam gate latches), needle gates, inspection gates, bottom gate and walk through vet compartment.

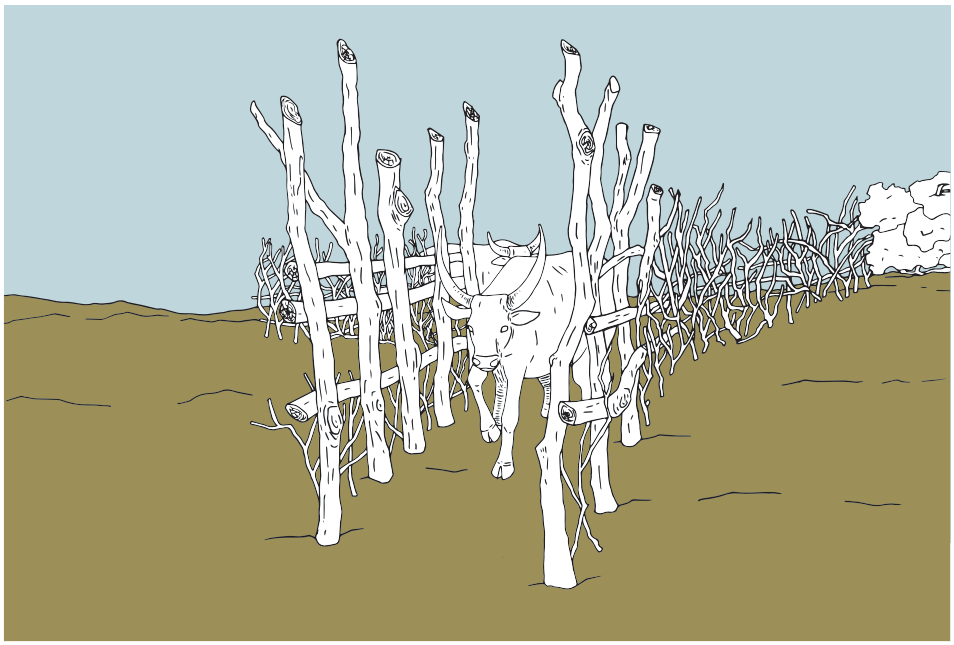


Figure 37: Locally adapted crush for vaccination of livestock in South Sudan

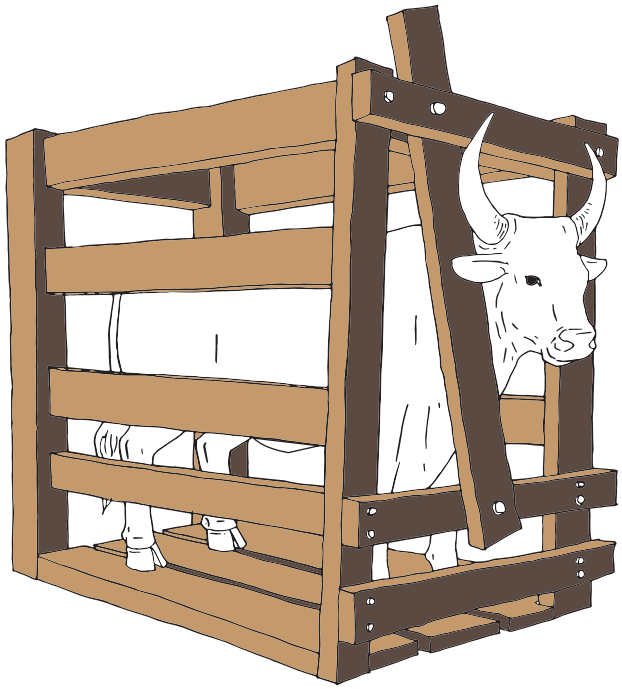


Figure 38: Improved cattle crush

The steps for restraining cattle in a cattle crush are as follows:

Cattle restrained in the crush. The head will be outside the gate. Direct the cattle into the open crush. Use the principles of the flight zone. Two people might be needed, one who makes the cow move and one who is to restraint the cow.
Close the dual head gate on the cow's neck in front of the shoulders. This is done by moving the lever on the side of the crush down.
Close the rear sliding gate for optimal animal control. When ready to close the crush do not have too many people around the crush, as it might make the cow nervous. By using your foot to manoeuvre the gate you avoid being in reach of the cattle, should it kick in defence.
Operate the side squeeze in order to position the cattle. Squeezing the animal in the crush actually calms it down and does not hurt it.
A head holder can be applied for better control.

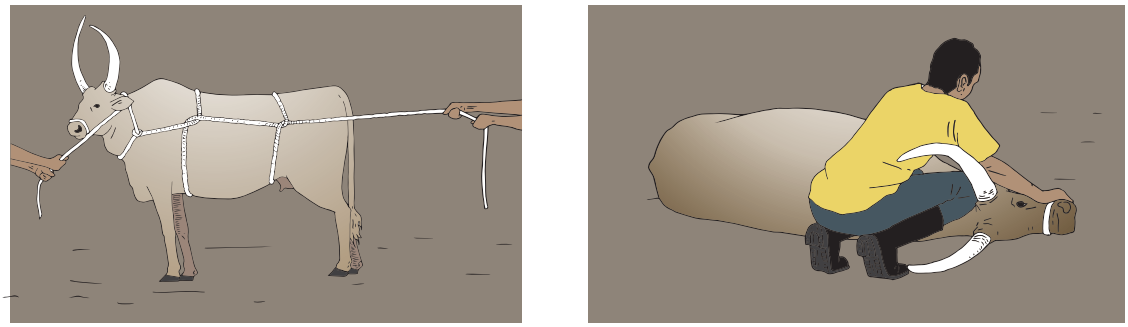


Figure 39: Restraining cattle

Halal rules of slaughtering

Halal food is the food which is allowed to be consumed according to Islamic rules, which includes standards for the slaughtering of animals as summarized below. Slaughtering practices before acceptable meat products are obtained by Muslim consumers are of utmost importance, especially for those who want to ensure they comply with halal requirements. In practice, the Muslim method of slaughter, now commonly referred to as the halal method, is shown to vary in the way it is applied.

The following animals are examples considered as halal:
Domesticated animals such as cows, buffalos, sheep, goats, camels, chickens, geese, ducks and turkeys;
Non-predatory wild animals such as deer, antelope, chamois, wild cows and zebras;
Non-predatory birds such as pigeons, sparrows, quails, starlings and ostriches;
Grasshoppers.

Requirements of halal animals to be slaughtered

The animal to be slaughtered has to be an animal that is halal.
A certificate must be issued by a veterinary authority which attests that animals to be slaughtered are healthy.
The animal to be slaughtered shall be alive or deemed to be an alive at the time of slaughter. The slaughtering procedure should not cause torture to animals and should be done with animal welfare consideration.
For a certain period before slaughtering, animals should be fed with halal food. This period is a minimum of three days for halal animals. Feeding of animals should be cut down for a period of six hours before slaughtering.
If animals have arrived from a long distance, they should first be allowed to rest before slaughtering.

Slaughterer of halal animals

The slaughterer shall be a Muslim who is mentally sound and fully understands the fundamental rules and conditions related to the slaughter of animals.
The slaughterer shall have a certificate of halal slaughtering issued by a competent authority supervising matters relating to health, hygiene, sanitation and rules of halal slaughtering.
A slaughter performed by religiously observant Jews or Christians who properly meets all halal requirements described herein may be used when a Muslim slaughterer is not available.

Factors to consider when establishing a slaughterhouse

Location: When siting a slaughterhouse, the key stakeholders (traders, butchers, livestock owners, local authorities, police and relevant ministries) must be consulted in choosing the location. This ensures sustainability and continued use – a key challenge across the country. Establish slaughter houses and slabs away from residential areas for the purpose of hygiene, protection and environmental pollution. Accessibility and easy access to the market are also important factors to consider.

Design: Must be simple and appropriate, with adequate lighting and water supply. Waste processing facilities are essential, and they can be connected to a biogas production system.

Floors: Brick, tile, smooth concrete or other impervious, waterproof materials are suitable for floors.

Drains: To carry away waste liquids, there should be sufficient drains of the proper size that are correctly located, trapped and vented. All floors should be sloped toward the drains. Generally, for adequate waste disposal, one drain is needed for each 18 m2 of floor space in slaughtering areas, and one drain for each 46 m2 in processing and other areas. The drains must not empty into streams or rivers.

Walls: Glazed tile, smooth cement plaster, rust-proof metal panels and smooth plastic panels are all acceptable for walls in processing and refrigerated areas because they can be effectively cleaned and sanitized. Other materials are also acceptable if they can be satisfactorily cleaned. In no instance should walls be made of materials that absorb moisture or other liquids. Ceilings must be tight, smooth and free from any scaling that may fall into the meat products, and they should also be of moisture-resistant materials.

Doors and doorways: All doorways should be wide enough to ensure that the meat never touch the doorways, which risks contamination.

Water supply: Whether from individually owned and controlled sources such as wells or streams, or from a municipal system, the water supply must be potable, and abundant cold and hot water must be distributed to all parts of the operation.

Lighting: In all areas wherever any processing occurs and where products are critically examined during sanitary control or for cleanliness, adequate light should be provided. In all other areas, such as dry storage, there should be sufficient light to keep the area orderly and sanitary.

Refrigeration: The main purpose of refrigeration is to cool the meat down after slaughter and to maintain it in a chilled state for short or long storage periods and for cutting and further processing. If frozen storage is provided and utilized, it should be maintained at the lowest possible temperature for maximum shelf life. Minus 12°C to minus 18°C is satisfactory freezer storage. However, large quantities of product must either be quick-frozen prior to storage or thinly spread out to facilitate freezing. It is also recommended that all rooms where meat is processed should be maintained at a temperature of about 12°C. In facilities where no refrigeration or cooling is furnished in processing areas, the handling of meat products is possible if all equipment contacting the products is thoroughly cleaned and sanitized from time to time (recommended every four hours). Frequent cleaning is necessary because in warmer temperatures bacteria multiply rapidly and the risk of product contamination increases.
Refrigeration, handling and transport of carcasses and meat

Refrigeration of carcasses

Carcasses should go into the cooler as soon as possible and should be as dry as possible. The object of refrigeration is to retard bacterial growth and extend the shelf life. Chilling meat post-mortem from 40°C down to 0°C and keeping it cold will give a shelf life of up to three weeks, provided high standards of hygiene were observed during slaughter and dressing.

Marketing of meat under refrigeration

Chilled meat must be kept cold until it is sold or cooked. Chilling is a fundamental operation which is about applying cold to meat to reduce its temperature quickly. An ideal storage temperature for fresh meat is just above freezing point (0°C). If the cold chain is broken, condensation forms and microbes grow rapidly. Do not overload, leave space for air circulation, open doors as little as possible and observe the highest hygiene standards when handling the meat.

Transport of meat

Vehicles for transporting meat and carcasses should be considered as an extension of the refrigerated storage. The objective must be to maintain the meat temperature at or near 0°C. Meat should be chilled to 0°C before loading. Meat should hang on rails, not be placed on the floor. Meat trucks should not carry anything other than meat.

Non-refrigerated handling and marketing of carcasses and meat

Where refrigeration is unavailable either owing to financial or technical reasons (e.g. no power supply), as is generally the case in South Sudan, the shelf life of meat is reduced to days or hours, not weeks. Slaughter and dressing must be near the point of sale and it must be quick and clean. If carcasses and meat are kept in well-insulated rooms, the temperature can be reduced with dry-ice blocks, if these are available.

Non-refrigerated storage and transport

Meat should be put on sale within a day of slaughter. If it has to be held it should be hung in a clean, well-lit hall with good ventilation. Insects, rodents and birds must be kept out and dust must not blow in. Trays of offal should be on shelves, not on the floor. Barrows for wheeling carcasses and quarters are better than carrying on shoulders, as they can be cleaned frequently. All staff must wear clean clothing and observe strict personal hygiene.

Marketing of cattle and products in South Sudan

Marketing is an important aspect of any livestock system as the mechanism whereby producers exchange their livestock and livestock products for cash. The cash is then used to acquire goods and services which farmers do not produce themselves, in order to satisfy a variety of needs ranging from food items, clothing, medication and schooling to the purchase of breeding stock and other production inputs and supplies.

Marketing of cattle and their products

Markets for livestock and livestock products should be identified in advance, i.e. before venturing into production;

A study should be conducted of the local markets to establish the appropriate time to sell livestock (marketing weeks/days) in a particular location;

Appropriate licences must be obtained from local authorities (meat inspection units, the public health office and the quality control office, etc.) for the butchery and sale of livestock and/or the operation of livestock sale points;

All livestock products being sold on the local market should be clean and properly packaged;

The sale of milk that is adulterated with water or flour, meat products soiled with grass, twigs, leaves, etc., is prohibited by law and must be avoided;

Livestock should be sold in designated holding yards.

Structure of cattle markets in South Sudan

Table 9: Structure of cattle markets in South Sudan

Type of market	Main sellers	Main buyers	Purpose of purchase
Primary collection markets (auctions)	Livestock owner, auctioneer	Other livestock keepers, middlemen	Stock replacement, fattening
		Local butchers	Slaughter
		Traders	Collection for resale in larger regional markets
Secondary distribution markets	Traders, middlemen	Butchers	Slaughter
		Traders	Resale in terminal markets
Terminal markets	Traders	Local slaughter houses	Slaughter
		Traders	Export

NB: It is important for pastoralists to monitor prices in the surrounding markets in order to secure the best price for their animals.

Agro-pastoral farming practices

This is a production system whereby livestock farming is practised alongside crop farming. The farmer keeps both livestock and crops concurrently, but in separate geographical locations. The two forms of production can complement each other in that livestock feed on crop residue and crop farming benefits from the application of manure and the use of animal traction. The majority of farmers in South Sudan are agro-pastoralists, who rear cattle as well as grow arable crops in the rainy season.

In South Sudan, based on the seasonal calendar, livestock are brought to herders' homesteads to feed on plant residues and provide manure for the farms. They are also allowed to graze in the fields following the harvest.

This system provides the household with both crops (cereals and legumes) and milk for protein. This practice has the following advantages and disadvantages:

Advantages of the agro-pastoralist system

During the dry season, animals can be moved to the homestead and kept in the crop farm in order to provide manure;

Livestock can feed on crop residue, which is a good source of dry roughage;

The local population is provided with access to dairy and meat products;

It enhances the income of livestock keepers since cash can be generated through the sale of dairy and meat products;

It provides easy access to livestock herds for vaccination and treatment during the dry season.

Disadvantages of the agro-pastoralist system

It can contribute to the spread of invasive weed species;

Cattle can destroy unprotected perennial and ratoon crops such as cassava, fruit trees, etc.

Recommendations

Animals brought to the homestead should be kept in specific areas reserved for the controlled accumulation of animal manure;

Pits should be dug for the storage of animal manure to reduce ammonia loss through volatilisation;

Local farmers should be encouraged to use compost manure to fertilise crop farms;

The use of draught power (ox ploughs) must be encouraged to ensure effective utilisation of both animal and crop resources at household level.

Hides and skins

These can be a valuable source of income if properly cured. The value of the hide is always equal to a quarter of the value of the animal. Unfortunately, the cattle owner never receives the full price due to poor processing and surrogate practices, e.g. poor flaying, curing and drying. Hides and skins can be of important economic and cultural value to local farmers if well utilised.

The following key benefits can be gained from hides and skins:

Economic

The sale of raw hides and skins to local processors can be an important source of income for local farmers;

Improving the quality of hides and skins can enable them to get higher prices on both local and national markets, as local tanneries can buy them for further processing into leather products.

Domestic and cultural uses

Hides and skins are processed to make water storage containers;
Hides and skins are traditionally used as bedding materials;
Local communities use skins to carry children and household items;
Hides and skins can be used to make drums;
Hides and skins can be used as clothing during ritual occasions.

Hide and skin processing in South Sudan

To obtain a good-quality skin or hide, specific slaughtering and flaying procedures must be followed. It should be ensured that:
An appropriate (and adequately sharp) knife is used;
The knife is held properly;
The carcass is flayed immediately after slaughter (while still warm);
The hide is kept free of blood and manure;
Cutting, gorging and scouring are all avoided;
The skin/hide is pulled or beaten off whenever possible;
Long (not short) cuts are made with the knife.
The following steps should be observed:

Skin the animal: Start by skinning the stock. This is the process of separating the skin from an animal using local knives or blades.

Fleshing: Scrape off flesh and fat from the skin to protect the hide from rotting. The hide should be fleshed immediately after it is cut from the animal's body.

Dry the skin or hide: The hide should be dried out for a few days to prepare it for tanning. Drying depends on the thickness of the hide and the amount of moisture in the air. Natural drying takes about 14 days. Hides that have been trimmed after flaying will also need to be trimmed after drying to give them a good shape. If a fresh animal skin cannot be processed immediately in the tannery, it is stored and preserved in order to halt decay.

Figure 40: Drying skins

This must be done quickly to prevent bacterial growth, which usually begins approximately 2 hours after slaughter. Bacteria can destroy the skin (putrefaction) and render it unusable for making fur or leather. The optimal temperature for storing the skins is between 4-7°C. Hanging them to drain the blood is also important. Common methods of preservation are freezing, salting and drying.

Trim and lace them.

This involves making holes all around the hide or skin through which strings or ropes made from the hide can be threaded. A large skin may need up to 34 holes, which can be made using either a knife or a punch. Skins should be hung in the shade with the flesh facing outward. Holes can also be punched along the edge of the hide and twine used to attach it to a drying rack. Alternatively, the hide may be left to dry on the ground.

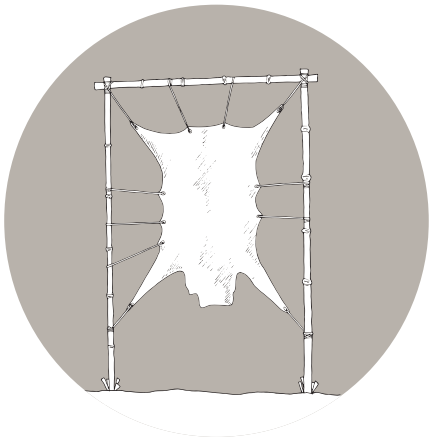


Figure 41: Lacing skins

Tanning

Tanning is the process of treating skins and hides of animals to produce leather. It involves chemical treatment of raw animal hides or skins to convert them into leather. A tanning agent displaces water from the interstices between the protein fibres and cements these fibres together. Animal hides go through several stages before they are ready for use in making products like belts, wallets, shoes, furniture and clothing. The stages before tanning may include fleshing, preservation or curing, soaking, liming, unhairing, splitting, deliming, bating, degreasing, bleaching, pickling, and depickling.

Rawhide is made by scraping the skin thin, perhaps soaking it in lime, and then stretching it while it dries. Rawhide is not technically "leather", but is usually lumped in with the other forms. Rawhide is stiffer and more brittle than other forms of leather, and is primarily found in uses such as drumheads where it doesn't need to flex significantly; it is also cut up into cords for use in lacing or stitching.

Vegetable tanning is a process of tanning hides that uses the tannins found in various types of vegetation and tree bark to produce supple leather that can be hardened and used for carving or stamping. Vegetable tanned leather is not stable in water. After a soaking it can shrink drastically and begin to deteriorate.

Chrome tanning is a process of tanning hides that uses various chromium sulphates to produce leather that is more pliable and less affected by water than vegetable tanned hides. The process also allows for a wider range of colours because of the chemical content. It involves soaking the hides in baths containing acidic salts until they are ready for the next step, chrome tanning. The bath includes chromium tanning agents and the acidity of the bath is decreased until the surface of the hides starts absorbing the chromium agents. The wet hides produced from this process are blue, and known as "wet blue hides." Chrome tanning is faster than vegetable tanning and can take up to a day with modern machinery. However, the wash water from chrome water is considered to be hazardous waste and should therefore be handled with care and with expert advice.

Aldehyde tanning is a process of tanning hides that uses chemicals that are often associated nowadays with disinfecting medical or dental equipment. Formaldehyde was one preservative in this category.

Table 10: Stages of the tanning process

RAW HIDES OR SKINS	
BEAMHOUSE	Sorting-Trimming
	Soaking- Liming
	Fleshing-Pelt splitting
TANNING	Deliming-Bating
	Degreasing
	Pickling
	Tanning
	Sammying
POST-TANNING	Splitting
	Shaving
	Retanning
	Neutralisation
	Dyeing
	Fatliquoring
	Sammying
	Drying
	Staking
FINISHING	Finishing
	Mechanical operations
	Sorting-Packing-Dispatching
FINISHED LEATHER	

In Sudan and South Sudan, vegetable tanning is the most widely used method for tanning skins. Using this method the hide or skin is soaked for 3-4 days in a solution made using garath seeds (Acacia spp) to tan. The seeds are removed from the pod, the pod is ground and the powder mixed with water. After 3-4 days, the skin or hide is removed from the solution. All remnants of hair, meat and fat will remain in the solution. The hide/skin is taken out for drying and is ready for use within a few days.

Fold the hides: Hides should always be folded with the hair on the inside to protect the grain (the most valuable part) and avoid cracking. This also reduces contamination by dust, rain, etc.

Store properly: When hides are not to be dispatched immediately for sale, they should be stored and sprayed or brined (applying salt). According to the leather dictionary, the salting preservation method primarily drains the skin. It is essential that the salt (chemical: sodium chloride) is fresh. A salt which has already been used for preservation contains too many microorganisms and therefore does not guarantee good preservation when reused. The salt should not contain impurities, due to iron compounds. Likewise, only very small amounts of calcium or magnesium compounds may be present as impurities. The method of salting is free from cooling, but must be carried out very carefully in order to avoid putrefaction (bacteria

growing and destroying the skin). Sufficient salt is required to completely saturate the skin so as to stop any bacterial growth. For this reason, the rawhide has to be salted with 40-50% salt in relation to the skin weight. This equates to more than one centimetre layer of salt on the flesh side of the skin. Therefore, a skin of 40-50 kg requires approximately 20-25 kg of salt. The process involves sprinkling the skin with solid salt (dry salting) or by treating the skin with salt solutions (wet salting).

Grading of hide and skins

This is the process of judging the quality of hides and skins via thorough inspection of the skin. To earn premium prices, the golden rule is to avoid faults and defects. For the purpose of this standard, faults and defects are distributed in five groups:

Natural defects caused by diseases and parasites on the living animal, e.g. anthrax, scars, ringworm, tumours, ticks, lice, warble, etc.

Mechanically caused defects by the living animal: brands, bruises, scratches, wounds, wire damage, etc.

Dirt, dung, urine stains, sand, seeds, etc.

Flaying defects such as cuts, scores, corduroy, holds, grain cracks, pulling machine damage, etc.

Curing and storing defects.

The quality of hides is directly related to its leather making characteristics, mainly the yield and quality. Grading can be in four grades:

First Grade

The first grade shall be done according to the following requirements:
Hide of good pattern, clean and well cured, there should be no sign of putrefaction (decay and rotting);
Free of defects in the butt and neck area, except for a maximum of 5 blind warbles;
With only a few score marks or one hole in the bellies;
Without brand marks.

Second Grade

The second grade shall be done according to the following requirements:
Hide of good pattern and well cured, showing no sign of putrefaction;
With a few small holes or cuts or other defects from group one and two in the butt;
With a moderate number of defects from groups one and two–except for brands and for holes in bellies and neck;
With ONE brand which is wholly within 18 cm of the perimeter of the hide;
With a maximum of ten open warbles or twenty blind warbles (caused by warble flies see growth cycle above);
With dung and urine stain not more than an area of 30 x 30 cm on each of the hind shanks.

Third Grade

The third grade shall be done according to the following requirements:
Hide of poor pattern or spoiled;
With some putrefaction defects;
With defects from group one and two – except for brands and for up to 30% of the hide area;
With a brand of which any portion is more than 18 cm from the perimeter of the hide;
With more than ten open warbles and 20 blind warbles;
With more dung and urine stain than acceptable for grade 2.

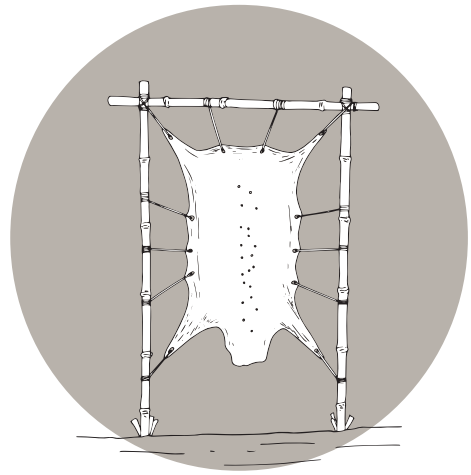


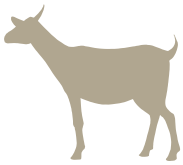
Figure 42: Holes through skins caused by wabble flies

Fourth Grade

The fourth grade shall be made according to the following requirements:
Very poor pattern or very spoiled hide
With any kind of defects covering up to 50% of the hide area.

Sheep and Goats

12.4 million goats and 12.1 million sheep

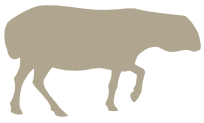


Subfamily:	Caprinae
Genus:	Capra
Species:	*C. aegagrus*
Subspecies:	*C. a. hircus*

Blackhead Persian

Toposa

Latuka-Bari



Subfamily:	Caprinae
Genus:	*Ovis*
Species:	*O. aries*

Blackhead Persian

Nilotic

Nuba Maned

Introduction

Since time immemorial, communities in South Sudan have reared sheep and goats as complementary sources of food alongside cattle rearing and the cultivation of crops. According to the Comprehensive Agriculture Master Plan report of 2015 report South Sudan has an estimated 12.3 million goats and 11.3 million sheep. Sheep (Ovis aries) and goats (Capra hircus) are small ruminant animals. Sheep and goats play an important role in the livelihood of a large percentage of pastoralists, smallholder farmers and land-less farmers. They bring many advantages to resource-poor farming communities in South Sudan due to their potentially high returns and ease of rearing.

Goats are browsers while sheep are grazers, which helps balance the effects of their rearing on the local environment. Goats have special feeding habits that allow them to take foliage which is not available to other livestock species. There is a high growth rate in both sheep and goat populations (2%) despite being slaughtered at higher numbers due to their prolificacy, short inter-kidding interval and regular breeding throughout the year.

Table 11: Nomenclature for Sheep and Goats

Nomenclature		
Traits	**Sheep**	**Goat**
Species	Ovine	Caprine
Group	Flock	Herd
Adult male	Ram	Buck
Adult female	Ewe	Doe
Young male	Ram lamb	Buckling
Young female	Ewe lamb	Goatling
New born	Born	Kid
Castrated Male	Wedder	Wether
Castrated Female	Spayed	Spayed
Act of parturition	Lambing	Kidding
Act of mating	Tupping	Servicing

The advantages and disadvantages of rearing sheep and goats include:

Advantages

Both sheep and goats are easier to handle and manage than cattle.
They feed on a variety of forage plants which makes them cheaper to maintain than cattle, especially during the dry season.
Goats are hardy and can adapt to and survive in different agro-climatic conditions including semi-arid areas with sparse vegetation, bushes and shrubs. Steeply sloped mountainous regions cannot be suited for cattle but goat and sheep can survive.
Being smaller in size, with a larger surface area, makes them well adapted to higher temperature and arid areas.

Low cost of maintenance, short term return and low risk make goats and sheep better suited for small and marginal farmers.
Higher crude fibre digestibility.
They are small-bodied animals that do not require much housing or space.
They are both a direct source of food (meat and milk) and a source of income when exported to the region (goat barbeque is popularly eaten in East Africa as nyama choma).
They have shorter gestation periods than cattle (145-154 days or 4-5 months).
They can be used as dowry and bride prices (3-4 goats are accepted as the equivalent of one cow).
They provide a good source of farm manure.
Both sheep and goat skins (processed as hides) can be used for making leather.
Where kept by agro-pastoralists, goat and sheep act as insurance during crop and or rain failure.
Sheep can be used for cultural festivals.
They have high disease resistance.
Sheep are gregarious animals and have the tendency of flocking together.

Disadvantages

Sheep and goats tend to wander and therefore require more labour to look after them, often coming from children who would otherwise be in school;
They can be more destructive to perennial crops and fruit trees around the homestead, especially in the case of goats because of their browsing habit.

Environmental, social and gender issues related to rearing sheep and goats

Environmental factors: Sheep and goats can be kept in nearly all parts of South Sudan regardless of ecological conditions. They do not pose serious environmental risks or threats, although their browsing nature can sometimes become a problem. Overgrazing exposes soil to all forms of erosion.

Social factors: Sheep and goats are a more important social asset than cattle. They are mostly slaughtered for visitors and are consumed during many festivities and ceremonies such as marriages, christenings and burials. Sheep and goats are very important in times of crisis management as they can be given as compensation or as gifts to friends.

Gender issues: In most cases, sheep and goats are managed by women who are able to make decisions on their use. However, men still maintain substantial control over livestock assets.

Common sheep and goat breeds in South Sudan

Table 12: Common sheep and goat breeds in South Sudan

Breed	Ecotype	Major characteristics
Thin-tailed sheep South Sudan hairy sheep	Nilotic (Dinka, Nuer, Shulluk, etc.) Mangalla	Thin tail Hairy body Small to medium size
Fat-tailed sheep	Toposa sheep	Fat tail White colour is common
Nilotic goat	Dinka, Nuer, Shulluk	Medium horn and ear Large body and legs
Dwarf/ mountainous or hilly goat	Latuka , Bari, Maban, etc.	Short horn and short ear, small size, short legs, quick movement, high tripling rate
Trans-boundary goat	Anglo-Nubian	Long ears, big udder, predominantly black in colour
East African small goat	Western Equatoria	Dwarf, medium size, predominantly white in colour

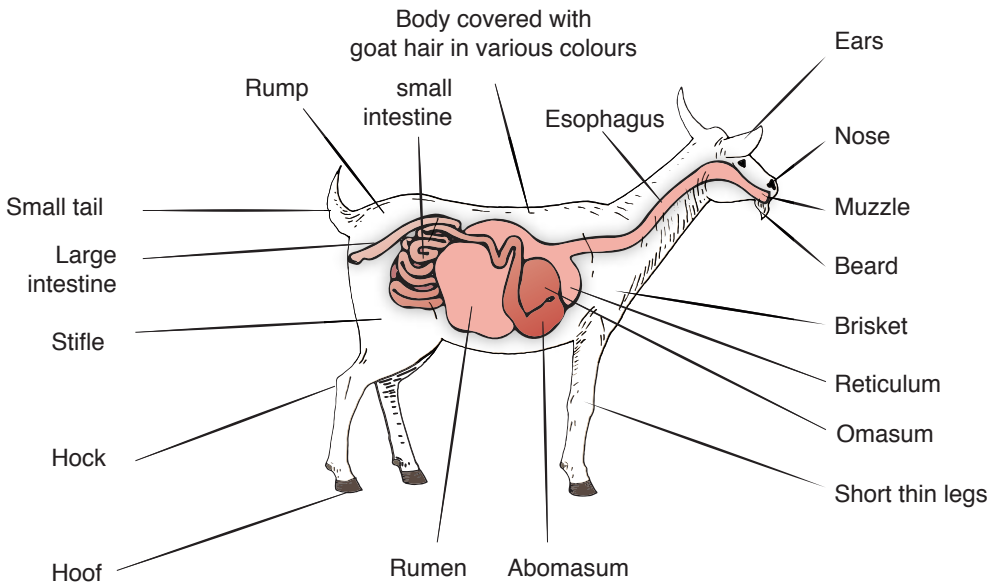


Figure 43: Anatomy of a goat

Criteria for selecting sheep and goats for breeding

Selection criteria for a doe (she-goat)

The doe should be well grown, healthy in appearance and should stand squarely on her feet;

She must have a high frequency rate of kidding;

The body should be wedge-shaped (triangular in shape) and sharp at the withers;

The teats must be disease-free and well-positioned perpendicular to the ground, providing plenty of room for a round, well-attached udder of a fair size;

The ribs should be deep, denoting the capacity to consume large amounts of feed;

Good body conformation (this is essential for milk production);

The doe should have straight legs.

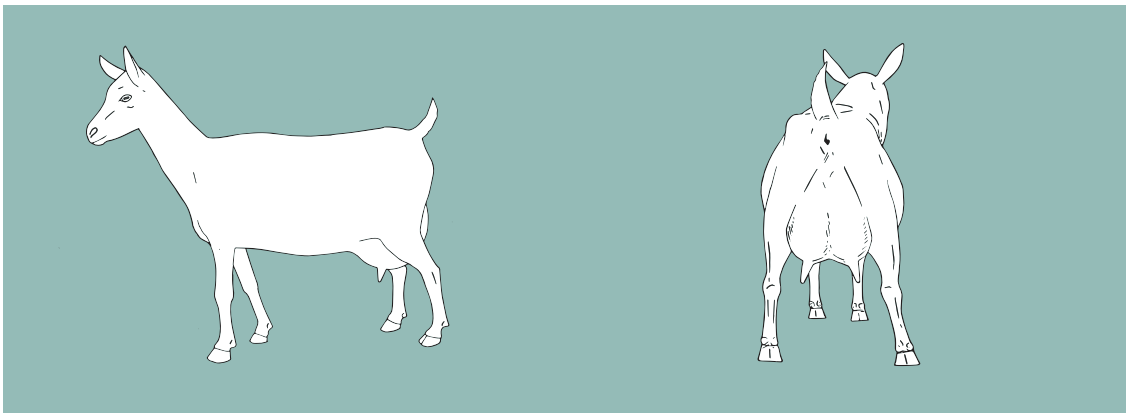
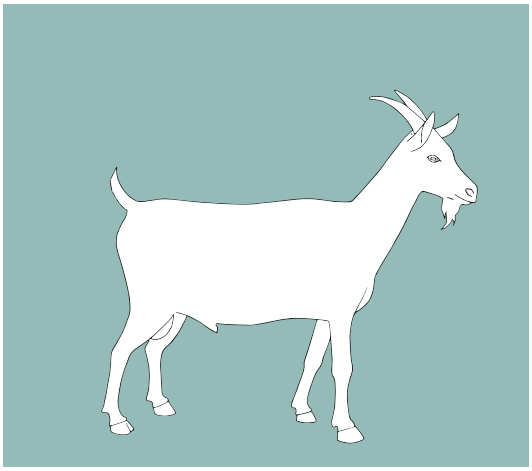


Figure 44: Shape of udder of goats

Selection criteria for a buck (he-goat)

The buck should have a strong, well developed frame and good body conformation and breeding character;
Legs should be straight and well-placed under the body, with good hooves;
The buck should be healthy and free of external and internal parasites;
The buck should be chosen from a good milking strain;
He should not be over-aggressive.



Features to look for when selecting goats or sheep for meat (chevon or mutton)

Round and compact shape
Well-built body muscles
Large body size
High feed conversion ratio

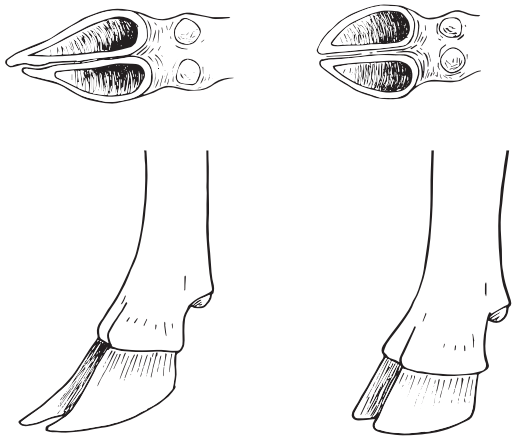


Figure 45: Hooves and their shapes

Determining the age of goats and sheep through dentition

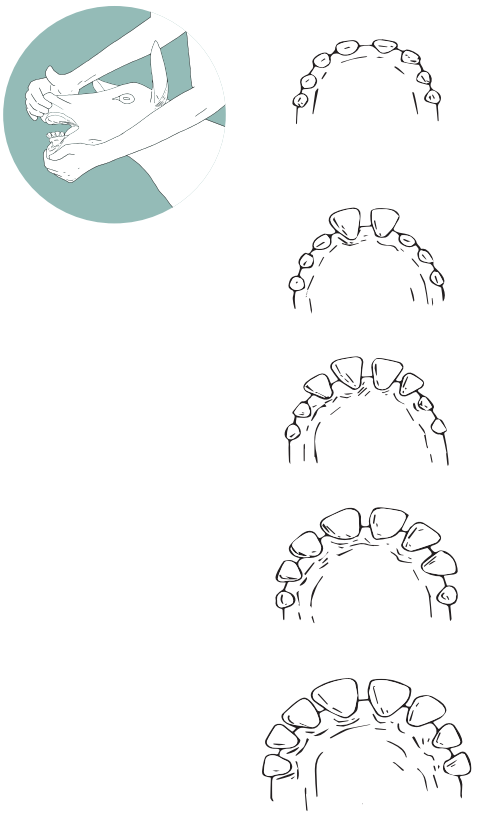


Figure 46:
Dentition for age of goats or sheep

Animal under one year old (no permanent teeth)
One year old (2 permanent teeth)
Two years old (4 permanent teeth)
Three years old (6 permanent teeth)
Four years old (8 permanent teeth)
Old animal, more than four years old
The age of a goat can be judged from the appearance of its front teeth (incisors) on the lower jaw (there are no teeth on the upper jaw). The kid at birth, or shortly afterwards, has teeth on the lower jaw. These are known as suckling teeth and are small and sharp in kids. When the kid is 12-14 months old the central pair is shed and is replaced by two large permanent teeth. When the kid is 24-26 months old two more small teeth are shed and are replaced by two large teeth, one on each side of the first pair. At 36-38 months old there are six permanent teeth, and by the time the goat is 48-50 months old a complete set of four pairs of permanent teeth is present.

General management of sheep and goats

Housing and shelter management: Normally sheep and goat do not require elaborate housing facilities but minimum provision will definitely increase productivity. Most sheep and goats are kept outside and are tied to a stake with a long rope (tether). The three common types of shelter for sheep and goats are also provided across South Sudan. These are (1) walled and roofed, (2) raised floor with wooden walls and (3) built of poles with a roof. Their attributes are as follows:

Table 13: Attributes of housing for sheep and goats

Walled and roofed	Raised floor with wooden walls	Poles with a roof
Wall of up to 1.5m high Well ventilated Keeps animals dry during the rainy season Easy to clean Warm Provides protection against predators and thieves	Warm and easy to clean Animals can be fed at the fence The floor is well drained resulting in reduced incidence of foot rot	Well ventilated The floor can get wet which increases susceptibility to foot rot disease Cheap to construct Exposes animals to rain, heat, cold and drafts

Feeding your sheep/goat

Goats generally accept a wide variety of feeds but they prefer leaves, fresh fodder, grains, seeds and pellets.

The quality of feed consumed by a goat/sheep depends on age, breed, sex, size and physiological status (e.g. pregnant or lactating).

The digestive systems of both sheep and goats are similar being ruminants. However, their feeding patterns differ significantly. Sheep are gazers while goats are natural browsers. Whilst goats also can feed on pasture forage, they prefer to eat shrubs, fresh shoots, buds, leaves, twigs, weeds and vines. As a result, a large variety of tree leaves (top feed) serve as promising feed resources for goat.

The major part of goat feed comes from natural vegetation on common grazing land and other non-cultivable areas.

Goats will consume about 3-5% of their body weight in dry matter daily.

Young goats will consume relatively more than mature goats.

As a thumb rule 2/3 of the energy requirements should be met through roughage. Half of the roughage should be leguminous green fodders and the other half should be grass or tender tree leaves.

Green leguminous fodder should be offered as needed to kids from 15 days onwards.

Provide salt and water to kids at all times.

Kids should be fed colostrum up to 5 days of age. Later on they can be put on kid starter rations.

Additional concentrates should be given to bucks and does during breeding season.

Pregnant and lactating shoats (sheep and goats) need more feed to produce milk and help the foetus to grow.

Minerals and proteins (such as salt licks) are useful to their diet.

0.75 – 1.0 Kg of this ration should be fed to each goat per day

Example of a supplementary ration for goats

Table 14: Supplementary ration for goats

Ingredient	Kilograms
A source of energy, e.g. sorghum, millet or maize bran	6.9kg
A higher protein feed, e.g. groundnut meal or leucaena leaves	3.0kg
Table /common salt (NaCl)	0.1kg
Total	10kg

Common grasses and legumes for forage

Grasses

Aristida spp., Cenchrus ciliaris, Chloris gayana, Cynodon dactylon, Dactylis glomerata, Digitaria spp., Eragro stissuperba, Exotheca abyssinica, Festuca spp., Hyperrhenia spp., Lolium spp., Melinis minutiflora, Panicum coloratum; Panicum maximum; Pennisetum catabasis; Pennisetum clandestinum; Pennisetum purpureum; Pennisetum schimperi; Setarias phacelata; Setarias plendida; Sorghum sudanense; Sporobolu shelvolus; Themeda triandra; Tripsa cumlaxacum

Watering

An unlimited supply of water must be available to shoats at all times;
Water must be clean and fit for consumption by shoats;
Water used in troughs must be changed on a daily basis and the trough itself kept clean to avoid contamination.

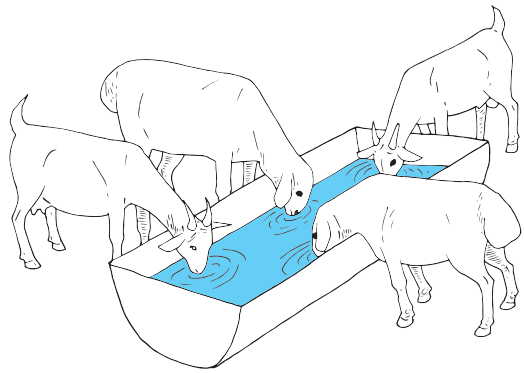


Figure 47: Goats and water trough

Other routine practices

- Be on the alert for signs of illness such as reduced feed intake, fever, abnormal discharge or unusual behaviour.
- Timely vaccination of sheep and goats is essential to the prevention of diseases such as contagious caprine pleuro-pneumonia (CCPP) and peste des petits ruminants (PPR).
- Sick animals must be identified, isolated and treated as soon as possible to avoid spreading disease to other animals within the flock.
- Animals should be regularly dewormed using a deworming agent (e.g. dexamethasone).
- Shoats should be sprayed or dipped to remove ticks and other ecto-parasites.
- The condition of any sick animals should be closely monitored on a daily basis.
- General hygiene, including the cleaning and maintenance of animal housing, is important.
- Any humans who tend the animals must be clean and wear full working attire.
- Each animal in the flock should be observed and checked for changes in behaviour or composure.
- Shoats should be debudded, dehorned and their hooves trimmed when necessary.
- Males that show undesirable genetic characteristics should be castrated in order to prevent the inheritance of such genes by the next generation.
- Consult the nearest veterinary officers in the Ministry of Livestock/Animal Resources closest to you for help if illness is suspected.

Breeding in goats

Breeding as a natural process of reproduction or a program is an important aspect of rearing sheep and goats for milk and meat production. Across South Sudan, breeding occurs naturally under the extensive system. In a controlled situation, a breeding objective must be clearly set out whether one is breeding for increased milk production or seeking to fatten the herd for meat production. Most livestock keepers in South Sudan use natural selection based on the observation of desired characteristics or traits.

Keeping milk safe for human consumption

In most communities in South Sudan goat's milk is part of the staple diet of children and the elderly. It is vital (and a requirement in most countries) to make milk safe for human consumption through pasteurisation. Milk is pasteurised by heating it to at least 62.8°C for 30 minutes, followed by rapid cooling to below 50°C. Following pasteurisation, natural lactic acid and bacteria remain in the milk. They are harmless, but if the milk is not kept cold, the bacteria multiply rapidly and cause it to turn sour.

Milking containers must be sterilised before and after milking using warm water, and they must remain covered. All milking containers must be made of aluminium. Milk must be sieved and boiled (or pasteurised) before drinking. In preparation for milking, the udder must be washed before milking and milking salve (ointment/oil) applied to the udder when it is too dry.

Common sheep and goat diseases and their control

There are numerous diseases that affect sheep and goats in South Sudan. Diseases are generally caused by viruses and bacteria. These include contagious caprine pleuro-pneumonia (CCPP), sheep pox, peste des petits ruminants (PPR), orf, anthrax and foot and mouth disease.

Figure 48: Community animal health worker treating a goat.
Courtesy FAO South Sudan

Table 15: Common sheep and goat diseases and their control

Name of disease	Clinical signs and symptoms	Control	Treatment
Contagious caprine pleuro-pneumonia (CCPP)	Clinical signs include fever (40-42°C), coughing, dyspnoea, high morbidity (about 100%) and high mortality (about 70%).	CCPP vaccination	Antibiotic injection (long-acting OTC)
Sheep and goat pox	Clinical signs include high fever, symptoms of pneumonia and acute enteritis. Skin lesions appear, particularly in areas free of wool.	Vaccination is available	
Peste des petits ruminants (PPR), also known as goat plague	PPR affects both goats and sheep. Clinical signs include abnormal breathing with coughing; discharge from the eyes, nose and mouth; oral sores; diarrhoea and death. The faeces are initially soft before becoming watery, foul-smelling and bloody. It may also contain pieces of dead gut tissue.	Quarantine is essential to avoid spread.	Use broad spectrum antibiotic to treat secondary infections.

Name of disease	Clinical signs and symptoms	Control	Treatment
Orf (contagious ecthyma)	Clinical signs include pustular and scabby lesions on the lips, muzzle and udder, emaciation and pneumonia in lambs.	The lesions should be treated with antiseptic drugs. A vaccine may be used in outbreaks. Affected animals should be isolated and vaccinated to reduce the number of new cases and shorten the course of infection.	
Anthrax	A clear symptom is when animals that appear to be in good condition die suddenly without showing overt signs of ill health. Also common are fever, staggering agitation, depression, lack of coordination, trembling and difficulty breathing, followed by rapid collapse, terminal convulsion and death. Bloody discharges from orifices such as the nose, mouth, ears, penis and rectum are sometimes observed.	Annual vaccination is recommended. This should be done 2-4 weeks before the onset of a known period of outbreaks.	
Heart water	This is the literal presence of water around the heart. The animals will become nervous and afraid of things. Clinical signs include hyperaesthesia (increased sensitivity), a high-step ping stiff gait, excessive blinking and chewing. Affected animals will isolate themselves. In the acute form of heart water, animals often show signs of anorexia and depression along with congested and friable mucous membranes.	Vaccination can help with the control of heart water. Control of tick infestation is a useful preventive measure in some instances, but it may be difficult and expensive to maintain in others.	OTC at 10 mg per kg per day, IM, or doxycycline at 2 mg per kg per day will usually produce a cure if administered early in the course of heart water infection.

General disease control measures

Timely vaccination of sheep and goats is essential to the prevention of diseases such as contagious caprine pleuro-pneumonia (CCPP) and peste des petits ruminants (PPR).

It is important to give colostrum (the creamy, yellowish first milk produced after birth) to the newborn animals immediately after birth. Young sheep and goats that take colostrum develop better immunity against common diseases as well as improved muscular strength.

National quarantine procedures must be followed in order to avoid disease transmission.

Animals must be vaccinated regularly (i.e. a vaccination calendar and treatment procedures have to be clearly followed).
A proper feeding regime is very important since it boosts the immunity of an animal.
Pastures should be well managed in order to avoid infection by disease-causing organisms and agents.

Common parasites and pests of sheep and goats and their control

Parasites
The parasites can be categorised as either endo-parasites (internal) or ecto-parasites (external). Some common parasites are:

- Internal parasites (endo-parasites)
- Gastrointestinal nematodes (roundworms)
- Lungworms
- Tapeworms
- Coccidia.
- External parasites (ecto-parasites)
- Ticks
- Tsetse flies
- Mites
- Fleas and others

Common predators of shoats in South Sudan are hyenas, foxes, baboons and lions.

Tapeworm.

Moniezia expansa is the tapeworm that commonly affects sheep and goats. Monieziosis is a cestodiasis caused by Moniezia sp. including Moniezia expansa and M. benedni. Sheep and goats become infected when they ingest mites containing tapeworm larvae. Once inside the animal, it takes 6 to 7 weeks for the larvae to develop into adult tapeworms. Mites are the intermediate host. When fully developed in the animal it affects the small intestine.

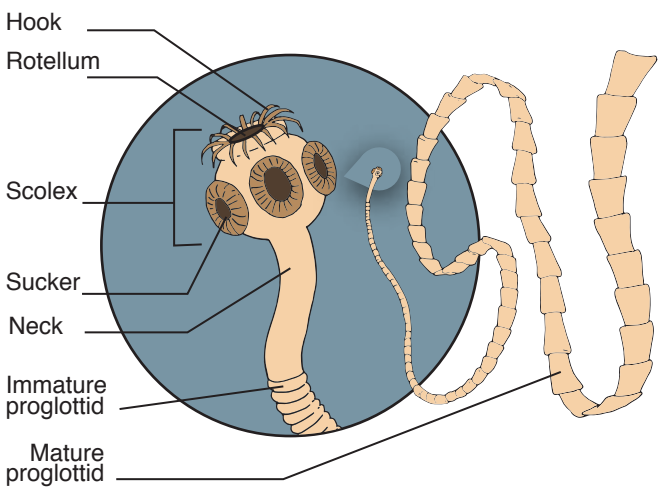


Figure 49: Tape Worm

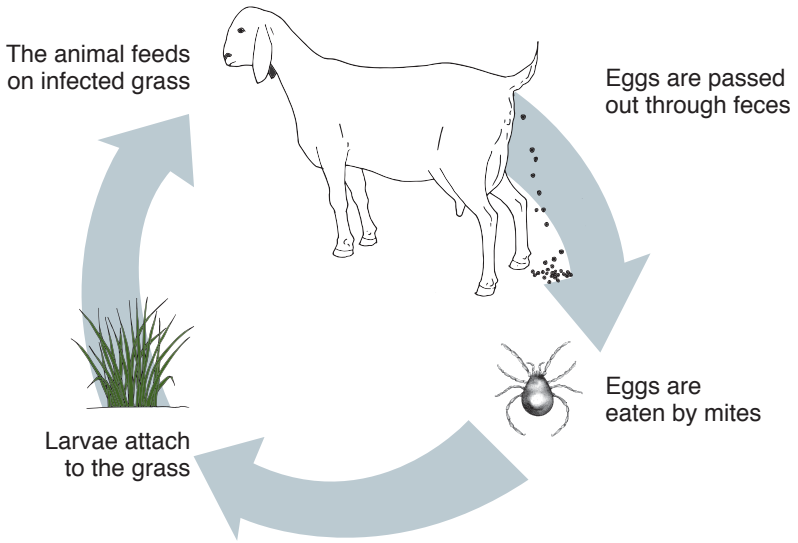


Figure 50: Transmission mode of tapeworm

Symptoms: When there are lots of Moniezia, the intestines will become obstructed or may even rupture. The toxins of the parasite cause young animals becoming neurotic (mild mental illness), including walking in circles, spasms and non-food mastication. Clinical symptoms include decreased appetite, emaciation, anaemia, listlessness, diarrhoea, gravid proglottid (pieces of the worm) in faeces.

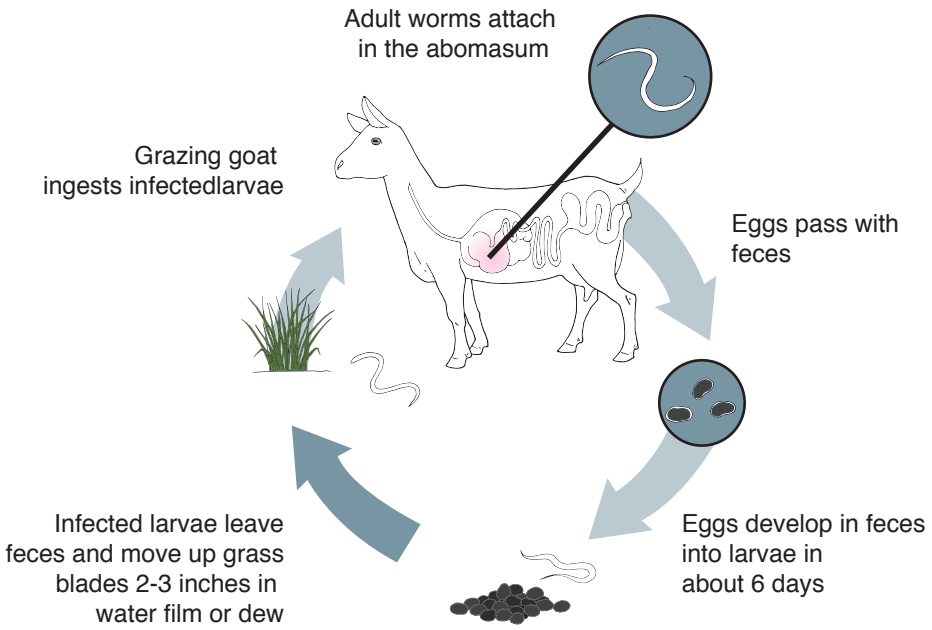


Figure 51: Life cycle of round worms

Symptoms: Adult animals affected by roundworms can go about looking healthy especially if they are well fed, but they still carry the nematode in their guts. Generally, young animals show stunted growth and development, are pot-bellied, have poor coats and may have diarrhoea. Animals with many blood-sucking worms can shows signs of anaemia. In extreme cases they may die.

Lungworms

These are very commonly found in cattle, sheep and goats, horses, mules and donkeys. They can however be very harmful, especially in sheep and goats. The worms live in the small bronchi of the lungs. When eggs are laid, they are coughed up and swallowed by the animal. The sheep can get respiratory complications, deteriorate quickly and die.

Treatment of intestinal parasites

Drugs used to treat gut worms are known as anthelmintics. Deworm all young goats before turning them out to pasture. This is where the parasite eggs live, and an un-wormed goat is highly susceptible to intestinal parasites. Deworm young goats again 2-3 weeks after the first deworming. Rotate goats among different pastures to keep parasite loads down. Diarrhoea and weight loss are the two most pronounced signs of round worm in goats.

The following are suggested medications for treating internal parasites:

- DECTOMAX INJECTABLE is effective against most roundworms of sheep, cattle and goats, parafilaria and sheep scab.
- FINIWORM is registered for cattle, sheep, goats, horses and pigs and is effective against most roundworm including migrating lungworm and nodular worm.
- NILZAN BOLUS is an anthelmentic for the treatment and control of gastrointestinal and pulmonary nematode infestations and chronic fascioliasis in cattle.
- SYSTAMEX is an effective treatment for susceptible strains of small brown stomach worm, (including inhibited larvae), stomach hair worm, barber's pole worm, small intestinal worm, thin-necked intestinal worm, nodule worm, black scour worm, hookworm, tapeworm and lungworm in cattle.
- VALBAZEN® is remedy for roundworms and milk tapeworms in cattle. It prevents roundworms eggs from hatching in the animal at dosing.
- VALBAZEN® FOR SHEEP AND GOATS is a remedy for roundworm, lungworm, milk tapeworm and liver fluke in sheep and goats. Prevents roundworm eggs from hatching in the animal at dosing.
- DECTOMAX INJECTABLE is effective against most roundworms of sheep, cattle and goats, parafilaria and sheep scab.

General livestock pest control

National quarantine procedures must be followed in order to avoid pest infestation;
Animals must be regularly dewormed and sprayed or dipped according to a strict calendar, as listed below;

Table 16: Stages of deworming

	Type of animal	Time of deworming
1st deworming	All animals	Late March or early April
2nd deworming	Animals under one year of age	Middle of July
3rd deworming	All animals	Late October

Overstocking should be avoided;
Livestock housing should be regularly cleaned to eliminate vectors of disease-causing organisms;
Pasture should be well managed and rotational grazing practised in order to avoid infestation by cysts or pests;
Regular and timely dipping and deworming is recommended.

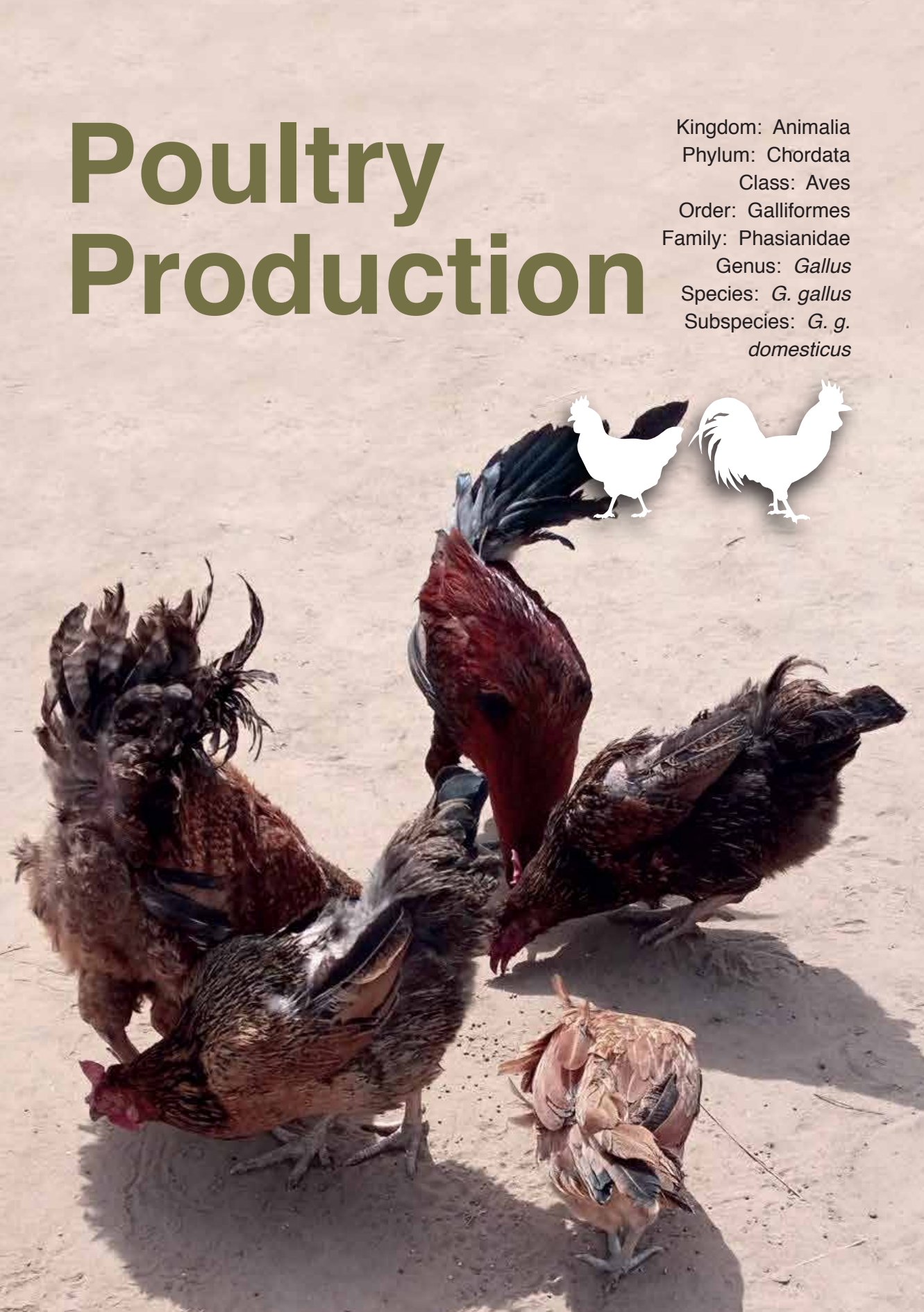
Marketing of sheep and goats and their products

Traditionally, sheep and goats are sold at local markets and often in villages. Local markets tend to be auction markets or sale yards at which live animals are sold. At the butcheries, sheep and goats are slaughtered and their meat sold by the kilogram. Goat meat (chevon) in particular is a delicacy when served in a popular dish called chaya-be-jamur or nyamachoma while mutton is very popular for religious festivities. When marketing, the following should be considered:

- Identification of markets for shoats and shoat products should be conducted before venturing into production;
- A study should be conducted of the local markets to establish the appropriate time to sell livestock (marketing weeks/days) in a particular location;
- Appropriate licences must be obtained from local authorities (meat inspection units, the public health office, the quality control office, etc.) for the butchery and sale of livestock and/or the operation of livestock sale points;
- All livestock products being sold on the local market should be clean and properly packaged;
- All sheep and goats should be sold at designated auction yards.

Poultry Production

Kingdom: Animalia
Phylum: Chordata
Class: Aves
Order: Galliformes
Family: Phasianidae
Genus: *Gallus*
Species: *G. gallus*
Subspecies: *G. g. domesticus*



Introduction

Poultry is an important source of income and animal protein for many households in South Sudan and across Africa. Birds (poultry) play a major role in the economic, social and religious lives of rural communities in South Sudan. Local poultry breeds are very well adapted to the local environmental conditions such as heat, cold, heavy rain and periodic shortages of food. Many rural households rear chickens because they thrive in nearly all conditions, require little space, are easy to feed and reproduce quickly.

The economic reasons for keeping birds include:

Egg production: Eggs are an important source of food that is high in quality protein and other nutrients.
Meat production: Poultry provides meat which is also a good source of high-quality protein and is well accepted by many people across tribes, cultures and religions.
Poultry manure production: Poultry manure is an excellent organic fertiliser that is used to improve the nutrient content of soil. Poultry droppings are also useful to fish farmers as they provide food for fish and manure for ponds.
Eggshells and feathers: These are used to furnish and decorate houses. Eggshells are also nutritious to animals and are a useful source of calcium in animal feed.
Poultry products and by-products such as eggs and meat: These are a source of income and livelihood, and they can complement household income from other sources.

Social and gender-related factors involved in keeping poultry in South Sudan

Chicken rearing in South Sudan is commonly associated with women and children, and chickens are the only essential domestic animals over which women have absolute control. Decisions as to when to eat and/or sell chickens are left entirely in the hands of women, which can empower them economically if the birds are of viable quality. In most cases, women have gained respect in the community due to their contribution to their family herds through the sale of chicken, which enables women to buy small animals such as goats and sheep. Chickens are often given as gifts or used during traditional ritual ceremonies.

Figure 52: Chicken farmer

Common chicken breeds in South Sudan

Chicken breeds are classified into two main categories, local (indigenous) and exotic (foreign).

Local breeds: These are tropical chickens traditionally raised by local communities; they are the most commonly kept birds in South Sudan. They are broadly grouped into 2 types: frizzled-feather or naked-neck. Local breeds of chicken in South Sudan are often named after tribes.

Kept in open range as street runners, they are tough and highly adaptable to the harsh environmental conditions of the tropics. They scavenge and feed on materials around the compounds including the gardens around the house. For this reason they can fend for themselves. When cooked, local chickens are usually very tough. They are, however, light in weight (with the male usually bigger) because of the quality of feed they live on and their breed. Hens (mature female chicken) produce three clutches of about 15-20 eggs per year. Tropical hens are very broody (inclined to incubate their eggs).

Exotic breeds: These are chickens from other regions and can be found throughout South Sudan and East Africa. Different types are classified according to their origin.

Mediterranean breeds (such as the white leghorn and Egyptian Fayoumi). White leghorns are known for their high rate of egg production. Their eggs are mostly white in colour. The white leghorn hens can lay from 300 to 380 eggs per year. They have an average weight of 2.7 kg (cocks) and 2 kg (hens) and can mature very early if well kept.

American breeds are well-known for their meat and egg production. Examples of American breeds are the Rhode Island and the New Hampshire, both of which are very popular among poultry keepers across the tropics. The New Hampshire has an average live weight of 4 kg (cocks) and 3 kg (hens). Rhode Island reds are equally popular due to their high adaptability, with the hens laying approximately 200 to 310 eggs a year. They tend to lay the most eggs in the first laying season.

English breeds are also known for their meat and egg production. One English breed that has become very popular is the Sussex (which has speckled and red varieties). Cocks weigh approximately 4.1 kg and hens about 3.2 kg. Their eggs are usually light brown and hens can lay between 180 to 320 eggs per year depending on the feed and care provided.

Asian breeds are well known for their weight and meat production. One Asian breed is the Brahma, which has an average weight of 5.4 kg (cocks) and 4.6 kg (hens). Brahma hens could lay from 130 to 150 eggs per year. They lay brown eggs which are generally well-accepted by consumers.

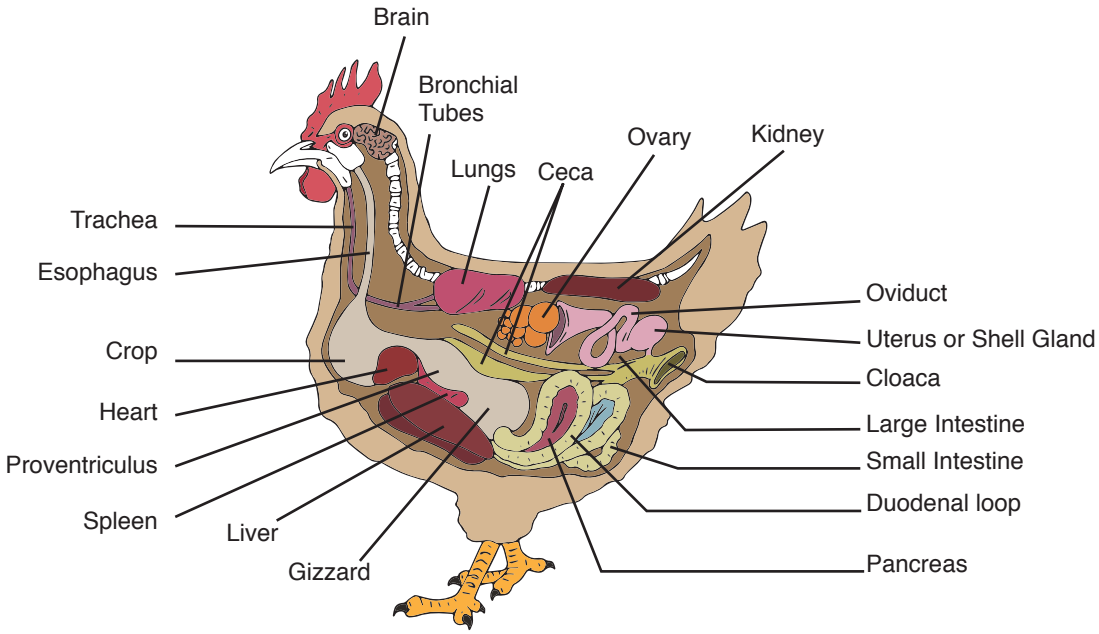


Figure 53: Internal parts of a bird

Improving local poultry breeds

The crossbreeding of exotic and tropical fowls is becoming popular among local fowl keepers in some parts of South Sudan. Local breeds are said to be more flavoursome and therefore fetch higher prices than crossbred broilers. However, it can take a long time to raise the local breeds and they are often very small and light. In contrast, an advantage of crossbred fowls is that they retain the desirable characteristics of the local breed, but mature more quickly and also tend to be heavier. For this reason they can be sold in larger numbers at a better average price and thus provide higher economic return to the keepers.

The strategy of crossbreeding is promoted by both the government and development partners. The products of crossbreeding are said to be much improved, bigger and more adaptable to the harsh climatic conditions of the free-range system. An example of such breed is Croilers. Crossbred birds are sometimes called grades.

The steps to improve poultry breeds are given below:
Identify a flock of chickens that you would like to improve to grade level. In most cases, this is done at household level. In cases where several households keep local breeds of fowl, all households should work together.

One option is to introduce a number of eggs from improved breeds to a brooding hen by replacing all the local eggs she is incubating. This should be timed to start as soon as she begins to sit on the eggs. The size (and particularly the smell) of the eggs should be similar to those replaced. It is suggested to smear the eggs with milk fat, shea butter, coconut oil or ash (all these are abundant in South Sudan).

The other option is to introduce purebred cockerels such as Rhode Island reds or New Hampshires to the flock of local fowls. For this to be effective, it is important to remove all local cocks from the flock. Usually one cock should be able to service ten hens.
Please note that a common setback of this cross breeding is the refusal of keepers to eliminate the cocks in their flocks. With this refusal, a mix of local and improved breeds will remain in circulation.

Selection criteria for breeding
Breeding is the practice of selecting poultry birds with good characteristics and mating them to produce a new generation with similar characteristics. Three main types of fowl (meat producer, egg producer and dual-purpose) are used for improved breeding depending on the interests of the breeder. The main aim of poultry breeding is to achieve good-quality meat, increased egg production and maintain a healthy flock.

Breeders should be sure to do the following:

- Observe the external features of the cocks, hens, growers and chicks to learn which features indicate a healthy chicken;
- Always choose birds that are lively and alert;
- A potentially good layer has a long, straight back and a broad bottom;
- Always check the belly or navel spot of newly hatched chicks;
- Keep new birds isolated for a few weeks before introducing them into the flock.
- It is important to select good quality cocks and hens. They should be properly selected then crossed in order to improve the quality of a given flock of chickens.

A good breeding cockerel should:

Be big and strong with a well-developed red comb;
Be healthy and alert at all times;
Be able to service ten hens;
Be young (8 to 16 months).

A good breeding hen should:

Be a good layer (with wide, moist cloacae, a wide sternum and space to fit 3 fingers between the pelvic bones);
Show good mothering ability (e.g. she should actively look for food for chicks);
Produce 15-20 eggs per clutch;
Lay big eggs weighing more than 40g;
Incubate the eggs well;
Have a broad head (with bright eyes, wax comb and wattles);
Have smooth and strong legs;
Be big and able to feed well in order to support her internal organs;
Be healthy.

Qualities of eggs suitable for incubation or hatching

An egg produced by a female bird kept without a male is called a non-fertile egg and will keep fresh for a long time. Eggs from a female kept with a male bird are alive and the young chick will start to grow in them if they are kept in a warm place.

The period during which fertilised eggs grow and hatch into chicks either naturally (through a hen sitting on the eggs) or through a mechanical method is called incubation. If temperature, relative humidity and ventilation are ideal, the period of incubation should be 21 days. A good poultry breeder must spend time with his/her chickens at least daily in order to observe incubating hens and those with chicks.

Eggs that are suitable for incubation and hatching should:

Be of normal size (weighing 39-41g for indigenous breeds and 55-60 g for exotic breeds);
Come from good parent stock;
Be clean;
Be of similar size, weight and oval shape to each other.

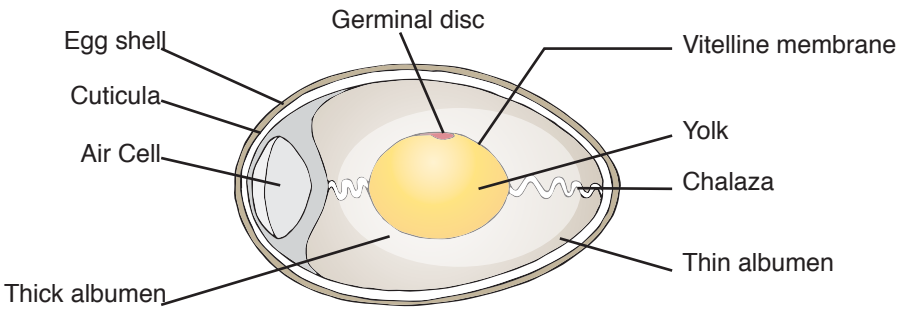


Figure 54: Internal Structure of an egg

Breeders should:

- Disqualify eggs of extreme size (too small or too big).
- Disqualify eggs of abnormal shape.
- Avoid trying to hatch eggs with soft shells. The shell should be strong.
- Incubate eggs mechanically (where necessary) using sunlight or an enclosed box with a bulb.
- Place only fertile eggs to hatch. Do this by observing the embryo through candling (candling is described below).

Understanding Candling

Candling is the process of holding a strong light above or below the egg to observe the embryo. This is important in order to know if the eggs are good enough to go into an incubator and also to observe the different stages of embryo development during incubation. Candling will also show if there are cracks on the eggshells. Any eggs with cracks should be discarded. There are many ways to candle an egg, but a candling box which can be easily made using cardboard is still the most common. Farmers can also use a torch with bright lights to candle their eggs.

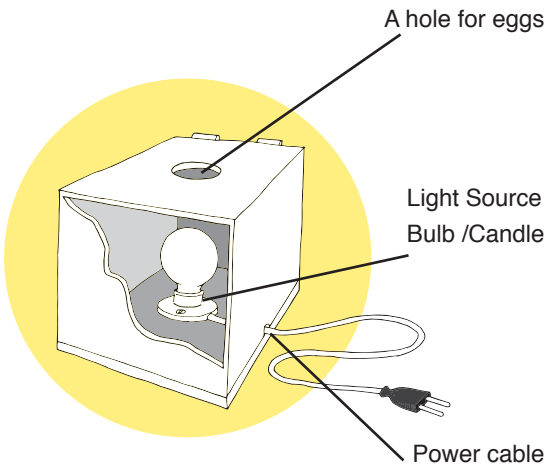


Figure 55: A candling box

Under candling, the embryo appears as a dark spot or spec. A healthy embryo will move slightly when light is shined on it. It is also possible to see the blood vessels of a healthy egg under candling. Check eggs before putting them in the incubator, 7 days later and on day 18 of the incubation period.

The following are important observations to note when candling:

Infertile eggs: These are easy to detect, as the egg is clear. Discard and do not incubate.

Early deaths: The embryo has developed for several days and then died. Candling will reveal a small dark area and disrupted blood vessels. Often deteriorating blood vessels will appear as a dark ring around the egg. Discard.

Late deaths: These are often difficult to tell apart from a viable embryo at the same stage of development. Look for the absence of movement and the breakdown of the blood vessels. Discard.

Viable embryos: These move in response to the light and have well defined blood vessels.

Conditions necessary for egg incubation and hatching:

- The laying site (box or other) should be isolated;
- Laying boxes must be of an appropriate size;
- The box should be kept in the shade or in a dark place away from parasites and predators;
- Dry straw should be placed in the laying boxes;
- The box should be cleaned, disinfected and fumigated after each hatching;
- The environment should be tranquil and well-ventilated;
- Good feed should be continuously available.

Poultry housing

Housing is very important in protection of birds against predators, thieves, rain, sun and extreme cold/hot conditions. It is advisable to provide a comfortable chicken house for efficient production and convenience. Site selection is very important before poultry house construction. Desirable sites conditions include dry locations which are raised and free from flooding, accessibility to water/feed, near to homesteads and good for future expansion. The house should be constructed in way that it will be dry and will provide chickens with enough space, ventilation, natural light and protection from predators. Provide 6 inch straw/grass on the floor. This makes the chickens productive and free from diseases. Regular cleaning of the house is recommended.
Good-quality poultry housing is required to:

- Protect birds from danger (predators and thieves);
- Protect birds from bad weather (rain, extreme heat and strong winds);
- Provide birds with a place to sleep and lay eggs;
- Prevent the spread of poultry disease;
- Enable better control and monitoring of birds.

A good poultry house should:

- Be well located and ventilated;
- Be located in a fenced compound at least 50 metres from the nearest residential area so as to avoid pollution by noise and odours;
- Have wide doors and numerous windows to allow maximum circulation of light and fresh air (as well as to facilitate easier cleaning).

NB: Houses meant for young chicks should be located at least 50 metres from those containing older birds in order to minimise the risk of transferring disease.

Floor space requirements are as follows:

- 1m² for 10 chickens (round house) and 1 m² for 5-8 chickens (wood or stick house);
- 15m² for 100 chickens (i.e. 5-6 birds per square metre during the laying period);
- 4m² for 25-30 chickens (wood or stick house).

The poultry house should face east to west to follow the course of the sun. It is important to ensure proper ventilation as air removes excess heat, moisture, dust and odours from the building as well as diluting airborne disease-causing organisms.
It is important for the building to be on a raised floor or well ramped. Feeders and drinkers should be cleaned daily and the entire house monthly. Droppings should be collected regularly for use as manure for the farm and garden.
The floor of the poultry house should be covered with sawdust, sand and straw. A water bath should be located at the entrance of the poultry house and regularly disinfected. The house should be disinfected and fumigated at least once every six months. The roof should be checked and repaired, along with any cracks in the walls or floor. The walls should be coated with cow dung to prevent the build-up of ticks.

Poultry production systems
Most birds are raised on the free range system in South Sudan. Under this system birds are allowed to roam around in the community picking food, sometimes in nearby gardens. They are allowed to access water around the communal water points. The other two types are the intensive and semi-intensive production systems which require proper housing facilities, routine care and management depending on terrain and climatic conditions.

Free-range extensive or backyard: This is the most common (and the traditional) form of keeping birds in South Sudan. Birds scavenge freely during the day and are housed in sheltered accommodation at night either with the family or in tiny structures inside the compound. The system is inexpensive, requires little labour and involves all members of the family since chickens are predominantly managed by women and children. A household keeps an average of 5-30 birds with minimal input.
The disadvantages of this system are that many birds are lost and never found because they move freely and are exposed to predators. They also lay eggs anywhere they find suitable. Controlling disease among the flock is impossible since their movement is uncontrolled and they often scavenge for food and thrive in unregulated environments. It is this system that the government and many development partners are trying to improve.

Semi-intensive:
This system is characterised by higher levels of inputs and labour than the free-range system. Feed is provided on a daily basis. The farmer must provide clean water and housing as well as veterinary care.

Figure 56: Birds in free range

Intensive/commercialised: This is mainly done by experienced farmers with access to feed, health services and a reliable market. Under the intensive system up to or more than 5,000 broilers and layers can be kept in a chicken house. The birds are provided with preventative healthcare and optimal commercial feeds that account for 70% of the production costs. Intensive chicken farming is done using either the built-up deep litter system or the battery cage system.

Figure 57: Birds in a battery cage system

Improved poultry production requires land, housing, access roads, continuous water supply, fencing, security, transportation, equipment, source of heat, waste disposal facilities, storage space and access to veterinary and extension services. Additionally, the farmer must have market information, knowledge of composting, risk awareness, risk management skills and a record keeping system. Birds kept under the intensive system are usually in a deep litter system, slatted floor system or the battery cage system:

Deep litter system: Birds are fully confined (with floor space allowance of three to four birds/m2 within a house, but can move around freely. The floor is covered with a deep litter (a 5-10 cm deep layer) of grain husks (maize or rice), straw, wood shavings or a similarly absorbent (but non-toxic) material. The fully enclosed system protects the birds from thieves and predators and is suitable for specially selected commercial breeds of egg or meat producing poultry (layers, breeder flocks and broilers).

Slatted floor system: Wire or wooden slatted floors are used instead of deep litter, which allows stocking rates to be increased to five birds/m2 of floor space. Birds have reduced contact with faeces and are allowed some freedom of movement.

Battery cage system: This is usually used for laying birds, which are kept throughout their productive life in cages. There is a high initial capital investment, and the system is mostly confined to large-scale commercial egg layer operations. There are also ethical concerns growing against keeping birds in cages.

Poultry equipment

Other equipment in the poultry house should include night perches, laying boxes, feeders and drinkers. Birds should be monitored daily, protected from the sun and rain, be well fed and kept warm. One square metre for every hen and 10 chicks is recommended. The following equipment is required to keep 100 birds using the deep litter system where automated machines are not available:

Feeding and watering

- 3 chick feeders (2 inches of feeding space per bird, 3 inches deep)
- 3 chick drinkers (2-litre capacity)
- 2 chicken feeders (4 inches of feeding space per bird, 6 inches deep)
- 2 chicken drinkers (8 to 10-litre capacity)
- Feed scoops (plastic plates or bowls can be used)
- 2 buckets
- 1 roll of twine (for hanging the feeders)

Brooding

• 1 brooder box
• 3 kerosene lamps or three 100-watt bulbs
• 4 rolls of plastic sheeting (for open-sided houses only)

Cleaning and handling of manure

• 1 broom
• 1 shovel
• 1 wheelbarrow

Egg handling (for layers only)

• 1 laying nest (20 cells)
• 6 egg trays (30-egg capacity each)
• Plastic bags (for packing and marketing eggs)

Miscellaneous

• 1 weighing scale
• 4 chicken crates
• Record books and sheets
• 2 jute sack-loads of litter material

Chicken production equipment

The main equipment used in chicken production is for feeding and watering. These can be improvised using locally available non-food items such as plastic plates, tin cans, wooden carvings, traditional pots and others.

Semi-intensive and intensive production systems may require specialized designs of feeders and drinkers. It is important to keep this equipment clean to minimize any potential disease onset or spread. A one-metre trough feeder is enough for 20 adult chickens to eat while a one-metre trough or a 35 cm (diameter) tube drinker is enough for 40 chickens to drink.

Figure 58: Watering cans

It is important that the feeders are constructed in such a way that feed waste is avoided. Also feed waste can be decreased if feeders are not filled to the top. It is better to fill feeders just half full and then check them regularly for refills. An empty tin placed upside down on a plate forms an excellent drinker. Commercial drinkers may also be bought at the market, either in metal or plastic.

Laying nests

The provision of laying nests is essential in the hen house for ease of the laying process and egg collection. There should be an adaptation period of the hen to the laying nest before the start of laying eggs, which is important to prevent the hen from laying eggs outside the house or even in the bush.

Figure 59: Birds in brooding boxes

It is recommended that eggs should be removed continuously (morning and evening) if you want to avoid the hens becoming broody. Nests built outside chicken houses are more exposed to predators and thieves. Nests should be placed inside the chicken house, preferably raised above the ground. A locally improvised nest box will typically measure 30 x 30 x 30 cm, enough for 5 layers. It is advisable to place the laying nests in the dark part of the house to prevent exposure to the sun. A calabash, nest basket or clay pot may measure 40 x 20 x 25 cm (upper diameter x height x lower diameter). A clay pot is made more or less the same as a calabash. It is recommended not to feed birds while on the nest and avoid collecting the first eggs laid.

Suggested intensive management practices for improved layer breeds

Table 17: Suggested intensive management practices

Age of the bird (weeks)	Management practices
0	The house should be thoroughly washed and disinfected 2-3 weeks before the arrival.
0	1 to 2 days before arrival of the chicks brooding facilities should be set up.
0-1	Reception of chicks and provision of optimum brooding care Vaccination of chicks against Newcastle, Marek and Gumboro disease before 10 days of age Feeding of chicks with mash
1-2	Continuation of brooding care Completion of vaccination as above
2-4	Debeaking (if not done at 1 day old) Continuation of brooding care Gradual phasing out of supplementary heating
4-6	Continuation of brooding care Discontinuation of supplementary heating Vaccination against Newcastle disease, Gumboro and fowl pox
6-8	Separation of cockerels from pullets where straight-run chicks were brooded Continuation of routine management practices
8-10	Changing of feed to grower mash Change to adult-size feeders and drinkers Deworming of birds
10-12	Initiation of feed restrictions if necessary Continuation of routine management practices
12-14	Continuation of feed restrictions if necessary Continuation of routine management practices
14-16	Continuation of feed restrictions if necessary Debeaking if necessary (be sure to provide ample feed and water during the days following debeaking)
16-18	Full feeding Vaccination against Newcastle Vaccination of breeder flocks at 18 weeks against Gumboro disease and H5N1 (bird flu)
18-19	Transfer of birds to the laying house
>19	Introduction of layer mash between 19 and 21 weeks

Chick brooding

Brooding refers to the rearing of chicks using heat supplementation either naturally by the hen or artificially. Naturally hatched chicks are reared and protected by the broody hen and can be left undisturbed as long as their yard is protected from predators.

Figure 60: Day-old chicks in a brooding house

The hen usually provides heat for her chicks and she guides the chicks where the feed is available. It is advisable to separate the broody hen from the flock to prevent other hens from disturbing her. In addition, provide a separate nest with free access to clean water and feed within a short distance.

The key factors to consider are housing, temperature, light, water, and feed. A good poultry keeper should observe the way chicks cluster or come together, as illustrated below:

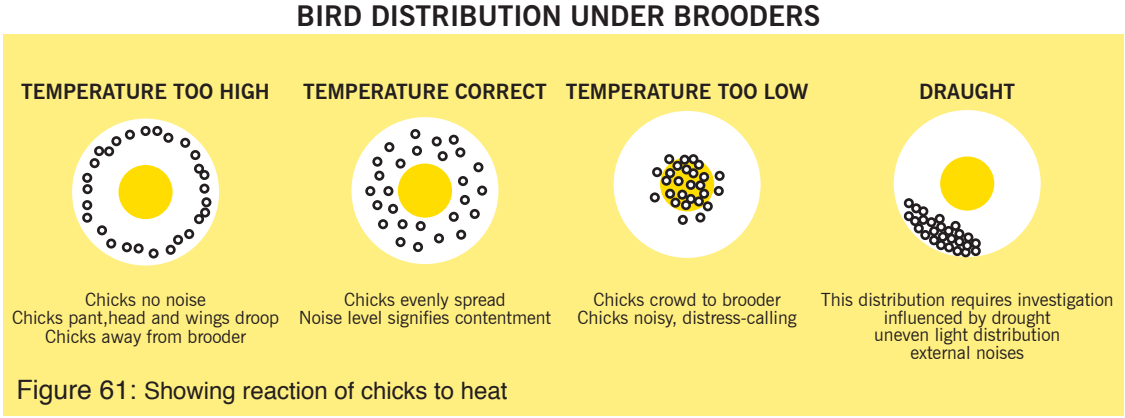


Figure 61: Showing reaction of chicks to heat

Young chicks require adequate temperature to survive. A newly hatched chick requires supplemental heat to maintain its body temperature, therefore, an external heat source must be provided to the chicks in the first few weeks. Under an intensive system, the brooding room should be heated prior to arrival of the chicks. Artificial brooding adapted by a semi-intensive and intensive production system usually incorporates use of heaters to brood the chicks. These can be made locally using charcoal heaters and grass boxes. This system is able to rear a large number of chicks at a time with low chick mortalities. Additional provision of ventilation, feeding and drinking equipment is advisable.

Table 18: Recommended temperature for chicks

Recommended Temperature for Chicks				
AGE	**CAGE BROODING**		**FLOOR BROODING**	
Day 1-3	33-34ºC	91-93ºC	35ºC	95ºC
Day 4-7	32-34ºC	90-93ºC	33ºC	92ºC
Day 8-14	29-31ºC	85-89ºC	31ºC	89ºC
Day 15- 21	26- 29ºC	80- 84ºC	29ºC	84ºC
Day 22-28	24-26ºC	75-79ºC	26ºC	79ºC
Day 29-35	21-23ºC	70-74ºC	23ºC	74ºC
Day 36 +	21ºC	70ºC	21ºC	70ºC

Observation of the birds during the brooding period can assist you in providing the most desirable temperatures. Birds that are cold will huddle together in a very tight group. Should this condition exist, the temperature needs to be increased. Chicks that are too hot will pant and appear drowsy. Chicks that are comfortable will be evenly dispersed within the cage and be active except during periods of rest. It is recommended to supplement heat for the first two weeks of life until chicks develop their own feathers at 2-3 weeks of age. Chicks reared through natural brooding get the heat they require from the hen. A grass box brooder can be made from timber, straw and reeds/wire meshes.

Poultry feeding

Food is a basic need of all living things. The growth, health and performance of all organisms is related to the amount and type of food they can access and consume. Poultry in particular are very good at converting feeds, therefore, the type of feed they are given will depend on the purpose for which the birds are kept (i.e. for either meat or eggs). Feeding is more regular in birds confined to small spaces compared to birds which are allowed to fend for themselves under a free-range system.

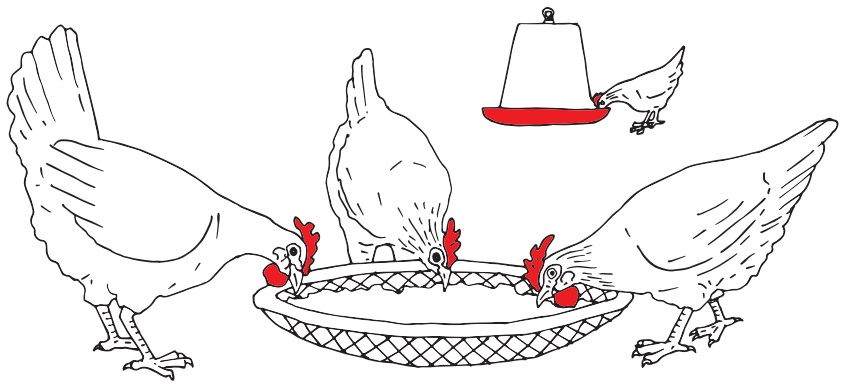


Figure 62: Birds feeding together and drinking in troughs

Feed chicken adequately

Feed should be given to birds in balanced rations composed of water, carbohydrates, protein, minerals and vitamins. Carbohydrates, which are required for energy, usually constitute 70-80% of the feed. Protein should constitute 10-40% of the feed as it supplies amino acids and is vital for egg production. Minerals can come from bone, ash, shells or salt. Vitamins are very useful for building the health of birds and are found in green vegetables.

It is important to provide the right feeding and drinking equipment to poultry in order to guard against disease and avoid contamination. Use of the correct equipment also avoids wastage of feed and water, which account for 60-80% of the cost of rearing birds under the intensive system. Using appropriate feeding and drinking equipment also facilitates the provision of medicines or vaccines to animals via water or feed.
Hygiene is very important in all poultry systems. Feeders and drinkers must therefore be provided in a metre of feeder space should be provided for every 15 chickens. The feeders and drinkers should be shielded against rain and sun. It should be raised off the floor to avoid contamination.

Composition of poultry feeds and their importance

The poultry industry's standard performance measurement is the feed conversion ratio (FCR). To calculate FCR take the total amount of feed consumed by the flock and divide it by the amount of weight gained (for broilers and cockerels) or the number of eggs produced (in the case of layers). The lower the FCR the better. The less the amount of feed given to birds the more profit a farmer is likely to make.

Feeding, ration formulation and watering
Local chickens are mostly on free range and usually scavenge for feed. However, alternative feed resources that are locally available can be identified and used as alternative feed. These include shrub leaves such as leucaena and calliandra; plants growing in swampy regions such as Azolla spp. and water hyacinths; termites, fruits (papaya and guava); and small animals (e.g. snails, earthworms). These products are rich in protein, vitamins and minerals, and are recommended for appropriate supplementation of diets of local chicken.

The key nutrients needed for proper growth are Carbohydrates, protein, vitamins, minerals and water. Their roles are explained in the table below.

Table 19: Feed materials and nutrient classes

Required nutrients	Role of each nutrient	Sources of nutrients	Locally available food types	Possible results of inadequate nutrients
Energy	Maintenance, energy and growth	Cereals and bran (millet, sorghum and rice)	Millet, sorghum and corn	Cessation of growth, reduced egg production
Protein	Growth, meat (muscle and egg production)	Groundnuts, sesame, cake, dry (leftovers) fish, blood meal, termites, worms, insects	Meat, fish, chicken soup, groundnut, soya bean cake	Wight loss, reduced egg production
Minerals	Egg production, formation of bones, reproduction	Bone meal, salt and oyster shells	Salt, pepper and bones	Failure to produce eggs, soft bones and soft eggshells
Vitamins	Body regulation, egg production	Green leaves (Leucaena, Moringa, Cassava)	Fruits, wild greens	Poor-quality eggs, reduced resistance to disease
Water	Importation for digestion, control of body temperature and cleansing of the body	drinkers	water	Weight loss, dehydration

Locally available feed ingredients

Carbohydrates: Millet and sorghum are ready for immediate use and are available in most villages and localities.

Protein: Groundnut or sesame cake can be pounded without sieving. Fish can be dried and pounded without sieving. Blood meal can be given as follows: 1 matchbox of salt added to 5 litres of blood or 1 teaspoon of salt to 2cups of blood. The mixture is boiled until it coagulates and is then dried out in the sun and finally pounded. It is important that all protein feeds are served using the feeder.

Vitamins: Leucaena and cassava leaves are cut and should be dried in the shade (not in the sun) so the leaves will keep their green colour. The leaves can either be ground or hung up so the birds have to jump to reach them (thus providing exercise while eating).

Minerals: Bones can be collected from abattoirs, slaughterhouses and butchers. Fish bones can also be used. To make bone meal, set a fire and add the bones to burn until they are coated with white ash. The burnt bones should be taken off the fire and left to cool, then pounded into a fine powder using a mortar and pestle. The bone meal should be sieved, collected and rationed. To feed bone meal to poultry, for practical purposes mix 13 parts (matchboxes) of bone meal with 1 part (matchbox) of salt.

How to formulate a ration for a free-range poultry system (all age groups)

Table 20: Ration formula

Ingredient	Small quantity (~ 2 tins)	Large quantity (~ 25 tins)
Sorghum	2 tins (1 kg) or 4 cups	3 tins or 6 cups
Millet	2 tins (1 kg) or 4 cups	3 tins or 6 cups
Maize	2 tins (1 kg) or 4 cups	20 tins (1 kg) or 40 cups
Groundnut/sesame cake	2 matchboxes (35g x 2)	1 tin or 2 cups
Bone meal/salt	1 matchbox (1 part salt with 13 parts bone meal)	Half a tin or 1 cup
Fish or blood meal	2 matchboxes	1 tin or 2 cups
Leucaena/Cassava leaves	2 matchboxes	1 tin or 2 cups
Termites	Always give to chicks	Always give to chicks
Water	Always provide clean water	Always provide clean water

Feeding birds concentrates from commercial feed makers

When using ready-made concentrates (from commercial feed-making companies), the following quantities are recommended for both the deep litter and battery cage systems:
For 100 broilers:

- 200 kg of broiler starter for chicks aged 0-5weeks;
- 300 kg of broiler finisher for chickens aged 5-8 weeks.

For 100 layers:

- 200 kg of chick mash (20% protein) for pullets aged 0-8 weeks;
- 550 kg of grower mash (16% protein) for pullets aged 8-20 weeks;
- For layers, mash feed consumption will increase from 101 to 135 g per day between the ages of 22 and 66 weeks.

Other routine practices

Watering: Chickens must be provided with clean water every day. Drinkers should be regularly washed and should be placed on a raised platform or hung up to avoid soiling of the water.
Early morning

- Fresh water should be provided early each morning;
- The hens' nests should be checked (they should have plenty of soft materials and be kept in a dark place);
- The flock should be observed to check that all birds are active;
- The birds should be tamed by offering small amounts of feed during each visit.
- Mid-afternoon
- All eggs should be collected;
- Chickens should be allowed to roam in the yard and food provided to confined birds.

Evening

- Clean water should be provided;
- All birds should be shut in the house;
- Any eggs laid during the day should be collected;
- Brooding hens that remained in the nest should be identified and given fertilised eggs to sit on.

Debeaking: This is done to chickens raised under the intensive system that can develop a bad habit of pecking eggs and each other. Usually a sharp-edged blade is used to cut the tip of the beak (two-thirds of the upper beak and one-third of the lower beak). Debeaking should be done carefully so as not to damage the nostrils of the chicken;
Culling: This is the removal and slaughter of birds from the flock (usually birds that are unhealthy, weak, poor producers, inferior or aged). As soon as chicks hatch, all those showing abnormalities such as crooked legs, etc. should be culled;
Brooding: This is the provision of care to chicks from the day they hatch until till they are about 10 days old (for improved breeds);

Assessing healthy and unhealthy chickens

It is important for farmers/poultry caregivers to learn to identify sick birds. Healthy birds usually have strong immunity and are able to fight diseases by themselves without any medical intervention. However, unhealthy birds often have difficulty in fighting diseases due to a lowered immune status. It is recommended that sick/unhealthy chicken birds are isolated from the healthy flock to minimize potential disease spread.

Healthy chickens have the following characteristics:

- A bright demeanour/behaviour and are clean;
- Have normally positioned head and neck;
- Able to move and walk freely;
- Eat and drink normally;
- Have bright eyes and comb;
- Lay eggs normally and have smooth and neat plumage;
- Excrete soft, compact and dark droppings;
- Are able to breathe quietly.

Unhealthy chickens have the following characteristics:

- Dull demeanour and are often dirty;
- Drooping head with closed eyes;
- Tired, drowsy and lifeless;
- Eat and drink less or do not eat at all;
- Lay less or stop laying eggs;
- Have ruffled and loose feathers;
- Excrete wet/watery droppings which may contain blood or worms;
- Have matted perineum with diarrhoea;
- Often cough, sneeze and breathe noisily with difficulties;
- Unable to move and have an abnormal voice/snoring.

General poultry healthcare management

Diseases and parasites in South Sudan are a major challenge to chicken production. Since their occurrence is relatively predictable, a seasonal disease control plan can be worked on to reduce risk. For example, Newcastle disease is common between January and April.

Major causes of chicken disease

Main disease causes in chicken are divided into living and non-living agents. These may further be divided into three categories: (1) germs and microorganisms, (2) parasitic worms and pests and (3) inappropriate or insufficient feeding and nutrition. According to the disease-causing agent and based on the attacking ability of the disease, chicken diseases may be classified as acute or chronic.

Acute disease occurs when a disease-causing agent enters the body of the chicken and rapidly multiplies to cause disease. This is subsequently followed by the disease spreading to various systems and may end within a short period of time with the bird either surviving or dying.

Chronic disease is caused by a small number of disease-causing agents which enter the body of the chicken and progress via multiplication to make the bird injured over a long period of time. If not treated or managed it can eventually cause the death of the bird.

Causes and examples of poultry diseases

Table 20: Disease types and classification

Infectious Diseases	
Viruses	Newcastle disease, avian encephalomyelitis, fowl pox, Marek's disease, infectious bronchitis, infectious laryngotracheitis, Gumboro disease (infectious bursal disease), duck virus hepatitis
Mycoplasma	Chronic respiratory disease
Bacteria	Fowl cholera, salmonellosis, pullorum, fowl typhoid, infectious sinusitis, colibacilosis
Parasites	Ectoparasites: lice, mites, ticks Endoparasites: nematodes, histomoniasis, haemoparasites, round worms, hair worms Avian malaria protozoa: coccidiosis, blackhead
Fungus	Aspergillosis: *A. flavis* (toxins), *A. fumigatus* (airsaculitis)
Non-Infectious Diseases	
Deficiencies	Rickets, curled toe paralysis, encephalomalacia
Toxicities	Salt poisoning, food poisoning (botulism from *Clostridium botulinum* toxins and *C. perfringens*), poisonous plants

Source: FAO, 2004

Sources of poultry diseases

Diseases can enter the village, town or compound through:

- Soil and air
- Sick and dead birds in the same flock
- Wild animals, domestic animals and humans
- Contaminated drinking water
- Contaminated feed
- Unhygienic animal housing
- Contact with markets or between villages
- Bird migrations

Some common ways infectious diseases are introduced into and spread within herds or flocks are:

Introduction of healthy animals that have recovered from disease but are still carriers or can still transmit the disease to other animals.

- Contact with inanimate objects that are contaminated with disease organisms (trucks and trailers, feeders, caterers, etc.).
- Contact with carcasses of dead animals that have not been disposed of properly.
- Impure water, such as surface drainage water.

- Rodents and free-flying birds.
- Mosquitoes. Fowl pox and encephalitis are commonly transmitted by mosquitoes.
- Shoes and clothing of persons who move from farm to farm.
- Contaminated feed and feed bags.
- Contaminated premises through soil, old litter or bedding.
- Airborne organisms that do not spread far through the air. This source of infection can be a strong factor in heavily populated livestock areas.

Prevention of disease

All preventative practices should begin with hygiene and sanitation. The cleaner and more hygienic a poultry house and its surroundings are, the more chance there is of minimising diseases and pests. To prevent disease from entering and spreading through villages or among flocks, the following should be considered:

- A 2-week quarantine of all new poultry (gifts and purchases) in the village;
- Isolation and treatment of all sick poultry to protect others;
- Slaughter and burial of sick chickens where necessary;
- Burning or burial of dead birds;
- Disinfection of the place in which the dead bird was found.
- Please note: Hands should always be washed with soap after any contact with sick animals or after burning or burial.

The impact of poultry disease includes:

- Loss of flock and income;
- Weight loss and delayed growth among birds;
- Reduced egg production rates.

Vaccination against common diseases of poultry

Vaccines are medicines given to birds to prevent a particular disease. All drugs or vaccines should be handled with maximum care and should be administered only by veterinary officers, trained community animal health workers (CAHWs) or paravets.

Preconditions and precautions during chicken vaccinations

- Most vaccines are administered through drinking water or as eye/nasal drops. If it is provided with drinking water, it is important to withdraw any water or access to water for two hours prior to vaccination to ensure the birds are thirsty enough to take vaccine-constituted water.
- The water and waterer should be free from any chemical contact and should not be made of iron material. Plastic or clay equipment is recommended for vaccination.

• Diseased/weak chickens should not be vaccinated.
• Ensure the vaccines are not expired.
• Vaccination syringes and droppers should be cleaned properly both before and after utilization.
• The vaccination should be done preferably in the morning hours when the weather condition is cold.
• The left vaccine should be discarded and not be used again.
• The vaccine should be used based on guidelines of the manufacture.
• Do not administer any other medications at least two days prior, during or four days after vaccination.

An indicative calendar for vaccination of birds is provided below as a guide.
The table below (which is not exhaustive and is intended for use as a guide) shows common diseases of poultry, their vaccines and the age at which to administer vaccines to birds. The first step is to be aware and to request information from local extension and veterinary officers in the Ministries of Agriculture and Animal Resources.

Table 21: Indicative calendar for vaccination of birds

Age of the bird	***Vaccination***	***Disease(s) against which protection is provided***
1-7 days	Intra-ocular (NDV 1/0) through the eye	Newcastle disease
18-20 days	Gumboro vaccine IBDV through drinking water	Gumboro disease
3-4 weeks	NDV Lasota through drinking water	Newcastle disease
3-4 weeks	Fowl pox vaccine (FPV) through a jab in the	Fowl pox
6 weeks (repeated at 8 weeks)	Komorov (NDVK) through intra muscular injection	Newcastle disease

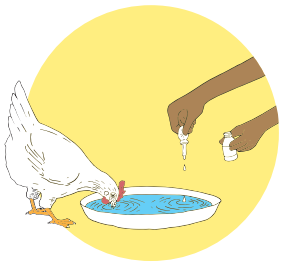
Nutrition related chicken diseases

Poor nutrition and insufficient feed may cause various deficiencies among the chicken, likely exposing them to other diseases due to reduced immunity. These conditions are common in semi-intensive and intensive production systems; however, local chickens can also be affected. Common symptoms of deficiencies include bone deformation and feather loss, difficulty in walking and deformed legs. Prevention or treatment if detected early is through provision of a balanced ration and supplementary diets such as fresh grass, bone meal, blood meal, crushed shells, etc. Nutritional diseases may be avoided when the chickens have access to normal vegetation. Therefore, they are rare in local scavenging chickens.

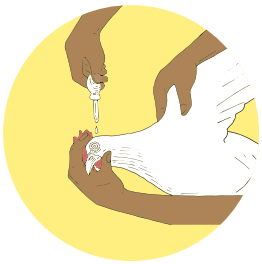
Work closely with paultry auxiliaries

Injection

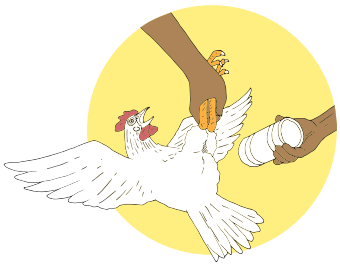
Dipping nostril of chicks into water with vaccine



Drinking water with vaccine and drug



Eye drop



Poultry dust for ectoparasites

Figure 63: Different ways of applying medication on poultry
Source: VSF-Germany

Common poultry diseases

NEW CASTLE DISEASE

Newcastle disease is a lethal virus that spreads quickly among the flock. A mortality rate of 90-100% is common. The disease attacks birds of all ages and occurs mostly at the beginning of winter when the weather is dry and cold (mid-November to February in Bahr-el-Ghazal; February and March in the Shilluk Kingdom; and March in the Equatorial area).

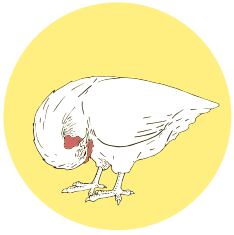


Figure 64: Symptoms of Newcastle disease

Birds affected	Chickens of all ages and (less frequently) guinea fowl and ducks
Agent	Virus
Transmission	Newcastle disease spreads through direct contact with respiratory, ocular and oral discharges and faeces. It attacks both the respiratory and nervous system of birds.
Symptoms	These include difficulty breathing, gasping and weakness, followed by the paralysis of one or both wings and legs. The bird may have a twisted neck and run in circles.
Treatment	None. Vaccination offers the best protection. In commercial poultry, birds should be vaccinated at two weeks and the vaccination repeated at 6-8 weeks.
Prevention	Chickens should never be bought at market between December and March. All new birds entering the compound should be quarantine for 15 days. Any sick birds should be isolated and slaughtered. Birds of all ages should be vaccinated at least 15 days prior to the known outbreak period of the disease. Sick birds should NEVER be vaccinated.
Vaccination	Newcastle vaccine can be administered orally, through the nostrils or via drinking water. It can also be injected. In a free-range system, chickens must be vaccinated before the wet season. Vaccination must be done 15 days before the outbreak season and repeated after 3 months.

FOWL POX

Fowl pox occurs in the wet season when new corn is on the market.

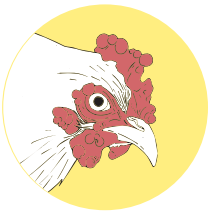


Figure 65: Fowl pox symptoms

Birds affected	Chickens (mostly chicks) and occasionally guinea fowl
Agent	Virus
Transmission	Fowl pox is transmitted through insects, dry wounds or contact with sick birds.
Symptoms	These include itching, pustules and nodules on the head and around the eyes and mouth. Sometimes pus is discharged from the eyes and nose, and in dead birds it can be found in the mouth and throat.
Treatment	Treatment is required as soon as the disease appears. Pus should be cleaned from the eyes and mouth, and cooking oil should be applied twice per day along with glycerine or iodine (Betadine).
Prevention	Vaccination should be done at the beginning of the dry season, and the quarantine new birds must be upheld. Poultry houses should be disinfected every 6 months.

Fowl Cholera

This is characterised by sudden mortality, with 90% of infected birds dying. Infection can occur through stress and the consumption of contaminated feed.

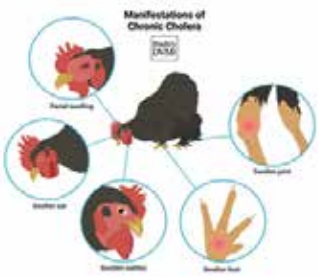


Figure 66: Fowl cholera

Birds affected	All poultry (mostly ducks)
Agent	*Pasteurella* bacterium
Transmission	Through chicken feed, stress or poor hygiene
Symptoms	These include inflammation of the crest or comb, respiratory problems, yellowish diarrhoea and loss of appetite.
Treatment	Antibiotics (tetracycline, chloramphenicol and sulphonamides)
Prevention	Vaccination is possible of chickens over 6 weeks old. Hygiene should be respected and stressful conditions avoided.

Fowl typhoid

Fowl typhoid spreads quickly. Chicks can die after 4 days.

Figure 67: Fowl typhoid symptoms

Birds affected	All poultry, but specifically chicks
Agent	*Salmonella* bacterium
Transmission	Salmonella is transmitted through contact with sick birds or from mother hens to chicks (through eggs or droppings).
Symptoms	Chickens will appear sleepy or drowsy and may produce white diarrhoea. Chicks may have bloated stomachs.
Treatment	Antibiotics (tetracycline, chloramphenicol, sulphonamides) with vitamins.
Prevention	Destruction of eggs laid by sick birds, isolation of sick chickens, burning of dead chicks and disinfection of the poultry house.

Coccidiosis

Coccidiosis is dangerous to chickens. Fowls aged 6-8 weeks are most susceptible to an attack of this disease

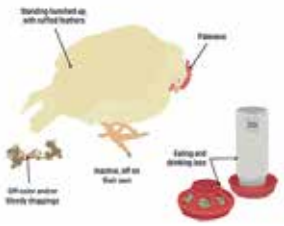


Figure 68: Coccidiosis symptoms

Birds affected	All poultry (mostly chickens)
Agent	Coccidian and eimeria parasites. These are parasites living in the wall of the gut.
Transmission	Through contact with chicken droppings, infected birds and contaminated feed and water.
Symptoms	These include bloody faeces, retarded growth, ruffled feathers, and drowsiness. Death is likely within 10 days.
Treatment	Sulphonamides, amprolium
Prevention	Coccidiosis can be avoided through regular cleaning and disinfection of the poultry house. Overcrowding and litter wetting should be avoided. In commercial poultry, coccidostats can be added to feed. Sanitation is, however, the most important factor in the prevention and treatment of this disease.

Gumboro disease

Gumboro is caused by a virus. Signs are most pronounced in birds of 4-6 weeks.

Figure 69: Gumboro symptoms

Birds affected	White leghorns are more susceptible than broilers and brown-egg layers.
Agent	Virus
Transmission	Direct contact with contaminated birds, people and equipment. Morbidity is high with mortality usually 0-20% but sometimes up to 60%.
Symptoms	Rapid onset, watery diarrhoea, ruffled feathers. Clinical symptoms may include trembling, ruffled feathers, poor appetite, dehydration, huddling, vent pecking, and depression.
Treatment	None. There is no treatment for IBD but support therapies such as vitamin and electrolyte supplements and antibiotics to treat any secondary bacterial infections may reduce the impact of the disease.
Prevention	Vaccination. Nobilis Gumboro D78 is a live freeze-dried vaccine for the immunisation of chickens against infectious bursal disease (Gumboro).

Marek

Marek is a viral disease.

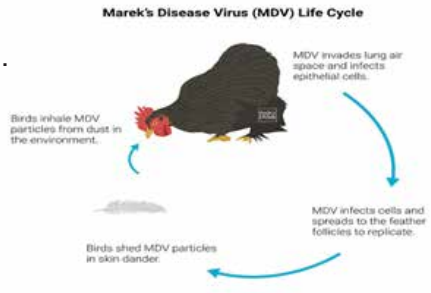


Figure 70: Marek symptoms

Birds affected	Mostly chicken. It rarely affects turkey.
Agent	Herpes virus infection of chickens
Transmission	By dust, faeces and saliva. Infected birds carry the virus for life. Morbidity is 10-50% and mortality up to 100%.
Symptoms	Neurological symptoms (blindness, strange movement), apathy, anaemia (paleness, emaciation). Greenish diarrhoea, weak breathing.
Treatment	None
Prevention	Vaccination

Internal parasites

Worms

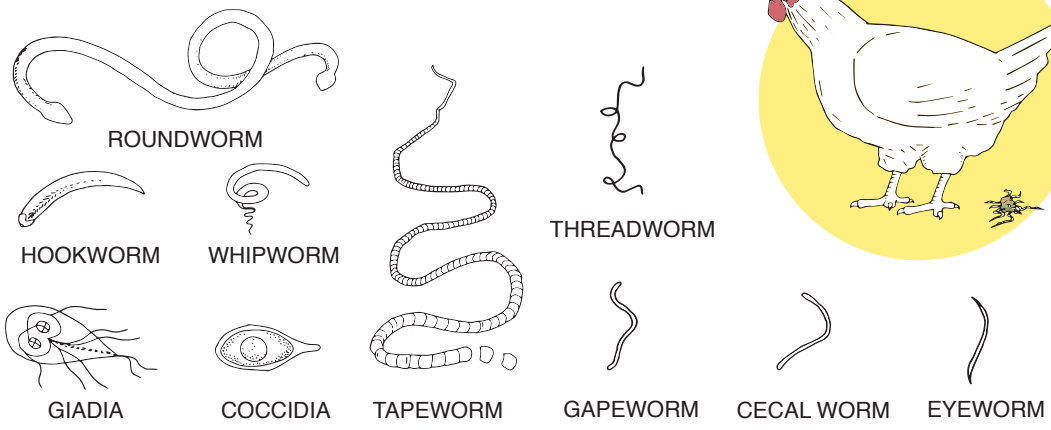


Figure 71: Common internal parasitic worms

Birds affected	All species (mostly young birds)
Agent	Various types of worm
Transmission	Through droppings and contact with the ground (insects and ground worms).
Symptoms	These include weight loss, delayed growth, reduced egg production and diarrhoea, sometimes with worms in the faeces.
Treatment	Deworming
Prevention	Deworming should be done every 2 or 3 months and feed distributed in feeding troughs. The poultry house, feeders and drinkers should be regularly cleaned.

Recent Diseases

It is also important to note that there are emerging diseases for which scientists have not found a vaccine. An example is the avian influenza (bird flu) virus. This has a high mortality if it occurs in your poultry; all infected birds should be removed and burnt in a pit.

External parasites

These may attack birds of all ages at any time, but occur most frequently in humid poultry houses with poor hygiene. Examples are mites, fleas, lice and ticks which cause weight loss and irritation of feathers and skin. To control external parasites birds must be treated with a powder or spray, e.g. Trichlorphon or Malathion. Cages and houses must be thoroughly cleaned. Chickens will clean their feathers daily with soil or sand (a dust bath). A shallow box containing sand and ashes (left from a fire) will be used by birds and helps to keep the feathers clean and free of infections. A little addition of a louse powder will make the dust bath better.

Figure 72: External parasites

Lice can be seen around the nose, mouth and belly. Treatment is done by dusting with dry lime or ash or applying oil. Nests may be protected with dry tobacco leaves mixed with ash.

Importance	External parasites are small organisms that attack the skin and feathers of a bird. Some (such as ticks, fleas and other bugs) will drain blood and until the bird dies from exhaustion. External parasites are also dangerous as they may transmit diseases to poultry.
Transmission	By contact between birds and through cracks in the floor, walls or roof of the poultry house.
Symptoms	These include loss of weight, feathers and productivity. Chickens may be noisy at night and refuse to enter the house. They may also peck at their own body due to irritation caused by mites.
Treatment	Application of insecticide (Sepou or louse powder) to the infected area and the environment (poultry house).
Prevention	Regular cleaning, disinfection and fumigation of the house (including smearing of the walls with whitewash to repel insects) and proper fencing to ensure protection from rain.

Scaly legs

This is caused by external parasites that irritate the skin on the bird's legs. It is common in birds above 2 years of age. The bird's legs will develop visible scales that will eventually cause lameness. The disease is treated by dipping the legs in oil or kerosene (once a day) until the scales disappear.

Cleaning cages and houses

If birds are infected with external parasites it will be necessary to thoroughly clean out cages and houses. All bedding and dirt must be removed, and all parts of the equipment should be thoroughly scrubbed with soap and hot water. If possible, you should then spray or paint the equipment with a mixture of paraffin and creosote in equal amounts or with nicotine sulphate (40%). You can use a hand pump to spray houses with a treatment for external parasites; your veterinary officer can advise you on this.

Always visit your local veterinary office. Your veterinary officers will advise you on what is available locally for you to use.

General chicken disease control and prevention methods

Poultry diseases often have immense economic and food security losses. The following are important strategies for disease control for local/backyard, semi-intensive and intensive poultry production systems:

- Maintain a clean and dry environment/housing for the birds with proper ventilation and natural lighting;
- Ensure appropriate vaccination of chickens through local community animal health workers or agricultural officers;
- Separate chicks from the adult chickens since chicks have low immunity and are prone to diseases;
- Separate and isolate dead/sick chickens from healthy chickens;
- Prevent introduction of new chickens from unknown areas, especially during occurrence of seasonal diseases;
- Newly acquired chickens should be quarantined for at least a month before mixing them with your flock;
- Limit the number of people attending the chickens, and avoid visitors in the chicken premises;
- It is advisable to avoid sharing or borrowing poultry equipment;
- Ensure clean water and appropriate feeding practices/scavenging to maintain a healthy flock;
- Always seek advice from relevant community animal health workers or agricultural officers on any suspect sick birds;

• Properly dispose dead chickens through deep burying or burning to prevent disease spread;
• Ensure well-constructed poultry houses, secure enough to deter predators and potential disease carriers such as rats.

Record keeping

It is important to keep records of your chickens whether it is traditional, semi-intensive or intensive production systems.
Record keeping is extremely important to successful poultry production in making:
Financial decisions – before creating a budget or making important and costly financial decisions, records need to be analysed;
Feeding decisions – records are useful in deciding what types of feed rations, the quantity of feed rations, and the effectiveness of a specific feed ration.
Depending on the size and production system, records may be collected on a daily or weekly or monthly basis. Daily observation of flocks is necessary in assessing the production and health of the flock as well as identifying early signs of disease, malnutrition or other problems. When these are discovered early, the necessary precautions may be taken.
There are different kinds of data to be collected during the chicken production process:

• **Feed related data:** These record the name of the farmer/household, type of feed, age of birds in weeks/months, the chicken category based on age (chicks, grower, layer/hen or cock) and feed intake (gm/day/head).
• **Chicks' data collection:** Chicks' data may include number at hatch, date of brooding, type/breed, age in days, mortality data, average body weight and causes of death.
• **Market related data:** May include number and chicken type sold (hen, cock, etc.), eggs sold, location of sale and income from sale of eggs/chicken. Chickens given as gifts and those consumed at home by family and friends should also be noted. Any expenditures related to the chickens (feeds, drugs, etc.) should be registered carefully, noting quantities, price and date of purchase.
• **Layers/hen data collection:** Captures data of brooding, hatching, start date of egg laying, breed/type, number of eggs laid per day/head, number of eggs broken or out of use, number of hens (present, died, transferred), eggs laid, dead chickens, cause of death and chickens given as gifts.
• **Health record sheets:** Captures data on date(s) of vaccination, type of vaccine, name of the disease, method of vaccination, etc.
• **Treatment data:** Captures data on any treatment given including the age of the chicken (in weeks), type of drug used and the method and dosage of drug administered (e.g. water, feed).

Table 22: Daily Egg Record

	Month 1	Month 2	Month 3	Month 4	Month 5	Month 6	Month 7	Month 8	Month 9	Month 10	Month 11	Month 12
1												
2												
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30												
31												
Total number of eggs												
Average number of birds												
Average number of eggs per bird												

Marketing of poultry products

Figure 73: Crates of eggs

Free-range farmers of local chickens do not often produce surplus eggs for sale, but when they do the eggs are sold at the farm gate. Local breeds are very popular and frequently found on all local markets. They are more likely to be eaten by families compared to cattle and goats. They can be sold, bartered or given as gifts; they are also served in most restaurants and grills in major cities and towns.

There are currently about 5 million chickens in the country. It is estimated that 250,000 to 450,000 broilers are sold per month in the major towns with most of them imported from Kenya, Uganda or Sudan.

Chicken is a very popular delicacy across Kiswahili speaking East African countries where the roasted or barbecued chicken parts are known as kuku choma. In South Sudan the same is called gideda al aragu. Eggs are fried or boiled and sold by street vendors, so the demand for them is high.

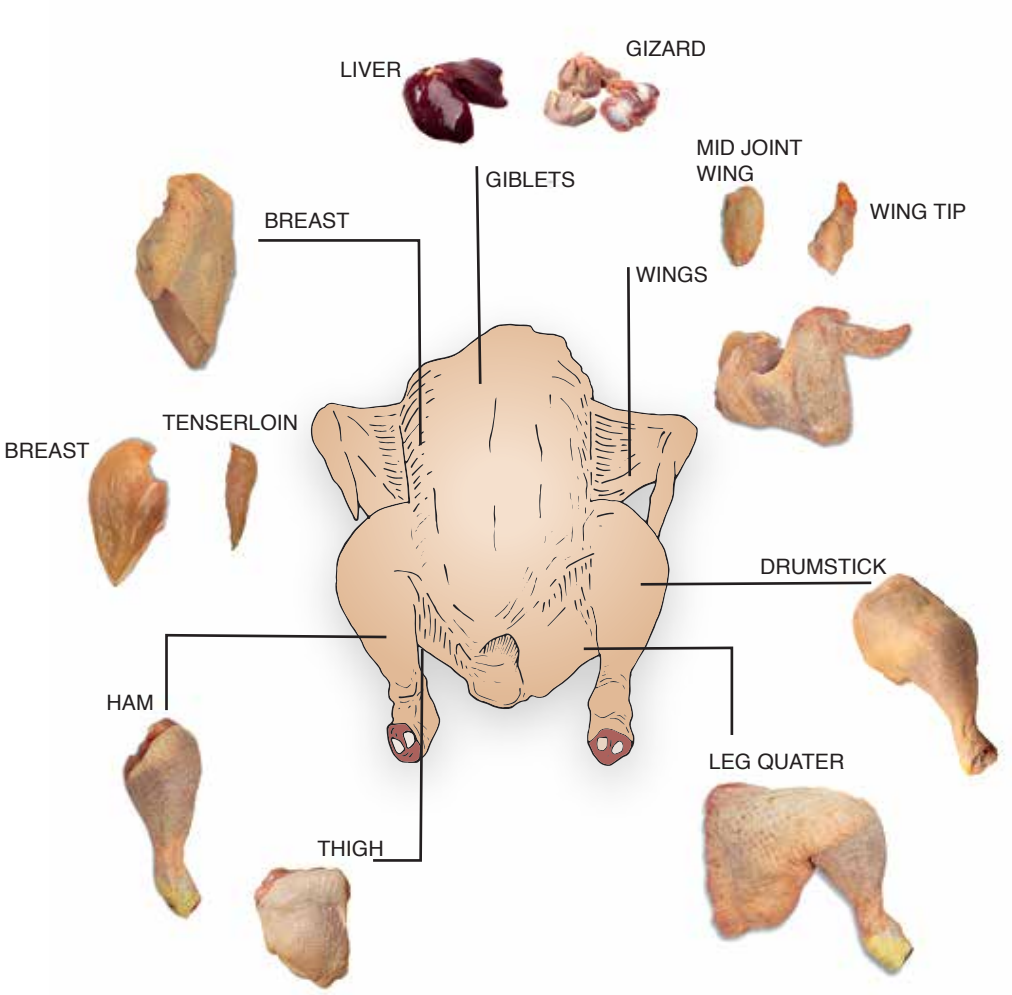

Figure 74: Chicken cuts

In the case of birds raised using the intensive system (such as broilers), farmers have to sell them by the seventh or eighth week and as such are more likely to supply restaurants and supermarkets. Most frozen broilers found in supermarkets are from other countries (some as far away as Brazil). For layers, eggs are required daily and are traded at all local markets and supermarkets. The demand for eggs is higher than the supply in South Sudan, with the shortage met through the import of eggs from neighbouring countries such as Uganda, Sudan, Kenya and Ethiopia.

Common livestock extension approaches, methods and institutions in South Sudan

There are many extension approaches and method in use in South Sudan. Many of these are pluralistic and delivered jointly by extension workers from government ministries (Livestock and Fisheries, and Ministry of Agriculture) and the non-governmental organizations guided by the National Agriculture and Livestock Extension policy (NALEP) of South Sudan. The most common approaches in use are:

- Farmer Field Schools (FFS), Agro-Pastoralist Field Schools (APFS), Fisher Folk Field Schools (FFFS) Pastoralist Field Schools (PFS), Pastoralist Livelihood and Education Field Schools (PLEFS);
- Group approach (extension group/production group/marketing group, etc.)
- Outreach approach (with a whole range of methods like lead farmers/farmer promoters; demo plots; farmer field days; farmer demonstrations, mass awareness campaigns and others)
- Community-based approach (extension delivered by community-based extension workers)
- Farmer-led extension approach (extension through lead farmers and collaboration between individual farmers)
- Block farm model (blocks of often more than 100 farms having a central demo plot and being serviced by a community-based extension worker)

Farmer field school concept

The basic principle of Farmer Field Schools (FFS) is to provide an opportunity for farmers to test new varieties and methods under local conditions but without risking their food security. Extension options can be visualised as a continuum between very prescriptive top-down approaches, like a seed company demonstration plot, to farmer-led research and farmer-farmer approaches. FFS are extension-led or farmer-led or something in between. Extension-led FFS are more top-down, with farmers following a syllabus designed by extension staff based on seasonal activities.

Farmer-led FFS are intended to help farmers run their own trials and research projects to develop solutions to their local problems, for example participatory variety selection trials. NGOs and governments tend to prefer extension-led FFS as these provide greater control over the crops and methods taught, and also fit better with log frames and annual work plans.

Top-down	Bottom-up
Extension-Led Farmer Field Schools Highly prescriptive Delivery of extension "package" Technology dissemination Seed/fertiliser company, government and NGO demonstration plots and farms	**Farmer-Led Farmer Field Schools** Free, open, demand-driven unpredictable Farmer-led research Farmer to Farmer

Paul Wagstaff: Concern Worldwide

The pastoralist field school (PFS) approach

Pastoralism and agro-pastoralism are two predominant systems common across South Sudan. PFS is an adaptation of the participatory and interactive learning farmer field school approach. PFSs are essentially schools without walls that introduce new technological innovations while building on indigenous knowledge. Through experiential learning techniques applied in group settings, with regular meetings over a longer time period, pastoralists learn how to analyse their situation and make informed decisions about their livelihood practices and resource use strategies. The purpose of the PFS is to improve the decision-making capacity of participants and their wider communities and to stimulate local innovation. A PFS usually comprises a group of between 25 and 30 pastoralists (including elders, men, women and youth) who meet regularly over a defined period of time to make observations that relate livestock production to the rangeland ecosystem.

The PFS approach, in contrast to most conventional extension approaches, strengthens the capacity of local communities to analyse their livelihood systems, identify their main constraints and test possible solutions. By merging their own traditional knowledge with external information, pastoralists can eventually identify and adopt the most suitable practices and technologies to their livelihood system and needs to become more productive, profitable and responsive to changing conditions.

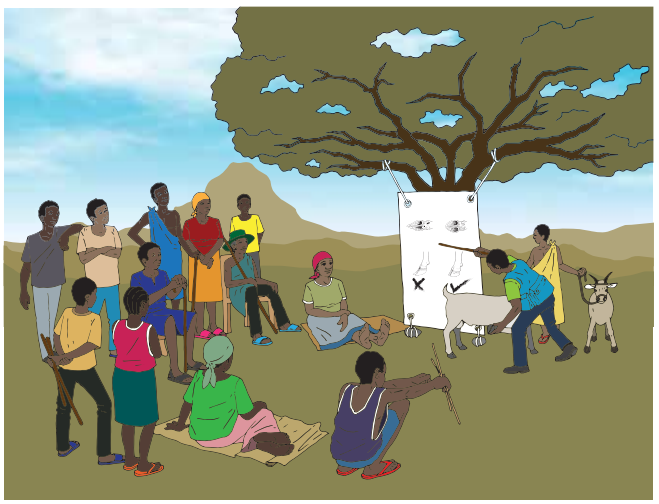

Figure 75: A field school in practice

The specific objectives of the PFS include:

Empower pastoralists with knowledge and skills to make them experts in their own context.
Enables pastoralist livelihoods to become more resilient and less vulnerable to disasters such as drought.
Facilitate pastoralist communities to learn new ways to solve problems and adapt to change.
Sharpen the ability of pastoralists to make critical and informed decisions that strengthen their coping mechanisms.
Help pastoralists learn how to organize themselves and their communities.
Provide platforms where pastoralist groupings and extension and research workers jointly test and adapt options within the specific local conditions.

Figure 76: A cattle camp in South Sudan.
Photo credit: FAO

Based on an adaptation of the farmer field schools, PFS are 'schools without walls' where capacity is developed from existing local knowledge. They are guided by the following key principles:
Learning is by doing and problem based;
The herd and the landscape are the main learning grounds;
Discovery-based learning tools trigger a spirit of curiosity and innovativeness;
Trained facilitators guide the learning process, not by teaching but by facilitating.
The 25-30 pastoralists would meet regularly in a local field setting, under the guidance of a trained facilitator. They make observations on livestock production and rangeland topics of study and compare the effects of alternative practices. As a result of the observations and analyses are done directly on-site, and participants make decisions on how to improve their practices. All PFSs follow this systematic action learning process where the key steps are observation, reflection, group discussion, analysis, decision making and action planning. The facilitator's role is key to a successful PFS, guiding the process and providing systematic follow-up support to ensure that learning is translated into practice.

PSF has proven to be an innovative and empowering capacity development approach for pastoralists. By merging their own traditional knowledge with external information, pastoralists identify and adopt the most suitable practices and technologies in order for their livelihood system to become more productive, profitable and resilient to climate change.

Why the pastoralist field school approach

Capacity building of rural communities has traditionally been seen by research and extension institutions as a mechanism to transfer technologies to land and resource users. This approach, however, has proved inadequate in complex situations where community members must frequently adjust their practices to changing conditions. Technology packages, delivered in a top-down manner, have often been too complex, expensive or poorly adapted to people's needs.

The PFS is itself not a top-down approach that gives blanket recommendations but provides "a basket of options". Due to the PFS approach being more localized, it is much more flexible and able to cater for local requirements and avoids the problem of bringing technologies that are not suitable for the resource poor. PFS also provides recommendations and links to market realities thus providing a means of improving communication linkages among pastoralist farmers, the public and the private sector extension service providers. Ultimately, the PFS links innovations and research for extension purposes.

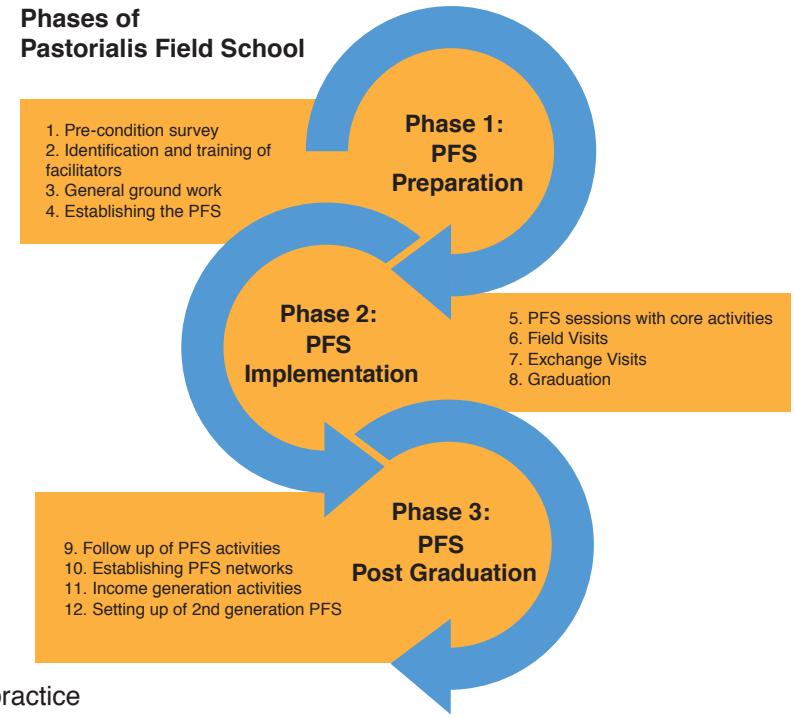

Figure 77: A field school in practice

In most pastoral areas, extension agents are few or lacking and therefore the pastoralist field school could be used to fill this gap as they are used as platforms for extension. PFS as a method of extension is a learning process with a lot of discussions, analyses and synthesis of new ideas. Through the analyses and discussions, new ideas are put to scale and informed decisions and recommendations are made on the new ideas. Pastoral field schools can also be used as a platform for the extension of ideas, exchange visits, field days, demonstrations and on-site training.

Phase 1: PFS Preparation

Steps

1. Pre-condition survey
2. Identification and training of facilitators
3. General ground work

    Establish contact with the community
    Awareness-raising meeting to introduce the PFS concept
    Identification of the participants
    Identification of the focal activity (PFS) learning enterprise
    Identification of the learning site

4. Establishing the PFS

Participatory introduction of the participants
Levelling of expectations
Identifying the host team
Participatory planning of PFS activities

    Establishing the PFS group
    Problem analysing and ranking
    Identifying pastoral solutions
    Developing the learning programme
    Developing a detailed budget
    Submitting a grant proposal
    PM&E plan

Phase 2: PFS Implementation

Steps

5. PFS sessions with core activities

    Comparative experimentation
    AESA/PESA
    Topic of the day
    Group dynamics
    PM&E

6. Field visits
7. Exchange visits
8. Graduation

Phase 3: PFS Post Graduation

Steps

9. Follow up of PFS activities
10. Establishing PFS networks
11. Income generation activities
12. Setting up of 2nd generation PFS

Additional information on the PFS can be found in the FAO Pastoralist Field School straining of Facilitators Manual.

Community animal health workers (CAHWs) in South Sudan

Community-based animal health workers (CAHWs) developed in zones where public veterinary services are limited or weak, as in the case of many countries in conflict or war. They are selected by their community in collaboration with private veterinary doctors, the veterinary public services and supporting bodies (projects and NGOs). In South Sudan CAHWs are very well recognized by the communities they serve. They are trained and overseen by the state and county government veterinary officers closest to them with additional support from humanitarian organizations.

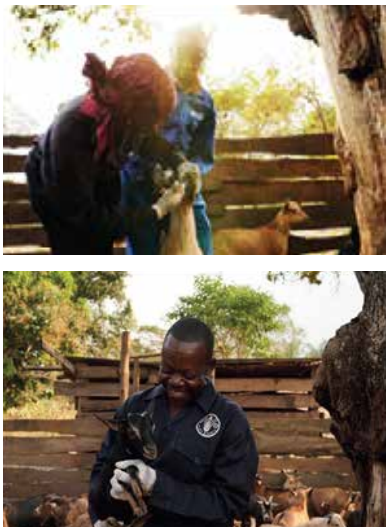

Figure 78: Community animal health workers at work

CAHWs provide basic animal health services and give husbandry advice to livestock keepers. They are responsible for popularizing certain farming techniques and methods in order to optimize animal production. More than 2,000 community animal health workers (CAHWs) are involved in the delivery of animal health services across the country.

The role of community-based animal health workers (CAHWs) are:

CAHWs conducts outreach, contact livestock owners and treat their animals. This includes carrying out clinical treatment, treating sick animals, recording the treatment and making necessary follow up. They refer difficult cases to a veterinarian, manage the activity on a cost-recovery basis and sell drugs to animal owners with instructions of their use.

Participate in outbreak investigation and take samples, if necessary, under the supervision of a qualified veterinarian or livestock health expert.
Carry out surveillance and report occurrences of livestock disease to the ministry of livestock representatives.
Create awareness about public health and animal welfare.
Participate in vaccination campaigns. Mobilize the community and vaccinate animals.
Keep drugs and tools away from the reach of children.

Since CAHWs are not government staff, their survival and upkeep depend on their ability to generate an income from the services they offer to the cattle keepers and their community. The contribution from the side of the owner helps the CAWHs to purchase new drugs or tools through which they maintain the service.

Figure 79: CAHW preparing to vaccinate cows in Warrap State (VSF-G) and another treating a goat

Community based animal traction (AT) trainers

The rising cost of farm tractors and the declining purchasing ability of farmers in developing countries are making animal traction (AT) a worthwhile option. Apart from being lower in initial and running costs, AT is technically less involving and culturally more compatible with the practices and educational status of a large number of farmers in developing countries. Furthermore, the droppings of the animal could be used as manure while the animal could be sold or slaughtered and used as meat when the farmer no longer feels the need for it. Thus as long as the animal is alive it not only maintains its initial cost, but its value could actually be appreciating.
Institutions training livestock extension workers in South Sudan

There are many institutions and centres of learning in South Sudan. In some of them courses on Animal Sciences and Livestock Management and related disciplines are offered leading to the award of Bachelor's degrees, master's degrees and PhDs in universities such as University of Upper Nile, University of Bahr el Gazal, University of Juba, Catholic University and the John Garang University of Science and Technology.
There are six training centres established to train specialists and extension staff. The centres are: Crop Training Centre in Yei, Kegelu Forestry Training centres, Nzara Agriculture Technology Training centre, Boma Wildlife training centre and Padak Fisheries training centre and Marial Lou Livestock training centre.

Marial Lou Livestock Training Centre for paravets and livestock extension workers

The Marial Lou Livestock Training Centre (MLLTC) was established in Tonj East (Warrap State) in 1996. Since its establishment, the institute has trained over 1,000 mid-level community-based animal health workers (CAHWs) or para-veterinary professionals (paravets) such as animal health auxiliaries (AHAs), stock persons (SPs) and general extension service providers for the delivery of animal health and production extension services across the country, contributing to poverty reduction.

Forming of herders' associations

Herders' associations can be set up to manage livestock and associated resources such as water and pasture. It is also easier to request veterinary services when in a group. There are currently no legal policies regulating herders' associations in South Sudan. Functional and effective herders' associations are therefore required do the following:

Identify and register all cattle camps in the boma.

Inform them of the advantages of registering all animal herds in the area.

Educate them on the importance of formalising their membership as an association and how it brings the following advantages:

- It makes livestock movement control easier;
- It facilitates livestock identification (branding);
- It makes it easier to organise livestock health management activities, e.g. vaccination campaigns
- It helps increase power to lobby the government for technical support for the improvement of the livestock industry;
- It facilitates the solution of conflicts;
- It can help introduce savings and credit among herders and even enable them to obtain loans from financial institutions such as rural or commercial banks;
- It can help herders to work like cooperatives;
- It can help organise adult literacy sessions.

Register all cattle owners in the camp (often they have their own laws).

Encourage them to write down their laws and agree to abide by them.

Identify their leaders and encourage members to rotate leadership after one or two terms.

Allow them to assess their own capacity to manage their herds and ask them in which areas they need more knowledge and information on cattle management.

Link them to the Department of Cooperatives of the relevant ministry at which they can be officially recognised and certified as a herders' group or association.

Managing conflicts arising from cattle rearing in South Sudan

A conflict is a misunderstanding or disagreement between two or more parties or persons. In South Sudan, conflict resulting from cattle herding and rearing is a major problem which has been known to spiral into inter-generational and inter-clan conflict, also causing revenge violence. Livestock keeping in South Sudan has been highly associated with internal conflict due to theft and cattle raiding. Disputes between crop and livestock keepers are largely triggered by inadequate water supply and scarce pasture resources for livestock. These disputes can persist over a very long time. Most of the conflict arises from the raiding of livestock and the lack of access to grazing areas and water points. Other factors include limited access to services such as education and health. Due to the high cultural significance of the herd, the resolution of cattle-related issues such as raiding can be much more difficult than that of others. The maps below show the cattle movement in 2014 and 2015 in South Sudan.

Source: FAO South Sudan 2014: Cattle movement in South Sudan

Source: FAO South Sudan 2015: Livestock Movement map

Figure 74: Map showing cattle movement

Resolving livestock-related conflict

To resolve livestock-related conflict issues, the following steps are recommended:

- Government streamlining of livestock management policies;
- Provision of livestock water points in strategic areas;
- Provision of adequate police services and security to reduce cattle theft and raiding;
- Establishment of an act of parliament prohibiting cattle rustling;
- Identification of well-mapped stock routes to reduce agro-pastoral conflict;
- Improved productivity of local animals (through breeding, pasture, fodder development, etc.) in order to enable handling of smaller numbers that can easily be managed;
- Formation and strengthening of herders' associations and capacity building of peace committees.
- Develop a national policy on livestock migration and management.
- Ensure equitable access to water and pasture by providing livestock water points and supporting pasture management in key areas, for instance in main grazing lands and along major migration routes.
- Promote commercialization of the livestock sector, emphasizing quality rather than numbers.
- Support community-based, inclusive and sustainable delivery of animal health services. This can be an important entry point for conflict mitigation.
- Promote diversification of livelihoods amongst pastoralist youth in cattle camps (see section 10 below –"Alternative education for pastoralists").
- Promote peaceful interaction between communities by supporting peace building activities and actors and by facilitating dialogues.
- Strengthen accountability for cattle raiding and livestock-related crimes by strengthening the justice sector personnel, including prosecution authorities, investigators and prison personnel to better investigate, prosecute and adjudicate crimes.
- Strengthen capacity of traditional authorities to resolve disputes that arise from livestock migration or cattle raiding in a peaceful manner.
- Support the regulation of livestock migration, specifically when migration routes pass through agricultural land, to prevent conflict between pastoralists and agriculturalists.

Range management (pasture/grazing land)

A range is an extensive area of land which contains forage grasses, legumes and other herbage plants on which animals such as cattle, sheep and goats can graze. It is also commonly called grazing land or pasture land.

Figure 80: Herding cattle in grassland

Nearly all cattle, goat and sheep herds in South Sudan are fed on open grass lands. Many pastoralists and agro-pastoralists walk their livestock in search of water and fresh grass during the dry season. This is the pastoralist culture. Though proper grass land and range management in South Sudan is limited, work has been done in East Africa, the Horn of Africa and in the West to improve livestock rearing that can be adapted to improve the range in the country.

Rangeland includes natural grassland, savannas, many wetlands, some deserts, tundra, and certain forbs and shrub communities. Pastures are those improved lands that have been seeded, irrigated, and fertilized and are primarily used for the production of adapted, domesticated forage plants for livestock. Other grazing lands include grazable forests, native pastures, and crop lands producing forage.

Range management is the use of grazing land to ensure consistent livestock production and simultaneously conserve range resources. Range management is a livestock farming system that is concerned with feeding cattle with adequate grasses and legumes in a controlled manner which leads to soil improvement rather than degradation. The character of a range depends on the composition of its crop. Selected grasses and legumes are grown in adequate numbers. A range can regenerate after being fed on by animals and can withstand being trampled by farm animals. It is important to avoid overgrazing and to reseed by replanting forage crops where they begin to show depletion.

There are two types of rangeland: permanent and temporary grassland. Permanent grassland should be fenced and grazed in rotation. The fence should provide protection and should divide the land into sections. Generally, a permanent rangeland is one which continuously produces crops for a relatively long to very long time, with or without resowing. It is also referred to as land used to grow grasses or other herbaceous forage naturally (self-seeded) or through cultivation (sown), and which is not included in the crop rotation. Temporary grasslands are sown grasslands included in a crop rotation.

Advantages of a rangeland

The advantages of a rangeland are that if is properly managed, it provides rich grass all through the year, thereby reducing the distance cattle have to walk in order to find food. Rangeland is easy to manage and saves labour, equipment use and power. It is important for water and soil conservation as the grass protects the soil against rain and other forms of erosion. The use of rangeland can also help to mitigate much of the conflict arising from disputes between crop and livestock farmers practising extensive systems of livestock rearing.

Importance of Green Fodder Production

Green forages have a cooling effect on the animal body, are more palatable, contain easily digestible nutrients and are slightly laxative. The use of concentrates no doubt will give the greatest animal production per unit feed intake, but this may not be economical in countries like South Sudan where grains and concentrates are costly and/or in short supply.

Systems of Fodder Production

Fodder production for intensive livestock farming

The requisites for intensive livestock farming are that:

(i) Fodder is required in uniform quantity throughout the year;
(ii) The fodder crops in the rotation should be high-yielding;
(iii) The area for production of fodder should be fully irrigated; and
(iv) Other inputs, such as fertilizers and pesticides, should be available in optimum quantity.

The different systems of fodder production fall into two categories: overlapping cropping and relay-cropping. In the overlapping system, a fodder crop is introduced in the field before the standing crop completes its life cycle. In relay-cropping, the fodder crops are grown in succession, i.e. one after another with the gap between the two crops being very small.

Value of Tree Fodder

Trees, which can be grown either in combination with agricultural crops or on separate land not usually fit for agriculture, offer opportunity for producing green nutritious fodder for the livestock. It is seldom realised that in some parts of South Sudan, more animals feed on shrubs and trees than on grass or grass-legume pasture. Trees can produce as much, if not more, green fodder per unit area as agricultural fodder crops. The more important desirable agronomic features of a tree species are:

Be reasonably easy and reliable to establish

Exhibit a good competitive ability against weeds
Remain productive under repeated grazing and browsing
Be well adapted to the particular climatic and soil-related features of the environment
Require little or no fertilizer
Be resistant to local pests and diseases
Have adequate forage production or be reliably vegetatively propagated
Have good nutritive value and reasonable palatability and acceptability to animals

Multipurpose tree species (MPTS)

The term 'multipurpose tree' refers to all woody perennials that are purposefully grown so as to provide more than one significant contribution to the production and/or 'service' functions of the land-use system they implement.

Nitrogen fixing tree species (NFTS)

No flowering plant grows without nitrogen and few crops grow economically without adding inputs of this plant nutrient. Many farmers and tree growers cannot afford to buy nitrogen fertilizers, so yield suffers. Nitrogen fixing trees (NFTs) are trees and shrubs that have the ability, through a symbiotic association with
certain soil bacteria, to take nitrogen out of the air and use it for growth. Nitrogen fixing trees (NFTs) have the ability to take nitrogen from the air and pass it on to other plants through the cycling of organic matter. Nitrogen is an essential nutrient for plant growth, and NFTs are a major source of nitrogen fertility in tropical
ecosystems. When integrated with a farm, orchard, garden, or forest, NFTs can be a major source of nitrogen fertilizer and mulch for crops.

Nutritive value of fodder trees

Shrubs and leguminous trees are a good source of digestible crude protein (DCP) for supplementary feeding to farm animals. Tree leaves are good sources of calcium but low in phosphorus. The nutritive value of shrubs and tree species vary widely due to varying inherent nutritive value between species and within species because of climatic and edaphic (soil-related) conditions, cutting and grazing strategies and the soil in which the plant is growing.

Feeding the tree tops during lean periods

All the tropical and subtropical grasses, owing to their faster rate of growth during the rainy season, provide grazing for livestock, mainly in the rainy and post-rainy periods. With the advent of dry season when there is a lack of sufficient moisture in the soil in a ready available form, they enter dormancy. Thus during the lean periods, treetops come to the rescue of the livestock owners. The young leafy, succulent material, highly nutritive and rich in crude protein and minerals, serves as a concentrate, even if fed in small quantities along with other dried grasses and crop residues. Some of the

important trees giving loppings and producing gum are Leucaena leucocephala, Sesbania aegyptiaca or sesbania sesban. The spacing between the trees should be 6-8 metres or even more in cattle yards and 5-6 metres on the bunds of the fields. Besides the use of trees on the farm for various purposes, the trees are planted in the pastures as companion species with grasses.

Carrying Capacity of Pasture

Cattle, sheep and goats in South Sudan are mostly maintained on pasture. The types of grasses in the pasture are highly variable according to the location. The carrying capacity of pasture is how many cattle, sheep, goats, etc. can be grazed on a unit of pasture or rangeland. Carrying capacity may also be defined as the maximum stocking rate possible which is consistent with maintaining or improving vegetation or related resources. The carrying capacity may vary depending on management goals, grazing systems, season of use, weather and many other factors. It may vary from year to year in the same area due to fluctuating forage production. There are several terms related to carrying capacity that need to be defined.

Stocking rate is defined as the number of specific kinds and classes of animals grazing or utilizing a unit of land for a specified time period. It may be expressed as animal unit months or animal unit days per acre, hectare or section. It may also be expresses in the reciprocal form (area of land/animal unit month or day).

Grazing capacity, although sometimes used synonymously with carrying capacity, is defined as the total number of animals which may be sustained on a given area based on total forage resources available, including harvested roughages and concentrates. Grazing capacity is the relationship between the number of animals and the area of land at any instant in time. It may be expressed as animal-units per acre(AU/ha.),or animal-units per section.

Commonly used grazing systems

There are four basic principles to consider when planning a grazing design. These are:
Balance the number of animals with available forage supply;
Obtain a uniform distribution of animals over the landscape;
Alternate periods of grazing and rest to manage and maintain the vegetation;
Use the kinds of livestock most suited to the forage supply and the objectives of management.
Common grazing systems for improved herding and range management are described below

Continuous grazing: Animals are allowed to graze in the pasture for extended periods of time. Animals often do well in this system since they are allowed to choose the plants they eat; however, plants are often overgrazed and under grazed in this system. This is an unrestricted livestock access to any part of the range during the entire grazing season with no rotation or resting. Under this system, it is difficult to match the stocking rate to the forage growth of the range during the entire grazing season. Severe overgrazing occurs where cattle congregate because there is no rotation or resting, while other areas are underutilized. Long-term productivity depends upon moderate levels of stocking. Continuous grazing can be a year-long or seasonal system. One advantage of this system is that it uses less fence and labour than for rotational systems.

Rotational grazing: In this system intensive grazing is followed by resting. Livestock are rotated among two or more pastures during the grazing season. Animals are allowed to graze for only a limited period of time, and animals are moved when existing forage has been removed. Under intensive rotational grazing systems pastures are subdivided into paddocks and use high stocking rates, where animals are forced to eat all forages. This system is the most efficient.

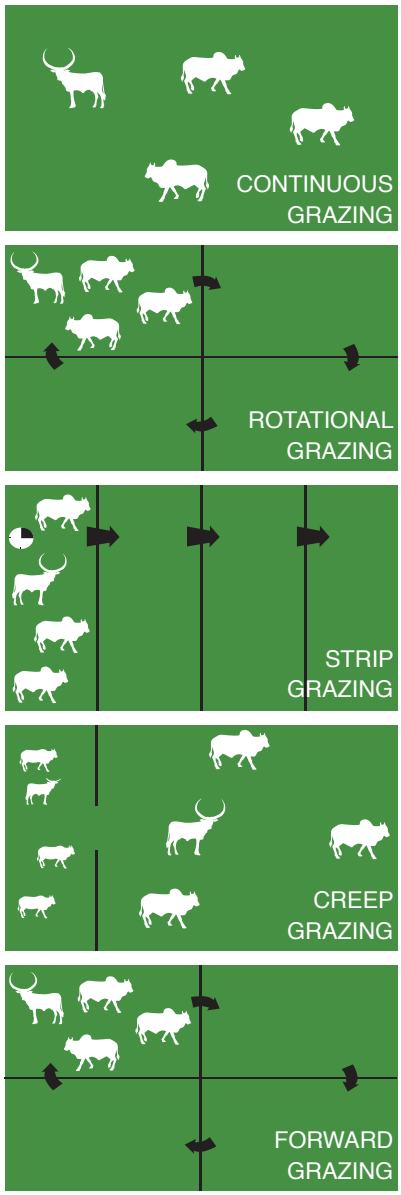

Figure 81: Grazing systems

Strip grazing. A high stocking rate of animals is used in a pasture for a limited period. This system usually involves a specially planted crop, typically an annual species such as rape, turnips or summer grasses.

Creep grazing is a form of grazing in which smaller animals are allowed to go (creep) from one pasture to another through openings in a fence. The openings are small enough to restrict the passage of larger animals to the creep pasture. Creep grazing can be used to give calves access to quality pasture while restricting cows to inferior pasture. It can also be used to allow lambs access to quality pasture while restricting cattle.

Forward Grazing: This method consists of 2 groups of livestock on a paddock, one following directly after the other. This method is often used to graze animals with higher nutritional needs (i.e. growing calves) first to allow them to selectively graze the more nutritious forages in a paddock, followed by the group with lower nutritional needs to utilize the remaining forage (i.e. beef cows).

Deferred grazing: Grazing is discontinued on different parts of the range in succeeding years to allow for resting and re-growth. It generally involves multiple or single herds. Forage is allowed to accumulate in a pasture for grazing at a later date. In deferred grazing stock are excluded from pasture areas to maximise germination and establishment of annual pasture seedlings.

Switch-back grazing. Livestock are rotated back and forth between two pastures.

Merrill grazing: Under this system each of 4 pastures is grazed for 12 months and rested 4 months.

Paddocks

In a rotational grazing system pastures are divided up into smaller units within the pasture; these smaller units are called paddocks. In some smaller operations, permanent fencing is used to divide the pasture. Temporary electric fence is a low cost, effective method of creating paddocks.

Common grasses and legumes for forage

Lands covered with grasses and legumes suitable for animals such as cattle and goats are called pastures. Pastures are valuable and they can be established almost anywhere. If they are properly planned

They are environmentally friendly;

They are low-input and sustainable, considered to be a best management practice (BMP);

They improve profitability as most pasture species are perennials, which provide payback over a long period while animals enjoy nutritious feed.

There is a wide variety of pasture (grasses and legumes) for grazing cattle, sheep and goats across the agro-ecological zones of South Sudan. Common pasture grasses and legumes in the region are:

Grasses

Aristida spp., Cenchrus ciliaris, Chloris gayana, Cynodondactylon, Dactylis glomerata, Digitaria spp., Eragrostis superba, Exothecaabyssinica, Festuca spp., Hyperrhenia spp., Lolium spp., Melinisminutiflora, Panicum coloratum; Panicum maximum; Pennisetum catabasis; Pennisetum clandestinum; Pennisetum purpureum; Pennisetum schimperi; Setaria sphacelata; Setaria splendida; Sorghum sudanense; Sporobolus helvolus; Themeda triandra; Tripsacum laxum

Legumes

Centrosema pubescens, Desmodium spp., Lablab purpureus, Medicago sativa, Macroptilium atropurpureum, Stylosanthes spp., Trifolium spp., Vigna spp.

Planning a pasture system

When planning a pasture system, it is important to consider the following:
Fixed resources – acreage, soil type, soil conditions
Semi-fixed resources – water supply, existing fences, grass base
Changeable resources – forage type, temporary fences and animal numbers
Seasonal usage – land and forage enterprises

Setting up a pasture system

Recommendations:

- Develop a 5-year farm/business plan. You need to plan ahead for when fields need to be renovated, and you need contingency plans.
- Use existing resources, e.g. fences, water and forage crops, whenever possible.
- Establish crops according to your plan.
- Existing pastures can be renovated later if they are needed now for grazing.
- Put your money into a good perimeter fence. This will help to keep predators out and your animals in.
- Map out your farm, giving each field its own identity.
- Soil test fields individually because each has its own characteristics and needs to be treated accordingly.
- Develop a practical watering system. This can be a common problem for many pastoralists as there are many factors to consider such as cost, environment and grazing system.
- Create a sacrificial area; this will protect your pastures. A sacrificial area is part of your pasture system that is permitted to become trashed. (Sacrificial areas are those areas where animals are held for a period of time during extreme weather conditions.)
- Estimate the carrying capacity of your pastures, which will determine the number of animals and paddocks (if rotational) required.
- Calculate the number of paddocks needed and days per paddock (if rotational).
- A temporary fence works well to form paddocks.

Suggested outline for training by extension agents

Topic:
Clearly state the topic you intend to cover during this session.
Objectives:
Start with "at the end of the topic, the trainees should be able to…" and list what you want them to have learned by the end of the session.

Facilitation method:
State here the type of facilitation method you intend to use. There are many methods, so be specific and chose the method that is most effective (this is not limited to lectures, demonstrations, field work or role playing). Remember that you could use a combination of methods.

Duration:
State the time required to carry out the training. Remember to be brief and precise and not to waste the participants' time. They may lose interest if the training takes too long, and you should rush your lectures due to limited time. Pick an appropriate time for training. Remember that your trainees will usually be adults, who have competing needs for their time so be sure to be creative, get straight to the point and make your points clearly.

Materials for training:
List all the required materials, training aids and possible equipment to be used in the training. Be sure to use illustrations as much as you can, especially if your trainees are without formal education.

Content:
List the specific concepts and knowledge that will be part of the training (such as common diseases of sheep and goats, for which you may refer to page 8 of this technical guide).

Resources:
State the sources of the information you are delivering. This is useful to provide further reading for the trainees as well as a reference. Resources can include technical guides (such as this one), textbooks and other publications.

Glossary

Abortion: premature expulsion of a non-viable foetus from the uterus after 45 days of pregnancy and before the normal 282-day term.
Afterbirth: the foetal membranes that attach the foetus to the membranes of the pregnant female and which are normally expelled from the female within 3 to 6 hrs. after parturition (see parturition).
Anaemia: a disease due to a deficiency in iron and/or the lack of red blood cells.
Antibiotic: a metabolic product of one microorganism or a chemical that in low concentrations is detrimental to activities of other microorganisms. Penicillin, tetracycline, and streptomycin are antibiotics. They are not effective against viruses.
Aseptic: free from bacterial contamination, sterile. Used to describe a type of food processing and packaging characterized by non-refrigerated storage and long shelf life products.
Bacteria: single-celled organisms living either independently or in close association with other living organisms; often referred to as microbes or microorganisms because of their microscopic size. Some bacteria are beneficial, but others cause infectious diseases.
Balanced ration: the daily food allowance of an animal containing all the dietary requirements to meet the purpose for which it is being fed.
Bloat: a disorder of ruminants usually characterized by an accumulation of gas in the rumen.
Bone meal: animal bones that were steamed under pressure and then ground. It contains 1.5-2.5% nitrogen, 12-15% phosphorus, and 20-34% calcium. It is used as a fertilizer and as a mineral supplement for feeding farm animals.
Bran: the seed coat of wheat and other cereal grains which is separated from flour and used as animal food.
Breed: animals having a common origin and characteristics that distinguish them from other groups within the same species. A breed is also group of animals of a certain species that through generations of selective breeding has become uniform in performance, appearance, and selection history.
Broad-spectrum antibiotic: an antibiotic that is active against a large number of microbial species.
Bull: a sexually mature uncastrated bovine male.
Castration: the removal of male reproductive organs (testicles) to reduce sexual activity and increase fattening of meat animals.
Cholesterol: a white, fat-soluble substance found in animal fats and oils, bile, blood, brain tissue, nervous tissue, liver, kidneys and adrenal glands. It is important in metabolism and is a precursor of certain hormones.

Colostrum: milk that is produced by the mother during the first few days after giving birth. This milk contains a high concentration of maternal antibodies to provide offspring with temporary protection against infectious diseases.

Complete ration: a blend of all feedstuffs (forages and grains) in one feed.

Concentrate: a feed high in nitrogen-free-extract (NFE) and total digestible nutrients (TDN) and low in crude fibre (less than 18%). Included are cereal grains, soybean oil meal, cottonseed meal and by-products of the milling industry such as corn gluten and wheat bran. A concentrate may be low or rich in protein.

Confinement: livestock kept in corrals or housing for maximum year-round production. Facilities may be partial or complete, usually with a solid floor and enclosed or covered.

Contagious: readily transmitted from one individual to another, with reference to an organism that causes a disease.

Cooperative: a form of business owned and controlled by the people who use its services, such as a milk marketing or processing cooperative.

Cow: a mature female bovine.

Critical temperature (lower): environmental temperature below which a calf has to expend energy to maintain its body temperature. It is calculated as the environmental temperature at which heat loss from the calf due to maintenance and utilization of feed is equal to the heat needed to maintain constant body temperature.

Critical temperature (upper): environmental temperature at which animal performance decreases because natural mechanisms that act to help the animal lose heat are insufficient to dissipate heat gain.

Crossbreed: offspring of parents of different breeds.

Culling: refers to the process of eliminating non-productive or undesirable animals.

Dairy animal: an animal from which milk production is intended for use or sale for human consumption, or is kept for raising replacement dairy animals.

Days in milk (DIM): the number of days during the present lactation that the animal has been milking.

Dehorn: to remove horns from animals or to treat young animals so horns will not develop. This is also referred to as dis-horn.

Deoxyribonucleic acid (DNA): the chemical substance that is the principal nuclear material of cells. The structure of DNA determines the structure of ribonucleic acid which, in turn, determines the structure of proteins of the cell.

Doe: a sexually mature female goat.

Domestication: is the process of conversion of wild animals to domestic use.

Dry: describes a non-lactating female. The dry period of dairy animals is the time between lactations (when a female is not secreting milk).

Ecto-parasite: a parasite, such as a flea, that lives on the outer surface of another animal. Ecto-parasites are also called external parasites.

Endo-parasite: a parasite, such as a tapeworm, that lives within another animal. Also called internal parasites

Ensilage: a green chop (forage) preserved by fermentation in a silo, pit or stack, usually in chopped form. Ensilage is also called silage.
Epidemic: the rapid spreading of a disease so that many animals or people have it concurrently.
Eradication: complete elimination of a disease from a region or country, especially one that is epidemic.
Flush season: the time of the year, usually spring and early summer, of maximum milk production. During this period, manufacturing facilities are usually operating at full capacity because there is a considerable daily surplus above the market's fluid needs.
Fodder: coarse food for cattle or other livestock, such as corn stalks or straw.
Food code: the food code is a collection of standards, guidelines and codes of practice adopted by the Codex Alimentarius Commission.
Food safety: the concept that food will not cause harm to the consumer when it is prepared and/or eaten according to its intended use.
Foot rot: an inflammation occurring between the toes and in the hooves of sheep and cattle. It is caused by a combination of fungus and bacteria.
Forage: roughage of high feeding value. Grasses and legumes cut at the proper stage of maturity and stored to preserve quality are forage. A crop that is high in fibre and grown especially to feed ruminant animals.
Forequarters: the two front quarters of the udder. Forequarters is also called the fore udder.
Gestation: This is the time between conception and birth, during which the embryo or fetus is developing in the uterus. The gestation period for a cow for example is about nine months long.
Green chop (fresh forage): forages harvested (cut and chopped) in the field and hauled to livestock. This minimizes the loss of moisture, colour, nutrients and wastage. Green chop is also called zero grazing or silage.
Halal food: is the food which is allowed to be consumed according to Islamic rules and that comply with the requirements mentioned in this standard.
Hay: dried forage (e.g. grasses, alfalfa, clovers) used for feeding livestock.
Heat period: that period of time when a female will accept a male in the act of mating. Heat period is also known as heat or oestrus.
Hectare: a metric unit of land measurement, which is equal to 100 m x 100 m or 2.47 acres.
Heifer: a bovine female less than three years of age who has not borne a calf. Young cows with their first calves are sometimes called first-calf heifers.
Holding area: refers to an area to hold dairy animals prior to entry into the milking parlour. This is sometimes referred to as a holding pen. A holding area may also include a wash pen.
Lactation period: the actual milk and component production for all animals in the herd that was completed during a 12-month period.

Mastitis: An inflammation of the mammary gland(s), usually caused by bacteria.

Milk composition: average composition of dairy cow milk that includes the following constituents: 87% water, 3.25% protein, 2.5% casein, 5% sugar (lactose), 3.7% fat and 0.8% minerals and vitamins.

Milk: normal mammary secretion of milking animals obtained from one or more milkings without either addition to it or extraction from it, intended for consumption as liquid milk or for further processing.

Milking parlour: an on farm structure where dairy animals are milked. Animals are brought to the milking parlour for milking, usually twice and sometimes three times a day.

Natural selection: is the process whereby animals that are better adapted to their environment have a higher chance of survival and produce more offspring than less adapted animals. The next generation thus, on average, will be more adapted than the current generation.

Overhead: operating expenses of the farm excluding labour and materials. Taxes, utilities, rent or mortgage payments are overhead expenses.

Parturition: the process of giving birth.

Pasteurisation: Microbiocidal heat treatment aimed at reducing the number of any pathogenic microorganisms in milk and liquid milk products, if present, to a level at which they do not constitute a significant health hazard. Pasteurisation conditions are designed to effectively destroy the organisms Mycobacterium tuberculosis and Coxiella burnettii. (Codex Alimentarius)

Paravet: persons who are authorized by the veterinary statutory body to deliver some animal health extension services (depending on qualifications and training) in a territory, which are delegated to them under the responsibility and direction of a veterinarian. Paravets are also called Community Animal Health Workers (CAHWs) in some countries.

Post mortem: after death. Post mortem in veterinary is a procedure that consists of a thorough examination of a corpse to determine the cause and manner of its death and to evaluate any disease or injury that may be present. It is usually performed by a specialised team of pathologists.

Production cycle: a sequence beginning with the mating of a mature female and progression through gestation, parturition and subsequent events in the life of both the dam and offspring.

Ration: the 24-hour feed allowance for an animal.

Roughages: feeds that contain a low density of nutrients and that are high in crude fibre (more than 18% of dry matter). Roughages include most fresh and dried forages and fodders.

Rumen: the first compartment of the ruminant stomach, also known as the first stomach. This is the site of fermentation of the consumed feed by microbes.

Species: is the largest group of animals that are capable of interbreeding and producing fertile offspring.

Silage: forage plants such as corn (maize), legumes, and grasses that have been chopped and stored in tower silos, pits or trenches for use as animal feed.

Silo: a structure in which forage is preserved by fermentation under anaerobic conditions and subsequently stored until fed to livestock.

UHT: ultra-high temperature heat processing that results in a sterile product (140°C for 3-4 seconds).

Zoonosis: a disease communicable from animals to humans and vice versa under natural conditions.

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Suggested outline for training by extension agents

Topic:

Clearly state the topic you intend to cover during this session.

Objectives:

Start with "at the end of the topic, the trainees should be able to…" and list what you want them to have learned by the end of the session.

Facilitation method:

State here the type of facilitation method you intend to use. There are many methods, so be specific and chose the method that is most effective (this is not limited to lectures, demonstrations, field work or role playing). Remember that you could use a combination of methods.

Duration:

State the time required to carry out the training. Remember to be brief and precise and not to waste the participants' time. They may lose interest if the training takes too long, and you should rush your lectures due to limited time. Pick an appropriate time for training. Remember that your trainees will usually be adults, who have competing needs for their time so be sure to be creative, get straight to the point and make your points clearly.

Materials for training:

List all the required materials, training aids and possible equipment to be used in the training. Be sure to use illustrations as much as you can, especially if your trainees are without formal education.

Content:

List the specific concepts and knowledge that will be part of the training (such as common diseases of sheep and goats, for which you may refer to page 8 of this technical guide).

Resources:

State the sources of the information you are delivering. This is useful to provide further reading for the trainees as well as a reference. Resources can include technical guides (such as this one), textbooks and other publications.

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