

Goat Management and Health

A Guide to Raising Healthy Goats



Developed by COMACO (Community Markets for Conservation),
a programme of the Wildlife Conservation Society in Zambia

*Created by Tamika Lewis '09, Cornell University College of Veterinary
Medicine and Alice Pell, M.S., Ph.D., Cornell International Institute for
Food, Agriculture and Development*

Table of Contents

<i>Section</i>	<i>Page</i>
Introduction	3
Basic Husbandry, Nutrition and Management	4
Assessing Goat Health	11
Goat Disease.....	16
Glossary	24
Appendix 1 – Basic External Anatomy of the Goat	26
Appendix 2 – Nutrition	27
Appendix 3 – Weight Estimation Using Heart Girth	29
Appendix 4 – Physical Exam Checklist for Goats.....	31
Appendix 5 – Tips for Leading Training Sessions.....	33
References	34

Introduction

Community Markets for Conservation (COMACO) is committed to improving people's livelihoods while protecting wildlife and the environment. If people earn good incomes from farming, poaching and over-fishing will decrease. COMACO has started projects in bee-keeping, rice and vegetable cultivation, poultry raising and fish farming. Now, COMACO is starting a project on goat rearing.

These projects are not separate efforts but rather are parts of a whole farming system. Goats contribute to this system not only by providing meat for sale and for home consumption, but also by their contributions to the other COMACO enterprises. Goats are multi-purpose animals: they provide meat, fertilizer, leather, and milk. Goat droppings added to fish ponds increase the growth of plankton eaten by the fish. Goat manure and refused feed make excellent compost which increases both soil fertility and the ability of the soil to hold water for better yields of sorghum, maize, rice and vegetables. The goat rearing project includes raising fodder trees for animal feed, but these trees have other uses: they can be used as living fences, to provide green manure for soil fertility and as sources of fire wood and poles for building. Crop by-products like rice husks and corn stover provide animal feeds during the dry season.

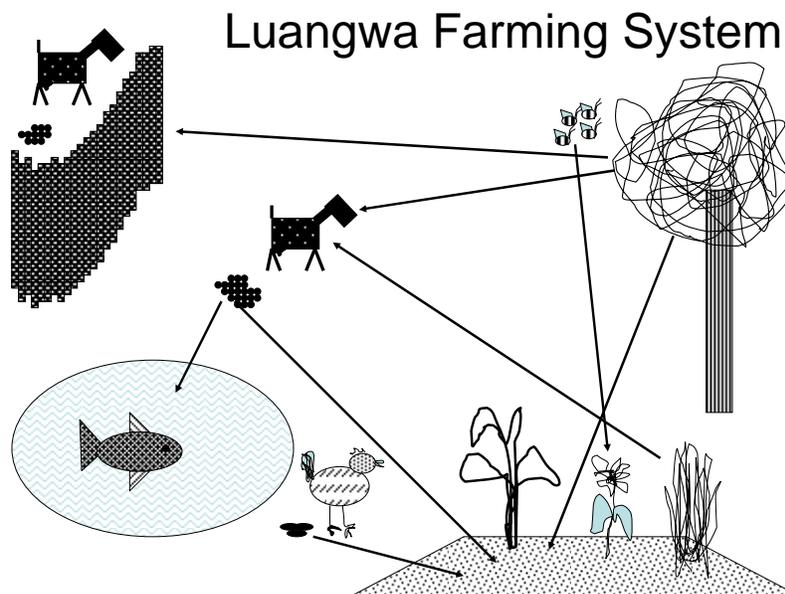


Figure 1. Examples of integration in a farming system in Luangwa. From these projects, people derive income and their diets are improved.

Basic Husbandry, Nutrition and Management

Nutrition

Good nutrition is essential to maintaining a healthy and productive goat herd. Goats require energy, protein, vitamins and minerals to grow efficiently, maintain good health and raise offspring. Failure to meet nutritional requirements decreases goat productivity and profitability. Even free-ranging goats may require dietary supplementation to meet these requirements. If animals are confined, it is especially important to pay attention to nutrition because the goats are completely dependent on people to provide what they need. Goats are selective eaters so do not expect them to “clean up their plates.” It is natural for them to leave poor quality feed in the feed trough. What they do not eat in 1-2 days should be removed and used as bedding or compost.

Goat diets should contain at least 9-10% crude protein for growing animals and about 12% for does in early lactation. A good approach to ensuring that animals have sufficient protein is by creating protein banks with trees and shrubs whose leaves have high levels of protein, such as *Calliandra*, *Leucaena*, *Mulberry*, *Desmodium*, *Sesbania*, and *Gliricidia*. Sufficient protein and energy to meet maintenance, growth and milk production requirements are necessary. The major nutritional problem for goats is providing adequate feed during the dry season.

The following section contains suggestions on sources of dietary supplements to daily grazing:

*Energy sources

- by-products and crop residues (good option during dry season)
- leftovers of potatoes, maize (mealie meal), rice, sorghum, and cassava
- overripe bananas or plantains

*Protein sources:

- leaves from protein bank trees
- soybeans/soybean seed coats
- other beans and peas
- groundnut oil cakes
- sunflower seeds

*Vitamin/mineral sources

- trace mineral salt
- eggshells or bones (burned in fire, then crushed)

Water water water!

For goats as with people, water is essential for health and adequate amounts of clean water should be available at all times. Water keeps animals hydrated and keeps all body systems functioning normally. Animals can die from dehydration, most likely caused by insufficient water supply or prolonged diarrhea. If water is not changed regularly, it will be contaminated with harmful bacteria becoming a source of disease in a herd. The water supply should be changed at least once a day or as needed.

Kid-rearing

In many goat operations, as many as 80% of the kids born die before weaning; with good management, this number can be reduced to about 10%! Increasing kid survival is one of the best ways to increase income from goats. Disease, parasites, scours (diarrhea), and predators are the primary killers of kids. A number of measures can be taken to improve goat health and increase kid survival. It is important to keep good records of how many kids are born and how many survive past weaning. Kid-rearing is also a good way to get human children involved in goat care.

1) Colostrum or “first milk”

The doe’s first milk is rich in antibodies for resistance to disease as well as other nutrients such as vitamins, minerals, protein, and energy. Colostrum contains much more fat than normal milk which provides the newly born kid with needed energy. The colostrum with antibodies is produced only for 2-3 days and the amount of antibodies to protect the kids decreases rapidly within 24 hours of birth. Kids should receive colostrum within 1 hour after birth and certainly within 6 hours of delivery. The benefits of colostrum are almost entirely lost if the kid does not receive it soon after birth. **Ensuring that kids receive colostrum is the most important thing we can do to increase kid survival.** Weak kids who most need colostrum often do not have the strength to suckle. As a result, they do not receive colostrum. This is especially true of twins. **We suggest confining does and kids in a safe, dry area for the first 5-7 days of life to make sure the kid is getting enough colostrum and that the mother is recovering from her pregnancy.** Here are some suggestions to make sure that kids, especially weak ones who may not nurse well on their own, are getting enough colostrum:

- a) Make sure milk is being let down by the doe and that the teat is not obstructed by milking a few drops with your hand.
- b) Squirt some into the kid’s mouth to get it started, and then watch to make sure it is nursing.
- c) After 4-6 hours, if it is still not nursing, give 2-3 oz. of milk from the doe in a bottle.
- d) Check on the kid and doe about 5-6 hours later and go through steps a and b above again. Continue to observe the mother and kid until you are confident that the doe has milk and that the kid is nursing well.

2) Doe nutrition

In order for the doe to make sufficient milk for the kid, her nutritional needs must be met. We suggest that about a 1/3 of the doe’s diet, (or approximately 1.2 kg) should consist of leaves from the protein bank, or other protein-rich supplements. You might also add in a handful of maize or left over *nshima* for the first 5 days

or so as a “donation of thanks” so to speak. This will give the doe the energy to make the milk needed by the kid. The rest of the diet should consist of shrubs and grasses the doe normally eats, which may be cut and carried to her enclosure.

3) Hand-rearing kids

Kids need milk until they are 4-6 weeks of age although they may nurse their mothers for 3-4 months. If a kid must be hand-reared, for the first 3-4 days after birth, it should receive 2-3 pints of milk divided into 3-4 feedings per day. They can be fed twice per day thereafter. Kids will start light grazing at about two weeks of age. Keep clean, fresh water and trace mineral salt available at all times, especially when kids are being weaned from milk.

4) Make sure that kids have clean, dry bedding. Wet bedding will increase the likelihood of pneumonia and other health problems.

5) Notes on birthing:

- a. Confining the doe right before she kids makes it easier to closely monitor the health of the mother and the kid during and after birth. Signs that the doe is about to kid include:
 - a) clear, thick discharge (mucous) from birth canal
 - b) she looks uncomfortable; is rising and lying down frequently
 - c) she goes off feed
 - d) she separates herself from the group
- b. Normally, a doe should not be in labor for longer than 3-4 hours. If labor persists or if there is any other sign the doe is having difficulty, you may need to intervene. When assisting with a difficult birth, you first must wash your hands well. When the doe is not having a contraction, put your hand into the birth canal over the top of the kid. The kid should be coming out with the nose and both front feet first. If the kid is not in that position, try to push back gently on the kid and rearrange its position. Once the kid is in the proper position, gently pull the kid when the doe is having a contraction.

Housing

Housing protects goats from predation by dogs and wildlife, controls parasite numbers, and prevents the goats from standing and lying in mud. If goats' feet are wet, they will get footrot that will cause them to become lame. Goats that lie in wet bedding may get pneumonia and other diseases. Housing with a slatted floor permits easy collection of manure for fertilizer. Housing must be clean and dry and provide some shade. Free-ranging goats also need shade. In addition, provided that the housing is kept clean and dry, confined goats are less likely to contract diseases from or transmit diseases to wildlife.

One housing option is a free-standing structure raised from the ground, with slats in the floor so that manure can fall through the floor to the ground:

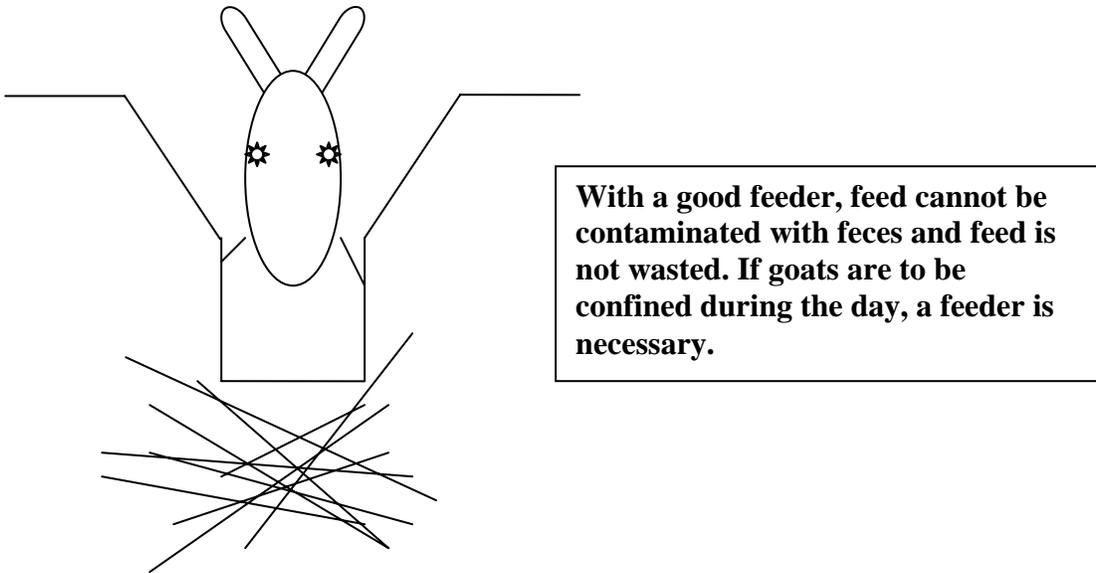


Figure 2 - Example of stand-alone goat shelter, Mambwa, Zambia. Photo courtesy Peter Hobbs, Cornell University.



Figure 3 - Example of a stand-alone shelter that uses less trees than an all wood shelter. Note the spaces left between bricks for ventilation. Photo courtesy of Heifer Project International, Zambia.

If animals are confined during the day, feed must be provided. Below is a sketch of a feed trough that will reduce the risk of parasites and feed wastage:



Parasites

Parasites often are a major cause of animal sickness and death if not managed properly, especially in young animals. Parasites can cause significant blood loss and diarrhea, which can lead to anemia, weight loss, dehydration and death. There are some basic practices that can be used to decrease internal parasite burdens within the herd. (See section on parasites in “Disease” section for more information on external parasite control):

- 1) If animals are confined and being fed out of a feeder, the feeder should be high enough that they are not eating off the ground and they cannot defecate into the feeder. They also need to receive adequate feed so that they are not picking through scraps on the ground where the parasite eggs live.
- 2) Animal enclosure maintenance – If goats are kept in enclosures for any period of time, they must be cleaned or swept out regularly. Parasites can be spread among animals in the herd when they are eaten by other goats. Feces make excellent crop fertilizer so cleaning out enclosures helps the animals and the crops!

Breeding management

Remember that half of the herd’s genes come from the males, so it is important to select strong, healthy bucks for breeding. Their offspring will be more likely to grow faster and resist disease. Castrating young males that are not as healthy or strong is an effective way to remove them from the breeding pool. For those participating in genetic improvement

programmes, castration of all males except those that are to be used for breeding is highly recommended.

Castration

Several methods of castrating goats are used, but the recommended method is castration with rubber bands. This method is only good for very young animals, up to a few days old. You must first hold the animal still, then squeeze both testicles down to the end of the scrotum (the skin surrounding the testicles). Then wrap the rubber band several times around the scrotum, until it is very tight. **You will want to make sure the penis is not captured in the rubber band along with the scrotum.** The entire scrotum should fall off after about two weeks.

Restraint

Goats can be called with grain or some other small treat. They should not be chased or stoned which will only stress them (and the chaser!) out. They can be safely restrained by grasping the horns at the base.

Hoof care

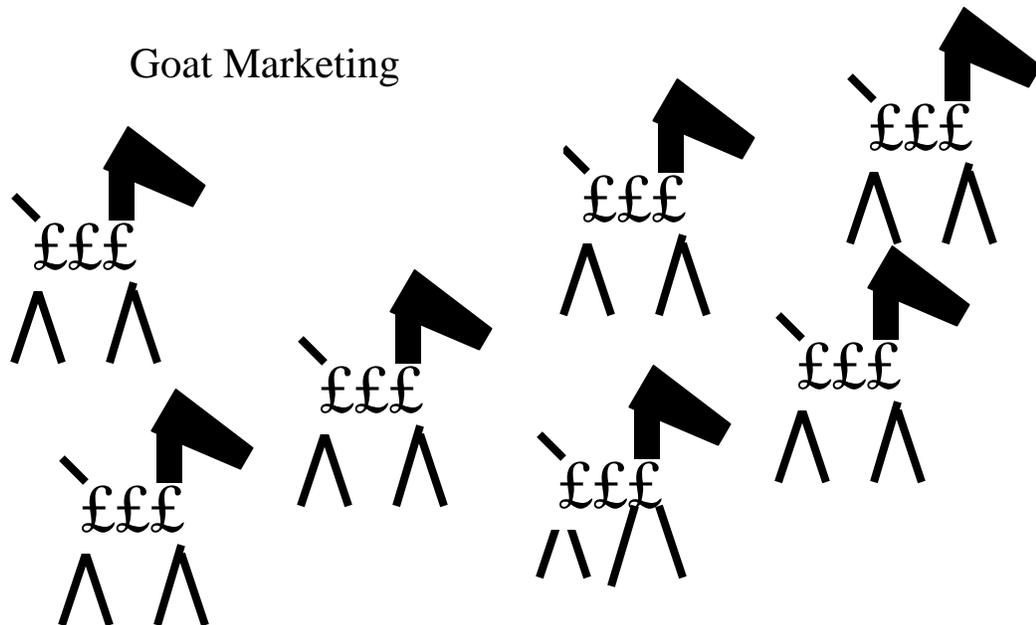
If a goat has very long feet or if an animal is limping, the hooves may need to be trimmed. Trimming decreases the occurrence of footrot and other causes of lameness. Hooves can be trimmed with shears or with a sharp knife.

Goat identification

Loss and theft of goats is often a problem. Permanent goat identification can prevent these losses. Plastic identification tags and ear-notching are possible ways to recognize goats. The advantage to using the plastic ear-tags that the animal can be easily identified and it is also possible to keep records on each animal.

Record keeping

Records provide important information to decide which goats should be kept for breeding and which should be sold. Animals with a history of slow growth and poor health should not be kept for breeding. It is recommended to keep records of goats' weight, growth rate, number of kids born, number of kids weaned, and health problems.



Marketing considerations

Consider marketing animals when they are at peak value. Evaluate muscle mass and overall health to determine when an animal is at its peak. When buying animals for breeding stock, it may be wise to pay a bit more for a well-grown, healthy animal than for a small, unthrifty goat.

When goats are sold largely determines the profitability of goat raising. If goats are sold when they are too young and small, the selling price will be low. If they are too large, money and time will have been wasted feeding and caring for them. Often, goats are sold to pay health or school fees. If possible, anticipating these expenses and selling the goats when the price is high will generate more income. This is especially true for school fees which are all due at the same time of year.

Assessing Goat Health

The best ways to prevent disease are to maintain cleanliness and good nutrition. If you determine a goat is sick, separate it from the herd until its health improves. Table 1 below contains general signs indicating whether a goat is sick or healthy. When introducing a new goat, keep it separated from the herd for two weeks and observe to ensure it is not sick before introducing it into the herd. Sick animals produce less than those that are healthy – they lose weight, become weak, and may even die. Many of the measures discussed in the “Basic Health and Husbandry” section will help to prevent the onset and spread of disease.

Healthy goat	Sick goat
On feet grazing most of the time	Lying down or rising and lying frequently
Firm, moist pelleted stools	Stools runny, bloody, or only a few hard pellets
Bright, clear eyes, light pink when lower lid pulled down	Eyes dull; may be pale or red when lower lid pulled down
Alert	Depressed
Eat and drink normally; chew cud	Eat and drink less, may stop chewing cud
Smooth hair coat	Rough hair coat
Sure footed	Limping (lame)

Table 1 – Sick goats vs. healthy goats.

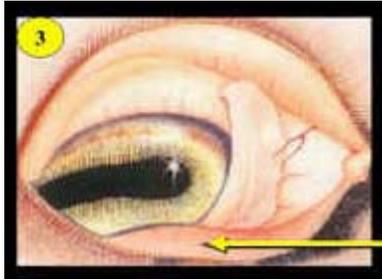
Physical Exam

The physical exam is the most effective way of evaluating the health of any animal. The following section aims to explain some of the more specific things that can be evaluated quickly during a physical exam to help determine the cause of illness. You may find you are more comfortable going in a different order than the one here; that is fine, as long as you are consistent in your routine. This will ensure that you check the main points every time.

- 1) Observe from afar: note if any goat is off feed, limping, or lying down excessively
- 2) Feces
Are they bloody? Pale? Runny? These may be signs of disease, such as parasites, poisoning, or infection.

3) Eyes

Pull down lower lid to check color of inner eyelid (conjunctiva). It should be light pink in a healthy animal.



cna.inta.gov.ar/helminto/Guidelines/hel8.htm

Figure 4 - The arrow indicates the area of the eye that should be evaluated (the conjunctiva).

Why evaluate? Abnormalities in color of conjunctiva may indicate the following:

- *Pale: may indicate anemia (blood loss or iron deficiency) from parasitism, poor nutrition or other causes
- *Yellow: copper toxicity, liver disease
- *Bright pink/red: pinkeye (bacterial infection of the eye)

Other general questions to ask when evaluating the eyes: Can the animal see?
Can it blink? Animals with eye infections often stop blinking.

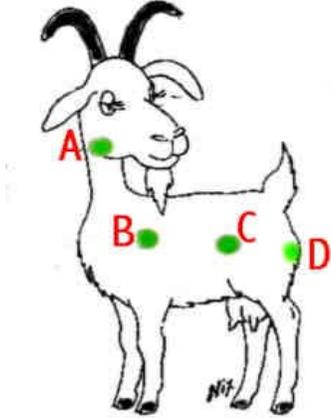
4) Mouth

Why evaluate? Are there any sores on the mouth or lips? Sores may indicate soremouth, which can be transmitted to humans. In humans, the sores may last for up to a month and are usually on the hands or arms. If infected once, it is unlikely for a person to come down with sores for a second time.

If you can get a look inside the mouth, look for missing or damaged teeth which can lead to decreased food intake and weight loss.

5) Lymph nodes

Lymph nodes are a network of structures located just under the skin as well as internally at various locations throughout the body, and are part of the body's defense against disease. They are all connected to each other. The most easily evaluated lymph nodes on goats are located at the angle of the jaw, and just in front of the shoulder. See the figure to the left for the most commonly evaluated lymph nodes' locations.



Why evaluate? Lymph nodes may be enlarged during any infection, but some common conditions that cause enlargement are caseous lymphadenitis (see section on “Goat Disease” for more information) and lymphoma (cancer).

Figure 5 - commonly evaluated lymph nodes in the goat: A = submandibular, B = prescapular, C = sublumbar, D = supramammary (on sides of udder)

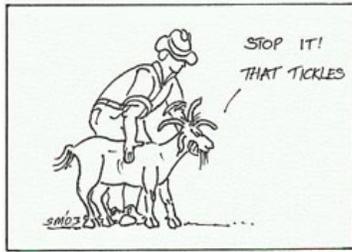
6) Udder

Feel and examine the udder for any abnormal swelling, redness, or heat. These may be indications of mastitis, or infection of the udder. If the animal is milking, check that milk can be expressed. Mastitis can lead to decreased production, decreased appetite and weight loss, loss of the ability to produce milk or possibly death if the infection spreads or is left untreated.

7) Feet

Check feet for footrot (see “Goat Disease” section for more information) or other possible causes of lameness, such as nails in the footpad. Hooves may need to be trimmed.

8) Body condition score (BCS)



Body condition is an estimate of fat and muscle mass in the animal. It is usually obvious whether an animal is fat or skinny; giving it a “score” is a good way of describing its overall condition to a third party, or comparing animals within the herd. Generally, we give the animal a “score” from 1 (very thin) to 5 (overweight) to indicate what kind of condition it is in. BCS is most commonly evaluated by feeling the ribs, loin and spinal column. See Appendix 2 for methods of estimating the animal’s weight using girth measurements. The following table suggests some guidelines for body condition scoring in goats:

Body Condition Scoring Table

Score	Backbone	Rib cage	Loin eye
BCS 1 Very thin	Easy to see and feel, sharp	Easy to feel and can feel under	No fat covering
BCS 2 Thin	Easy to feel, but smooth	Smooth, slightly rounded, need to use slight pressure to feel	Smooth, even fat cover
BCS 3 Good Condition	Smooth and rounded	Smooth, even feel	Smooth, even fat cover
BCS 4 Fat	Can feel with firm pressure, no points can be felt	Individual ribs can not be felt, but can still feel indent between ribs	Thick fat
BCS 5 Obese	Smooth, no individual vertebra can be felt	Individual ribs can not be felt. No separation of ribs felt	Thick fat covering, may be lumpy and "jiggly"

Table 2 – Body Condition Scoring
<http://bedford.extension.psu.edu/agriculture/Goat/Body%20Condition%20Scoring.htm>

Why evaluate? A very thin animal, or one that is losing weight, may indicate disease or malnutrition. Some common causes of weight loss despite sufficient feed include but are not limited to dental disease, lameness, blindness, and ongoing disease (such as pneumonia, mastitis, etc.). It is important to compare

members of the herd when evaluating body condition. This may indicate whether it is a herd or individual problem. Target BCS for a herd is 3.

9) Temperature

The normal temperature for a goat is between 38.6 and 40° C. Above normal temperature (fever) is often an indication of an infectious disease. Below normal temperature may indicate an animal is going into shock as a result of dehydration or disease. In very young kids, below normal temperature indicates that it is unable to maintain body temperature, often due to lack of milk and energy.

10) Urine

Why evaluate?

- a) To check color – if dark brown or bloody, may indicate copper poisoning or infection
- b) To check smell – if “sweet” smelling, this may be an indication of a metabolic problem usually related to pregnancy or lactation (see section on “pregnancy toxemia” in section entitled “Goat Disease” for more information)

IMPORTANT NOTE: ALWAYS WASH HANDS AFTER HANDLING LIVESTOCK. SOME DISEASES CAN INFECT HUMANS AND HUMANS MAY ACCIDENTALLY SPREAD DISEASE BETWEEN ANIMALS.

Goat Disease

Common Diseases and Conditions Affecting Goats (in alphabetical order)

The following are some of the more common diseases known to affect goats in the Luangwa Valley region, in alphabetical order. For each disease or condition, common signs, causes and methods of transmission, and control measures are included. In the field, diagnosis will have to be made mainly on the basis of signs (symptoms); if there are further diagnostic methods available on the ground, they have been mentioned as well. Wildlife reservoirs of disease have been indicated where applicable, and may be important in identifying the source of disease in a domestic herd. Knowing which wildlife species carry certain diseases may also help determine whether livestock should be confined in certain areas. Remember that if vaccination is not available, the best ways to prevent disease are with good nutrition, proper housing and cleanliness.

I. Bloat (FAIRLY COMMON, CAN BE FATAL)

Signs: enlarged abdomen, bleating frequently

Cause: eating a lot of lush highly nutritious grass/herbs, maize grain or mealie meal at one time; poisoning may also cause bloat

Control: depends on the cause - for bloat due to eating lush grass, give cooking oil; put a stick in the mouth so that they chew, which will make them burp

II. Brucellosis (ZOO NOTIC)

Brucellosis can cause “Malta fever” in humans, which can be a sign that there is disease within the herd. Humans usually get it by drinking raw milk from infected goats or cows. Boil milk for tea to avoid transmission of brucellosis to humans. The signs in people include fever, muscle pain, headache, loss of appetite, sweating and weakness.

Signs (in goats): abortion (especially if under stress)

Cause/spread: by milk, urine, feces, fetuses and placenta; transmitted by inhalation or through breaks in skin

Control: vaccination; if vaccine not available, burn or bury aborted fetuses and placenta; do not breed animals that have been sick with brucellosis

III. Caseous lymphadenitis (CL) (COMMON; ZOONOTIC POTENTIAL)

Signs: large abscesses on the neck or shoulder, enlarged lymph nodes, weight loss, breathing problems



Figure 6 - Goat with swollen lymph node due to CL.

Cause/spread: can enter through skin, eyes or mouth

Control:

- *break and drain abscesses by cutting a “cross” at the bottom of the lump
- *pus should be burned or disposed of so it does not come into contact with people or goats
- *keep infected animals with open sores isolated for 1-2 weeks to prevent spread in the herd, as goats will lick each other’s open wounds
- *isolate kids (if older than 6 weeks) from infected does
- *vaccine available

IV. Causes of newborn (birth – 5 months) diarrhea – coccidiosis and cryptosporidiosis (COMMON, ZOONOTIC)

The organisms that cause this disease are similar in many respects, but coccidiosis is the most common cause of diarrhea in kids 3 weeks to 5 months of age and often is the cause of diarrhea at weaning. Cryptosporidiosis is most common in animals 1 month and younger.

Signs: very loose diarrhea (may be yellow-green to bloody), weight loss, reduced growth, abdominal pain, loss of appetite

Cause/spread: ingestion of feces; more common in humid/moist conditions; not as common in free-range goats.

Control:

- *most goats develop resistance at or before 5 months of age
- *supportive care is the best treatment - separate sick goats, treat with rehydration salts (salt-sugar mixture) if very bad diarrhea, give small amounts of milk at a time

*maintain good hygiene and management (clean bedding, pen raking, clean water supply)

*Other possible causes of abdominal pain and acute diarrhea in 1 week – 1 month old kids: bacteria, virus, toxin ingestion (contaminated water or plant material)

*Other causes of abdominal pain without diarrhea: bloat

*Other causes of sudden death in kids: septicemia (blood poisoning), toxins

Wildlife reservoir: can be transmitted between wildlife and livestock

V. East Coast Fever (Theileriasis)

Signs: fever, loss of appetite, depression, swollen lymph nodes, runny nose and eyes; 2-3 week course of illness marked by coughing, decreased milk production, weight loss, weakness, anemia

Cause/spread: spread by ticks

Control: tick control measures (insecticides, tick removal)

Diagnosis: on post-mortem examination liver may be yellow; kidneys may show patchy dark splotches

Wildlife reservoir: may be transmitted (by ticks) between livestock and African buffalo (*Syncerus caffer*), waterbucks (*Kobus spp.*), and most wild antelopes

VI. Entropion (UNCOMMON)

Entropion is a condition in which the lower eyelid rolls inward, causing the eyelashes to rub and scratch against the surface of the eye. This can be a very uncomfortable and painful condition, and can occur in goats of all ages, but is most common in very young or very old goats.

Signs: tearing, closed eyes, pus (thick yellowish-white fluid) draining from eyes



Figures 7 and 8 - Left: goat with entropion; note the rolled-in, swollen eyelids (www.goatworld.com). Right: sheep with infected entropion (www.danekeclublambs.com)

Control/management: in kids, treat by drying and rolling the eyelid outward 2-3 times per day over a 1-2 day period

VII. Foot and Mouth Disease (FMD) (UNCOMMON, BUT VERY IMPORTANT)

Goats infected with FMD usually do not show signs of disease and are not severely affected. The main concern with FMD in goats is that even if they are not showing signs, they may spread infection to cattle and wildlife. Also, there is a potentially high mortality rate in kids infected with the disease. FMD is most likely found along the Victoria Falls border between Zambia and Zimbabwe, but it is important to be aware of its existence to monitor spread.

Signs: high newborn mortality rate, lameness, mouth sores, loss of appetite, depression

Cause/spread: close contact between animals; can be airborne or transmitted by objects or insects; highly contagious between animals and can jump species

Control: no specific treatment; confine infected animals, give easily chewed feed (re: mouth sores); vaccine is available (most effective if locally produced)

Wildlife reservoir: any cloven-hoofed animal, domestic or wild, can carry and transmit FMD; elephants, rats, and mice may also be affected

Diagnosis: presence of lesions or sores on feet, mouth, inside throat, on teats; “tiger heart” (striped heart muscle) in kids

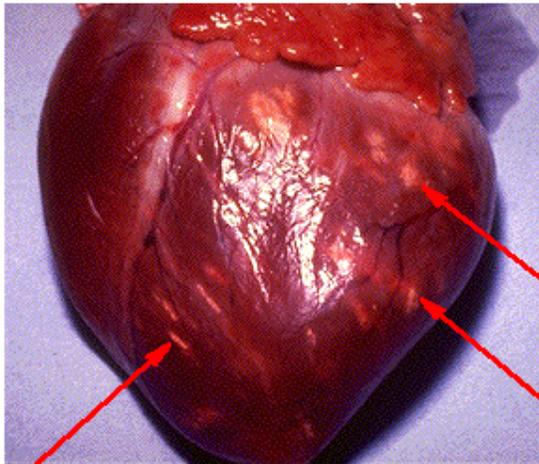


Figure 9 - “Tiger heart” lesion seen in Foot and Mouth Disease..

http://www.bio.davidson.edu/Courses/Immunology/Students/Spring2003/Ho/pig_myocarditis.gif

VIII. Footrot (FAIRLY COMMON, ESPECIALLY IN RAIN SEASON)

Footrot is a bacterial infection involving the hoof and footpad, most common in warm, wet weather.

Signs: lameness, pus where skin meets hoof, outer hoof detaches from foot pad, weight loss, tetanus (stiffness), swelling in between digits, “praying position” (kneeling)



Figure 10 - Sheep with painful feet due to footrot in “praying position.” www.pipvet.com

Cause/spread:

Infection by direct contact. These conditions make it more likely for an animal to suffer from footrot:

- *wet, muddy yards
- *overgrown hooves
- *nail in hoof
- *overcrowding
- *lots of ticks - ticks bite between digits, leaving broken skin for germs or bacteria to enter

Other diseases that might look like footrot include: foot and mouth disease, bluetongue virus.

Control:

- *prevent by hoof trimming and keeping clean, dry enclosures
- *if infected, hoof trim should be followed by kerosene application
- *burn or bury trimmings if possible

IX. Heartwater (FAIRLY COMMON AND VERY SERIOUS)

Heartwater (*Cowdria ruminantium*) is a disease that can be spread by ticks. It can make an animal very sick suddenly or they may become sick gradually. It may kill up to 90% of infected goats.

Signs:

*Sudden, severe presentation (peracute or acute):

- 1) peracute - high fever, paddling, convulsions; these signs may last for minutes to hours and usually end in death
- 2) acute – 2-5 days of depression, loss of appetite, fever, rapid and labored breathing, halt in cud chewing, muscle twitching, bleating, teeth grinding, excessive blinking, frequent urination and defecation, circling, convulsions, diarrhea

*Less severe (subacute): fever, watery eyes and nose, coughing, difficulty breathing, diarrhea, twitching or mild convulsions

Control: tick control for prevention

Diagnosis: post-mortem findings may include fluid in the heart sac or chest cavity; dark red spots on the surface of the heart

Wildlife reservoirs: water buffalo, antelope, wildebeest, eland, and springbok may carry and transmit the disease

X. Mastitis (FAIRLY COMMON, CAN BE SERIOUS IF UNTREATED)

This is an infection that affects the udder where milk is made.

Signs: udder is swollen, hard, red and sore; high temperature occasionally; lying down, bleating; milk contains semi-solid particles (pus and occasionally blood); loss of ability to produce milk in half or all of the udder; parts of the udder may turn black and the tissue dies – if this happens the goat may die within ~ 24 hours but this level of severity is uncommon

Cause: more likely to occur if there is damage to the teat end and canal, which allows harmful bacteria to enter

Control: keep clean, dry bedding for does; if the kid is over 6 weeks old, stop it from nursing the doe, and the doe will need to be milked out at least 3 times a day until the udder is normal

XI. Parasites (VERY COMMON)

Parasites have been discussed briefly in other sections. They can be internal or external. Some parasites, such as the external ones that cause various types of mange, can be very difficult to eliminate. “Bottle jaw” is a hardened swelling

beneath the jaw most often caused by parasites (internal or external). It can also be seen when a goat is weak or becoming ill (see picture below). Most parasites can be transmitted between wildlife and livestock. See section on parasites in “Husbandry and Management” section for ways to prevent parasite spread.



Figure 11 - “Bottle jaw.”



Figure 12 - Clockwise from top left: parasites live in water; a goat with “bottle jaw”; anemia from parasitism; wasting caused by parasitism (www.attra.ncat.org).

A. External parasites (mange mites, lice, ticks, fleas)

Signs: bumps on the skin of the head, neck, shoulders and sides, hair loss, itchy skin around eyes and ears, thickened skin; finding actual ticks or fleas on the animal; animals may rub up against posts or trees to relieve itching, weight loss, anemia (pale conjunctiva upon pulling down lower eyelid), bottle jaw.

Cause/spread: spread by direct contact between animals, especially in crowded or uncleanly conditions

Control: spray or dip with repellent or insecticide; if not available, engine oil mixed with nicotine (in small amounts) may be rubbed on the animal to keep ticks off; under conditions of stress and poor nutrition, mange is much more likely

B. Internal parasites (worms)

Signs: diarrhea, weight loss, anemia, whole or partial worms in feces (note: some types of worms will not be visible in the feces at all), bottle jaw, rough hair coat, eggs “glued” in hair around hind end

Cause/spread: ingestion of eggs in stool, uncleanly housing

Control: see section in “Husbandry and Management”

XII. Pregnancy toxemia (“twin kid disease”) (UNCOMMON)

This is a condition that can occur in the doe most commonly in the few weeks before giving birth or at the start of lactation. It usually occurs in goats that are either too skinny or too fat, and is most likely to occur if the doe is carrying twins, triplets or a very large kid.

Signs: sweet breath, loss of appetite, depression, reluctance to rise, decreased stool production (few, dry pellets), swelling of lower limbs, teeth grinding; in severe cases these signs may progress to blindness, star gazing, tremors and coma
Control: treat by providing a higher quality source of feed and/or thick sugar water when signs are first noticed; may be prevented by maintaining good nutrition and management in addition to good body condition score (~3) before and during pregnancy

XIII. Soremouth (VERY COMMON; ZOO NOTIC)

Signs: scabs primarily on lips, gums and around mouth, but can spread to other parts of the body; in humans, sores most commonly found on hands and arms
Cause/spread: direct contact; scabs are infectious; only sheep, goats and humans have been known to have soremouth
Control: vaccine available

XIV. Tetanus (FAIRLY COMMON)

Signs: stiff limbs, “sawhorse” stance with legs farther apart than usual, mild bloat, stiff ears and tail, difficulty opening the mouth, straining to defecate (constipation), neck bent back, convulsions, collapse with stiffening of all limbs; once tetanus is severe enough that the animal has collapsed and cannot rise, death usually occurs within 24 to 36 hours
Cause: caused by bacteria found in soil and animal droppings and can affect any animal; infects animals most commonly by entering deep wounds
Control: vaccination for prevention; if vaccine is not available, tetanus is best prevented by cleaning wounds promptly and thoroughly and by avoiding the use of elastic bands for castration; treatment is difficult and expensive

GLOSSARY

abdomen: mid-section of the animal, containing the stomach, liver and other organs
abscess: a lump or bump filled with pus
acute: sudden and severe
anemia: condition caused most commonly by blood loss, poor nutrition or iron deficiency; an animal may be weak or short of breath due to anemia
antibodies: proteins that help protect the body from disease; high amounts are found in the doe's first milk or "colostrum"
bacteria: organisms, some of which cause disease; bacteria cannot be seen with the naked eye
bottle jaw: hardened swelling beneath the jaw most often caused by internal or external parasites; can also be seen when a goat is weak or becoming ill.
buck: male goat
castration: removal of testicles so that a goat can no longer breed
cloven-hoofed: having split hooves; goats, cattle, sheep, and antelope are examples of cloven-hoofed animals
colostrum: antibody and nutrient-rich "first milk" produced by doe
conjunctiva: the inner part of the lower eyelid; color can be checked to detect anemia, eye infection and more
contraction: squeezing or tightening of muscles; when an animal is in labor, contractions help the baby to be pushed out of the birth canal
convulsions: tremors or shaking
cud: food that is brought back up for rechewing
defecate: to produce manure or stool
dehydration: loss of water and fluids from the body leading to decreased function of body systems; often caused by diarrhea or lack of access to water
diarrhea: loose or runny stools
doe: female goat
dystocia: difficult birth
feces: stool or manure
fetus: baby while still inside the animal
fever: higher than normal temperature
genetics: characteristics passed down from parents to offspring; half of the genetics come from the father, half from the mother
husbandry: management practices used for the care of animals
hygiene: management practices used to maintain cleanliness
ingestion: eating or swallowing
inhalation: breathing in
insecticide: a substance or chemical that kills insects
isolate: separate from the group
kid: a baby goat
lactation: production of milk
lameness: condition resulting from injury to the feet or legs leading to limping
metabolic: related to the way the body processes and regulates nutrient use
mortality: death

peracute: extremely severe and sudden, even more than acute; use: “peracute” heartwater causes sudden death

placenta: provides fetus with nutrients and oxygen during pregnancy; also known as the “after birth”

pneumonia: infection of the lungs causing difficulties in breathing, runny nose, coughing

post-mortem: after death; use: “post-mortem examination” is an examination of the animal after it dies

protein bank: a row of trees or shrubs that have leaves with high protein content

reservoir: a population that may carry and transmit a disease, without showing signs themselves

subacute: less severe than acute, usually more gradual progression of disease

teat: the part of the udder milk comes out of

toxin: poison

trace mineral salts: a compound of salts used to provide mineral supplementation

transmission: spread of disease

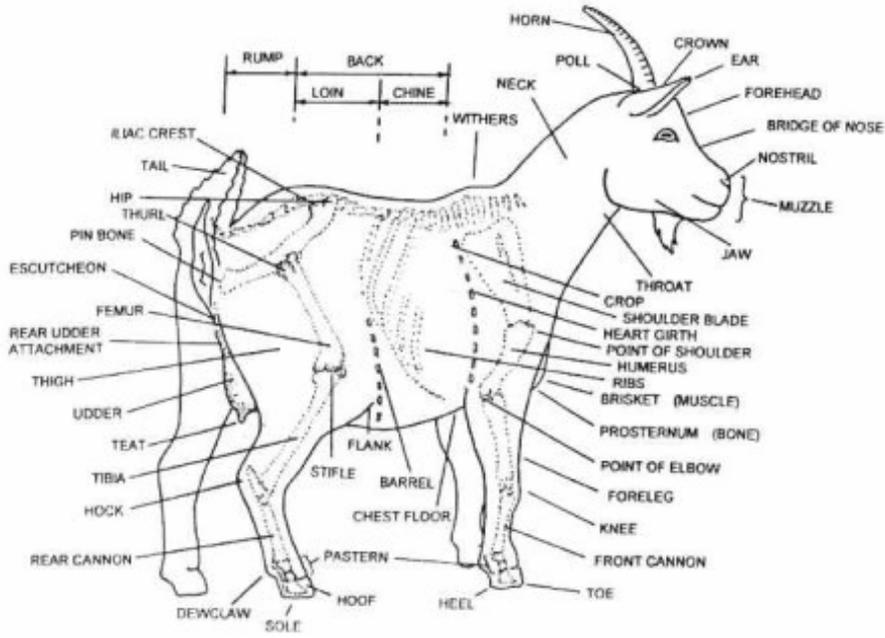
trough: structure used for feeding of animals

udder: the milk making organ

virus: types of proteins that often cause disease; a virus is different from a bacteria in that a bacteria can survive without a host; foot and mouth disease is an example of a virus

zoonotic: describes diseases that can be spread between humans and non-human animals

Appendix 1 – Basic External Anatomy of the Goat

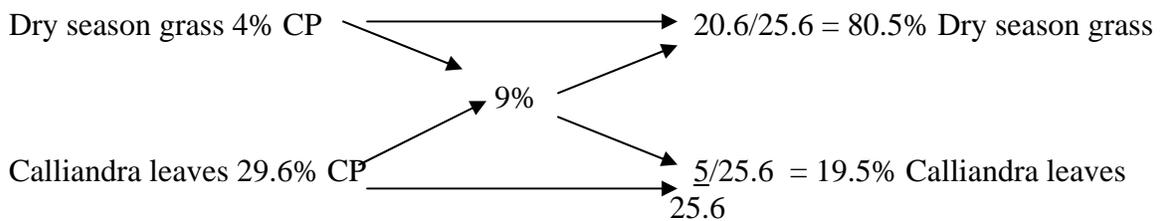


Appendix 2 - Nutrition

Calculation of Amounts of Feed Required

Pearson's Square

The Pearson's Square method is used to calculate how much of two feeds should be included in a ration to meet an animal's requirement. In the example below, the animal needs a diet containing 9 % Crude Protein. This information is obtained from tables of feed requirements. There are two feeds available: 1) Dry season grass that contains 4 % Crude Protein and 2) Calliandra leaves that contain 40% Crude Protein.



Next, we must estimate how much a goat will eat during the day. There are many ways to predict this, but we will use a simple formula where DMI (dry matter intake) = 3% * BW (Body weight)

For example, if a goat weighs 20 kg, she will eat about 0.6 kg of dry matter each day.

Nutritionists talk about DRY MATTER because different feeds contain different amounts of water and this water does not provide nutrients to the goat. However, the water in a feed does help satisfy the animals' need for water. To calculate the amount of other nutrients required by animals, dry matter is used.

For example, the dry season grass probably is about 30% dry matter while the Calliandra leaves are about 90%.



90 % Dry Matter and 10 %
Water = Calliandra



40 % Dry Matter and 60 %
Water = Dry Season grass

Below are the last calculations needed to calculate what the goat should be fed:

Amount to offer (kg) = (% of each feed needed to meet requirement (from Pearson's Square) * Dry matter intake, kg) / Dry matter content of feed

$(0.805 \text{ dry season grass} * 0.6 \text{ kg intake}) / 0.3 = 1.6 \text{ kg dry season grass}$

$(0.195 * 0.6 \text{ kg intake}) / 0.9 = 0.13 \text{ kg Calliandra leaves}$

Below is a feed table with several common feeds (from the Cornell Net Carbohydrate and Protein System Feed Library, version 6.0; Dube, J.S.; Mbugua, D.M.; Nherera, F.V.):

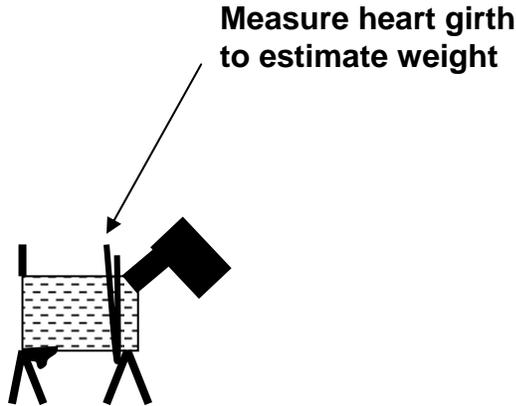
Feed	Dry Matter	Crude Protein¹	Neutral detergent fiber¹
<i>Acacia nilotica</i>	91.1	18.2	28.0
Banana leaves	25.7	13.6	54.3
Calliandra leaves, dried (<i>Calliandra calothyrsus</i>)	90.4	29.6	28.5
Cassava peelings	18.8	3.4	20.2
Desmodium (<i>Desmodium intortum</i>)	90.1	20.0	38.3
Gliricidia hay (<i>Gliricidia sepium</i>)	88.5	24.4	37.3
Guinea grass, fresh (<i>Panicum maximum</i>) ²	26.1	6.1 – 9.6	66.9 – 72.6
Maize stover, dry season (<i>Zea mays</i>)	30.7	6.0	64.8
Napier grass, fresh (<i>Pennisetum Purpureum</i>)	23.7	6.6 – 10.4	65.8 – 74.0

¹ Percent on Dry Matter basis. Neutral detergent fiber (NDF) is a measure of fiber content that is strongly and inversely related to energy value (high NDF levels mean low energy values).

² Crude protein and energy values vary depending on maturity of the grass. Immature grass contains more protein and energy than more mature plants.

Appendix 3 – Weight Estimation Using Heart Girth

It is possible to estimate the weight of goats by measuring their girth directly behind the front legs with a meter tape. Do not include the shoulder blades in your measurement. A good way to ensure accurate measurement is to press down on the shoulder blades with your hands, and place the tape just behind your hands.



Tables 1-3 below are weight and measuring charts for pygmy goats and dairy goats, respectively. For the common Zambian goat, the pygmy chart should give a fairly accurate conversion. The dairy goat chart should be more accurate for Boer goats or Boer cross breeds. Zambian goats have not been formally classified, so neither chart will be completely accurate, but these measurements will be useful to roughly estimate body weight. Please note that weight does not always correlate well with age.

Age	Birth	1 mo.	2 mo.	3 mo.	4 mo.	5 mo.	6 mo.	8 mo.	10 mo.	12 mo.	-	-	-	-	-	-
Heart girth (cm)	-	-	-	-	-	55.9	58.4	61.5	64.8	67.3	69.9	71.1	72.9	76.2	78.7	81.3
Weight (kg)	1.5	4.8	8.3	11.8	13.2	14.5	15.5	19.1	20.9	22.7	25.9	27.2	28.6	32.3	34.5	36.4

Table 1 – Pygmy bucks’ heart girth to weight conversions. Adapted from Kinne, 2002.

Age	Birth	1 mo.	2 mo.	3 mo.	4 mo.	5 mo.	6 mo.	8 mo.	10 mo.	12 mo.	-	-	-	-	-	-	-
Heart girth (cm)	-	-	-	50	53.3	55.9	58.4	59.7	66	69.9	71.1	72.4	73.7	76.2	78.7	81.3	83.8
Weight (kg)	1.4	4.3	6.8	9.1	11.1	12.9	14.6	17.3	19.5	22.3	25	26.4	28.2	30.9	32.7	35	36.4

Table 2 – Pygmy does’ heart girth to weight conversion. Adapted from Kinne, 2002.

Cm	Kg	Cm	Kg	Cm	Kg	Cm	Kg
25	2	46	11	66	29	86	55
28	2.5	48	12	89	31	89	59
31	3	51	14	71	34	91	64
33	3.6	53	16	74	37	94	68
36	4.5	56	18	76	40	97	73
38	5.5	58	21	79	42	99	77
41	6.8	61	23	81	46	102	82
43	8.6	64	26	84	50	104	86

Table 3 – Dairy goat weight tape conversion from centimeters to kilograms. Adapted from Meyers-Raybon 2004.

Appendix 4 -Physical Exam Checklist for Goats

1. Observe from afar (is the animal with the group? breathing normally? limping? scratching or rubbing?)

Findings: _____

2. Identifying characteristics of the animal (tag, color pattern, markings, etc.): _____

3. Feces

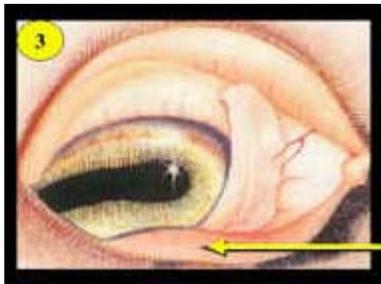
Describe: _____

4. Ears (ticks, sores, etc.)

Findings: _____

5. Eyes

Color of conjunctiva: _____



cniia.inta.gov.ar/helminto/Guidelines/hel18.htm

The arrow indicates the area of the eye that should be evaluated (the conjunctiva).

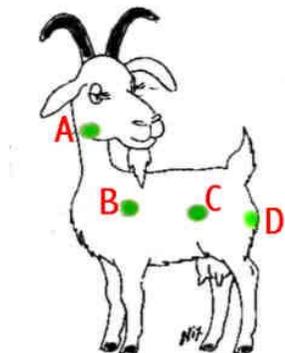
Other observations (blind? blinking? discharge?) _____

6. Mouth

Sores? Describe location and appearance. _____

Other observations (missing teeth, etc.) _____

7. Lymph nodes



- A (normal or large) = _____
 B (normal or large) = _____
 C (normal or large) = _____
 D (normal or large) = _____

Figure 5 - commonly evaluated lymph nodes in the goat: A = submandibular, B = prescapular, C = sublumbar, D = supramammary (on sides of udder)

8. Udder findings: _____

9. Feet

Hoof trim needed (yes or no)? _____

Hoof trim completed (include initials and date if completed) _____

10. Body condition score (BCS)

BCS (1-5): _____

Body Condition Scoring Table

Score	Backbone	Rib cage	Loin eye
BCS 1 Very thin	Easy to see and feel, sharp	Easy to feel and can feel under	No fat covering
BCS 2 Thin	Easy to feel, but smooth	Smooth, slightly rounded, need to use slight pressure to feel	Smooth, even fat cover
BCS 3 Good Condition	Smooth and rounded	Smooth, even feel	Smooth, even fat cover
BCS 4 Fat	Can feel with firm pressure, no points can be felt	Individual ribs can not be felt, but can still feel indent between ribs	Thick fat
BCS 5 Obese	Smooth, no individual vertebra can be felt	Individual ribs can not be felt. No separation of ribs felt	Thick fat covering, may be lumpy and "jiggly"

Table 2 – Body Condition Scoring

<http://bedford.extension.psu.edu/agriculture/Goat/Body%20Condition%20Scoring.htm>

11. Temperature _____

12. Urine findings (smell, color) _____

13. Other observations? _____

Name of person completing examination: _____

Date: _____

Appendix 5 – Tips for Leading Training Sessions

See document entitled “Leading Training Sessions on Goat Management and Health” for more

It is said that people remember 80% of what they do, 50% of what they are shown, and only 20% of what they are told. Therefore, the most important tip for training people on any topic is to get them as involved as possible. Here are some suggestions for conducting effective and interactive training sessions:

1. **Start each session with introductions.** If you are working with a group where you might be new to anyone, start by introducing yourself and letting the group know exactly why you are there. Include your name, title, regional assignment, and the name and purpose of the organization you are working with.
2. **State objectives for the session.** Follow introductions by telling the group exactly what they will learn during the training session. For example, you might say, “At the end of today’s session you will know the best ways to increase kid survival in your goat herds.”
3. **Ask questions!** For example, if teaching about nutrition, ask the audience why they think good nutrition is important. Make note of their responses and use them to start a discussion on nutrition.
4. **Encourage small group (3-5 people) or partner discussion.** Pose a question and give groups a chance to discuss. This will encourage people who are too shy to speak in front of the whole group to get involved in the discussion. You might assign groups so that participants are not always talking with people they interact with every day. An easy way to do this is to assign everyone a number. Have them count off up to the number of groups you want them to be divided into. For example, say “You are a one, you are a two, etc..” Start over from “one” when you get to the number of groups you want. Then say “All the ones, over here. All the twos, over here, etc.”
5. **Demonstrate procedures.** Show the procedure once without a full explanation, then show it once more while explaining each step of what you are doing. Then let participants practice. Have them explain each step of the procedure as they complete it. If it is a large group, break it into smaller groups to complete the procedure. Have them explain the steps of the procedure to each other as they complete the steps.
6. **Assess learning.** At the end of the session, ask questions to assess what the trainees have understood and learned from the session. You will find some suggested questions for goat management training below.
7. **Preview the next session.** If you will be returning to the group to conduct further training, tell them what they will be learning at the next session.

References

Dube, J.S. 2002. Variation in proanthocyanidin levels of provenances of six acacia species and the influence of proanthocyanidins on ruminant nutrition. Ph.D. Dissertation, University of Zimbabwe, Harare.

Forse, Bill. Where There is No Vet. Macmillan Education. 1999.

Kinne, Maxine. “Guessing Isn’t Good Enough (Pygmy Goat Weight and Measuring Chart).” 2002. www.kinne.net/weights.htm

Mbugua, D.M. 2003. The effects of anti-nutritive compounds on tropical legumes on ruminant nutrient utilization, excretion and decomposition of manure in the soil. Ph.D. Dissertation, Cornell University, Ithaca, NY.

Meyers-Raybon, Donna. “Body Scoring Helps Breeders Evaluate Condition of Dairy Goats.” *Dairy Goat Journal*. May-June 2004.
www.dairygoatjournal.com/issues/05_06_04.html

Nherera, F.V. 2006. Predicting energy and protein supply and milk production of dairy cows consuming high forage rations in the eastern highlands of Kenya. Ph.D. Dissertation, Cornell University, Ithaca, NY.

Smith, Mary; Sherman, David. Goat Medicine. Lea & Febiger. 1994.

“Orf Virus Infection In Humans - NY, Illinois, California, And Tennessee, 2004—2005.”
Medical News Today. 31 Jan 2006.
<http://www.medicalnewstoday.com/medicalnews.php?newsid=36857>

Useful URLs

General information on goats:

<http://www.goatworld.com/>

Environment, land use, and agricultural development information:

Coping with Drought

<http://www.oneworld.org/odi/pdn/drought/index.html>

Pastoral Development Network

<http://www.oneworld.org/odi/pdn/index.html>

Livestock, Land use and Agricultural Intensification in Sub-Saharan Africa
<http://www.oneworld.org/odi/pdn/papers/paper37a.html>

FAO article on draft animals
<http://www.fao.org/ag/ags/agse/chapterps1/chapterps1-e.htm>

Livestock and the Environment (comprehensive FAO report on livestock and the environment)
<http://www.fao.org/WAICENT/FAOINFO/AGRICULT/aga/LSPA/LXEHTML/tech/index.htm>

Livestock development planning system
<http://www.fao.org/WAICENT/FAOINFO/AGRICULT/aga/LSPA/Ldps2/download.htm>

Nutrition and feed information:

This Winrock web site lists lots of trees and describes their applications and ecozones.
<http://www.winrock.org/fnrm/factnet/factpub/factsh.htm>

FAO feed dictionary which contains data on feed composition on tropical grasses and legumes from around the world.
www.fao.org/waicent/faoinfo/agricult/aga/agap/frg/tfeed8/index.htm

FAO agroforestry teaching materials (Better Farming Guide)
<http://www.fao.org/ag/AGA/AGAP/FRG/Facts/bfs42/2a.htm>

FAO Better Farming Guide on Feeding Straw
<http://www.fao.org/ag/AGA/AGAP/FRG/Facts/bfs42/2a.htm>

FAO site on problem soils
<http://www.fao.org/ag/AGL/agll/prosoil/psintro.htm>

FAO Animal Feed Resources Database (Extensive database of tropical forages)
<http://www.fao.org/WAICENT/FAOINFO/AGRICULT/AGA/AGAP/FRG/AFRIS/default.htm>

FAO Grassland Index (includes pictures of many tropical forages)
<http://www.fao.org/WAICENT/FAOINFO/AGRICULT/AGP/AGPC/doc/GBASE/Default.htm>

FAO Country Pasture/Forage Profiles

<http://www.fao.org/ag/AGP/AGPC/doc/pasture/forage.htm>

Tropical Silage Making

<http://www.fao.org/ag/AGP/AGPC/gp/SILAGE/Home.htm>

FAO Conference on Tropical Feeds and Feeding Resources

<http://www.fao.org/WAICENT/FAOINFO/AGRICULT/AGA/AGAP/FRG/ECO/NF95/ECONF95.HTM>

Agroforestree database (ICRAF) - Information on agroforestry tree species

<http://198.93.235.8/cfdocs/examples/treesd/AFT/AFT.htm>

ICRAF Ecoregional programs

<http://www.icraf.cgiar.org/regional/regional.htm>