



The Trinidad & Tobago

Dairy Goat Manual

Breeds, Milking, Herd Health, Records



TRINIDAD AND TOBAGO GOAT AND SHEEP SOCIETY (TTGSS)

INTER-AMERICAN INSTITUTE FOR COOPERATION ON AGRICULTURE (IICA)



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Preface

The Inter-American Institute for Cooperation on Agriculture (IICA) has been collaborating with the Trinidad and Tobago Goat and Sheep Society (TTGSS), under its flagship programme: Sustainability and Competitiveness of Agricultural Chains, to develop the local dairy goat industry. This effort was largely focused on increasing the knowledge and skills of members of the Society through a series of workshops which exposed industry members to various facets of dairy goat management, including: breeding; feeds and feeding; handling and storage of milk; health and sanitation; pen design and construction; marketing and preparation of value-added products. A business plan and inputs from an established Dairy Goat Stakeholders' Committee were also important elements of the capacity-building and developmental process

This manual is also a contributor to the capacity-building process for the industry, as it captures many of the themes covered in the training workshops. It, therefore, serves as a good reference document for dairy goat farmers to reinforce much of the subject matter that was covered during the training. Its graphic photo illustrations and references to local situations may also appeal to other stakeholders in the sector.

The IICA Delegation here in Trinidad and Tobago is, therefore, very pleased to have collaborated with the TTGSS and others who would have contributed to this very important reference document for the continued development and improvement of the dairy goat sector in Trinidad and Tobago.

Gregg C. E. Rawlins

Representative, IICA Delegation in Trinidad and Tobago



Contributors

This manual is the effort of the Executive Committee of the Trinidad and Tobago Goat and Sheep Society (TTGSS), which was instrumental in conceptualizing the idea and turning it into an easy to use reference document. Support for the production of the manual was obtained from The Inter-American Institute for Cooperation on Agriculture (IICA). The invaluable contributions of the following persons from the TTGSS were key to preparation and editing of the manual:

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The Technical Staff of IICA including Edric Harry and Lisa Harrynanan would have ensured the successful completion of this manual. A special thanks to Gregg C.E. Rawlins, Representative, IICA Delegation in Trinidad and Tobago for supporting the process. Thanks to all other persons who would have contributed in some measure.



Introduction

The information contained in this manual describes the important aspects of dairy goat production in Trinidad and Tobago. Its purpose is to help you and other farmers improve your production. The manual assumes that you are interested in dairy goat production but it does not assume that you know anything about rearing them.

This manual provides you with some basic knowledge and technologies about various aspects of dairy goat production including but not limited to: choosing good goats, nutrition, feeding, breeding, grooming, disease control and treatment. There is a chapter which gives an example of proper record keeping tables and even includes a herd projection table for a 20 doe unit.

If you are an experienced farmer, you might benefit from the comparison between your ideas and the ones expressed in this manual. If you are a new farmer, review each section carefully, be sure you understand everything and that you can relate the given information with your own experience and situation.

If you still have questions after reading this manual feel free to contact your County Veterinary Office or the Trinidad and Tobago Goat and Sheep Society for any additional information.



Important Terms

Buck (Billy)	Male goat over one year old
Buckling	Male goat under one year old
Cabrito	Meat from a goat under one year of age
Chevon	Meat from a goat over one year of age
Doe (Nanny)	Female goat over one year old
Doeling	Female goat under one year old
Flock/Herd	A quantity of goats
Gestation	The period of time from conception to birth where the embryo develops in the uterus.
Gestation Length	Actual length in days from conception to birth
Heat	The period of time in which the doe's eggs are released and she is ready to accept the buck for mating. It is the most fertile period.
Kid	Baby goat of any sex usually under six months
Kidding	The act of giving birth (for goats)
Lactation	The secretion of milk from the mammary gland (udder or breast)
Lactation Length	The period of time in which the doe produces milk
Lactation Yield	The amount of milk produced from kidding to drying off
Wether	A castrated male goat
Yearling	A goat that is about one year in age





Getting Started: The Basics

There is evidence that goats are among the first animals to be domesticated. They provide us with meat, milk and skins. Wild goats originated in Persia and Asia Minor, the Mediterranean and the Himalayas, from these areas goats were domesticated and distributed around the world by explorers who carried them on board ships as sources of milk and meat.



Today it is estimated that there are more than 460 million goats worldwide, in fact more persons consume goat's milk than cow's milk annually. Goats are more efficient than cattle and other domestic animals in their ability to convert plants and plant material into valuable animal proteins such as milk and meat making them ideal for local production.

Managing a dairy herd however, is by no means an easy job and anyone interested in doing so should consider researching dairy goat farming before getting started. This can be done by visiting some existing goat dairies and reviewing how they are managed. As a potential producer, you should observe the common practices involved in dairy goat farming and decide what practices you can implement on your enterprise and what you would like to do differently.

Remember that farming requires time, labour and proper management. Evaluate the amount of time that can be spent on your farm; goats have to be milked at least once daily and kidding periods require you spend additional time on your farm. Therefore, it is important to plan ahead to meet these demands.

Labour is another major factor to consider when developing your operation. Family members may serve as the major source of labour, but be sure they are as committed to this enterprise as you are. Skilled labour should also be available for grooming and veterinary practices which need to be carried out. It is always better to have a skilled and experienced individual taking care of your animals. When looking at labour, keep in mind chore time and managing the farm's finances. Check your local Veterinarian for all health related matters.

Proper management is a key factor in the success of the goat dairy business. If management skills are lacking it is important to develop these skills by doing research or by attending some of the many training sessions conducted by the Ministry of Agriculture or the Trinidad and Tobago Goat and Sheep Society. Larger enterprises may even choose to hire a farm manager. There are many management areas that require knowledge including: animal selection, genetics, milking procedure, milking equipment, animal care, animal housing, feeds and feeding, financial oversight and record keeping. Trinidad and Tobago is comprised mainly of small farms so it may be impossible for farmers to afford outsourcing this expertise from private consultants. One way to gain information on the important management areas is to contact the Trinidad and Tobago Goat and Sheep Society (<https://www.facebook.com/groups/103647285501/>), as they provide management plans and practical training to farmers at a significantly reduced cost. The Ministry of Agriculture also has a lot of published information on dairy goat farming which is available to the public (<http://www.agriculture.gov.tt>).

Industry development

Trinidad and Tobago lies to the south of the West Indian archipelago and it is just 11 km away from the Venezuelan coast and has a population of about 1.4 M people. Agriculture contributes roughly 0.4 % of the national GDP and employs an estimated 4 % of the population. The economy is dependent on the fluctuating world price of oil, whilst the emphasis on natural gas and petrochemicals and the lure of industrial work have been to the detriment of the agriculture industry.



The twin island Republic imports the majority of its food supplies with local production accounting for only approximately 8 % of its required staple foods. The increase of global food prices has motivated the Government, farmers, processors and citizens into prioritizing agriculture as a way to diversify the economy, increase the country's food security, and provide sustainable and productive employment opportunities.

Small ruminants have been selected as one of the major groups of livestock that can have an important role to play in improving food security in Trinidad and Tobago, because of their efficient feed conversion ratio (FCR), their ability to make good use of local forage species and their requirement for smaller spaces compared to large ruminants. Goats in particular can be raised as dual purpose animals producing both milk and meat. The goat meat industry is well developed but the dairy industry is much smaller. Over the past few years however, there has been an increase in the demand for goat's milk as the public is becoming much more aware of its nutritional benefits leading to increased opportunities in the field of dairy goat production.

The production systems in Trinidad and Tobago are generally characterized as small-scale and low-input, and few breeding or productivity records are kept. There are approximately five major breeds used in the dairy sector and mixed breeds are quite common. The first step involved in the development of a dairy goat enterprise is the selection of animals.

Breed Selection

The first decision that must be made when establishing any livestock enterprise is the species and breeds that will comprise your herd. There are several major breeds of dairy goats recognized worldwide but of these four major breeds are reared in Trinidad and Tobago. Each breed differs from the other in body size, milk volume and milk composition. Breed selection should be based on the market that you intend to supply. For example if you are producing milk for consumers who drink pasteurized milk then a high milk fat content is preferred, but if the milk is being produced for making cheese then milk with a high protein content is preferred. If you are purchasing an existing milking herd from a farmer, the breed should already be known. Additional animals can always be purchased and introduced to the herd as part of a genetic improvement programme. If you decide to develop your herd from the ground up, then you will be able to select the breed(s) of your choice. Proper research should be done on each breed and their performance before purchasing stock.

Dairy Goat Breeds

Toggenburg

The Toggenburg is the oldest registered breed of goat in the world, being established in Switzerland in the 1600's. This animal is considered a medium-sized breed with does reaching a weight of at least 120 lb / 55 kg. Toggenburgs have short to medium length hair that is soft and fine. The hair colour can vary from light fawn to dark chocolate but there is no preference for any shade. The breed has characteristic white markings on their bodies as follows: "white ears with dark spot in middle; two white stripes down the face from above each eye to the muzzle; hind legs white from hocks to hooves; forelegs white from knees downward with a dark lien (band) below knee acceptable; a white triangle on either side of the tail; a white spot may be present



at root of wattles or in that area if no wattles are present. The ears are erect and carried forward. Facial lines may be dished or straight but never Roman” (Handbook of Australian Livestock, Australian Meat & Livestock Corporation, 1989, 3rd Edition).

This breed performs best in cooler conditions and shade should therefore be provided for them if they are being grazed. Toggenburg are known for their excellent udder development. In fact they produce more milk than Alpines and have an average butterfat content of 3.2 % which makes their milk creamy in texture.

Alpine

The French-Alpine is a breed of goat which originated in the Alps. The colour of this breed varies greatly, ranging from black to white; animals often display a variety of colours and shades that may range from pure white through shades of fawn, grey, brown, black and red or various shadings and combinations of these colours. There are recognized colour patterns, such as:

- i) *Chamoisee* (tan, red or brown with black markings on the head a black stripe down the back and black stripes on the hind legs)
- ii) *Sundgau* colour patterns have black and white markings on the face and underside
- iii) *Cou blanc* have a white neck and shoulders shade through silver grey to a glossy black on the hind quarters, there may also be grey or black markings on the head.

Both sexes are generally short haired but bucks usually have a roach of long hair running along the spine. The beard of males is also quite pronounced. The ears in the Alpine should be medium-sized, fine textured, and preferably erect. Mature females of this breed should stand not less than 30 in. at the withers and should weigh not less than 135 lb. Males should stand from 34 to 40 in. at the withers and should weigh not less than 170 lb.

French-Alpine females are excellent milkers and usually have large, well-shaped udders with well-placed teats of desirable shape. The French-alpine is also referred to as the Alpine Dairy goat. These are hardy, adaptable animals that thrive in any climate while maintaining good health and excellent production. The milk butterfat content is estimated to be 3.5 %. There are also British and Swiss Alpines.



Toggenburgs have distinct white markings on the face and rump.



Alpines have a variety of colour patterns.



Anglo-Nubian

Anglo-Nubians are probably the most common dairy breed found in Trinidad and Tobago. It is common to think that the breed originated in Africa but the breed was actually developed in Britain by crossing the African and Indian goats with native English goats. The Anglo-Nubian is a relatively large, proud, graceful dairy goat and is regarded as an “aristocratic” appearing goat. This goat has very long, pendulous ears that hang close to the head, carries a decidedly Roman nose and is always short-haired.



Anglo-Nubians are known for their long ears

Any solid or parti-coloured coat is permitted in the Anglo-Nubian but black, red or tan are the most common colours. Usually there is shorter hair on the Anglo-Nubian males, particularly along the back and on the thigh, than is commonly found on the Swiss breeds. The udder of the Anglo-Nubian is capacious but is sometimes more pendulous than that of the Swiss breeds. A mature doe should stand at least 30 in. at the withers and weigh 135 lb or over, while the males should stand at least 35 in. at the withers and weigh at least 175 lb. The Anglo Nubian is an all-purpose goat, useful for meat, milk and hide production. It is not a heavy milk producer but has a high average butter fat content of between 4-5 percent.

Saanen

Next in popularity to the Anglo Nubian breed is the Saanen. The Saanen dairy goat originated in the Saanen Valley of Switzerland. These large goats are heavy milk producers and usually yield 3 - 4 % butterfat content. These animals are usually calm and mild mannered.



Saanen are usually calm and mild mannered.

Saanens are white or light cream in colour, with white preferred. Spots on the skin are not discriminated against. Small spots of colour on the hair are allowable but not desirable. The hair should be short and fine, although a fringe over the spine and thighs is often present. Ears should be erect and alertly carried, preferably pointing forward. The face should be straight or dished. A tendency toward a Roman nose is discriminated against. The breed is sensitive to excessive sunlight and performs best in cooler conditions, hence shade should be provided.

Purchasing Goats

There are a variety of ways to begin your search for dairy goats. The Ministry of Agriculture has breeding stock available to farmers and The Trinidad and Tobago Goat and Sheep Society is able to introduce farmers and persons interested in purchasing goats to each other. Farmers also place classified ads for sale animals and



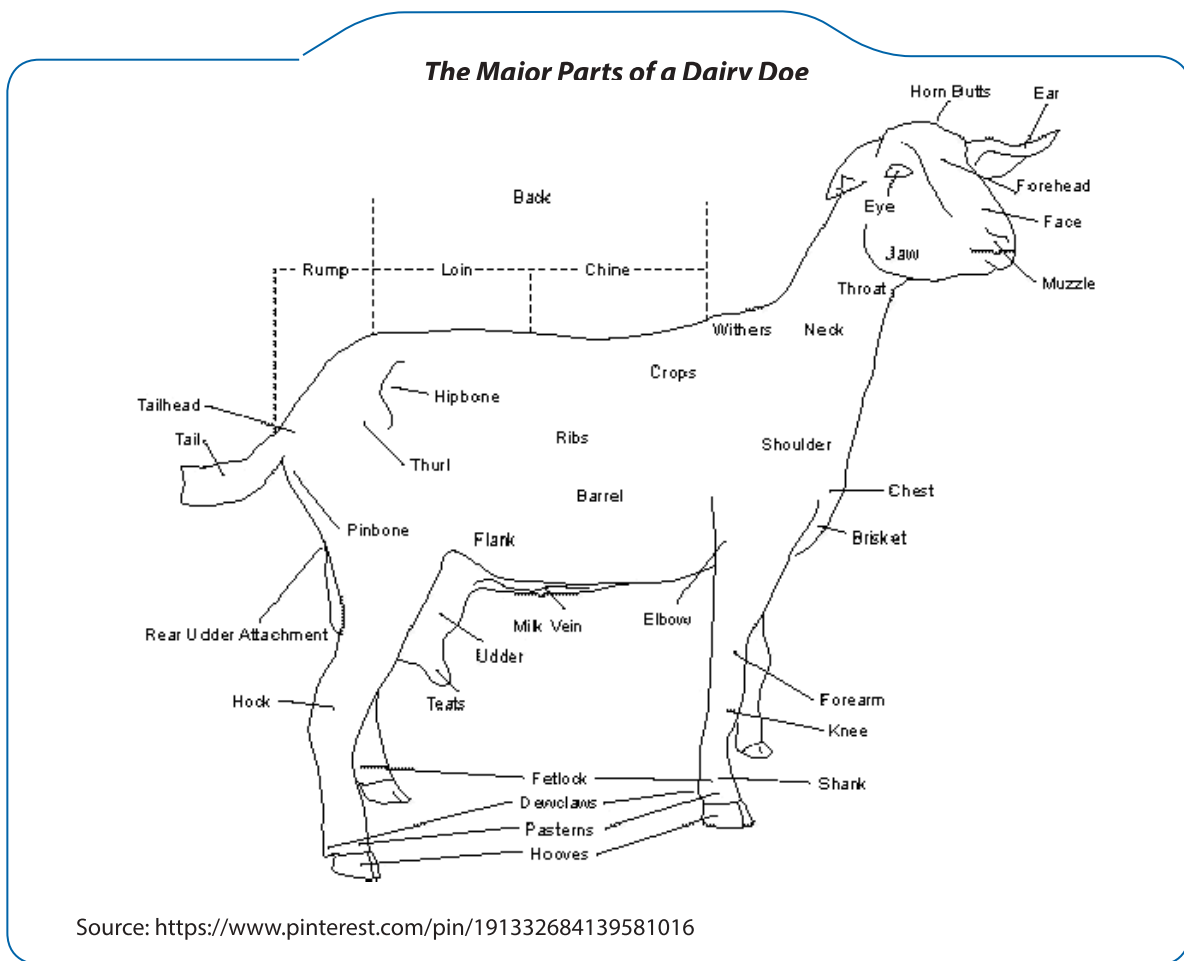
use social media as an avenue for purchasing and selling animals. It may therefore be wise to check sites like Facebook when looking to acquire animals. No matter where you search, you must consider the price, source, conformation and health status of the animal.

Price is usually decided by the owner, but ultimately the buyer decides if he is willing to spend hundreds or even thousands of dollars on a good goat. Farmers with registration papers or good pedigree records are able to demand a higher price for their goats, which in most cases are imported, high quality animals. If you are a beginner, you may want to start with local less expensive animals since they tend to be more adapted to environmental conditions.

The Ministry of Agriculture offers a subsidized Veterinary service to farmers. Farmers can request a health check for the animal, which can include blood sampling to determine the health status of the animal before it is purchased and brought to your farm. This would avoid disease problems from affecting your farms. Each county has a Veterinary office where one can request such services. It is also important to ensure that any new animal brought onto your farm must be isolated for at least 21 days before it is added to your herd. This will ensure that any contagious disease that the animal may be carrying will be manifested and controlled so that it will not infect the other animals on the farm.

As a buyer, you should find out as much facts about the seller as possible. The breeder or seller should have knowledge on proper breeding techniques and should be honest and experienced. The goats should be kept under good living conditions and have access to clean water, adequate feed and forage. The better the living conditions the better the body condition of the animal. One important factor to consider before purchasing a new animal is the actual conformation of the animal. The conformation of an animal refers to the general appearance of the animal. To be able to determine if an animal has a good conformation you must first learn the major parts of the dairy goat.





Animal Conformation

To properly decide on the conformation of an animal you must first observe the animal from a distance. If you are purchasing a doe, she should be feminine with harmonious blending of parts and a nice smooth coat. Hooves should be well trimmed and facing forward. The animal should have an attractive carriage and graceful walk. Usually animals that have a good carriage and proper stand convert to good milkers. The following section describes the main parts of the animal that should be observed.

Head

The head should be moderately long with a concave or straight nose bridge to the nose except in the Anglo Nubian breed which must be a definite Roman nose. The eyes should be bright and there should be no mucus discharge from the ears or nose. The animal should also have all its teeth intact and they should not be worn down or damaged. The neck of the dairy goat should be clean-cut and feminine in does and masculine in bucks, with a length appropriate to the size of the animal. The neck must blend into the shoulders smoothly and join at the withers. A well-defined neck is a good indicator for a large, well-developed wind pipe.



Forelegs

The forelegs should be set squarely and support the body of the animal; it should also be set well apart to give room for the chest of the animal.

Rib Cage, Chest and Back

The rib cage should be well sprung from the spine with a wide spacing between the ribs. The chest should be broad and deep allowing for a well-developed respiratory system. The animal should display a straight back with just a slight rise before the hip bones.

Hip-bones

The hip-bones should be slightly higher than the shoulder. There should be a great distance between the hipbones and pin-bones. The slope of the rump should be slight and the rump should be broad. The broader the rump, the stronger the likelihood that the goat will have a high well defined udder.

Barrel

The barrel of the animal should be large in depth, length and breadth; this indicates a large well developed rumen and good carrying capacity (for young).

Udder and Teats

It is important to have a well-defined udder which is free from abnormalities such as double teats, spur teat or teat with double orifices. The teat should not be very small nor should they be very large. It should be set high and free from harm. The back legs should not rub against the udder when the animal walks as this can predispose her to mastitis.

Skin

The condition of the skin reflects the general condition the entire animal. The skin should be free from external parasites like mites and lice. If the hair on the animal is patchy or ruffled this may be signs of poor nutrition and internal parasites. In general, the coat should be smooth, clean and free from parasites.

The goat should be observed from all directions with a critical eye. A good dairy goat has a classic wedge shape when viewed from above. She should have a delicate neck and a barrel that is wider than the shoulders. The top-line should be straight with a slightly sloping rump. Based on the conformation and source of the animal an appropriate price can be decided on. The better the conformation and source of the animal the higher the buying price.

Endnotes

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Animal Housing

Once you have decided to purchase dairy goats you must have somewhere to house them. It may be important to seek the help of an existing farmer to help you build your pens. The pen design will depend on your method of production and the financial investment you are willing to make. Dairy goats in Trinidad and Tobago are commonly reared in intensive systems, this means that they are kept in pens and are not allowed to go out and graze, the farmer brings everything that is needed by the animal into the pen. Some farmers also rear their goats in a semi- intensive system which allows the animals to go out and graze during the day and to come to the pens in the afternoon for milking and to spend the night. You must decide which method best suits your enterprise.



Ideal housing for goats should provide light with good air flow and access to clean feed, water and bedding. The pens should also be designed to allow for easy cleaning. Safe, comfortable, clean facilities are necessary for the production of high quality milk. This chapter will focus on the basics of animal housing and the main materials used to produce a safe and secure shelter for your animals.

Location

Location of any farm should be discussed with the Environmental Management Authority (EMA), especially if the farm is going to be established near a residential area or if the number of animals being reared on the farm exceeds 20 heads. The premises will contain not only the animal shelters but the milking parlour as well and should be easily accessible to workers and any vehicles that may now or in the future require access to the farm, in all weather conditions. The area around the pens should be clean and free of pests and anything that might attract pests. The area should also be free from offensive odours, e.g. manure heaps.

The drive-way should be wide enough to allow tractor access and should be solid yet easily drained. Any overhanging branches and other obstructions should be removed from the driveway. Keep livestock off access roads. There should also be access to electrical power and water when selecting the farm site.

Key Note

Having the proper design and layout of your farm holding is important for easy management; it minimises the time taken for milking, moving animals and cleaning up. You should consider the following points carefully when deciding on your pen design and farm layout:

- Available financial investment
- Future expansion
- Animal Comfort
- Operator comfort and safety
- Ease of milking and cleaning
- Available construction materials

There are many private consultants that can provide information on pen design and farm layout but in Trinidad and Tobago, the Ministry of Agriculture also provides information and advice on animal shed design and construction. The Trinidad and Tobago Goat and Sheep Society are also providers of farm plans, therefore any new or existing farmers that are contemplating expansion or starting a dairy goat enterprise can contact the Goat and Sheep Society for help. Their plans are usually cheaper than private agricultural consultants. You can also visit existing operations to observe their work routines and farm layout; this can help you to decide which system is best suited to you.

It is important to note that not all dairy goat systems need to be built from the ground up. Cow systems can be modified for rearing dairy goats and chicken pens can easily be converted into goat housing. If housing



systems are being redesigned you must take into consideration that goats are smaller and much more agile than other ruminants, making it easy for them to fit through or under a small space, therefore any escape spaces should be blocked.

Once you have decided on the farm layout and pen design, you can begin to build your animal housing.

Housing

Goats are able to adapt to many different types of housing. Proper dairy goat housing does not need to be expensive to be functional. There are various housing systems suitable for rearing goats including:

- Intensive systems
- Semi-Intensive systems
- Extensive systems

Whatever the husbandry system or climatic conditions, all animals including goats, need to be protected from the elements. If the goats are being allowed to graze during the daytime, then sheds should be built in the pastures providing shelter during the extremely hot periods. The sheds will also protect the animals from rain, however, goats are able to tolerate getting wet and being cold, but should not have to endure these conditions for long periods as it can leave the goats susceptible to diseases like pneumonia and hoof rot. Housing for goats, regardless of the system should meet some basic requirements including:

- Relative humidity between 60 – 80 %
- Adequate temperatures for all categories of animals especially kids
- Adequate space for all categories of animals
- Side walls should be 2.5 m to 3 m high
- Protection from rain, heat and strong winds

Flooring

Your socio-economic situation will determine your flooring type, but always remember that the flooring used will affect the health and comfort of your animals. Flooring must be smooth but not slippery; designed, constructed and maintained so as not to cause injury or suffering to animals housed in the pens. There are a variety of flooring systems that can be used for rearing dairy goats. The most common system is the raised slatted floors floor system. Slatted flooring is a good choice for dairy goats; slats should ideally be 70 - 100 mm wide, 25 - 30 mm thick, with 25 mm spaces between them. Another option to creating slatted floors is the use of steel, this option is however very expensive. If steel is being used then each length should be placed 1 cm apart. There are also commercially available plastic, steel and concrete slatted floors.

Flat flooring can also be used to rear goats. If the pens are on concrete or dirt, then they should be bedded with straw, saw dust or any other absorbent material (poor quality hay). The bedding must be absorbent and should be changed regularly to prevent a buildup of harmful organisms. The depth of the bedding should be approximately 10 cm deep if the floor is concrete or dirt. Some farmers also use wooden pallets which they



place on the dirt or concrete floors. This system may help with disease control, but the wooden pallets must be removed each time the pen is cleaned to effectively clean the pen. Concrete floors can be used without bedding but in cases like that; the pens would have to be cleaned daily.



Wooden slatted floors



Steel floors



Concrete floors without bedding



Flat dirt floors with hay bedding

Pen Size Requirements

The size of the building you need is dependent on several factors including the size of your herd, climatic conditions, pasture size, feeding requirement, storage requirement and most importantly your budget. The standard recommended space per animal is 12- 20 square feet but the spacing can be higher if an open yard system is used. In hot climates, lower figures can be used if the goat is spending time out grazing during the day, but if the animals are being kept in an intensive system then the standard housing requirements should be followed. It is also important to factor in the space needed by kids and plans for future expansion of the herd.



Feeding Troughs and Feed Storage

The design of a proper feeding trough is important. A well-designed trough will prevent the loss of feed and allow for easy feeding. Troughs should be designed to prevent the animals from entering and contaminating the feed but it should make it easy for the goats to eat and for you to clean and fill. Feeding troughs can be constructed to hold forage or feed, but the troughs can also be designed to hold both.

A good trough can be built using concrete, wood or steel strapping but a good alternative is PVC. Three to four (3- 4) inch diameter PVC pipes can be cut in half laterally to make feeders for kids and adults, however, you will require a pipe that is about 15 in. in diameter to provide enough feed. The ends of the pipes can be blocked with end caps to avoid wastage. PVC is easy to clean and allows the animals to eat freely. Feeders, troughs and feed bins in the milking.

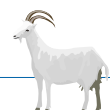
Feed stuff such as brewers' grains, silage or other wet feeds should be kept away from the milking shed unless it is being stored in a fly-proof area. The feed storage area should prevent insects from contaminating the feed stuff or milk.



A Simple Wooden Forage Feeder



PVC Concentrate Feeder





A Composite Feeder for Both Forage and Concentrate

The Holding Yards/Pens

Holding pens are areas where the animals are kept before milking. If a holding yard is being used, it should be large enough to contain the number of animals that are going to be milked. In the holding yard, a maximum of 3 does can be kept in each square metre. Most local farms however, house does close to the milking parlour or milk the does in their pen thereby eliminating the need for a holding yard.

Holding yards should have a gradient of between 1 : 30 or 1 : 50 which allows for easy cleaning and draining of liquid waste. The surface should be corrugated to prevent slipping and the pen should be designed to allow for the cleaner areas to wash towards the dirtier areas, thus controlling the spread of any harmful organisms. It is advisable to clean the yard after each milking.

Utilities

Water Supply

Water is important to all living things; it is therefore necessary to have an adequate supply of high quality drinking water. Water will also be needed for:

- Washing udders and teats before milking
- Cleaning Equipment (milking machine, bulk tanks, etc.)
- Cleaning Pens



In Trinidad and Tobago, farmers usually use water that is supplied by the Water and Sewage Authority (WASA). Rainwater can also be used but the storage tanks and guttering should be cleaned frequently if the water is to be good for dairy use; else it should be flushed before each prolonged use. Water from rivers, wells and ponds can also be used on farms for cleaning/washing and well water can be used for drinking but it must first be analysed for its suitability. The Water and Sewage Authority (WASA) must be contacted for permission to establish any wells, ponds or large water collection systems in Trinidad and Tobago.

Hot water is also needed on the farm and should be at least 90 °C for post milking sterilisation of equipment and milking machines. The water heater needed on your farm will depend on the size of your machine, the number of does being milked and the amount of hot water needed for other farm functions including mixing feeds and sterilizing equipment. Usually a machine with 2 teat cups requires 10 L of hot water per day but the requirement for the other farm activities must be calculated based on the farm needs.

Electrical

The State authority (T&TEC) has a wiring code that must be observed at all times. Farmers should employ an electrical contractor or trained electrician to carry out alterations, repairs or additional electrical installations. The farmer should ensure that all electrical equipment is maintained and should never overload wiring installations. This can be avoided by installing an overload safety switch and surge protectors. Weatherproof outlets and fittings should be used in all external areas and in areas exposed to wind, rain or other moisture. All electrical fitting and wiring should be checked at least once per year to avoid any electrical accidents.

Chemicals: Storage and Use

It is important to store and use any chemicals on the farm correctly. Always follow the recommendations on storage. Unskilled operators and children should never handle dairy detergents and antibiotics. Any chemicals that can contaminate the milk should not be stored in the milking area. The following should always be observed:

- Chemicals should be stored in a cool dry place.
- Antibiotics should never be used without veterinary advice.
- Expired drugs should be disposed of appropriately. Never use expired drugs.
- Record all goats under treatment noting the drug used and the withholding period.
- Give the full dosage and for the recommended period of time.
- Gloves should be used when administering medications and hands washed after handling any chemicals.

The proper use of antibiotics is very important. Antibiotic resistance is becoming a huge problem worldwide. The resistant strains of bacteria are no longer able to be treated with antibiotics.

Manure Handling

Goat housing should be designed with manure disposal in mind. If the animals are being housed on slatted floors then the pens can be cleaned regularly. This depends on the height of the pens and the type of manure disposal system. Flat-floor systems should be cleaned at least every 2 months to prevent a buildup of harmful organisms. Manure should be exposed to a few hours of sunlight for a minimum of 1 - 2 weeks to allow for to



reduction of any harmful disease agents before it can be used. Composting of animal waste is a good choice as it reduces odours and fly problems. Composted manure is an excellent natural soil fertilizer which can receive a good price thereby providing an additional source of income to farmers.

Fencing

Fencing for dairy goats is similar to the types of fencing used for other types of livestock. The fencing needs to be maintained as goats are agile creatures and can jump fences or find holes and spaces allowing them to escape their enclosures. Fences therefore need to be safe as well as sturdy, preventing injury and loss.

In pastures, plain barbed wire fences are not recommended as they are a poor barrier unless kept tightly strained, and maintenance requirements are high. Hog wire is a great alternative to barbed wire and can be used with “live” posts. “Live” posts include trees such as *Glyricidia* and *Leucena* with leaves that can be used as fodder, and the trunk as fence posts. Chain link wire can also be used along with “live” posts but may be expensive to purchase. Electric fencing is generally ideal for dairy goats that are outside grazing, it is relatively cheap and easy to install. Electric fencing for managed grazing uses removable posts and 1, 2 or 3 hot wires. The posts can be moved around allowing for rotational grazing. Manufacturers’ recommendations for installation and use should always be followed when using electrical fencing. Some local farmers also use wooden pallets to construct fences; these are a good alternative but may need to be changed more frequently than wire fences.



A typical hog wire fence used in Jamaica.



A wooden pallet fence used in Trinidad.

Endnotes

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Nutrition and Feeding

The most important and expensive characteristic of dairy goat farming is nutrition. You can have the best genetic stock housed under the best conditions but without proper nutrition the animals will not perform well. Feeding dairy goats therefore involves combining various feedstuffs into an acceptable and palatable ration which will meet nutritional requirements of the animal while still being economical to the farmer.



Goats are ruminants and this has an impact on their dietary needs, they must also be fed according to their physiological state. For example, animals that are pregnant and those producing milk will require special nutrition when compared to an animal that is open.

The majority of the goat's diet should comprise forages and hay. This however does not mean that any type of grass can be fed to animals that are pregnant or milking. It is important to note that forages alone do not provide goats with all their required vitamins and minerals, these may be provided to the animals through the concentrate fraction of their diet.

Most farmers in Trinidad and Tobago "cut and carry grass" to their animals from un-cultivated fields or from roadsides. Hay is also available from the Government Stations and concentrate feeds are purchased from agricultural shops. It is important however to contemplate the benefits of having your own high quality pastures since it will decrease the amount of labour needed to cut forage from open fields and roadsides. This chapter will focus on the digestive system of the goat, pastures and the important factors to consider when deciding on a feeding programme. We will begin by learning about the digestive system of the dairy goat.

The Digestive System

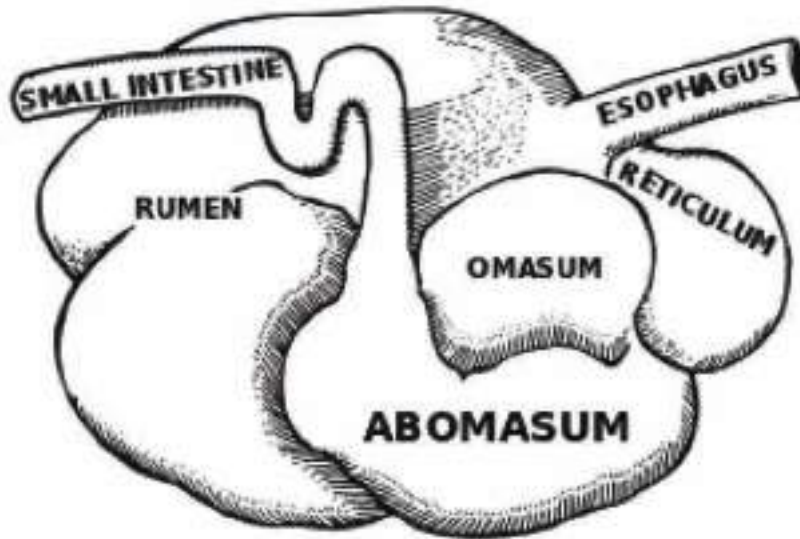
Goats are ruminants; this basically means that they have a four chambered stomach. The word "ruminant" comes from the Latin *ruminare*, which means "to chew over again". Ruminant animals including cattle, goats and sheep all ruminate or regurgitate their food and chew it over before beginning to digest it. Ruminants feed on plant matter which is comprised of cellulose, other carbohydrates and water. This has made it necessary for them to have a specially designed digestive system.

The four chambered stomach of ruminants is made up of the rumen, reticulum, omasum and the abomasum. The abomasum is in fact the true stomach and corresponds with the single glandular stomach in monogastric animals. The rumen is big with numerous microorganisms such as bacteria and protozoans living there and in the reticulum. When the dairy goat consumes large quantities of grass during feeding time, it enters the rumen and the microbes begin to digest and ferment this grass. Fermentation breaks down the starch, protein, fats and cellulose contained in the grass. The larger pieces of grass which are much more difficult to digest are regurgitated as cud and when the animal is relaxed, it is re-chewed and swallowed again. After the microbes have digested these materials, the products of their digestion are transported to the abomasum where final digestion and absorption takes place.

Goats do not have any enzymes that can breakdown cellulose and therefore must rely on the microbes in their rumen and reticulum to digest the cellulose in the forages that they consume. Nutritionists commonly say that farmers feed the stomach microbes and the microbes feed the goat, because without the microbes the goat would be unable to digest forages.



The ruminant stomach



The microbes are very sensitive and adapted to a given diet. It is very difficult for them to cope well when the animal's diet is changed, therefore, it is necessary to gradually change the goat's diet or the animal may become sick.

The rumen and reticulum make up approximately 30 % of the stomach space of a kid fed on milk but it occupies 85 % of the stomach space in a fully grown doe. The dairy goat must have a well-developed rumen to efficiently digest the forage component of its diet. You can help the rumen develop by introducing forage to kids while they are still drinking milk as this will help them to develop the microbes needed to breakdown the forage and build rumen capacity.

Kids drink only milk during the first few weeks after birth. While drinking milk they stretch their necks. This stretching allows the milk to go pass a slit in the esophagus, by-passing the rumen and reticulum and entering the omasum. In the omasum it mixes with digestive juices and is then transported to the abomasum to be digested. Kids being bucket fed run the risk of milk entering the rumen which can lead to bloat and scour. The feeding pan or bottle should therefore be raised above the head of the kid, encouraging the kid to stretch his neck to drink the milk.

It is important that the farmer introduce kids to forage at an early age, but milk producing animals require special consideration. Milk production requires that more protein is included in the diet when compared to an animal being fed for maintenance. Dairy animals also require a greater amount of calcium and other trace minerals. The milking doe's ration should therefore comprise of at least 16 % protein while the dry doe or buck can consume a concentrate with as little as 12 % protein. You must ensure that the diet contains enough protein.



Nutritional Requirements of Dairy Goats

Similar to other farm animals, goats also have minimum nutritional daily requirements. Unfortunately, only a select few definitive minimum daily requirements have been listed for goats. This is changing however, and more research is being done with regards to the husbandry and dietary needs of dairy goats. The following sections will look at the major components of the dairy goat diet.

Water	<p>Goats should have constant access to fresh, clean water. Feeds also contain some percentage of water, for example dry grasses and grain have 8 - 10 % water while green growing plants have 70 - 80 % water. The amount of water consumed by the animal will therefore depend on its diet. The type of forage consumed by the animal will also determine how much of the forage the animal will need to consume to meet its nutritional requirements. The more water in its forage the larger the quantity of forage needed to meet the animals' nutritional needs.</p>
Carbohydrates	<p>Approximately 75% percent of a plant's dry matter is carbohydrates. Carbohydrates are the chief source of energy for the goat and include sugars, starches and cellulose. Sugars and starches are easily digested while cellulose is much more difficult to digest and may even require more energy for digestion than the energy that is provided in the forage. That is why it is better to feed fine stemmed, leafy green forages to your animals because it contains less indigestible materials.</p> <p>Commercial concentrate feeds also have carbohydrates and is divided into two categories: crude fibre and nitrogen free extract. Nitrogen free extract includes the easy to digest carbohydrates like starches and sugars while crude fibre is plain fibre.</p>
Fats	<p>The fat component refers to fats and oils which are part of the diet. They are quite similar except that fats are solid at room temperature while oils are liquid at room temperature. Fats, including cholesterol and carotene, found in grains and grasses, are vital for life and can be used to form important vitamins.</p>



Proteins	<p>Proteins make up an important part of the diet, are extremely complex and are made up of small molecules called amino acids which join together to form a protein. There are many types of proteins, some of which are more important than others. Proteins are broken down into amino acids before they can be utilized by the animal.</p> <p>In plants, protein is usually concentrated in the rapidly growing parts of the plant like the leaves and seeds. Protein or crude protein includes all of the nitrogenous compounds in feeds. Protein is expensive and if over-fed in the diet can lead to increased costs of production and wastage. Animals should therefore be fed according to their individual needs. Young growing and lactating animals require more protein than animals only being fed for maintenance.</p>
Minerals	<p>Mineral matter is also referred to as ash. Forage minerals come from the soil. Calcium and phosphorus are extremely important to animals. Other important minerals are iodine, iron, copper and cobalt. If an animal lacks iron, cobalt or copper it can become anaemic but if too much copper and cobalt is given to the animal it can die from toxicity. It is therefore important to have the right amount of each mineral in the diet.</p>
Vitamins	<p>Vitamins are also important to dairy goats. Vitamin A is important for growth, reproduction and milk production. It can be synthesized from carotene in their diet. Carotene is mainly supplied by corn in the animals' diet. If Vitamin A is deficient, the animal will display poor growth and poor reproductive performance. Vitamin D is also important for goats; a lack of this vitamin can lead to rickets and a weakened skeleton. Vitamin D is supplied by sun light but is also present in sun dried hay.</p>

Formulating the Animal's Diet

The brief descriptions given above will aid in your ability to design a diet that is suited for the needs of your animals. Concentrate feeds are considered supplemental feeding and provide the nutritional needs that are not met by forages. Forages or roughage should form the basis of the animal's diet. They can include green plants or dried plant matter (hay). Corn stalks, root crops and legumes are also considered roughage.

Green forage is rich in vitamins but it also contains a high percentage of water and less nutrients when compared to hay. An animal will therefore need to consume huge quantities of this forage to meet its nutritional needs. Diets that have a lot of green forages can also lead to bloat. This does not mean that green forages are not desirable, but that they must be understood and managed properly if it is to be fed to goats. Animals can gain access to green forages in two ways:



- By grazing
- By Soiling

Soiling is also known as confinement feeding or a “cut and carry” system. This system is very popular among commercial dairy producers in Trinidad and Tobago. It keeps the goats away from dogs, thieves and harmful, poisonous substances like weedicides and insecticides.

Pasturing goats on the other hand also has its advantages. Firstly, it reduces feed costs but you may have to spend money on fencing. Pastures need to be well managed if they are to provide adequate nutrition to the goats. Goats are browsers and do not graze close to the ground, it may therefore be beneficial to include some shrubs in your pastures.

Good pasture management involves planting forage that is suitable for the environment, removal of unwanted plant species and rotational grazing. The ideal pasture should be well fertilized, planted with desired plant species and properly managed to avoid overgrazing.

Rotational grazing is the simplest way to utilize pastures properly, but the area must be fenced. With rotational grazing, the pasture is divided into paddocks or small pastures. The size of the paddock will depend on the several factors including the number of animals being grazed and fencing costs. The animals are allowed to eat from one paddock at a time, then after a few days they are moved to another paddock. This allows the old paddock to regenerate while the new paddock is being used.

Pasture Production

Pasture establishment and management should be an important aspect of farm management. Maximising the amount of forage being produced can be achieved through a combination of:

- Selection of vigorous pasture grass and legume species.
- Proper pasture management including using the right fertiliser types and quantities.

When establishing pastures initially, it may be necessary to plough and rotavate the land. Selection of forage is also important as there are a variety of tropical forages available so selection should be based on the needs of the farmer. Accurate fertilizer application is often sufficient to promote the growth of these species and will also lead to better root systems, longer persistence of quality pasture and healthier soil biology e.g. worms and higher organic matter. Advice on the best pasture species and fertiliser needs for particular districts is obtainable from local agricultural department offices, TTGSS and fertiliser company representatives. Soil sampling is recommended to accurately determine plant nutrient deficiencies and fertiliser needs. Soil testing services is offered by the Ministry of Agriculture, Land and Fisheries.



Tropical Forages

There are over 100 varieties of tropical forages that can be used to feed dairy goats. This section of the manual will discuss 3 of the main forages used in dairy goat production systems throughout Trinidad and Tobago.

1. Mulato II (*Brachiaria hibrido*, CIAT 36087) –

Mulato can be cultivated from seeds or planted vegetatively from stolon cuttings. This grass has excellent nutritive value at 90 days and 168 days' regrowth, achieving crude protein values of 13.1 % and 10.6 %, respectively. This grass is a perennial with a semi-erect growth habit that requires well-drained soils of medium to high fertility with pH 4.5–8.0 but can grow in less fertile soils as well. It is adapted to an annual rainfall of 1 000–3 500 mm with good production in the dry season (<https://hancockseed.com/mulato-ii-grasseed-50-lb-bag-473.html>).



Mulato grass

2. Trichanthera (*Trichanthera gigantea*)-

This shrub has a moderate to high nutritive value based on soil conditions and management practices under which it is grown; if it is fertilized the nutritive value tends to be higher. The crude protein content ranges from 12 - 22 % and the dry matter content ranges from 50 - 70 %. This shrub has comparatively high ash and calcium concentrations of 16 - 20 % and 2.4 - 3.8 % of DM respectively. It is well adapted to acid infertile soils with a pH down to 4.5 and can grow to a height of 15 m. (http://www.tropicalforages.info/key/Forages/Media/Html/Trichanthera_gigantea.htm)



Trichanthera gigantea forage

- 3. Moringa (*Moringa oleifera*)-** This legume is widely distributed and is also referred to by the following names: drumstick tree, ben oil tree, benzolive tree and horse-radish tree. Moringa is propagated from seeds or from cuttings. The legume should be sown at the beginning of the rainy season on elevated seed beds so that it is protected from water-logging but it can benefit from soil moisture. While propagation through seeds is well adapted to foliage production, propagation from cuttings is suitable for high-grade fruit production and for root production. Moringa has an outstanding growth rate and can be harvested for foliage in less than 2.5 months. Optimal cutting intervals range from 15



to 75 days, depending on local conditions and management practices. Moringa leaves are a valuable source of protein for ruminants but they have a moderate palatability. It is estimated that the crude protein in Moringa can reach more than 20 % with proper management practices. Ruminants find this forage palatable and studies have shown that Moringa can improve dairy goat milk production.



***Moringa Oleifera* Leaves and Flowers**

Silage

If you have excess roughage you can produce silage. Silage can be very difficult to produce and will require a silo if large quantities are being made but small quantities can be prepared in garbage bags using grass and legume cuttings. The first step in producing garbage bag silage involves chipping the forage into small pieces and allowing it to air dry for a few hours. The cuttings are then be placed into the bag, try to remove as much air as possible from the bag and tie the top of the bag. The bags should then be placed in the sun for approximately 3 weeks. Once the bag is air tight, silage should form. There may be a layer of mold at the top of the bag when it is opened but that is normal since some air may have been trapped in the bag. If the entire bag of grass is slimy however, then the silage is no good and should be disposed. Good forage silage should have a pleasant aroma. Once you open a bag of silage you should use it within 2 - 3 days. The same protocol can be applied to producing silage in a silo but additives like molasses can be added to aid with fermentation.





Steel Silo

Hay

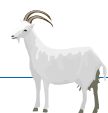
Hay refers to grasses or legumes that have been cut at an early stage and dried. Hay is available to farmers from the Ministry of Agriculture and farmers interested in trying hay can contact their county offices for information regarding sourcing hay.



Loose Hay



Hay Bales



Supplemental Feeding

Feeding high quality forages is usually adequate for maintaining goats but they will sometimes require supplemental feeding, especially if they are high producing animals. Dairy Goats require a proper balanced diet consisting of energy, protein, vitamins, minerals and clean water. Supplemental concentrate feeds should never make up more than 50 % of the animal's diet. Even high producing does should not be given more than 4 lb of grain per day. If you are changing the diet of your animals, it is important to do so gradually since their rumen microbes need to adapt to the new feeds. Feeding very high levels of concentrate can also upset the rumen.

There are a variety of commercial supplemental concentrate mixes available in Trinidad and Tobago including 14 %, 16 % and 18 % crude protein rations. When selecting one of these rations farmers must select based on the needs of the animal and the quality of forage being fed to them. To balance the diet, the following advice can be followed:

- Feed each animal individually and based on their physiological stage.
- Feed 3 - 5 % of their body weight each day.
- Feed your goats 1lb of concentrate for maintenance and an extra pound for each 2 lb of milk it produces daily.
- Avoid sudden changes in the feed as this can result in damage to the stomach flora and lead to illness.
- Pay attention to the levels of nutrients in the animals feed (protein, vitamins and minerals).

Practice and experience will help you to develop the best feeding system for your farm.



18% Dairy Ration Pellets



High Protein Alfalfa Pellets



Endnotes

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Grooming

Dairy goats require specific grooming to perform optimally. It is therefore imperative that the producer be equipped to perform the grooming tasks. These include disbudding, hoof trimming, tattooing and hair clipping. The most important grooming task is by far hoof trimming, which assists in preventing hoof rot.



Hoof Care

The proper maintenance of your goat's feet is very important but is often an overlooked activity of health care. Keeping the hooves well-trimmed is the key to a healthy foot resulting in a healthy animal. The hooves of a goat are similar to human nails and continually grow, if neglected the animal can become predisposed to infection, hoof rot and in extreme cases, the animal can become crippled. It is therefore necessary to trim the hooves on a regular basis.

The regularity of trimming depends on a variety of factors, but should be done at least once to twice per year in conjunction with foot baths (this helps to combat foot rot). The environment in which the goat is housed can affect the rate at which the hooves grow. Animals that are housed on deep litter systems or in slatted floor systems will require more hoof attention than those raised on concrete floors or those that are allowed to graze in open fields and pastures. This is because walking over concrete or stones aids in the wearing down of the hooves.

In Trinidad and Tobago, most dairy goats are kept in pens; therefore hoof trimming must be done. Trimming reduces the number of cracks and crevices in the hoof where bacteria enter and can hide, removes any infected areas and exposes disease causing organisms to air and various medications. All affected tissue should be trimmed away. Many times, this involves removing a large portion of the hoof wall as well as the overgrown portion. This is necessary if the medication and oxygen are to reach the bacteria and kill them.

There are several proven methods that can be used to successfully trim the animals' hooves but they require specific tools. The tool of choice depends on the farmer and his experience. The tools used include hoof trimmers, hoof knife, pruning shears, surform or even a grinder can be used. Regardless of the tool, the goal remains the same, removing any overgrown outer layer of the hoof. When trimming feet, it is important to disinfect the trimming instruments (foot shears or knife) between animals to prevent spreading of any infections. During a severe outbreak of hoof rot, trimming without any other treatment may actually increase the severity of the disease. If there are problems or questions on how much to trim, request the help of a veterinarian. The procedure used by each farmer may vary but usually follows the same main steps.

How to Trim Hooves

1. Restrain the animal. This can be done by placing the animal into a milking stanchion which keeps the animal still or if a helper is present one individual can hold the animal in position while the other trims the hooves.
2. Once the goat is secured, stand against her rear and grasp one hind leg and lift it between your legs. Ensure that you have a firm grip on the ankle.
3. Use a brush or the pointy end of the trimming tool to clean out any manure or dirt that may be embedded in the hoof.
4. Next carefully cut off any over grown parts of the hoof and trim off the excess toe. The toes tend to wear down less than the other parts of the hoof. Check the heels as well and trim off any excess heel.



5. A smoothing tool such as a surform can then be used. Only the horny hoof material should be planed off and the fleshy part should be pink. Do not plane too deep because this may cut the animal.
6. Let the animal stand to observe how the hoof and the animal looks. A goat with good hooves will stand squarely.
7. Repeat on the other hind leg.
8. To do the front legs squat down beside the front leg, bring the foot up to your knees and begin trimming.
9. Once completed the animal should stand squarely.



Front Hoof Trimming



Rear Hoof Trimming

Disbudding

Disbudding is another major grooming practice that is often done. Some farmers disbud their animals while others choose not to. Kids should ideally be disbudded within the first two weeks after birth. This is done with a disbudding iron. If you do not know how to disbud you should consult a veterinarian since doing this incorrectly can lead to the death of your kids. Disbudding kids at this age is a lot less stressful than dehorning them later on. Kids are disbudded to prevent injury to other goats and farm operators. Animals with horns can get caught on fences or feeding troughs. Horned animals also require more pen space than dehorned animals.



Disbudding



How to Disbud Using a Disbudding Iron

1. Ensure the hair around the horn bud is clipped with a scissors to reveal the bud.
2. The animal should ideally be given a tetanus antitoxin by a veterinarian.
3. The nerves leading to the horn bud should be anesthetized to reduce pain.
4. Heat the disbudding iron.
5. Hold the kid on your lap or place it into a kid holding box.
6. Hold the kid firmly by the muzzle and press the iron into the buds and count to 10, remove the iron and check to see if the buds have been removed. A circular bronze colouration should be seen around the horn buds. If the buds are still present you may need to place the iron back on the buds for an additional count to 10.
7. Pain medication and an antibiotic should be administered by a veterinarian to prevent infection and reduce pain
8. Spray the horn bud area with Screwworm / anti myiasis spray to prevent fly infestation.
9. Pain management such as the use of painkillers should be administered by a veterinarian. Console the kid.

Caustic dehorning paste can also be used to remove the buds, but it is less successful than the disbudding iron and is potentially much more dangerous to the kid. These pastes can be ordered online from some animal supply stores. When using this method, the caustic paste has to be left on the buds for 30 minutes, during this time the kid has to be restrained to avoid any of the paste spreading to other parts of its body and causing damage.



Kid Being Disbudded in a Kid Holding Box. Note: spray around horn bud areas.

Animal Identification

Kid Identification goes hand in hand with proper records. Many local farms source their replacement does from the kids that have been produced on the farm, therefore a protocol needs to be developed as to how these kids will be identified. Permanent identification also allows the tracking of animals for health and reproductive purposes.



There are many tools that can be used to identify the kids. Tattooing the kids within two weeks of age allows for permanent identification which is one of the most effective ways to track the animals during their life time. The tattoo can be placed on the ear of the kid or on the underside of the tail. To carry out this protocol the farmer must decide the numbering system he is going to use (e.g. 01, 02, 03 or 001, 002, 003 etc.).



Caprine ear tattooing machine

How to Tattoo

To successfully tattoo an animal, you must first decide where you are going to apply the tattoo. Tattoos can be placed on the inside of the ear or on the underside of the tail. This manual will describe how ear tattooing can be done.

1. Properly restrain the animal
2. Clean the area to be tattooed using a piece of cotton dipped in alcohol (alcohol swab). Try to stay away from veins and warts.
3. Paste a generous amount of ink on the cleaned area. This can be done with a brush or with your finger.
4. Place the correct number into the tattooing machine and position the machine over the desired area. Squeeze down firmly making sure to puncture the skin.
5. Gently release the ear and pull the skin free.
6. Put some more ink on the area and rub it in.
7. The tattoo should remain. The ear may take some time to heal.

Ear tags are another popular form of animal identification. This method involves placing a plastic pre-numbered ear tag on the ear of the animal with the use of an applicator. This is the most common method of animal identification used in Trinidad and Tobago.





Ear Tag Applicator



A Pre- Numbered Ear Tag



Applied Ear Tag

Numbered neck chains are also available to farmers. The chains that are selected must be strong and the tags durable or the animals will bite them off.

Hair Care

Goats with long shaggy hair can become over heated in hot climates and may require their hair to be clipped. Removing the excess hair also ensures that it does not get into the milk during milking. Electric hair clippers can be used to remove the excess hair but scissors also work well. A hair cut can help your goat to perform better under hot climatic conditions.

Endnotes

1. Meat Goat Herd Health - Procedures and Prevention. L, Dawson, J, Allen, and B. Olcott. 2000. Langston University, Agricultural Research and Extension Division.
2. Dairy Goat Management: Best Management Practices. Clara Hedrich. 2008. University of Wisconsin Emerging Agricultural Markets Team. (www.wdga.org/resources/bmp1.pdf).





Herd Health

There are a number of diseases that dairy goats may contract in Trinidad and Tobago. In the following pages some of the more common ones will be briefly described. There are other diseases that dairy goats may contract that are not listed. To accurately identify a disease or health problem with a dairy goat, contact your veterinarian or regional vet services office for the correct procedure, medication and dosage that will best fit the animal's health needs. As a producer it is important that you know the basic physiological data of a dairy goat.



Table 1 shows the basic physiological data for dairy goats.

Parameter	Normal Range for Goats
Temperature	101.5- 104.5 °F
Pulse	70-80 per minute
Respiration	12-20 per minute
Puberty	Occurs at 4 to 12 months depending on the breed.
Estrous cycle length	18-23 days
Heat period	18-24 hours (average)
Gestation length	150 days (average)

Foot Problems

Goats suffer from a variety of hoof diseases these include foot scald and foot rot. Foot Scald occurs as the onset of Hoof Rot and is caused by improper levels of copper and sulphur in the diet of the animal. As the scald progresses, it is referred to as foot rot. Hoof rot is caused by certain anaerobic bacteria including *Fusobacterium necrophorum* and *Dichelobacter nodosus*. These foot diseases can result in lameness, reduced weight gain, decreased milk production and decreased reproductive capabilities as severely infected animals are reluctant to move in order to feed and mate. Additionally, pregnant animals sometimes are unable to reach to full term pregnancy with a diseased foot. Apart from production losses, these diseases also increase medical costs and raise the farms culling rates. Other diseases that are sometimes confused with foot rot include foot abscesses and laminitis.

To efficiently control hoof rot, several management practices that reduce the predisposing factors to the disease must be used along with the timely treatment of infected goats. The best results are obtained when several of the following methods are combined into a hoof rot management programme:

- 1. Hoof Trimming:** This should be done as a routine management practice by all small ruminant producers. It helps to remove any excess or overgrown hoof and also reduces the number of cracks and crevices where bacteria can hide. If the animal already has the disease, trimming exposes the diseasecausing organisms to air, and can be destroyed by any applied medications. Hoof trimming should be done at least twice per year, but in a slatted floor system, it may be necessary to trim hooves every 6 weeks. Remember to disinfect the trimming instruments between animals and implement hoof baths.



- 2. Footbaths:** Footbaths are simple medications mixed into water and placed at the entrance of the pen or milking parlour so that the animals can walk through the baths. In Trinidad and Tobago, two different solutions are commonly used in foot baths: Zinc sulphate and Copper sulphate. Footbaths should be used routinely after hoof trimming but can also be used as a general management practice 1-2 times per week. The following are the common mixtures used:
- Zinc sulphate. 10% solution = 16 pounds of zinc sulphate dissolved in 20 gallons of water is perhaps the most effective and least toxic of the two baths that will be discussed in this manual. A piece of cloth can be added to all the solutions to reduce wastage and to discourage consumption by the animal as it stands in the solution. Soaking the animal's feet in the solution for 30 - 60 minutes increases its efficacy in a treatment programme. If the bath is being used as part of a control programme then the animals do not need to stand in the bath for long periods of time; 5 minutes may be sufficient. When designing the foot bath area, it is important to consider the duration of soaking. Adequately sized baths/soaks are required to accommodate the flock and allow sufficient contact time with the solution.
 - Copper sulphate (bluestone) solutions. 10% solution = 16 pounds of Copper sulphate dissolved in 20 gallons of water is also useful in controlling hoof rot but is also toxic if consumed by the goats. Similar, to the Zinc sulphate mixture, a piece of cloth or sponge can be placed into the bath to prevent the goats from drinking the solution. Hot water helps dissolve the copper sulphate. This solution is very corrosive so it should not be used in metal foot baths.

Care must be taken when disposing of wastewater from the foot bath and its impact on the environment.

For larger flocks, consider erecting a chute with a footbath within the chute and perhaps a scale at the end, so that any veterinary /animal husbandry tasks can be performed easily.

- 3. Dry chemicals:** Zinc sulphate powder can be used as a dry bath. The powder should be placed into a box in an area where goats must walk through. The dry bath will not treat infected animals, but will help decrease the spread of the disease. Lime, disinfectants, or drying agents can be used in conjunction with the dry bath around feed or water troughs to reduce moisture and decrease the spread of the disease.
- 4. Antibiotics:** Penicillin and streptomycin combinations used either as a one-shot treatment or every day up to 10 days has been proven to be effective in treating foot rot. Single injections of long-acting tetracycline have also been successful in some cases. Tetracycline should not be administered to pregnant or lactating animals. Administration of any type of antibiotic must be administered by a veterinarian and animals that are intended for slaughter should not be given antibiotics. Animals intended for slaughter and given antibiotics must be given adequate time to allow for the withdrawal period required for meat. This withdrawal period depends upon the antibiotic given.



- 5. Topical medications:** There are several different medications that can be applied to the hoof immediately after trimming and are helpful in controlling foot rot. These are similar to footbaths but are used immediately after hoof trimming.
- Zinc sulphate (10 %) - 1/4 lb of zinc sulphate in one quart of water.
 - Copper sulphate (10 %) in vinegar - 1/4 lb of copper sulphate in one-quart vinegar.
 - Hoof cure treatments that are sold commercially.

Management

Proper management of all aspects of your goats is the key to preventing and controlling disease. Any properly balanced diet reduces the risk of developing hoof diseases, especially as improper levels of copper and sulphur in the diet can lead to foot scald. Hooves should constantly be observed to ensure that they do not dry out and crack. Cracked hooves allow harmful bacteria to enter the feet predisposing the animal to developing hoof rot. Hoof trimming can help in preventing the disease and may be needed as often as every 4 - 6 weeks for optimum management. Regularly disinfect pens and include footbaths as a routine management practice for optimal disease prevention.



An Extreme Case of Hoof Rot with Maggots.

Enterotoxaemia

Enterotoxaemia also called “Overeating Disease” is not caused by overeating, but by a toxin (poison) produced by the bacterium *Clostridium perfringens* type C or D. The predominant predisposing nutritional factor in goats is linked with the sudden exposure to fresh, green pasture, grain or large increases in the quantity of milk consumed. This leads to indigestion and allows more time for bacteria to proliferate and toxins to accumulate within the intestinal tract. These bacteria are normally present in the soil and the intestinal tract in relatively small numbers, however, under certain conditions (as described above), the bacteria reproduces uncontrollably in the animal’s intestine and produces the toxin. In high quantities, the toxin is lethal. Similarly, to Foot Scald, the disease is associated with the animal’s diet.



Signs

There are three forms of this disease: the per-acute, sub-acute and chronic forms. In the per acute (sudden onset of the disease and the disease is usually severe) disease course, a kid may be found dead with no signs of illness. This usually occurs if the animal has consumed large quantities of concentrate.

The per-acute course prolongs for up to 24 hours and usually ends in death. Initially the temperature may increase to 105 °F . Kids with acute enterotoxaemia may cry so loudly that it may sound like screaming, this is an indication of abdominal pain. Depression, wobbly gait and recumbence occur early. The animal may also show signs of convulsions and may slip into a coma before death or die groaning or even crying. These signs occur in kids but can occur in adult milking goats from either Type C or D bacterial infections.

The Subacute form of the disease affects mostly the older kids and adults. This form of the disease can prolong for days and even weeks. Animals affected with this disease refuse to eat and begin to lose condition and very often show signs of severe diarrhoea, occasionally with epithelial shreds in the faeces. Animals with this form of the disease can be treated and will survive if treatment is administered efficiently.

The Chronic form of this disease is associated with intermittent illness which lasts for several weeks. The goat will have a dull, starry look, an irregular appetite; drop in milk production and growth rate but with treatment should make a full recovery.

Diagnosis

Definitive diagnosis for this disease can only be made in the laboratory via cell culture for the bacteria. PCR can also be used to identify the toxin gene associated with this disease. Please consult your veterinarian for assistance in diagnosis.

Treatment and Control

Treatment includes immediate administration of Clostridium C & D anti-toxin by a veterinarian (antitoxin not currently available in Trinidad). Milk of Magnesia and activated charcoal can also be given to the infected animal to bind the toxins and remove them from the body. The animal will also need supplemented nutrition and electrolytes; coconut water can be orally administered to keep the goat hydrated. Pain medication (Banamine) can also be given to the goat to help with the abdominal pain. A farmer should contact a veterinarian if he suspects that he has an Enterotoxaemia problem on his farm as this will allow the veterinarian to give the best control measures to the farmer. It is important to note however that sudden changes in the diet of the animal is the main cause of the disease and should therefore be avoided at all cost. You should have a proper feeding programme on your farm and animals should be fed at a similar time each day.

Bloat

Bloat is a result of an over-production of gas that becomes trapped within the rumen. Gas is a natural by-product of digestive fermentation in the rumen and is expelled. There are two types of bloat: frothy bloat and dry bloat. Frothy bloat occurs from the over-eating of lush, damp leguminous pastures or feeds such as clover or alfalfa. Frothy bloat is more dangerous than dry bloat and the rumen expands with foam very quickly.



Dry or free-gas bloat is caused by indigestion of any underlying cause or eating too much green. Gas forms in the rumen in pockets and is trapped in the uppermost portions of the rumen. As more gas forms, the animal is unable to release gas and the animal gets bloated.

Obstructional bloat is a form of dry bloat caused when an object gets loaded in the oesophagus blocking the passage of air so the animal cannot bloat.

Signs:

- Usually a swelling on the left side is seen with a gradual increase in size over time. The paralumbar fossa fills out and when this is tapped it sounds like a drum. As the gas increases this swelling may extend over the back and extended down on the right side of the abdomen.
- As the swelling increases the animal may show signs of discomfort and will spread its back legs out and back to ease the discomfort.
- Signs of pain include grinding of teeth, appearing depressed and kicking its belly.
- As pain increases animal may drop to its right side and may continue to bawl and grunt. Additionally the back legs will spread apart causing respiratory distress and then dies.

Treatment

Frothy bloat: Introduce a product that can break down the froth into solid pockets of gas which can be passed out. In emergencies, simple soap solutions can be used. Antigas or AntiBloat are products that can be used.

Dry bloat: A stomach tube can be passed through the oesophagus into the rumen to relieve gas. When the stomach tube is inserted, Anti-bloat, Anti-gas or Milk of Magnesia can be used to relieve the gas. In extreme emergency cases, a sharp object such as a 16 or 18 gauge needle, trocar and cannula, can be used.

Notes

1. Bloat is common on most farms and usually comes unexpected. It is always a good idea to keep Anti-bloat products at hand.
2. Limit grazing on lush, green pastures.
3. Have a secure area for grain or ration.
4. Have secure holding pens for animals.

Tetanus

Tetanus is also referred to as "lock jaw". This disease is caused by a specific neurotoxin that is produced by the *Clostridium tetani* bacteria in necrotic tissue. This bacterium is usually found in the soil and in animal faeces. The spores of this bacterium can remain in the soil for years as it is resistant to destruction. Tetanus has a group of characteristic signs associated with the syndrome; these include muscular rigidity, hyperesthesia (increased sensitivity to sensory stimuli) and convulsions. The disease causing organism usually enters into the goat's system through cuts, scrapes and puncture wounds that the animals may receive while grazing but can also enter into the body when the farmer or veterinarian is performing routine procedures such as



disbudding, dehorning, tattooing, castration, and hoof trimming. Wounds caused by dog bites, wire and nail punctures or galvanise wounds are also possible means of infection. Spores may be released when cleaning out accumulation of manure under slatted flooring systems or in deep litter systems so care must be taken to remove animals before cleaning areas where there are accumulations of manure over time.

Signs

The incubation for this disease is usually 10-14 days. Early signs of tetanus include: a nervous expression, a stiff gait, and mild bloat. The area around the site of the infection may be stiff as well. The first indication of infection might be a slight limp on the left hind leg which will progress to some stiffness, hopping, limping or dragging of the leg followed by both legs becoming stiff which leads to the animal falling. As the disease progress, the animal develops a reluctance to move, ears may be erect, tail may be stiff and elevated, eyes may not move. The affected animal will have difficulty trying to get up showing stiffness and rigidity of legs making it difficult for movement so the animal. The animal will try to move but will be able to drag its body as there is no control over its back legs. The animal may also become constipated. Shortly after, the animal become hyperaesthetic and will respond to touch and noises by stiffening up. Convulsions will usually follow. Eventually the animal becomes permanently recumbent with rigid extension of all limbs and will have difficulty opening its mouth. Affected animals will convulse periodically at the slightest disturbance. Once recumbent, the jaws lock down and the animal will have difficulty breathing. The animal will show extreme pain and death usually occurs within 24 to 36 hours.

Treatment and Control

If detected early, sedatives and antibiotics can be used along with tetanus antitoxin to treat the disease, but it often fails. The site of infection should be opened to allow for proper air flow, cleaning and to allow the wound to be infiltrated with penicillin or tetanus antitoxin. This will reduce the chance that more pre-existing toxins will be absorbed during tissue manipulation. Excessive tissue manipulation can also cause the toxins to spread rapidly and may make the animal dramatically worse. Consult with your veterinarian for proper treatment and management.

Prevention of this disease is much more effective and economical than treatment of affected goats. An annual vaccination programme should be implemented on your farm. The Ministry of Agriculture offers this service at a subsidised cost. It may be wiser to vaccinate all susceptible goats on your farm to achieve optimal disease prevention. Note that this could be costly as Tetanus toxoid is used as a preventative measure rather than the Tetanus anti-toxin. Sharp objects should be removed from the pens and pastures because they may cause damage to the goats and predispose them to contracting tetanus. Use clean equipment in tattooing, tagging, castrations and disbudding. Remember, prevention is always better than cure!

Pregnancy Toxaemia

This disease is also known as pregnancy disease, ketosis or twin lamb disease. It occurs during late pregnancy and happens more frequently in doe's that are carrying multiple foetuses. Pregnancy toxaemia is a metabolic disease of goats and the following factors predisposes the pregnant doe:

- Multiple foetuses.



- Poor nutrition and undernourishment during late pregnancy when the foetuses are rapidly growing.
- Stress such as severe weather, sudden changes in feed, other diseases or transportation.

The disease usually appears in the last 30 days of pregnancy. The mortality rate is high in affected animals as both the doe and the foetuses can be lost.

Causes

As pregnancy progresses, an increasing demand is made on the available blood glucose supply of the doe because of foetal development. Glucose requirements during late pregnancy are increased up to 70 - 80 % since most of the foetal development takes place during this stage. The doe's blood sugar level will decrease as the pregnancy progresses and pregnancy toxemia may develop when levels decrease to about 18 mg per 100 ml blood.

Clinical Signs

The clinical signs displayed by the animal begin with isolation. Initially, the animal tends to separate from others and to display mild depression. As the disease progresses the doe will show signs of visual impairment as she will usually run into objects or will not react when she is approached. Teeth grinding is common as well as dullness and depression become progressively severe and the doe becomes reluctant to move and eat. Eventually she becomes recumbent. The temperature and pulse of the animal usually remains within normal limits and respiration is usually normal until the later stages when it may become laboured. The appetite is poor or absent. Ketones may be detected in the urine and the breath of the animal will also be sweet almost like the smell of molasses. During the last stages of this disease does become comatose and eventually die.

Treatment and Control

Oral administration of glycerine, glycerol, propylene glycol or intravenous administration of glucose may be effective in the early stages of the disease. A dose rate of 50 mls. of glycerine given orally twice per day is recommended for sheep and goats. Intravenous administration of electrolyte solutions with dextrose or glucose can help the animal to retain energy. In severe cases, caesarean section or other humane methods of terminating pregnancy may be effective in saving the life of the doe and her kids.

An adequate nutritional level throughout the pregnancy will prevent pregnancy toxemia. Management during the late stage of pregnancy is important for preventing this disease. Addition of crack corn in the diet will supply the energy level required for the doe. Protein and energy levels during the last 30-40 days of pregnancy should meet the doe's maintenance requirements as well as the growth requirements of the foetuses. You must avoid sudden changes in feed and reduce the stress on the animal as much as possible. Monitoring the pregnant animals can allow for early detection of the disease and aid in reducing any losses associated with this disease.

Mastitis

Mastitis is an inflammation of the mammary gland caused by a variety of ways. It can result from faulty milking machines, improper sanitation, absence of a milking procedure, trauma and mostly by microorganisms. It



results in physical, chemical and bacterial changes to the milk and also physiological changes in the udder. Two most common organisms involved in mastitis in dairy goats are *Staphylococcus aureus* and *Streptococcus agalactiae*. These organisms are similar to those that cause mastitis in cows and infections usually spreads during the milking process from infected to susceptible goats.

Mastitis may manifest in four ways:

1. **Peracute mastitis** occurs suddenly and is the most difficult to determine. This is because the animal may show or may not show any clinical signs. At milking a clear watery discharge is seen, which is the only indication that there may be a problem. There may or may not be an elevated temperature, decrease in appetite, depression or these signs might be absent. A discolouration around the base of the teat may be seen as well. Usually the animal is found dead 6-8 hours from last being seen. On examination the udder is swollen, discoloured, greenish, purplish, or brown in colour.
2. **Acute mastitis** is characterized by a sudden onset, painful udders that are swollen and reddish. The animal will be off feed, have a fever and show signs of depression and weakness. There will be physical changes to the milk from affected quarters. Depending on the severity, there will be clots, flakes or watery milk. Death usually follows within 24-48 hours.
3. **Subclinical mastitis** cannot be determined or seen with the naked eye and therefore requires laboratory testing to confirm its presence. The California Mastitis Test (CMT) is the most common method used. If subclinical mastitis is undetected will develop into clinical mastitis.
4. **Clinical mastitis** can be physically observed with the naked eye by signs such as inflammation, swelling, pain, fever and physical changes to the milk. Clinical cases may exist as any of four stages of the infection. If clinical mastitis is improperly managed or detected can lead to fibrosis, atrophy of the udder. Repeated incidences may lead to higher culling rates in the heard.

Diagnosis

Subclinical mastitis in goats cannot be determined by just looking at the milk. This form of mastitis requires testing to confirm its existence. Older methods involved the use of mastitis test kits such as the California or Massachusetts mastitis test kits and can be identified by mixing the milk with the reagent and looking for physical changes in the colour and consistency of the milk. Now there are other devices that can give a digital readout in seconds using your cell phone or the Draminski mastitis detector. CMT and Standard Plate Count (SPC) tests are used to determine the level of Somatic Cell Counts (SCC) and also the amount of colony forming units (CFU) of bacteria per ml. These two tests are the indicators for milk quality. A healthy dairy goat herd should have a SCC under 500,000 per ml of milk. For healthier milk there will be a lower the SCC reading. A good producer will keep in mind that goats in heat produce a higher somatic cell count than normal goats in their milk and this usually returns to normal within a day.





CMT Test

Clinical mastitis can be seen by looking for physical changes in the milk and with the udder.

Prevention and Treatment

Animals can easily become susceptible to mastitis. Sanitation and milking technique are very important to prevent mastitis from occurring. A milker should always exercise proper hygienic practices, follow a milking procedure and pay attention to the animal when milking. All workers involved in milking should wear clean gloves and use separate paper or cloth towel of every animal being milked. If a milking machine is being used then it should always be sanitized before and after the milking session. The milking process should be done rapidly and performed by trained operators. Over milking or inadequate preparation for milking, take a toll in causing stress and injury to the milking doe. If hand-milking, the milker should not pull on the teat and udder which may lead to injury. Managing these factors will directly affect mastitis resistance and susceptibility in your dairy herd.

There are intra-mammary infusions used to insert into the teat canal for mastitis treatment. 'Dry cow' treatments can be used when drying off the goats as a preventative measure before the next lactation. A single udder infusion dose is recommended for each udder half in the goat.

In severe acute attacks of mastitis, systemic administration of antibiotics by intravenous or other parenteral means is suggested and should be administered by a veterinarian. Frequent udder massage with gentle hand milking may be helpful to relieve pressure in the affected gland to aid recovery. Hydration therapy and Red Udder ointment can be caused to soften the udder to get rid of the hardness and lumps in the udder. Simple stripping in most cases gets rid of subclinical mastitis and early stages of clinical mastitis. When mastitis cases are treated by a veterinarian, be sure that you follow milk-withholding instructions given.



Internal Parasites

Coccidiosis

Coccidiosis is a contagious disease of goats and is common in young kids. The disease is caused by *Isospora* and the more common *Eimeria* spp of which there are 12 types, which parasitize and destroy cells lining the intestinal tract of the goat. An infected goat will shed thousands of these microscopic coccidial oocysts in its faeces every day. When first passed, the oocysts are harmless to another goat but if conditions are favourable (warmth and moisture) for their growth, these oocysts will mature or sporulate into the infective stage of this parasite. This usually occurs in approximately 3 days. One oocyst develops into eight infective sporozoites. If a young kid swallows the sporulated oocyst, the sporozoites are released and rapidly enter the intestinal cells. From here on, the life cycle gets very complicated but eventually reproductive stages are reached and new oocysts are produced and released. The entire life cycle from infective oocyst to new oocyst takes approximately 2-3 weeks.

If a young kid is suddenly exposed to many sporulated oocysts, it can become severely ill 2 to 3 weeks later. It will lose its appetite, become listless and weak. It may display abdominal pain by crying or getting up again as soon as it lies down. At first, the kid might have a fever, but later the body temperature is normal or even below normal. The kid will show signs of diarrhoea that is pasty, and then becomes watery causing the kid to rapidly dehydrate. The diarrhoea is rarely bloody. Signs of infection often show 2-3 weeks after the kids are weaned. Infestation usually occurs after weaning, as the lactic acid in the digestive tract during weaning prevents infestation.

Young weak kids may die quickly by a severe attack of coccidiosis while others who are stronger will develop a chronic disease characterized by intermittent diarrhoea and stunted growth. The kid will have digestive problems because of the severely damaged intestines. As consequence, this kid will be potbellied, lasting for months afterwards.

Even though coccidiosis is typically a disease of the young growing kid, most adults are mildly infected and continuously shed oocysts which serve to infect young kids. Occasionally an adult goat shows temporary diarrhoea when stressed or exposed to a new species of coccidia. This is especially common after the doe has been boarded at another farm for breeding purposes.

Diagnosis

Diagnosis of coccidiosis can be based on clinical signs or microscopic faecal examinations. Coccidiosis is so common that it should be suspected whenever kids older than about 2 weeks of age have watery diarrhoea. Sudden changes in the diet can also cause diarrhoea and make the kid more susceptible to coccidiosis. Diets high in concentrates or lush green forage also predisposes kid to coccidiosis.

If a kid dies of coccidiosis, post-mortem examination will quickly confirm the diagnosis. The small intestine will have many irregularly raised white areas, often about ¼ inches in diameter. A smear sample viewed under a microscope will also show the presence of the parasite.



Whether or not a goat gets sick with coccidiosis depends on several factors. The age of the goat sometimes affects the outcome of the situation. This is partly because an older animal would usually have had time to develop some immunity to the parasite and are less likely to die. Good nutrition (including vitamin E-selenium supplementation in selenium deficient areas) helps the goat to defend itself against coccidiosis. The area where the kids are being kept should also be cleaned daily and should not be kept moist as this encourages the growth of the parasite. If the kid is exposed to a large quantity of oocysts, this will destroy all the intestinal cells at one time and kill the kid. If the kids become infected, Amprolium®, a coccidiostat should be administered to control the parasites. This along with supportive therapy will help the kid recover if done early. Coconut water can be used to provide electrolytes to the kid.

This disease is normally spread by the feco-oral route and care should be taken in positioning the water and feeder troughs or containers. Care should be taken prevent the animals from defecating in the containers where they drink and eat. The clinical signs of this disease can be confused with those of endoparasitism and where both exist sometimes make a lethal combination.

Gastrointestinal Worms (Helminths)

Helminths are categorized into three classes:

Neematodes, Cestodes and Trematodes.

Nematodes (Roundworms): There are a whole range of nematodes that parasitize the stomach and small intestine of goats namely *Haemonchus contortus* (barber pole). Others include: *Ostertagia*, *Trichostrongylus*, *Trichuris* (whipworm), and *Dictylocaulus* (lung worm).

Cestodes (Tapeworm): The most common tapeworm is *Moniezia expansa*.

Trematodes (Flukes): The most common trematode or fluke is *Fasciola hepatica*.

Lung worms reside in the lungs and irritate the bronchioles inside of the lung. The irritation and pain due to this parasite causes the animal to cough. Tapeworms have hooks which attach to the wall of the intestine and feed on the nutrients required by the animals. As such weight loss, anaemia, diarrhoea and emaciation occur. In large enough numbers, tapeworms can obstruct the intestine and cause death. Stomach worms are voracious bloodsuckers and destroy the lining of the stomach to gain access the bloodstream. The severe destruction of the lining of the stomach can cause pain, diarrhoea, anaemia, and weight loss due to the animal's inability to digest feed completely.

Identification

The standard method to test for parasites is to look for parasite eggs in the faeces of the animals using a microscope; this works for both lung worms and gastrointestinal worms. The various parasite families have different egg shapes, which helps in identifying them. However, to determine the specific parasite, other tests may be needed. To identify the specific parasite, faecal samples are checked in the laboratory. The eggs are



usually cultured in a laboratory, allowed to hatch and the worm eggs are then identified under a microscope. To quantify the parasitic load and decide if the animal is heavily infested then an EPG or eggs per gram test can be conducted. This is also done using a microscope to quantify the eggs but a special slide called a McMaster© slide is used to hold a special mixture containing the faecal sample, which is mixed in a solution of super saturated sodium chloride or sugar. The super saturated solution allows the eggs to float to the top of the solution and they are then counted under the microscope. The count is then multiplied by 50 to calculate the number of eggs present in one gram of faeces. Larger numbers indicate a higher infestation of parasites.

Signs of Infestation

There are common signs associated with parasites and they are as follows:

- Weight loss - animals do not get all the nutrients they need.
- Diarrhoea - detected by dirty tail and hind end.
- Rough hair coat - when nutrients are insufficient, the animals' hair loses its lustre.
- Lethargy- animals keep their head and ears down and are unwilling to stand for long periods of time.
- Weakness - animals are easier to catch or unstable when walking.
- Anaemia - animals' gums, perineum, and eyes appear white due to blood loss.
- Fever or, in the late stages of disease, cold extremities (e.g., ears and legs).
- Fast breathing (lung worms) - animals try to get oxygen into their damaged lungs.
- Coughing (lung worms) - animals cough from the irritation of their damaged lungs.
- Bottle jaw (stomach worms, tapeworms and liver flukes) - animals have fluctuant swelling under the jaw from the accumulation of fluid (submandibular oedema). Sometimes it can spread to under the abdomen.

Treatment and Control

There are three classes of drugs used for deworming goats. It is important to use these drugs as recommended on the label as using a drug in any way other than that listed in the drug pamphlet is considered 'extra label drug use' and can only be done by veterinary prescription.

It is very important to note that all de-wormers are not effective against all parasites. In addition, some dewormers that were once effective against a specific parasite are no longer effective, due to the development of resistance by some worms. Therefore, just because you apply a dewormer does not mean you've killed the worms; you must be sure to use the right dewormer for your specific situation.

Goats have a much higher metabolic rate than cattle; therefore, the drug dosages for goats will likely be higher than those listed for cattle. To properly treat your animal, the worm (parasite) burden must also be considered. Under dosing will lead to resistance problems with the dewormers. Some de-wormers can be given orally or be injected subcutaneously (under the skin). Consult with your veterinarian about the best option for your specific circumstances. Financial considerations will determine whether you are opting to eradicate or control the parasite problem. No deworming program should be undertaken without improvements to sanitation and nutrition of the animals.



Affected animals should be moved into an area that can be easily cleaned and disinfected away from unaffected animals at the time of treatment. After treating affected animals, wait 3 to 4 days and retest to determine the effectiveness of the treatment. Animals that still show high burdens after treatment should be retreated and retested 7 to 14 days later. Animals that still have high burdens after a second treatment are likely to be very susceptible and can act as carriers for parasites, infecting other animals in the flock. In addition, it can also be that the dosage you are using is too low or that the dewormer being used is inadequate or expired. A combination dewormer may be needed. You should consult your veterinarian if you are having this problem. These animals should be culled from the flock to decrease the burden of parasites in the entire flock and to increase the susceptibility of parasites in the flock to dewormers. This action can prevent re-infestation of animals' and need for further treatment.

The best prevention is to reduce your animals' exposure to parasites by providing a clean environment beginning at birth and avoiding overcrowding of pens or premises. Balanced nutrition is very important to keep animals healthy and help them develop appropriate resistance to external pathogens, especially for dams before and after lambing/kidding. Other important preventive actions are to:

- Avoid pasturing in damp areas and during early morning and evening hours, when there is dew on the pasture.
- Rotate pastures to avoid high burdens of parasites.
- Select animals from bloodlines that show low worm burdens.
- Use the FAMACHA© system as a guide when de-worming for stomach worms.

FAMACHA

The FAMACHA method was developed in South Africa by Francois Malan to combat the *Haemonchus contortus* worm. By using the FAMACHA system, only the goats that need deworming would be treated. Treating goats is expensive and the parasites build up resistance to the dewormers commonly used. The FAMACHA system consists of a score card which is used to determine the levels of anaemia displayed by the animal identified. Red or pink ocular membranes indicate that the parasite load of the animal is not high. Light pink or white membranes indicate a high parasite burden and the need for deworming.



The FAMACHA scorecard

The FAMACHA scoring system is only useful when dealing with the blood sucking, *Haemonchus contortus* parasite. This worm lives in the animal's gastrointestinal tract and heavy infestations result in the animal becoming anaemic. The symptoms of anaemia show up in the colour of the membrane of the eye or can even be observed in the colour of the gums of animals' jaw. In the FAMACHA system, that eyelid colour is matched



up with a scorecard that ranks colour on a 1 to 5 scale. A dark red eyelid membrane colour is given a score of 1 indicating that the animal is healthy and has no significant signs of anaemia. A white colour is a score of 5 and indicates an unhealthy animal with severe anaemia. The intermediate light red, pink and pinkish white colours indicated by scores 2 through 4 indicate increasing levels of anaemia that generally correspond to the parasite burden of the animal. In general, if an animal scores a 3, 4 or 5 it is treated with a natural or chemical dewormer. Sometimes resistance to a particular dewormer may develop thus limiting the effectiveness of it. This means that another class of dewormer should be used. Consult a veterinarian in instances where this occurs since they can advise on the best de-wormers to use. Keep in mind that some dewormers can cause abortions.

Another method of determining the parasite load is by analysing a faecal sample from each individual animal. This is usually done in a laboratory, by a veterinarian or lab technician and is referred to as a faecal egg count test. This method is usually costlier than the FAMACHA method as it requires trained technicians and special equipment.

After selecting the animals to be dewormed, the correct dosage of the dewormer must be applied. The dosage rate listed on the dewormer label for sheep and cattle should generally be increased by 1 ½ times to 2 times when used for a goat, as a goat's metabolism is faster than a cow or sheep's; so a goat dosed at the rate listed for cattle or sheep will be under-dosed. Knowing the weight of the doe is critical to calculate the correct dosage which is usually based on live-weight. Weights can be collected using a weigh band or a scale.

General Considerations:

Consult your vet with assistance to collecting and analysing faecal samples, identifying the types of parasites present and advice on control and treatment measures for your farm.

Intensive slatted floor housing systems although more costly general tends to control nematode infestations thereby reducing or eliminating deworming costs.

Semi Intensive systems of production generally tend to have a higher parasite burden when the animals are grazed and may require more frequent deworming.

Extensive systems tend to recycle infestation and the parasite burden depends on the amount of animals and frequency grazed, pastures management or rotational grazing and usually flares up in the wet season.

Consider fasting before deworming to improve effectiveness of the dewormers. Always pay attention to withdrawal periods for meat and milk.

Urolithiasis (Urinary/Stones)

Urolithiasis means stones or calculi at any location of the urinary tract in goats. It is caused when undissolved mineral, especially calcium, block the urinary tract of the goat. They are usually found in goats with high protein diet or unbalanced diets. Frequent urinary tract infections can lead to uroliths.

Signs of Infection:

- Frequent attempts at urination
- Dribbling of urine



- Blood in urine
- Depression, arching of back, bawling,
- Crystals may be seen around the prepuce
- Animal may be unable to stand
- Stomach becomes distended.
- The animal can die especially if the bladder ruptures.

Treatment and Prevention:

- Provide clean fresh water at all times
- Withhold feed for 24 hours and use ammonium chloride at 0.2g/kg in 1 gallon of water may help by drenching the animal
- Consult a veterinarian if the animal is unable to urinate
- Urethral process can be clipped off or a catheter can be used to allow calculi to pass

Contagious Ecthyma - ORF (Scabby Mouth)

ORF is a painful skin disease of sheep and goats. This virus infection is commonly referred to as Scabby Mouth. Vesicles appear around the lip which leads to the development of sores then it turns into scabs. These scabs are seen around the mouth, nose, teat, udder, ears, eyes. It is caused by a pox virus and signs appear within 2 days of infection. By the 11th day scabs are seen which can last up to 2 weeks. ORF is spread from animal to animal or by objects which animals come in contact with. The disease is more severe in goats than sheep.

Signs of Infection:

- Pustules or water filled blebs which burst and form the scabs
- Animals are reluctant to feed, walk or nurse their young (lambs and kids are at risk)

Treatment:

It is a viral disease therefore antibiotics are not necessary unless there is a secondary infection of the wounds. Antibiotics can be used topically or systemically. The disease will usually run its course in 2 - 4 weeks.

Crusts can remain infective for up to 3 years and should not be removed as this can delay healing time and increase the caretaker's chance of getting infected.

Prevention:

- Quarantine new animals for up to one month
- Buy from disease free stock

Notes:

1. This is a zoonotic disease that can spread from animal to animal and animal to man. Use a pair of gloves when attending to these animals and always wash hands thoroughly. Do not assume that because the disease ran its course, that everything has cleared up and the animal is no longer infective.



2. The application of disinfectant with a small paint brush seems to have some success in shortening the course of the disease and bringing early relief to affected animals.

Abscesses

An abscess is a swelling with a lumpy appearance that is filled with pus. It is caused by many organisms especially bacteria. They can appear on any part of the body and are commonly seen on or under the jaw, neck, shoulders, hind limbs and udder.

The swelling starts as firm raised areas not painful to touch, enlarges and becomes softer and filled with fluid. It becomes painful and may burst discharging pus onto the skin or may be resorbed and disappear or be encapsulated where it remains a flattish raised area after it regresses.

Treatment:

- Flush ruptured abscess with iodine 7% and pack the area with a topical antibiotic
- If abscess is a result of a puncture wound, use tetanus antitoxin
- If the wound is not ruptured, and becomes a discomfort to the animal, you can shave, sterilize a lower area of the abscess, lance, drain, flush with iodine and pack with topical antibiotic
- Always consult your veterinarian if not sure what the problem might be since other diseases such as CLA (Caseous Lymphadenitis) can be present. For example do not cut a CLA abscess. If a CLA abscess is cut, it can infect the entire farm and can remain infective to other animals.

Herd Health Summary

The main goal of a herd health programme is to improve the herd's productivity and to maximize returns. This goal is achieved through nutritional management, disease control, reproductive management, parasite control, environmental management as well as biosecurity and isolation control. All aspects of dairy herd management work hand in hand to achieve improved herd productivity.

Each herd is unique and the plan must be tailored to fit the situation. Records are important in assessing progress and helping to determine the next step. Farmers must work with veterinarians and consultants to develop an annual calendar for their goat dairy. This calendar should list the approximate times and ages when certain activities should be performed to maximize profits per productive unit. These activities should include breeding, weaning, deworming and sales.

Endnotes

1. Dairy Goat Management: Best Management Practices, Clara Hedrich (University of Wisconsin Emerging Agricultural Markets Team, April 2008, www.wdga.org/resources/bmp1.pdf).
2. Kahn, C. M. (2010). The Merck Veterinary Manual (10th ed.). Whitehouse Station, N.J., U.S.A. MERCK & CO., INC.







The Buck, Breeding and Kidding

To produce milk, a dairy goat must first produce kids; this cannot be done without breeding. Breeding requires that the doe be served, and this can be done via artificial insemination but in most cases in Trinidad and Tobago, a buck is used.

A buck requires that same amount of housing, feeding and grooming as a doe, which means that having a buck can be an additional expense to the farmer. Some farmers choose not to house a buck on their farm and instead carry their does to other farmers who have bucks as this may be a more economical alternative. If your dairy enterprise is close to a residential area it may also be another reason for not keeping a buck since they give off a high characteristic smell. Bucks can also be dangerous, especially if the farmer is not physically or mentally equipped to manage a robust buck.



A good buck can be very expensive, but will be able to provide good genetic material to help your herd improve. When choosing a buck, ensure that it will produce superior offspring. Look at his offspring or relatives and determine if they are high producers, that they grow well and produce lots of milk. His mother and grandmother should have been good producers. Next, assess the conformation of the buck. He should be masculine and stand strong with well hung testicles. REMEMBER: purchasing a good buck does not mean that he will perform well on your enterprise. You should ensure that the housing and feeds provided on your enterprise meets all his requirements or he may not perform as well as expected.

A buck can be used for limited service even before he is one-year-old. A mature buck can serve more than one hundred does' in a year but should be limited to approximately 20 - 25 does per breeding cycle.

Breeding and Kidding Protocols

The major objective of a dairy goat production system is maximizing production. To achieve the best production on your farm you must first develop a breeding protocol. A proper breeding protocol is very important to the success of your farm as it ensures that animals are bred and that they reproduce efficiently.

Before developing a breeding programme, a farmer must decide on the maximum number of does that will breed in a given period. The does will kid approximately 5 months after breeding, therefore labour must be available during that time. Proper maternity pens should also be prepared for the kidding period. The goal on any dairy farm should be to have milk year-round, therefore the breeding programme should be designed to have goats kidding each month, otherwise there may be periods of shortfall. To properly set up a breeding programme, you must first understand the doe's oestrous cycle. A good breeding programme will decide on the date of breeding a doe based on lactation or it applies knowledge of the oestrous cycle of the doe to determine when she will next be in heat. It also includes criteria for culling unproductive does and selecting a replacement buck. Good records provide easy access to the majority of the information needed for developing the breeding protocol.

The Doe's Cycle

As mentioned above it is important to have goats kidding all year-round but some imported animals show seasonality and are only able to kid in the summer months until they become acclimatized. The average duration of the goat oestrous cycle is 21 days but this can vary with different breeds or environmental changes. The average duration of standing estrus is 36 hours, but can range from 24 – 48 hours depending on age, breed, season, and presence of a male, with ovulation occurring anytime between 24 - 36 hours after the onset of estrus.

Oestrus detection in goats is based on behavioural signs like "riding", bleating and flagging of the tail and physiological signs like reddened vulva and vaginal discharge. The onset of puberty typically occurs at 6 – 8 months of age, but varies depending on the season of birth, breed, nutritional status, and presence of a male. Puberty in well-grown bucks is demonstrated as early as 4 months. The pregnancy or gestation period for goats is approximately 150 days or 5 months.



Breeding Systems

In Trinidad and Tobago there are 4 primary breeding systems to consider when developing a breeding programme. They include: hand mating, group breeding and AI (artificial insemination). If groups of animals are being bred together then an oestrus synchronization protocol can be used in tandem with one of the above mentioned breeding systems.

Hand Mating

Hand mating is considered the traditional method of breeding and basically involves selecting the buck for the doe and mating them. If this system is used then the exact date of copulation can be recorded; it will be obvious whether the buck has actually bred the doe. Hand mating requires more labour than other types of breeding systems since the farm operators must observe the herd for does in heat and then select the buck for breeding. This method of breeding can be used with an oestrus synchronization protocol and is best used for small scale enterprises.

Group Breeding

If a farmer decides on group breeding, then this involves placing a buck into a pen of does. This system requires the least amount of labour and is commonly used in Trinidad and Tobago. The buck will naturally select the does that are in heat and breed them. In some cases, more than one doe can come into heat on the same day, so an experienced buck will breed all the female in heat but an inexperienced buck may just single out one female in heat and will not breed the others. To properly record the breeding date, a farm worker or the farmer must observe the breeding herd early in the morning or afternoon to try to identify each breeding. Alternatively, a harness with a crayon marker can be attached to the buck to aid the farmer in detecting the does which have been mounted and bred.

If you are using a yearling buck, there should be no more than 10 – 15 does in the pen but a mature, experienced buck can be placed with 15 – 30 does per pen. This system can be used together with oestrous synchronization to ensure that the female comes into heat in a shorter period of time. It also ensures that kidding occurs at the same time, allowing the farmer or farm manager to better manage the labour needed at kidding.



A group of Alpine females ready for group breeding.



Artificial Insemination

Artificial Insemination (AI) provides farmers with the opportunity to include superior genetics on their farm by using semen from bucks that are of the highest quality. Artificial insemination is offered by the Ministry of Agriculture, Land and Fisheries. Farmers must be able to correctly identify signs of heat in the female to benefit from successful artificial insemination. However, successful AI is dependent on the AI technician.

Once the doe is observed to be in heat, she is ready to be bred. The most common signs that a doe is in heat are:

- **Vocalization:** Increase in calls made by the animals.
- **Tail Flapping:** Increased tail flickering
- **Aggression:** A submissive and easy-going doe can be transformed by hormones, leading to fights with other goats.
- **Unusual Feeding Patterns:** Animals may not eat while there are in heat.
- **Physical Changes:** Vaginal discharge, along with redness and swelling of the vulva is often seen in a doe in heat.

It is important to contact the Artificial Breeding Centre as soon as signs of heat are detected in a doe that is going to be bred by artificial insemination. Farmers can contact the Artificial Breeding Centre at 1-868-667-9291 or 1-868-667-9449.

Oestrus Synchronization

the term "oestrus" refers to the point of female sexual excitement in mammals which causes ovulation. At ovulation time which is commonly called "heat", females are the most receptive to mating. Oestrous synchronization targets female mammals to come into heat within a short time usually between 36 to 96 hours. This is achieved through the use of 1 or more hormones. The synchronization of the oestrous cycle is often used in the large ruminant industry but is now commonly being used for sheep and dairy goats. Oestrous synchronization is commonly used together with pen mating or artificial insemination.

The common methods of estrous synchronization involve the use of Controlled Internal Drug Release (CIDR) technology and PG 600 to heat synchronize does. There are a wide variety of protocols that can be used; therefore a farmer should consult with an agricultural consultant or veterinarian to determine which protocol best suits his breeding programme.



CIDR Applicator

Breeding Young stock

Doelings can be bred at about 7 to 10 months of age, depending on the size and breed of the animal. During the first year the animal's nutrition is very important, a proper balanced diet will allow the doeling to reach an acceptable weight of approximately 70 - 80 lb by 7-10 months. Body weight relative to breed is more



important than age, and can influence future performance of the animal. Does should have a body score of approximately 3.0 - 3.5, not too fat or too thin, as this may cause conception problems.

Locally, it may be advantageous to breed does at 10 to 12 months of age. This will allow the doelings to attain a good weight and body condition score. The disadvantage of waiting so long however is the additional cost to the farmer as he has to raise the doe with no financial returns. The advantage here is, by giving the doelings extra time, she is better able to carry off-springs which are usually born healthier, stronger, larger and have better livability.

The doeling may be able to conceive as early as three months of age but they should never be bred at this stage since her future growth can be permanently stunted. In order to prevent any early breeding, all bucklings should be separated from the doelings at an early age.

Bucks must be prepared for the breeding period with good nutrition, parasite control and hoof trimming. Always use a proper buck for breeding; he should have plump testicles that are firm and symmetrical. If any abnormalities are observed before the breeding programme begins then it may be safer to exclude that buck from your breeding programme. Many debilitating diseases including arthritis, foot rot, and infections can affect fertility of bucks and should be treated before the breeding period begins to ensure that the buck is able to perform efficiently.

Managing The Pregnant Doe

The Pregnant Doe

The most important step after breeding is confirming pregnancy. The ultrasound is an effective tool used to determine whether or not the doe is pregnant. Ultra-sonography can also identify other reproductive traits such as twins or congenital defects. It is important to note that even if some does are initially detected as being pregnant they may abort or even reabsorb the foetus, therefore pregnancy detection should be done at intervals during pregnancy to ensure that the doe is pregnant throughout the 150 - day gestation period. This can be done at days 30 , 60 , 90 and 120.

In Trinidad and Tobago there are a few reproductive diseases that can cause abortions in goats. These include Brucellosis and Chlamydial infections. Abortions can also occur due to physical trauma for example if the doe falls or is hit in the stomach. Stress can also cause abortions and the doe should therefore be kept as calm as possible.

At about 1 month prior to kidding, the internal parasites within the doe become very active, and this is termed the periparturient rise. At this stage the FAMACHA system can be used to quickly identify the does that will need deworming or not. The pregnant doe should have a 45 - 60 day dry period prior to kidding which will allow her body to rest and prepare for kidding. During the last 3 weeks of pregnancy, a steam-up, high protein, supplement feed should be fed so does can easily transition to the milking ration and aid in preventing metabolic disorders such as ketosis and milk fever.



Kidding (Parturition)

The process of giving birth in goats is also referred to as parturition or kidding. As kidding time approaches you can observe some physiological changes in the doe, her udder will rapidly enlarge and the vulva changes bright pink to red and becomes swollen. Many farmers report a mucous discharge before the parturition process begins. This discharge is the cervical plug and it is usually a sticky mucus exudate. This is evidence that the doe will give birth within 8-12 hours. The goat may also begin to release milk from the teat.

Kidding occurs in stages. The first stage can last between 1-6 hours; at this stage the doe that is being kept with other females will isolate herself and move around a lot, usually standing then sitting at regular intervals. The farmer may move her to an individual pen at this time. Ensure that the kidding area is clean and sanitized.

The second stage of kidding is delivery of the kids and this usually occurs a short time after the water bag can be viewed. Kids can present in a variety of birthing positions including being presented either with their front feet forward or in posterior presentation where their rear feet are presented first. Always remain vigilant during the kidding process as some does can have a difficult birth and may require help, but in most cases the doe will do well when left alone. If the doe is having multiple kids she may rest between deliveries.

After kidding, the doe should begin to lick the kids to clean them and may even eat part of the foetal membranes. The farmer should observe the kids and ensure that they are standing. In many commercial systems, the kids are immediately removed from the mother and hand fed colostrum. In other systems the kids are left with the does but the farmer must ensure that the kids are suckling colostrum from the mother. If there are disease problems on the farm, then kids should be removed from their dams and bottle fed heat-treated colostrum and then pasteurized milk. If this system is being used, then the doe should be milked immediately after parturition to collect the colostrum for her kids.

After giving birth, the doe should be monitored closely to ensure that she does not retain any foetal membranes. Passing of the placenta is the final stage of the kidding process and it should normally be expelled within 6 hours after kidding. If she does not expel the placenta, or shows signs of illness or weakness or excessive bleeding consult the veterinarian. After kidding the doe should be monitored to ensure that she has no health problems such as a uterine infection. The kids will also require special attention. The special needs of the kids will be discussed in the following chapter.

Endnotes

1. Dairy Goat Management: Best Management Practices. Clara Hedrich. 2008. University of Wisconsin Emerging Agricultural Markets Team. (www.wdga.org/resources/bmp1.pdf).
2. Dairy Farm Management Systems | Goats. R. Rubino, M. Pizzillo, S. Claps, J. Boyazoglu. 2011. Encyclopedia of Dairy Sciences (Second Edition). Pages 59-66.
3. Shelton. M. Reproduction and Breeding of Goats. Journal of Dairy Science. 1978. 61:7. Pp 994-1010.





Rearing Kids

To efficiently produce kids that will grow into replacement stock or can be sold as breeding stock, a farm must have a good kid management system. Good management is required from the birth of the kids all the way up to breeding but special attention should be placed on birth to weaning since pre-weaning mortality can be high under local conditions.



Maintaining low mortality from birth to weaning while producing a 90 - 110 lb animal can be a very difficult task because rearing kids is highly labour intensive. Therefore, attention should be given to your system of kid management with the aim of reducing labour while keeping mortality low.

The selection of replacement stock is also crucial for the successful management of a dairy farm. The female kids should be selected to form the replacement stock on a dairy farm. Obviously not all female kids will be kept, but those that are selected should have good growth rates, good conformation and should come from high producing mothers. The majority of your replacement does should come from above average producing does. By adding all the above mentioned protocols into your kid rearing management you will be able to improve productivity on your farm.

Raising Kids

Pre Parturition

A properly designed kid management programme begins prior to parturition. It starts with the management of the mother's nutrition. Goats have a gestation period of 5 months or 150 days and most of the development of the dairy goat foetus occurs during late gestation. During this period, the mother's feed intake is reduced since the growing foetus is occupying a large space in her abdomen. The reduced amounts of food that she eats must therefore be able to meet her nutritional requirements and her growing foetus. Good nutrition during this stage is essential to producing healthy kids.

Depending upon the forage source and size of the doe during the dry period, 1 to 2 lb of an 18 % crude protein concentrate ration should be fed daily. If the farmer does not have access to an 18 % ration, then 14 - 16 % crude protein ration may be used. Pregnant does should also be allowed to exercise, and this may be done by grazing. In a fully intensive system, exercise can be attained by walking the does through the pen corridors. An overly fat doe should be prevented since too much fat especially around the rump can lead to difficulty during parturition. Clean water and mineral blocks should be available with good quality forages at all times. At birth a kid should weigh between 5 - 10 lb, underweight kids are usually weak and require extra care. In most cases they do not survive to weaning.



Grazing During Late Gestation Allows for Exercise



Kidding

The doe should always kid in a clean environment as newborns are susceptible to disease organisms. Therefore, a high level of sanitation plays an important role in ensuring the survival of the kids after birth. Maternity pens that are on the floor can be bedded with hay, sawdust (preferably shavings), shredded paper or any absorbent material. Slatted floors can also be used in maternity pens but the slats must be closer than those fitted for adult pens, ½ inch spacing is ideal for slat spacing for kids. Goats can be allowed to kid in an open, clean pasture but this system is not recommended when compared to the other systems described above. Pasture kidding leaves the new-born kids susceptible to the elements and predators, and it also does not give the farmer as much control over the birthing process since he may not be able to observe what is going on in the pastures.

The maternity pens or pasture should be located near a well-travelled area in order to monitor the does for any birthing difficulties. First-time mothers should be monitored closely since they are much more susceptible to birthing complications than second and third parturition does. If does are bred to bucks known to sire large kids, then she will be more susceptible to difficulties than does bred to bucks that produce average sized kids.

Immediately after kidding, the kid should be monitored to ensure that its airways are clear and that the kid is breathing on its own, excess mucus should be removed from the kids face. The second step in the care of the new born kid is the navel dip. Dipping the navel in a 5 % iodine solution prevents any disease causing organisms from entering directly into the body of the kids through the navel cord which is a direct route to the Circulatory system. If the navel cord is long it can be clipped to 3 to 4 inches in length to prevent the cord from dragging on the floor. If there is any bleeding the cord should be tied with surgical suture material. If no surgical material is available, dental floss or any clean string may be used in its place. Dipping of the cord in iodine also helps to promote rapid drying of the cord and the eventual breaking away of the cord from the navel. If the navel cord is not dipped in iodine, the kid can develop 'navel ill', joint ill or blindness and can die if not treated or managed properly.

The third critical step is the feeding of colostrum milk soon after birth. The colostrum, or first milk, contains antibodies which the kid needs to help prevent diseases. The intestinal wall of the new-born kid readily absorbs the protein antibodies but as the hours go by after birth, the ability to absorb these antibodies is reduced. Therefore, the new-born needs to receive this antibody rich colostrum as soon after birth as possible because the longer you delay the colostrum, the fewer antibodies will be absorbed by the kids and the less chance they have of fighting off infections. This consumption of colostrum must occur as early as possible, ideally within 1/2 hour after birth because there is a rapid reduction in the permeability of the intestinal wall of the newborn to the antibodies present in the milk.

Colostrum also provides nutrition and serves as a laxative to the kid. The first bowel movement is meconium (like a sticky black tar), it is the leftover material from when the kid was in the amniotic sac. On a dairy farm, colostrum should be bottled fed, ensuring that the kid gets sufficient amounts of raw colostrum. Kids should be fed 1 ounce of colostrum per pound of body weight (1 oz / lb live weight) 3 times during the first 24 hours, therefore a 5-pound kid should get 5 ounces every 8 hours. The important guide here is to treat these kids as



your own babies as some will not be able to consume 5 ounces at once and may require feeding every hour for the first few days until their stomach enlarges.

To prevent the spread of diseases via the colostrum, it should be heat-treated before it is given to the kids. The heat kills the disease causing organisms in the milk. To heat treat the colostrum, it should be heated to 135 – 145 °F for approximately 1 hour. Two major diseases passed on by colostrum in Trinidad and Tobago are CAE (Caprine Arthritis Encephalitis) and Johne's disease. Any excess colostrum can be frozen in a colostrum bank in the event that a doe has poor quality colostrum or very little. There are commercially available colostrum mixes that can be purchased and fed to the kids if farm production of colostrum is low.

Birth to Weaning

If allowed to suckle, kids consume small amounts of milk at very frequent intervals therefore artificial rearing should mimic natural feeding patterns. This practice will however, be very labour intensive as kids should be fed up to four times daily for the first two to four days after birth and twice daily thereafter. Small, frequent feedings increase digestibility and decrease digestive disturbances whereas the consumption of large quantities of milk may lead to bloat due to entry of milk into the reticulo-rumen instead of the abomasum. If the kid is given large quantities of milk it can also lead to diarrhoea because the stomach is unable to process the milk efficiently. Kids will consume the milk more efficiently if it is warm; they will not consume large quantities of cold milk. When feeding the kid ensure that you hold the feeding bottle above the kid's head which causes the kid to stretch upwards to drink; this also aid the milk in getting into the abomasum.

As the kids get older they can be introduced to creep-feed and forages. If the kids are being left with their mother, then the creep feed can be the same feed that is being fed to the mothers but placed in an area that only the kids can access. If the kids are held in pens away from their mothers, then the feed can be placed in feeding troughs. The kids will also begin to nibble at the forages provided in the pen; try to dry the forages before placing them in the kidding pens since forages high in moisture can lead to diarrhoea.

Weaning

In most commercial systems, kids are removed from their mothers soon after birth but in other systems in which mothers are housed with the kids, they can be weaned as early as six weeks and not more than at eight weeks old. Determination of the time of weaning is based on the amount of concentrate, forage and water the kids are consuming. The most important consideration when weaning a dairy goat kid is to ensure that it is consuming sufficient feeds for adequate growth and development in the absence of milk.

Dry feed consumption is important in developing a good growth rate after weaning. A kid that is consuming a ¼ lb of concentrate feed per day should wean well. Usually kids eating only forage but no concentrate will not wean compared to kids that are fed a concentrate supplement. From 1 week old, you can place a small amount of 17 % - 21 % CP concentrate feed in a feeder for the kids; this is known as creep feed. When the kids are eating grain well you can introduce them to forage.



One of the biggest causes of kid death is coccidiosis, a protozoa that is mostly introduced by wild birds as they steal food and defecate in feed troughs and water containers. It develops in the intestines of the kid as discussed in the animal health chapter of this manual. If kids have a heavy infestation of coccidiosis coupled with endoparasites it can lead to stunted growth, weakness and in many cases, death. You may need to place medication in the water or feed to prevent coccidiosis if it is present on your farm in large quantities.

Housing

Housing for kids as mentioned before is very important and should provide a safe, clean environment. The following are important to rearing healthy kids:

- Avoid overcrowding
- Keep pens dry, so design pens to allow for proper ventilation and drainage as this helps to prevent a build-up of ammonia in the pens.
- Slatted floors should be placed ½ in. apart in kidding pens.

Remember an excellent nutritional programme will not compensate for poor housing. Unsanitary housing with poor ventilation has a negative effect on the growth and performance of the kids.



Dry pens help prevent disease

Buck Kids

A dairy farmer must decide how to manage his buck kids. In most cases the buck kids are kept and sold alive for religious services such as Eid or sold to other farmers as breeding stock depending on their genetic quality. Buck kids to be slaughtered should be castrated if they are going to be slaughtered at an older age; castrating can be done at two to four weeks of age.

Several methods can be used for castration. This process should be done by individuals who have experience with the method being used. Be sure to perform the castration process carefully and use a high level of



sanitation to prevent any sickness or death from infections. Some of the tools that can be used to castrate kids are listed below:

- Burdizzo – this is a metal instrument that severs or crushes the epididymal cord and associated blood vessels leading to the testicles.
- Elastrator – This is a tool that stretches a heavy-duty rubber band over the scrotum and testicles. Over a period 1-2 weeks the band will reduce the blood flow to the testis, severing the spermatic cord and causing the testis to drop off.
- Castration knife – This is the traditional method used to castrate kids and should be performed by a veterinarian. This process is considered an open castration where the testicles are surgically removed via a small incision in the testicular sac. Anesthetics are needed for this technique.

Weaning to Breeding

The objective of raising the dairy goat kid should be to produce a lactating animal in the shortest possible time. Ideally animals should be between 90-110 lb depending on the breed by 12 months at latest. For example, if a Saanen doe is weaned at 8 weeks weighing 20 lb. then she will have to put on 90 lb in 10 months to attain her ideal breeding weight. This means that she will have to be fed approximately 1/3 lb ration daily.

To gain 90 lbs in 10 months, she will have to consume both concentrate and forages. The forage component of the diet should form the core of the diet. Supplemental concentrates can then be added to the diet to meet the nutritional needs that the forages are unable to meet. Forage quality is therefore very important. Typically, the growing parts of the plant such as the leaves and young stems have a higher nutritive value than the average for the whole plant. The kid grazing on improved pasture is able to select plant parts which have a higher nutritional value. If a farmer has a cut and carry system, he should also aim to select forage that has a high nutritive value, old forage crops should be avoided if possible.

Kids must also have access to clean drinking water at all times and should be allowed to jump and run as these are good forms of exercise for the growing kid. Attention must be given to control of internal parasites, especially coccidiosis. Treatment of kids using a coccidiostat, either liquid or solid, should begin at 3 weeks of age and continue at recommended intervals throughout the post-weaning period. Hooves should also be monitored and trimmed regularly to prevent susceptibility to hoof rot.

Summary

This chapter discussed a variety of management techniques available for raising healthy replacement stock. Selection should be aimed at selecting a healthy doeling with improved genetic potential as compared to her dam. Kids that have good growth rate and conformation are also ideal candidates for replacement stock. Particular attention needs to be paid to the nutrition of the kids being considered as replacement stock. Poor nutrition can reduce growth rates and add additional stress to weaned animals. Additionally, stress and disease-causing organisms often interact to produce high kid mortality but cleanliness, proper nutrition and a good herd health programme are the best ways to prevent such losses. A good record keeping system can

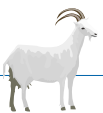


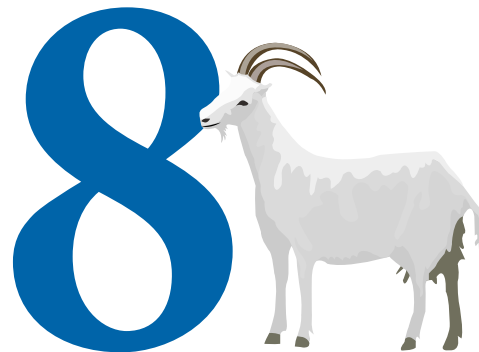
aid in the proper identification and selection of high quality breeding stock which will allow for the successful development of the breeding herd.

Endnotes

1. Dairy Goat Management: Best Management Practices. Clara Hedrich. 2008. University of Wisconsin Emerging Agricultural Markets Team. (www.wdga.org/resources/bmp1.pdf).
2. Rearing systems for dairy goats. P. L. Greenwood. 1993. Small Ruminant Research, 10:3.npp 189-199.







Milk and Milking Parlour Requirements

The main reason for rearing dairy goats is the production of milk, either for personal consumption or sale. Goats in Trinidad and Tobago produce approximately 2 litres of milk daily, however this varies depending on the natural lactation curve.

In goats the quantity of milk being produced usually rises quite rapidly after parturition to meet the needs of the new-born kid and peak milk production usually occurs at about 2 months after kidding. From the peak, the lactation curve gradually slopes downwards. A good goat can milk for up to 305 days post partum after which she can be dried off.



Goat's milk does not taste any different from cow's milk. It appears whiter than cow's milk because of the absence of carotene (from the grass or forage) which gives cow milk a yellow hue. In goats, the carotene is converted into vitamin A. If the goat is managed well and milked in a clean, sanitized environment the milk should not have any off smells.

Despite the similarities between goat's milk and cow's milk, the composition and structure of the fat in each type of milk is the biggest difference. Goat's milk has smaller fat globules, as the size of the fat globules makes goat's milk easier to digest than cow's milk hence persons who are lactose intolerant can consume goat's milk. Most of the other biochemical compositions are similar as shown by the following table:

Average Composition of Goat and Cow Milk

Element	Goat	Cow
Water (%)	87.5	87.2
Protein (g)	3.3	3.3
Fats (g)	4.0	3.7
Carbohydrates (g)	4.6	4.7
Calcium (mg)	129.0	117.0
Phosphorus (mg)	106.0	151.0
Iron (mg)	0.05	0.05
Vitamin A (IU)	185.0	138.0
Thiamine (mg)	0.04	0.03
Riboflavin (mg)	0.14	0.17
Niacin (mg)	0.30	0.08
Vitamin B12 (ug)	0.07	0.36



The composition of your milk will vary depending on the breeds that comprise your herd. Herds with Anglo-Nubian and Boer mixes tend to produce milk with higher butterfat content than farms that rear Saanen alone.

Once you have milk, you can decide if you want to sell raw milk, pasteurized milk or value added dairy products such as cheese, yogurt or ice cream. Always remember that milk is the ideal medium for bacteria. It can also attract, incubate and transmit many diseases. It is therefore important that you take all the necessary precautions to prevent the milk from becoming contaminated. This starts before milking, with the design of the milking parlour.

Milking Shed Design

You must consider the following before designing your milking parlour, keeping in mind that you may not need to design an entire new building to milk, depending on the size of your herd. You may only require a milking stand that is housed away from the main animal pens. You should however still consider the following:

- What are your future developmental plans?
- What will be the maximum number of animals to be milk in a given period?
- How much time will be allocated for milking and cleaning, considering that milking should be done within 1 ½ hours?
- What size shed should be built?
- How many milking units will you need?
- How should you design your parlour?
- How will you manage your waste?
- How will you ensure the safety and comfort of your workers and animals?
- What are the Food and Drug regulations governing your enterprise?
- What are the environmental regulations governing your enterprise?

Before selecting a milking machine or designing your parlour, it is important to do some research. Ensure that the selected machine has readily available replacement parts locally.

Dairy Shed Design

There are many dairy shed designs that can be used for dairy goats. The recommended design for commercial production systems is a herringbone design. In this system, the does are milked from the back and the machine is held in the middle of the parlour between two lanes of animals. For a small herd, 2-4 milking units may be used but as herds get larger you can increase to 8 units managed by one labourer. Space can be allocated in case of future expansion plans. A “double-up” system, which means that there will be a set of cups for each side of the milking parlour, can help to milk the herd faster than a system that employs a “swing- over” design which shares a single set of cups. Highline or low line systems are available, however low line systems are considered better for udder health as less ‘lift’ is required to move the milk during the milking process.

The milking platform can either be a raised platform, a sunken pit or flat on the ground. A combination of the platforms can also be suitable for a dairy goat unit. If you are installing a pit on your farm, the pit depth is



critical for operator comfort and should not be more than 1-meter deep. The pit width can be as little as 1 200 mm for one operator but is usually is 1 500 mm allowing for easy movement during the milking process. If a swing-over system is being used, then the width must be less than 2 000 mm wide; this will allow for the easy movement of the cup from side to side. The pit should also have a drain pipe to allow for easy cleaning and drying.

A single lane milking parlour can also be used but this will only allow for a single group of animals to be milked at a time. This system also allows for the does to be milked from the back. If your enterprise consists of only a few goats, then an entire milking shed may not be required, just a milking stand. This stand will allow you to milk one goat at a time.

Bio-security should be considered when designing your milking shed. Foot bath facilities at the entrances and exits of the parlour help to prevent any harmful organisms from entering the milking area. Both animals and workers should pass through the footbath since both can carry harmful organisms.



A Swing-over System with a Pit and Platform Herringbone Design.

Milking Machines

You should select a milking machine and milking equipment based on availability of parts and service. The selected machine should be purchased to meet the current milking needs of the farm but should facilitate further growth. The machine selection and installation is important as poor installation can lead to problems when milking and even injure the animals. The machine should be installed allowing for easy cleaning and sanitation. Removable parts should be located in an area where they can be easily removed for cleaning, servicing, inspections and upgrading. It is important that the farmer service his milking machine at least once quarterly. This will keep the machine running efficiently and will reduce the risk of improper suction which can injure the does.



There are requirements for dairy goats when being milked and the machine selected should meet these. The milking machine is usually hooked up to a vacuum pump. The pumps for most bucket systems are portable and have fitted safety guards. When installing the pump ensure that the pump exhaust is directed away from other equipment (e.g. condenser unit) or from traffic areas. The pump helps regulate the suction in the machine. The following Pump capacity tables are taken from the International Standards Organisation (ISO) and the pump requirement for goats is as follows:

<10 units = 150 + 80 L / min per unit

>10 units = 950 + 45 L / min per unit

For example, 12 units would require pump capacity of 1040 L/min.

The other important part of the milking machine is the suction or teat cups. The teat cup has a liner that comes into direct contact with the teat of the animal and must therefore be clean at all times. The liners used should match the cups of the milking machine, if the both do not match correctly then there will not be enough tension during the milking process resulting in an increase in the amount of time needed to milk the herd. The mouthpiece of the liner must be comfortable for the goat and should not restrict milk flow.

Liners and rubber ware should be changed regularly because they tend to wear faster than the other parts of the machine. Damaged or cracked liners cannot be cleaned properly causing bacteria and milk particles to get stuck in the cracks leading to a reduced milk quality and increased risk of mastitis infections. The entire milking machine should be checked and cleaned before and after each milking to aid in preventing the spread of diseases.

Milk Vessels

A variety of holding containers can be used to store milk. For bucket milk machines, the milk can be transferred manually into a churn or stainless steel bucket, then bottled and stored in a freezer. The milk can also be pasteurized, bottled and stored in the freezer or sold immediately. Regardless of the system you use, the milk should be stored in a container that is made of high grade stainless steel, glass or food grade plastic. The vessels should be able to have an airtight lid or cover to prevent any contamination.



100 Gallon Storage Vats.



Milking Management

Animal Identification

To correctly track the production of your herd, you must be able to identify your milking animals. It is especially important when animals are treated with antibiotics or any other drug that requires a withholding period. Proper animal identification allows you to track an animal's individual milk production and can help you to decide your top producers and which 'milkers' should be culled from the herd. Various systems are used locally, including ear tags, neck chains/collars, write-on neck collars, leg straps and tattoos.

Udder Preparation

Cleaning the udder and teat will reduce the risk of mastitis and ensures that the milk is free from contamination and odour. The doe's udder and teats should be clean and dry before teat cups are put on. Depending on the condition of the animal, the udder and teat can be washed if they are muddy or the teat can be dusted if it is dusty. After washing the udder with clean water the area should be dried with disposable paper towels. Dirty water running back down the udder, is likely to contaminate teats. Clipping the hair on udders can reduce the accumulation of dirt around that area. A mud free environment, in particular well-formed walkways, will reduce contamination.

Machine Milking Procedure

To produce high quality milk consistently, a farmer must follow a milking routine which includes proper milking procedures. When milking goats, the milker's hygiene has to be considered. You should always shower before milking and change into clean clothes. Milkers' gloves or disposable gloves should be worn to avoid contamination during the milking process. Milkers' gloves and disposable gloves have non-porous surfaces that do not harbour bacteria and can easily be cleaned. The following steps are critical to reduce bacterial count on the udder and in the milk.



<p>Step 1. Pre-dip</p>	<p>After the animal has been restrained and the udder and teats are washed and dusted it should be pre-dipped. The pre-dip solution is a 0.5 % iodine solution. Each teat must be dipped individually; the dip should cover up to ¾ of the teat and be applied for approximately 30 seconds. Research shows that effective predipping reduces bacterial counts in milk by 5 - 6 times and reduced the risk of isolation of Listeria by 4 times.</p>
<p>Step 2. Fore-stripping</p>	<p>Fore-stripping allows the milker to check the goat for signs of mastitis. The first stream of milk is milked into a strip cup. Milk that is bloody red or clumpy shows signs of mastitis. This technique is the only method to detect mild clinical mastitis. Early detection of mastitis is important to successfully treat the infection, but it also allows the milker to discard the milk before it enters the milk vat and is used for drinking.</p>
<p>Step 3. Adequate drying</p>	<p>Drying of the teats is the most important step in pre-milking protocol as moisture promotes the growth of bacteria. Single use dry paper towels or sanitized cloth towels maybe used to dry the udder and teat and disposed. Do not dry several animals with the same towel as this can lead to cross contamination especially if animals in the herd are positive for mastitis.</p>
<p>Step 4. Milking</p>	<p>After the initial stimulus for milk let-down, it is best to milk the goat within 5 -6 minutes. This is the period in which oxytocin (the hormone responsible for milk let-down) is functional. The cups should be attached to the teat immediately after drying to make full use of the release of oxytocin. The cups should fit the does properly. Once the doe is being milked keep your eyes on the teat cups to ensure they are on properly and to ensure that the animal has been properly milked. Over milking may cause damage to the udder and teat and can leave the animal susceptible to mastitis.</p>
<p>Step 5. Post-dip</p>	<p>After milking, the goat's teat should be dipped in a post-dip solution to avoid any harmful bacteria from entering into the open teat canal. Use a quality commercially prepared product that is compatible with the pre-dip (3% iodine solution).</p>



Hand Milking Protocol

The protocol for hand milking follows the same protocols as those covered in the machine milking protocol. Hand milking however involves practice and some basic equipment. These include: a milking stand (optional), a milk bucket (stainless steel or enamel is best but any deep, clean container can be used), one strip cup (for examining the milk prior to milking, if the farmer has access to a Draminski® Mastitis Detector, that can be used instead of the cup), a filter or strainer or clean cloth for straining the milk, a vat, teat dip (3% percent), soap and water, clean clothes.

The goat can be restrained and placed into the milking stand or tied in the milking area. A small amount of concentrate feed can be offered to the animal to keep her busy during the milking period. The milking stand or milking area should be clean and located away from the goat pens, as smells can contaminate the milk. Again basic sanitation of the person milking the goats should be extremely high. The milker should remain in the parlour to do the milking while another person bring in the doe to be milked. Avoid contamination of the milk as much as possible.

Once the animal is restrained the milker should again wash his hands. The pre-milking protocol for hand milking is exactly the same as that used in machine milking. Once the udder has been washed the animal can be checked for mastitis in the exact method as used for machine milking. The udder and teat should be dried at this stage again.

The milker can now begin to milk the goat by grasping the teat with thumb and index finger together to trap the milk in the teat. Gently apply pressure on the teat with a second finger forcing the milk down further. The third finger does the same and then the little finger. This transfers the milk down the teat canal into the milking bucket. The milker should not drag or pull down on the teat and milking should be done as quickly as possible. The udder will feel noticeably empty and no more milk will be expressed. After milking a post dip should be carried out to prevent bacteria from entering the teat and causing disease.

Hand milking is the most common method of milking in Trinidad and Tobago but as the industry develops and farms become larger more farmers are moving towards milking machines.

Try to milk the doe(s) twice daily, every morning and evening, on a regular schedule. Milking 12 hours apart is ideal and will help maximize production and limit stress on the udder, but this may vary according to personal schedules. It is important to record milk weights per milking as this can indicate health and value of the doe over a period of time.



Pasteurization

Once you have milked your goats you can either sell you milk raw or choose to pasteurize the milk. In Trinidad and Tobago, any milk that has to be sold to the public should be pasteurized. Pasteurization involves heating the milk to kill the bacteria that will cause the milk to spoil thereby extending the shelf life. Basic pasteurization or vat pasteurization involves heating the milk to 62.8 °C (145 °F) for 30 min. There are home-sized pasteurization machines that can achieve this task and these are the ones that are used locally for goat milk pasteurization. Larger more commercial businesses may use different processes; these are outlined below:

- HTST (High Temperature, Short Time) - milk is forced between metal plates or through pipes heated on the outside by hot water, and the milk is heated to 72 °C (161 °F) for 15 seconds. Milk simply labeled “pasteurized” is usually treated with the HTST method.
- UHT, (Ultra Heat Treatment) - the milk is pasteurized at a temperature between 135-150 °C (275-302 °F) for four seconds. This process lets consumers store milk for several months without refrigeration in proper packaging.
- ESL (Extended Shelf Life) – the milk has a microbial filtration step and lower temperatures than UHT milk.

Once the milk has been pasteurized it can be used to produce a wide variety of value added dairy products or it can be sold to groceries and stores.

Endnotes

1. Dairy Goat Management: Best Management Practices. Clara Hedrich. 2008. University of Wisconsin Emerging Agricultural Markets Team. (www.wdga.org/resources/bmp1.pdf).
2. A Guide to Starting a Commercial Goat Dairy. C. Delaney. 2012. Vermont. UVM Center for Sustainable Agriculture, a programme of UVM Extension.







Dairy and Value Added Products

The primary reason for rearing dairy goats is the collection of fresh goat's milk. Milk production by the herd will fluctuate throughout the year and you may end up with more milk than you can sell. Excess milk can be converted into value added dairy goat products for which there is a lucrative niche market with tremendous economic potential.

A wide range of dairy products can be produced from goat's milk including edible products like yogurt, cheese, ice cream and confectionaries as well as a variety of skin care products including soaps, lotions and body butter.



It is also important to remember that 'culled' dairy goats' meat can be used to create burgers, sausages and roasts. Their beautiful coats can be transformed into hides and leather and their tallow (fat) can be used to create beautiful candles. This chapter will explain how you can use fresh or pasteurized goat's milk and meat to produce some of these products at home.

YOGURT

One of the simplest products that can be produced from goat's milk is yogurt. Yogurt has been used for centuries and is rich in probiotics which aid in digestion and improves intestinal health. It is produced by fermenting milk with special bacteria commonly known as "bacterial cultures" and include lactobacilli or lactic-acid bacteria. These cultures are present in plain yogurt or can be purchased from companies such as Cultures for Health and Yogourmet. There are several ways of making yogurt with different types of heaters, yogurt makers and bacterial cultures but it can also be made at home without any special equipment. It is important to use milk that is free from antibiotics since the antibiotics in the milk will kill the starter cultures, preventing the milk from curdling. The following is a simple recipe for producing plain yogurt.



Yogurt can be served with fresh ripe Julie mangoes.

Making Yogurt

You will need

- 1 litre pasteurized goat milk (fresh milk can also be used)
- 1/4 cup plain yogurt with active cultures or yogurt cultures
- Sterile container with lid for incubating (litre canning jar is a good choice)
- Stainless steel pot
- Stainless steel spoon

Method

- 1. Sterilize Your Tools:** Before you begin it is important to clean your tools including containers and utensils so there are no rogue bacteria floating around to compete with the good variety in the yogurt culture. This can be done by boiling the container and utensils for ten minutes.
- 2. Heat the Milk:** Yogurt can be made from room-temperature milk but to achieve the best, most consistent results it is recommended to first heat the milk to at least 180 °F (82.2 ° C). Heating the milk also kills any harmful bacteria that may be present in the milk.
- 3. Cooling the Milk:** Once the milk has been heated it must be cooled to 115°F (46.1 °C). This can be done by placing the pot into an ice bath or by allowing the milk to cool naturally. Stirring the milk can aid in speeding up the cooling process.
- 4. Add the Starter Culture:** The starter culture can then be added to the milk. Empty the cooled milk into the sterile container and add your starter (plain yogurt or the purchased starter culture). **If you are**



using yogurt as a starter, in a separate bowl, stir together the starter yogurt and a small amount of the warm milk, then add this to the rest of the warm milk and stir to incorporate it, this is an important step because if cold yogurt is added to the warm milk it may drop the temperature of the milk too much.

- 5. Incubate:** Once your starter is combined with the milk all that's left is to cover it and keep the yogurt at a steady temperature (110°F to 115°F or 43.3-46.1°C), undisturbed, for 5 to 10 hours, which allows the good bacteria to flourish. Temperatures below 90 °F (32.2 °C) will cause the bacteria to work slowly and lengthen the incubation period, while those above 115 °F (46.1 °C) will kill the starter culture. This is the incubation stage and can be accomplished with a yogurt machine or your baking oven. The length of time needed for the yogurt to properly set depends on a number of factors, including the incubation temperature (higher temperatures make for faster incubation, but take it too high and your cultures will die), the type of cultures used as your starter and your personal preferences for flavour and texture. It is important to allow the yogurt to set, which means that it should not be disturbed or mixed during the incubation period.
- 6. Remove from Incubation:** Once five hours have passed you can begin to check your yogurt; this can be done hourly; as more time passes the yogurt will become more acidic. You can stop the incubation process shortly before the yogurt reaches the acidity you like. The appearance of the product is also important and the mixture will thicken as time passes. Once the yogurt gains the desired taste and texture it can be removed from incubation.
- 7. Storage:** The finished yogurt can then be placed into the refrigerator.
- 8. Serving:** The yogurt can then be served with fresh fruits or other toppings (chocolate, sprinkles or caramel).



CHEESE

There has been an increase in the demand for goat cheese over the past few years and many training courses have been given to both farmers and cooks on the basics of making cheese. Making simple cheeses does not require expensive, specialized equipment and can be done at home. Making special “aged” or “vintage” cheeses however, requires a lot of experience and specialty equipment. Goat’s milk can be used to produce a variety of cheeses including cheddar, feta, mozzarella and queso blanco.



Marinated queso blanco served with bread.

Milk can be curdled by using animal rennet, vegetable rennet, vinegar or citric acid (lime or lemon juice) each producing different results. In order for the milk to curdle it must be heated, similar to yogurt, and starter cultures can be added depending on the type of cheese being produced. These cultures aid in adding flavour and texture to the cheese. Some cheeses are pressed and others are not. Aged cheeses are held for specific times at specific temperature, humidity and pressure.

Cheeses can be produced from raw or pasteurized milk. Pasteurized milk contains no pathogenic (disease-causing) bacteria. The cheese maker has to add cultures to the milk to produce the specific cheese required. This provides more control over the cheese making process but raw milk also produces delicious cheeses. Simple cheeses can be produced using raw or pasteurized milk, a thermometer, large stainless steel pot (stockpot), stirring spoon, cheese cloth, colander and vinegar or lime juice.

Simple Cheeses

Marinated Queso Blanco

You will need

- 2 liters of milk
- 1/4 cup vinegar or lime juice
- 1 cup olive oil
- 2 pimentos
- 1 hot pepper
- 1 head of garlic
- 1 rosemary branch
- Stockpot
- Stirring spoon



- Colander
- Cheese cloth

Method

- 1. Heat the Milk:** The milk should be heated to 85°C (185°F) or close to boiling.
- 2. Remove from Heat:** Remove the pot from direct heat.
- 3. Add Vinegar/Lime Juice:** Add in the vinegar or lime juice slowly while stirring. The milk should begin to curdle and separate into curds and whey.
- 4. Separating the Curds:** Once the curds form they can be removed from the whey. Line the colander with the cheese cloth and pour the curds and whey into the colander. The curds will be collected in the cheese cloth while the whey drains out.
- 5. Draining the Curd:** Tie the corners of the cheese cloth together and hang the cheese allowing it to drain for several hours, until it stops dripping.
- 6. Preparing Seasoning:** Cut the hot pepper and 1 head of garlic into small cubes and dry them in the oven for approximately 5 minutes at 350 °C (662 °C).
- 7. Seasoning:** At this stage add the dried hot peppers, garlic and salt to the cheese, mixing the seasoning evenly into the cheese.
- 8. Molding:** The cheese should then be placed into a container or mold with a desired shape and pressure can be added to help the cheese take shape. This can take 20 minutes to 10 hour depending on the firmness you desire.
- 9. Slicing:** once the cheese is removed from the mold it is cut into cubes
- 10. Marinating the Cheese:** Place the olive oil, rosemary and sliced pimento into a glass jar with a lid. Add the cubed cheese to the mixture.
- 11. Storage:** the cheese can be stored in the refrigerator and served with crackers or used in stir fries.



GOAT MILK ICE CREAM

Everyone enjoys ice cream, but if you are lactose intolerant you should try making ice cream from goats' milk. Surprising as it may be, people with lactose intolerance to cows' milk can consume goats' milk without complications. You can add your favorite flavour to your ice cream such as vanilla, mango or even pineapple. The following is a recipe for an easy to make mango ice cream.

You will need

- 1 cup goat milk
- 3 cups heavy cream
- 2 cup mango (pureed)
- 1 Tbsp custard powder
- 2 drops vanilla extract
- 1 cup granulated sugar

Method

1. **Preparing the Custard:** Mix the custard in 1/4 cup of the milk and place it aside.
2. **Mixing the Rest of Ingredients:** Heat the remainder of goat milk and the sugar together, allowing the sugar to dissolve and the mixture to come to a boil.
3. **Adding the Custard:** When the mixture boils, add the custard mixture and bring to a boil again, simmer for half a minute shut the heat and cool to room temperature.
4. **Add in the Mango Puree:** Add in the mango puree, cream and vanilla. Mix well and transfer on to a container with a tight lid. If an ice cream machine is being used the mixture can be placed into the machine at this point. If it is being frozen then follow the other steps.
5. **Freezing:** Freeze until the mixture is almost set. Take the mixture out of the freezer and whip up with a hand beater and place back into the freezer. The lid should always be tightly shut, as this avoids crystals from forming. Whip once more when almost set and place back in the freezer.
6. **Serving:** Once completed the ice cream can be served with cake, chutney or fresh fruit toppings



Mango ice cream server with mango chutney



GOAT MILK FUDGE

This is a simple recipe for producing fudge using goat milk.

You will need

- 2 Cups of sugar
- 3oz Baking chocolate
- 1 cup goat milk
- 1/4 teaspoon salt
- 1 teaspoon vanilla extract
- 1 Tbsp. butter

Method

1. **Mixing the Ingredients:** Mix the sugar, chocolate, goat milk and salt in a heavy saucepan.
2. **Heating:** Bring to 236°F or to soft ball stage (if a drop is placed into cold water it will form into a soft ball).
3. **Remove from Heat:** Remove the pan from direct heat and add the vanilla extract and butter. Mix until creamy and thick.
4. **Setting:** Place the mixture into a buttered dish and allow it to cool.
5. **Cutting:** Cut the set mixture in to small squares.
6. **Serving and Storage:** The fudge can be stored in the fridge and eaten chilled.



Fudge made from goat's milk



GOAT SAUSAGE

Chevon (goat meat) can be transformed into tasty sausages or burgers. Just like cheese, there are many recipes for making sausage and you have to decide which flavors you want.

Sausages can be produced from prime cuts of meat or from the bits and pieces of meat that are left over after doing specialty cuts. Because of the leanness of chevon sausages, some type of fat needs to be added in with the meat. Pork fat is the easiest fat to obtain. Spices add extra flavour to the sausage and you can even develop a signature mix. If you are new at making sausage, then start off with a simple recipe like the one provided below.

Garlic Chevon Sausage

You will need

- 1 pound of chevon (ground)
- 2 Tbsps. Parmesan cheese (crumbles)
- 1 egg
- Salt and pepper to taste
- 2 teaspoons all-purpose seasoning
- 1 teaspoon shadow beni (grind)
- ¼ cup breadcrumbs
- ¼ cup flour
- 4 Tbsps. Butter
- 1 teaspoon olive oil
- ½ cup white wine
- 2 cups beef stock

Method

1. Mix the ground chevon, egg, all-purpose seasoning, shadow beni, salt and pepper together in a large bowl.
2. Add in enough bread crumbs to hold the mixture together when formed into a ball.
3. Shape the mixture into a loaf and place aside.
4. Combine the flour and remainder of bread crumbs in another bowl.
5. Coat the meat with the flour mixture and brown in a saucepan containing the butter and olive oil.
6. Add the wine.
7. Once the wine is almost evaporated, add in the beef stock, cover and simmer over low heat turning occasionally for about 45 minutes or until the inside is cooked.
8. Remove from the heat and serve with bread or pasta.





Records and Financials

A recording system starts at birth and involves permanently identifying each individual animal from the herd. Such a system is the basis for a successful dairy production enterprise. The recording system can be as simple as a list of animals in the herd or it can be complex and as elaborate as having individual animal records on production, reproduction, health and ancestry. Updated information on individual animals and farm records allow the farmer to manage his herd appropriately.



There are many computer programmes that you can purchase that have specific fields to fill out for each animal on your farm. You can also develop your own form, using common software that is on most home computers such as excel. Paper and pen or pencil works just fine, too. The important thing is that you complete the entry on the computer or write things down!

All of the important dates in the life of your animal should be written down. Things to have in a record-keeping system may include:

- Birth date or date the animal came to your farm.
- Sire, dam and siblings (either from your farm or the farm the animal came from).
- Vaccinations and other health information, such as treatments for illness and routine health care.
- Breeding record and subsequent birthing record, and Management events such as hoof trimming.
- Body weight to monitor growth.
- Feed cost and feed fed per animal.
- Other items deemed important for your management.

This chapter is aimed at providing an example of correctly taking records.

Establishing a Record Keeping System

Proper farm records can be kept once the farm has an animal identification system in practice. As mentioned in previously under the animal identification section, the main types of identification tools used in Trinidad and Tobago are tattoos, ear tags and neck chains.

The farmer needs to decide what specific information he will collect and his method of storing the data. Codes can be assigned to each label to make collecting the data efficient. The following tables give examples of codes that are commonly used:



BREED CODES	
BREED	CODE
ALPINE	AP
BOER	BR
NUBIAN	NB
SAANEN	SA
TOGGENBURG	TO
CROSS BRED	XX
SEX CODE	
DOE	D
BUCK	B
LIVE CODE	
BORN ALIVE AND WEANED	1
DIED AT BIRTH/STILLBORN	2
DIED WITHIN 72 HRS	3
DIED AFTER 72 HRS	4
DIED AFTER 2 WKS	5
ABORTED	6
KIDDING EASE SCORE	
NO ASSISTANCE	1
SLIGHT ASSISTANCE	2
HARD PULL	3
CAESAREAN SECTION	4
ABNORMAL PRESENTATION	5

BIRTH TYPE CODES	
SINGLE	SN
TWIN	TN
TRIPLET	TR
QUAD	QU
OTHER list in comments	OT
If the kid is a result of embryo transfer place E in front of Birth Type	E
REARING CODES	
Born As - Raised as	
Single – Single	1
Single – Twin	2
Twin – Single	3
Twin – Twin	4
Triplet – Single	5
Triplet – Twin	6
Triplet – Triplet	7
For Quads, use Triplet values	
If fostered, indicated doe ID in comment	
CULL REASON CODES	
DIED	1
AGE	2
OPEN/FAILED TO KID	3
LOST KID EARLY	4
BAD UDDER	5
FOOT PROBLEMS	6
CL	7
SINGLE BIRTH	8
POOR PERFORMANCE	9
DISPOSITION	10
OTHER	11

By using codes, it makes the collection and storage of the data easy to understand. As mentioned above a farmer can purchase software for data collection or he can design his own database or even store the information in a farm record book. The following sections will show the appropriate way to collect and store data. It is important to remember that the examples given can be altered to suit a farmer's individual needs.

Dates of Service and Probable Dates of Kidding Records

By recording the date of breeding for an animal, the expected birth date of the kids can be calculated. As discussed, the gestation length for goats is approximately 150 days, therefore it can be concluded that the doe will kid 150 days after being bred. The date of service and probable dates of kidding can be recorded in the following table:



Date of Breeding	Doe ID#	Buck ID#	Pregnancy Diagnosis (Day30)	Pregnancy Diagnosis (Day60)	Expected Kidding Date
01/01/2016	03	45	Confirmed	Confirmed	30/05/2016

Inventory of Breeding Does and Bucks

It is important to have an inventory of all the animals on the farm. The following table can be used to collect and store this information:

Animal ID#	Sex	Date of Birth	Dam ID	Sire ID
100	F	01/01/2016	50	1

Kidding Records- Information on the Mother

The following table gives an example on collecting and storing kidding information for the doe:

Animal ID	Kidding Date	Kidding Ease	Kidding Type
100	01/01/2017	1	SN

Kidding Records- Information on the Kid

The following table gives an example on collecting and storing kidding information for the kid:

Animal ID	Sex	Date of Birth	Rearing Type	Birth Weight (lbs)	Dam ID	Sire ID
150	F	01/01/2017	1	5	100	3



Veterinary Records

The following table gives an example on collecting and storing medical information on the farm:

Date	Animal ID#	Treatment	Remarks
01/01/15	25	Dewormed with Ivermectin (1ml)	Animal was dewormed because of a 5 FAMACHA score.

Replacements, Sales, Deaths and Cull Records

The following table gives an example on collecting and storing information regarding animal movement on the farm:

Animal ID#	Date	Destination	Reason for Culling or Death
10	02/01/15	Butcher	Poor reproductive performance

Weights of kids

The following table gives an example on collecting and storing information regarding kid growth on the farm:

Animal ID#	Sire ID#	Dam ID#	Date of Birth	Birth Weight (lb)	Date	Weaning Weight (lb)	Date	Yearling Weight (lb)
105	02	10	01/01/15	4	01/03/15	30	01/01/16	80

When entering dates it is important to stick to the computer format year, month and date to avoid confusion as you may have learned it day, month and year especially when using double digit entries.



Financial Records

Animal records go hand in hand with financial records. If a farmer keeps proper financial records he will be able to determine his expenses and profits. Financial records can be kept in a simple ledger book which can be purchased at any book store. To keep complete financial records a farmer should contact the TTGSS for advice and planning.

Farm Projection- Breeding Stock

Appendix 1 provides an example of breeding projections for a 20 doe breeding unit for a 5-year period. Farmers can use these projections to determine when they should breed and the expected kid dates. This information can help a farmer calculate his projected returns. It is important to note that these projections will vary from farm to farm; therefore a farmer should contact a TTGSS representative to determine his individual farm projections which will be based on his production and management systems.

Farm Projections- Financials

Appendix 2 provides the calculated cost for developing a 20 doe dairy unit. These projections were developed based on the current cost of breeding stock, equipment and materials in 2016. The cost of establishing a 20 doe breeding unit will vary depending on the pen design and layout of the farm. It also depends on where the initial breeding stock is being sourced from. To design a proposal with the projected cost of designing any size dairy unit a farmer should consult a TTGSS representative for advice.

Endnotes

1. A Guide to Starting a Commercial Goat Dairy. C. Delaney. 2012. Vermont. UVM Center for Sustainable Agriculture, a programme of UVM Extension.
2. Robert Parsons et al., Profitability of Small Ruminant Farmstead Dairy Processing Operations Proceedings of the 11th Annual Great Lakes Dairy Sheep Symposium, 2005, Burlington, Vermont, pp. 27–35.



Glossary

Abomasum – The true stomach of a ruminant where enzymatic digestion occurs.

Abscess - Boil or localized collection of pus.

Afterbirth - The placenta and associated membranes expelled from the uterus after kidding.

AI - Artificial insemination.

Alveoli - Tiny hollow spheres in the udder whose cells secrete milk.

Anthelmintic - A drug used to kill worms.

Ash - The mineral matter of a feed.

Balling gun - A device used to administer a bolus (a large pill).

Blind teat - A non-functional half of an udder (usually due to mastitis).

Bloat - An excessive accumulation of gas in the rumen and reticulum.

Bolus - A large pill for animals or regurgitated food that has been chewed (cud).

Breed - Animals with similar characteristics of conformation and colour, which when mated together can produce offspring with the same characteristics.

Breeding season - The period when goats will usually breed.

Buck - A male goat.

Buckling - A young male.

Browse - Bushy or woody plants.

Burdizzo - A castrating device that crushes the spermatic cords.

Butterfat - The fat contained in milk.

CAE (caprine arthritis encephalitis) - A type of arthritis that affects goats caused by a retrovirus.

CMT (California mastitis test)- A diagnostic kit used to determine if a doe has mastitis.

Caprine - Scientific term pertaining to or derived from a goat.

Chevon - Goats' meat

Cistern - Final temporary storage area for milk in the udder.

Colostrum - The first thick, yellowish milk a goat produces after giving birth. It is rich in antibodies.

Concentrate - The non-forage part of the goat's diet. It consists principally of grain but can also include oil meal and other feed supplements.

Confinement feeding - Feeding goats restricted to a pen or holding area.

Conformation - The overall physical attributes of an animal.

Creep feeder- An enclosed feeder for supplementing the ration of kids but excludes the large animals.

Cull - To remove an animal from the herd.

Dam - Female parent.

Disbudding iron - A tool used to burn the horn buds from young animals to prevent horn growth.

Doe - A female goat.



Doeling - A young female goat.

Drenching - Giving medicine from a bottle.

Dry period - The period when the goat is not producing milk.

Elastrator rings - Castrating rings resembling rubber bands, they are applied with a castrating tool called an elastrator.

Electrolyte - Mineral salts necessary for life including sodium, potassium, calcium and magnesium.

Enterotoxaemia - A bacterial infection, usually resulting in death, it is also known as overeating disease.

Feed additive - Anything added to the animals feed, including preservatives, medicine and growth promotants.

Flushing - Feeding females more generously 2 to 3 weeks before breeding in order to stimulate the onset of heat and improving the chances of conception. It is also done before parturition to prevent pregnancy toxaemia.

Forage - The grass, hay or legume portion of a goat's diet.

Freshen - To give birth (kid) and start milking.

Gestation - The time between breeding and kidding (150 days).

Hand mating - Controlled breeding.

Hay - Dried forage.

Heat - Estrus, the period when the doe is ready to breed.

Hormone - A chemical secreted into the bloodstream by an endocrine gland, bringing about a physiological response in another part of the body.

Horn bump - Small bumps on the head from which the horns grow.

IM (intramuscular) - Within the muscle.

Inbreeding - The mating of closely related individuals.

Johne's disease - A wasting disease.

Ketosis - Over accumulation of ketones in the body, responsible for pregnancy disease, acetonemia, twin lambing disease and others that occur at the end of pregnancy or within the month of kidding.

Kid - A goat under one year of age.

Lactation - The period in which a goat is producing milk.

Lactation curve - Daily milk production as represented on a graph.

Legume - A family of plants having nodules on the roots bearing nitrogen fixing bacteria, including Moringa oleifera.

Mastitis - Inflammation of the udder usually caused by an infection.

Microorganism - Any living creature microscopic in size.

Milking stand - A platform where the goat can be restrained to be milked.

Off-feed - Not eating as much feed as normal.

Overconditioned - Fat.

Polled - Naturally hornless.

Precocious milker - A goat that produces milk without being bred.



Purebred - An animal whose ancestry can be tracked back to the establishment of a breed through the records of a registry association.

Raw milk - Unpasteurized milk.

Rennet - An enzyme used to curdle milk and make cheese.

Retained placenta - A placenta not expelled after kidding or shortly thereafter.

Reticulum - The second compartment of the ruminant stomach.

Rotational grazing - A system for pasturing livestock by which one small section of pasture is used at a time; this prevents overgrazing and renews plant growth.

Roughage - High-fibre, low total digestibility nutrient feed, consisting of coarse and bulky plants or plant parts.

Rumen - The first large compartment of the stomach where cellulose is broken down.

Scours - Persistent diarrhoea in young animals.

Service - Mating.

Settled - Becoming pregnant.

Silage - Fodder preserved by fermentation.

Sire - Male parent.

Stanchion - A device for restraining a goat by the neck for feeding or mating.

Standing heat - The period during which the doe will accept the buck for mating.

Streak canal - Opening at the end of the teat, surrounded by sphincter muscles.

Strip - To remove the last milk from the udder.

Strip cup - A cup into which the first squirt of milk from each teat is directed to show any abnormalities.

Subcutaneous - Beneath the skin.

Tattoo - Permanent identification of an animal produced by placing indelible ink under the skin usually on the ear or tail.

Toxic - Poisonous in nature.

Trace minerals - A mineral nutrient essential to animal health but used only in small quantities.

Udder - An encased group of mammary glands along with a teat.

Udder wash - A dilute chemical solution, usually an iodine compound for washing the udder before milking.

Wattle - Small fleshy appendage.

Wether - A castrated buck.

Whey - The liquid remaining when the curd is removed during the cheese making process.

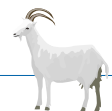


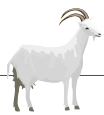
APPENDIX 1

Breeding herd projections for a 20 doe breeding unit



Year	Month	# of does bred	# of does kidding	# of Kids	# Kids weaned	# Doelings Weaned	# Bucklings Weaned	# of doelings 6 mths retained	# of doelings 6 mths sold	# of bucklings 6 mths retained	# of bucklings 6 mths sold	Doelings retained 9 mths old	# of Breeding Does per month	# of Breeding Rams per Month	# Of Fatteners per month
2016	January	20											20	1	0
	February	20											40	2	0
	March	20											60	3	0
	April	20											80	4	0
	May	20											100	5	0
	June		20	30									100	5	0
	July	20	20	30									100	5	0
	August	20	20	30	26	13	13						100	5	26
	September	20	20	30	26	13	13						100	5	53
	October	20	20	30	26	13	13						100	5	79
	November	20			26	13	13						100	5	79
	2017	December		20	30	26	13	13	4	9	1	12		100	5
January			20	30	26	13	13	4	9	1	12		100	5	79
February			20	30	26	13	13	4	9	1	12		100	5	79
March		24	20	30	26	13	13	4	9	1	12	4	104	5	79
April		24	20	30	26	13	13	4	9	1	12	4	108	5	79
May		24			26	13	13						112	6	79
June		24						4	9	1	12	4	116	6	53
July		24						4	9	1	12	4	120	6	26
August			24	36									120	6	0
September		28	24	36	32	16	16	4	9	1	12	4	124	6	32
October		28	24	36	32	16	16	4	9	1	12	4	128	6	63
November		28	24	36	32	16	16						132	7	95
December	28	24	36	32	16	16						136	7	95	
2018	January	28			32	16	16						140	7	95
	February		28	42				5	11	2	14		140	7	63
	March		28	42	37	18	18	5	11	2	14		140	7	68
	April		28	42	37	18	18	5	11	2	14		140	7	74
	May	33	28	42	37	18	18	5	11	2	14	5	144	7	111
	June	33	28	42	37	18	18	5	11	2	14	5	149	7	111
	July	33			37	18	18						154	8	111





Year	Month	# of does bred	# of does kidding	# of Kids	# Kids weaned	# Doelings Weaned	# Bucklings Weaned	# of doelings 6 mths retained	# of doelings 6 mths sold	# of bucklings 6 mths retained	# of bucklings 6 mths sold	Doelings retained 9 mths old	# of Breeding Does per month	# of Breeding Rams per Month	# Of Fatteners per month
	August	33						6	13	2	17	5	159	8	74
	September	33						6	13	2	17	5	163	8	37
	October		33	49				6	13	2	17		163	8	0
	November		33	49	43	22	22	6	13	2	17		163	8	43
	December	38	33	49	43	22	22	6	13	2	17	6	169	8	86
2019	January	38	33	49	43	22	22					6	174	9	129
	February	38	33	49	43	22	22					6	180	9	129
	March	38			43	22	22					6	185	9	129
	April	38						6	15	2	19	6	191	10	86
	May		38	57				6	15	2	19		191	10	43
	June		38	57	50	25	25	6	15	2	19		191	10	50
	July		38	57	50	25	25	6	15	2	19	6	191	10	101
	August	45	38	57	50	25	25	6	15	2	19	6	197	10	151
	September	45	38	57	50	25	25					6	204	10	151
	October	45			50	25	25					6	210	11	151
	November	45						8	18	3	23	6	217	11	101
	December	45						8	18	3	23		223	11	50
2020	January		45	67				8	18	3	23		223	11	0
	February		45	67	59	29	29	8	18	3	23	8	223	11	59
	March		45	67	59	29	29	8	18	3	23	8	223	11	118
	April		45	67	59	29	29					8	223	11	177
	May		45	67	59	29	29					8	223	11	177
	June				59	29	29					8	223	11	177
	July							9	21	3	27		223	11	118
	August							9	21	3	27		223	11	59
	September							9	21	3	27		223	11	0
	October							9	21	3	27		223	11	0
	November							9	21	3	27		223	11	0
	December												223	11	0

Appendix 2: Estimated Costs For Developing A 20 Doe Dairy Goat Breeding Unit

PARTICULARS	TOTAL
PHYSICAL ASSETS	
1. Pens, Parlour and Feed Areas	\$ (130,535.59)
4. Seed Stock	\$ (225,000.00)
7. Pasture establishment	\$ (14,750.00)
2. Plumbing Costs	\$ (10,519.00)
3. Electrical Costs	\$ (8,230.00)
5. Veterinary Supplies Costs	\$ (3,820.00)
6. Farm Supplies Costs	\$ (3,674.00)
7. Tractor	\$ (150,000.00)
8. Milking Equipment	\$ (26,500.00)
Total Physical Inputs	\$ (546,528.59)
Contingency (5%)	\$ (27,326.43)
Total Investment Costs	\$ (573,855.02)



Appendix 3: Projected revenue for a 20 doe dairy unit over 3 years

Year	Bucklings sold	Buckling Income	Doelings sold	Doeling Income	Total Milk Sales	Total Animal sales
PY1	4	\$14,625.00	2	\$4,500.00	\$108,000.00	\$127,125.00
PY2	24	\$82,050.00	11	\$22,200.00	\$144,250.00	\$248,500.00
PY3	30	\$76,032.00	17	\$33,792.00	\$216,465.50	\$326,289.50
TOTAL	58	\$172,707.00	30	\$60,492.00	\$468,715.50	\$701,914.50



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