Managing Production Risks for Small Ruminant Producers

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To My Producers

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# TABLE OF CONTENTS

Acknowledgments........................................................................................................ 1

Table of Contents........................................................................................................ 2

Introduction.................................................................................................................. 3

Production Risks.......................................................................................................... 3-20
  Health Care (Controllable Risks) ........................................................................... 3-10
  Bio-security Protocols.............................................................................................. 4-10

Reproduction and Breeding Management................................................................. 10-20
  Nutrition Impact on Reproduction......................................................................... 11-12
  Establishing a Breeding Program .......................................................................... 12-15
  Heritability Estimates............................................................................................... 15-17
  Purchasing Breeding: What are the Risks?............................................................. 17-20

Enterprise Diversification to Improve Resilience...................................................... 20

A Final Note.................................................................................................................. 21

Appendices.................................................................................................................... 22-24
  Appendix 1 - Leg Positions ..................................................................................... 22
  Appendix 2 - Assessing Production Risks on Your Farm ...................................... 23
  Appendix 3 – Body Condition Scoring ................................................................. 24

References..................................................................................................................... 25
INTRODUCTION

Agriculture is an industry that is in constant change and change often brings about an increased exposure to risk. Unfortunately, risks are an integral and unavoidable part of agriculture, but most risks can be managed. In fact, there are several established risk management tools that farmers can use to manage the risks they face each day. Risk management is the term that is used to describe an activity that is directed towards assessing, mitigating (to an acceptable level) and monitoring of risks on the farm. It is relatively a new term in agriculture, but definitely not a new concept. According to the United States Department of Agriculture (USDA), risk management is generally categorized under five main categories and they include production, marketing, finance, legal and human risk. This publication, however, will primarily focus on production risks (i.e., health and nutrition) that small ruminant (goat and sheep) producers can face when operating a goat or sheep enterprise.

PRODUCTION RISKS

Animal production is defined as the technology and care that is required for raising animals for profit. Animal production involves health, feeding, breeding, housing and the eventual marketing of products (Saunders Comprehensive Veterinary Dictionary, 2007 Elsevier) to consumers. Some of the risks that can affect production include pestilence, drought, disease, predators, disasters or any condition that may influence the quality or quantity of the products that are produced.

Health Care (Controllable Risks)

Healthy animals are typically productive animals. They are the animals that can best help you reach the production and marketing goals you have established for your farm. Most risks associated with health care can be controlled through the use of sound management practices. To learn about the proper management and care of small ruminants before purchasing them, contact your local extension office to find out about educational opportunities offered in your area. Some of the skills that you will need to acquire to help you manage your herd or flock include hoof trimming, administering medications, both injectable and oral, castration procedures, and ear tagging and tattooing your animals for identification purposes. It is
also important to establish a client-patient relationship with a veterinarian for consultation and guidance and for assistance in the case of an emergency. If a veterinarian is not available in your area, contact your local extension agent for advice.

**Plan of Action for Health Care**

After receiving training, develop a herd health program for the animals on your farm. Your plan should include a bio-security protocol for the farm, a deworming and vaccination program for the animals, a plan for the proper removal and disposal of manure and dead animals, a plan for the proper use of chemicals (i.e., herbicides, deworming medications, fertilizers) and you will also need to establish a good record-keeping system.

Health records should be maintained at all times. A good record-keeping system should enable you to record the identification of the animal that was treated, record the type of medication that was administered, report the route the medication was administered (i.e., oral, intramuscular), and record the duration of the treatment, and the dosage that was given. Records can also be used as a management tool. For example, look at your records, and identify the animals that are ill frequently. If you cull those animals, you can eliminate the problematic animals in your herd or flock while reducing your production cost because sick animals can be very expensive to treat.

A log sheet should also be kept to record the daily observations (i.e., diarrhea, mucous discharge, bloat) of the animals, but first make sure you learn how to recognize some of the common diseases that can affect your goats or sheep. While you may not be able to prevent every ailment, but you should be able to recognize the serious or even the more deadly symptoms of some diseases that can harm your animals, and therefore, take the necessary steps to handle the situation before it gets out of control. If you do not educate yourself or know what to look for and learn how to prevent an outbreak on your farm you can lose a lot of money if the animal(s) should succumb to the illness. Thus, your financial losses may be felt for a long time. Therefore, educate yourself and make sure you have a health kit (i.e., dewormer, needles, antibiotics) on your farm at all times in case of an emergency and treatment is required.

**Bio-security Protocols**

Bio-security (biological safety and well-being) is the practice used to prevent the introduction and transmission of infectious diseases on the farm. A bio-security program is one of the most effective means for controlling diseases and no disease prevention program can work effectively without it (Mobley, et al, 2008). The goal of the program is to stop the transmission of disease-causing agents by preventing, minimizing or controlling cross-contamination...
of body fluids between animals, animals to feed, or equipment that may directly or indirectly make contact with animals (Mobley, et al, 2008). This management practice is based on the principle that it is easier to prevent disease than it is to treat or react to a problem caused by the disease. The advantages of adopting a bio-security program are numerous. An effective program can improve the cost-efficiency of the farm, improve the reputation of the producer, and allow the producer to better maintain the health status of the herd/flock by reducing the onslaught of disease (Mobley et. al, 2008), thus, ultimately reducing production and economic losses. An effective bio-security program should therefore include a unit to quarantine new arrivals, a sick pen, a sanitation protocol for the farm, a quality assurance plan, a plan for controlling traffic on the farm and a plan for addressing potential food safety risks on the farm.

**Plan of Action for Bio-security**

**The Quarantine Pen**

Before bringing any animals onto your farm make sure you have designated an area for the quarantine pen and a pen for the sick animals on your farm. A quarantine unit should be as far away from the rest of the animals on the farm as possible. If your new arrivals can touch noses with the other animals on your farm, then you do not have an effective quarantine unit. As a general rule of thumb, animals under quarantine should be isolated for at least 4 to 6 weeks from the rest of the animals and as far away from the rest of the herd/flock as possible. This doesn’t necessary mean that once the new animals leave the quarantine unit that they are completely disease free. Unfortunately, there are some diseases that have longer incubation periods than others and the new animals may not show any symptoms for several months. Incubation is the term that is used to describe the period from when the animal was infected until the time the symptoms began to show. This period can be as short as a few weeks to as long as a few years depending on the type of disease the animal has been exposed to. Hopefully, after 4 to 6 weeks of isolation, any potential problems will have been identified before the new animals are introduced into the herd or flock. Thus, the risk of exposure to disease in the healthy animal on the farm will be minimized. This is also why it is important to have another pen located on the farm to isolate sick animals.
The Sick Pen

When an animal is not feeling well, it should be immediately taken to the sick pen to prevent the transmission of disease to the other animals on the farm. If an outbreak does occur, the cost of treating the entire group of animals can be expensive. Production cost could also escalate if the animals should die from the disease. However, if they do survive, they may not continue to thrive as often seen in younger animals that are heavily infested with internal parasites. When selling animals that are managed under these conditions, more than likely they will command a lower price at the market than was once anticipated and the loss in revenue could be financially devastating. One way to help prevent the introduction and transmission of diseases onto your farm is to stop purchasing animals from other farms once you have established your breeding stock. A closed herd/flock can help you control the introduction of certain virulent organisms from entering onto your farm. Examples of some organisms that can create havoc on the farm include the *Corynebacterium pseudotuberculosis* bacteria which causes Caseous Lymphadenitis in both goats and sheep and the virus Caprine arthritis and encephalitis (CAE) which causes arthritis in adult animals and encephalitis in kids between 2 and 6 months of age (Logan et al, 2004). According to the Merck Veterinary Online Manual (2008), CAE is a disease that occurs in both goats and sheep. On the other hand, gastrointestinal parasites such as *Haemonchus contortus*, the blood-sucking worm and coccidiosis are also known to cause severe economic losses (i.e., high mortality rates) to the goat and sheep industry each year. Therefore, isolating your farm from other animals, quarantining new animals or isolating sick animals can be a tremendous help in preventing an epidemic from occurring on your farm. Other suggestions are discussed later in this text.

Sanitation Practices

Good sanitation practices are absolutely necessary to prevent and reduce the propagation of harmful pathogens on the farm. A good sanitation program should include a plan for sanitizing and disinfecting equipment, feeders and waterers when in use. The water tubs should be cleaned at least 3 to 4 times during the course of a week, unless they are automatic waterers which may require less attention. Stagnant water is an ideal breeding ground for mosquitoes which are known carriers of the disease Encephalitis and the West Nile Virus. Both diseases are harmful to humans. Keep the feeders off the ground to prevent the animals from standing, urinating and defecating on the feed. If you are having problems keeping
your animals out of their troughs, check with your local feed store, extension agent or get in touch with an experienced producer who can recommend a trough that is more suitable for your animals.

If you haven’t already noticed, goats and sheep are quite agile creatures and they love to climb, especially on top of a round bale of hay. This may seem cute and harmless at first, but the hay can quickly become soiled and contaminated with the animal’s excrements. Once the hay has been tainted it should not be used for feeding purposes because it may cause health problems in your animals. This type of wastage can also contribute to higher production costs. To reduce excessive hay wastage, consider using square bales of hay and purchase a hay rack or feeder that is designed for use in small ruminants.

Another area on the facility that will require your attention is the shelters. Just like the waterers and the feeders, the shelters must also be kept clean as well as draft-free and well-ventilated at all times. Manure should not be allowed to build up in the shelters or old bedding materials, used needles and other debris. Immediately dispose of all dead animals, which can be carriers of harmful bacteria and viruses, and develop a plan for controlling pests (i.e., rodents, flies, ticks) on your farm. There are several types of portable shelters (i.e., EZ Hutch) available on the market today and the benefits of using a portable shelter are numerous. The shelters can be easily moved from one area to the next; therefore, there is less chance for manure build up. Other benefits are the shelters are light weight, and can be moved with a small tractor or truck, and can be used in a pasture rotational system. They also easy to clean and can be disinfected when needed.

Even after you have taken all necessary precautions on your farm and an epidemic still occurs, relocate the entire herd or flock to a sick pen if adequate space is available. Clean and disinfect the waterers, feeders, and equipment with Clorox and thoroughly clean the animal’s living quarters. Remove old hay, bedding and manure as much as possible. If the housing units have concrete floors, clean and disinfect the floors. Allow the pastures to rest as long as possible before introducing the animals back into the area. If a pen is not available to move the entire herd or flock, still treat the animals and clean and disinfect all equipment used in the area as well as the feeding and water troughs as mentioned earlier, remove old bedding materials, debris, and manure and properly dispose of all dead animals.
Traffic Control

It is important to control the traffic that enters your farm to prevent the introduction of disease. Trucks delivering hay or feed to your farm can bring unwanted pathogens onto your farm from the wheels of the vehicle. By restricting where feed trucks, tractors or other vehicles can move on the farm can significantly reduce the introduction of disease on your farm. Most importantly, always limit the movement of other producers on your farm. If the producer has to come inside of your animal’s facility, make sure they disinfect their shoes in a solution of Clorox and water before they enter your animal’s unit. “Poly-Boots” (disposable boot covers) are also available through several agricultural supply companies that can be used to cover your visitor’s shoes as noted in the picture on the right. Other ways to reduce the introduction of disease on the farm is by limiting the sharing or borrowing of equipment from other producers. The management practices that are established on one farm may not be necessarily the same ones you practice on your farm. Viruses, bacteria and other pathogens can be easily transported by the sharing of contaminated equipment, so be careful.

Other potential carriers of diseases are pets, rodents (i.e., salmonellosis, leptospirosis and hantaviruses), wildlife and birds. Birds and their droppings can carry over 60 diseases. Some of the diseases birds can transmit include the Avian Flu Virus, St. Louis Encephalitis, Salmonellosis, E.coli and Chicken Mites, just to name a few. Insects are also known transmitters of diseases, particularly flies, mosquitoes, fleas, ticks and lice. Flies can transmit pink eye from one animal to the next and some mosquitoes are carriers of the West Nile virus and Encephalitis. Since pets and wildlife (i.e., deer, raccoons) can cause diseases to occur on your farm, develop an effective strategy to control these unwanted visitors and pests.

Quality Assurance Protocols

A Quality Assurance (QA) program is designed to ensure that producers maintain their livestock in such a manner that the products that are produced are safe and wholesome for the consumer. To enhance carcass quality, certain precautions must be taken to prevent chemical residues and pathogen contaminations in the meat. The carcass must be free of defects such as injection site blemishes and bruises to maximize marketability of your products, thus increasing your profit margin. Some helpful suggestions
are listed in Table 1 to help avoid discounts on marketed products as the result of abscesses and lesions on the carcass.

<table>
<thead>
<tr>
<th>TABLE 1. Administering Medications</th>
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</table>

- Purchase good quality needles, change needles often (preferably between animals) and discard damaged and used needles in the proper containers.

- Use the proper needle size for the appropriate medication. Use the smallest needle possible, but large enough to prevent the needle from breaking the muscle.

- Give injections according to label instructions. Subcutaneous (SQ) – injection under the skin; Intramuscular (IM) – injection in the muscle; Intravenous (IV) – injection in the vein; Orally (O) – in the mouth or in the water; Topical (T) – pour on and Medicated Feed (MF) – medication in the feed.

- Give the appropriate dosage per injection site. Don’t give more than 5cc IM or 60 cc of fluids SQ per injection site for small ruminants.

- Don’t use dull or dirty needles and always use SQ routes when the product’s label permits.

- Clean the site with an antiseptic such as alcohol or a 7% iodine solution prior to administering any injections. This procedure will help reduce the introduction of bacteria or other pathogens into the animal’s body which can make them ill.

- When treating, restrain the animal properly to avoid breaking the needle off in the animal’s tissue or injecting yourself.

- Keep all equipment clean and free from manure and other debris.

- All medications must be administered at the point of the shoulder or in the neck region. This practice is used to prevent blemishes in the most expensive cuts of the meat.

- Properly store all medications according to label use, use the proper withdrawal period before marketing your animal for food and do not sell animals that have a broken needle in their hide.

- Keep records of all medical treatments. The records should include information on route of administration (i.e., SQ, IM, IV), dosage rate, date given, who administered the treatment, and withdrawal date.

(Adapted from the Ohio Beef Quality Assurance Program, 2001)

Food Safety Risks on the Farm (Controllable Risk)

Food safety is a scientific discipline describing the proper handling, preparation, and storage of food to prevent food borne illness. In recent years, it has been recognized that most food borne related illnesses (i.e., Salmonella, Listeriosis, E. coli H0157:H7) start on the farm and not at the processor. Once an outbreak does occur, efforts are made to trace back where the meat was processed and the farm the animal(s) originated from. In most cases, the remaining animal(s) on the suspect farm will be quarantined and/or destroyed which increases
the farmer’s production risks as well as financial risks. These measures are taken to prevent the further spread of the disease. An incident of this nature could ruin your reputation, cause economic losses to the industry if consumers refuse to buy goat or sheep products, ruin you financially and increase your legal risks. This is especially true if someone should die or become injured or sick from eating product(s) produced from your farm. Thus, producers must do their part to ensure that safe and wholesome products are sold into the market at all times.

**Plan of Action for Reducing Food Safety Risks**

Refer to Table 2 for some guidelines that can be followed to reduce food safety risks on your farm.

<table>
<thead>
<tr>
<th>TABLE 2. Administering Medications</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>• Isolate sick and new animals (minimal of 4 weeks) and don’t sell other producers your sick animals.</strong></td>
</tr>
<tr>
<td><strong>• Always practice the proper withdrawal period with all of your medications to reduce the risk of selling animals marketed for food that still have chemical residues left in the meat. Some consumers are extremely sensitive to antibiotics or other chemical residue which may cause them to get sick or die.</strong></td>
</tr>
<tr>
<td><strong>• Don’t bring animals to market (i.e., livestock auction, processor) that are lethargic, scouring, covered with manure, have abscesses or are listless.</strong></td>
</tr>
<tr>
<td><strong>• Don’t purchase animals from a livestock auction for your farm, there is usually something wrong with them.</strong></td>
</tr>
<tr>
<td><strong>• Always practice good sanitation on the farm at all times and properly dispose of dead animals.</strong></td>
</tr>
<tr>
<td><strong>• Develop a relationship with a veterinarian and the local extension agent to seek assistance and guidance when needed.</strong></td>
</tr>
<tr>
<td><strong>• Develop a strong bio-security program to prevent the introduction and transmission of diseases on the farm and learn how to protect the herd or flock from bioterrorism threats.</strong></td>
</tr>
<tr>
<td><strong>• Always provide clean water for the animals daily and don’t feed them from the ground.</strong></td>
</tr>
<tr>
<td><strong>• Don’t send animals to market that are sick, especially with a reportable disease.</strong></td>
</tr>
</tbody>
</table>

**Reproduction and Breeding Management (Controllable Risks)**

Reproduction efficiency in small ruminants is the ability of the female to successfully breed and give birth to live offspring at least three times every two years, and wean at least one and one-half to two offspring each year. Maintaining good reproductive functions in the herd or flock is pivotal to the success of any livestock production system. Some factors that contribute to reproduction efficiency of the doe and ewe are ovulation rates, conception rates, the number of offspring born, the number of offspring weaned, the
survivability of the offspring, the frequency in which the offspring are produced, the length of the reproductive life of the female and the ability of the animal to produce marketable kids or lambs. These factors have a major impact on the profitability of the herd/flock. If the female cannot reproduce, she is of no value to you. Genetics of the animal and the environment (i.e., nutrition, health care) in which the animals are managed will dictate how efficient the doe, the ewe, the buck and the ram will be in the herd or flock.

Reproduction management to a great extent is a controllable risk in goats and sheep. In order for your animals to express their maximum genetic potential, their environment must be carefully managed. The factors having the greatest impact on reproduction are health care and nutrition. Since health and its impact on production have already been discussed in a previous section, nutrition will be the focus of this next section.

**Nutrition Impact on Reproduction**

Nutrition is the process by which a living organism assimilates food and uses it for growth and replacement of tissues. Studies have shown that animals that are maintained on poor nutrition are more susceptible to disease, have impaired reproduction function and usually have lower body condition scores (BCS). Body condition scores have been used for years by farmers to objectively evaluate the nutritional status of their livestock. The animal is palpated to determine the amount of fat that can be felt over the hip area, ribs and spine and is then assigned a numeric value on a scale between 1 and 9. This scale is typically used for meat goats. However, some producers may prefer to use the 1 to 5 scale to assign a numeric value to their dairy or meat goats. Generally, this is the same scale that is used to measure the BCS of sheep. Both scales can be used effectively to evaluate the nutritional status of small ruminants. For the purpose of this section, we will use the 1 to 9 scale for meat goats. For an explanation on how to use the 1 to 5 scale, refer to page 24 of this publication.

Goats that are assigned a body condition score between 1 to 3 (thinner fleshed - low plane of nutrition) are generally very thin animals. They have very little, to no, fat covering the spine and hip bone areas. The tail and hip
bones are quite prominent and their individual ribs can be visibly seen, as in the case with animals in a condition score of 1 (refer to Appendix 3). Animals that are in thin condition (BSC 1) are low milk producers, produce poor quality colostrum and produce small, thin, weak kids. Furthermore, mortality rates are typically high, and the growth rates of nursing kids are low. The weaning weights of the kids and the litter sizes are also low. There is a high frequency of single births, long rebreeding intervals (R.C. Noble, 2004) and increased incidents of dystocia (kidding difficulty). Sheep will also exhibit the same reproductive problems if they are maintained on a poor plane of nutrition.

Does with body condition scores between 4 to 6 are considered moderately fleshed. The spine and the ribs can be individually identified with palpation with some fat over the ribs of goats with a body score of 4. Animals in moderate condition are usually good milk producers, produce good quality colostrums and produce kids with good growth rates and weaning weights. Animals that are maintained on a moderate plane of nutrition have also been known to have high twinning rates and are quick to rebreed (R.C. Noble, 2004).

Over-conditioned (BCS = 7 – 9) goats tend to be fat. The animal is very fleshy and the spinal and transverse processes (the edges of the long bones that stick out to each side of the loin) are almost impossible to palpate (BCS = 8). These goats are high milk producers they produce good quality colostrum and they produce kids that are heavy at birth and weaning. Mortality and morbidity rates are lower among animals maintained in this condition, they are quick to rebreed and their twinning rates are high (R.C. Noble, 2004). However, animals that are over-conditioned tend to have increased incidents of dystocia (kidding problems) and metabolic disorders such as pregnancy toxemia. Any of these conditions can potentially lead to the death of the female and her offspring if the proper measures are not taken.

**Plan of Action to Improve Nutrition**

To further reduce production risks in your herd or flock, provide adequate nutrition based on the physiological stage (i.e., lactation, maintenance, breeding, gestation) of the animal. Provide good quality forages for year-round grazing. Provide fresh water and minerals daily. Test the soil at least once per year to obtain optimum forage quality, provide adequate stocking rates in the pastures, and plan for drought conditions. Additional suggestions include monitoring body condition scores of the herd/flock, practice rotational grazing and supplement the diet when necessary (prior to breeding, during gestation and after parturition). When animals are in poor
condition, they are more susceptible to disease and their reproduction performance may be impaired.

**Establishing a Sound Breeding Program**

A sound breeding program is also imperative for improving production and reproduction efficiency in the herd or flock. Prior to starting the breeding season, make sure your animals are in the best condition for breeding.

**Plan of Action for Prenatal Care**

One to two months before the male is moved to the pen with the females, check to see if your animals are healthy and examine the entire group for internal parasites. You can do this by sending fecal samples to your local veterinarian clinic or you can examine them yourself by using the Mac Master’s Flotation test for microscopic fecal examinations. If this is not an option, ask your extension agent if training is available for learning how to conduct the flotation test or learn how to use the FAMACHA Anemia Guide® system. This guide is used to determine if your goats or sheep will require deworming for the parasite *Haemonchus Contortus*, the bloodsucking worm. If your animals require treatment, deworm them as soon as possible. This is also a good time to vaccinate (C&D tetanus toxoid) your animals as well as trim their hooves, increase their feed supplement, if required, and monitor their BCS. The doe’s BCS should be between 5 and 6 if you are using the 1 to 9 numeric scale and the ewes should have a BCS between 3 and 3.5 when using the 1 to 5 numeric scale as explained on page 24 of this text. Studies have shown that when the female is in optimum condition, you can expect her to have high ovulation and fertility rates, a shorter interval for rebreeding, healthier and heavier offspring, good milk production, and increased survivability among the offspring, which is why it makes good economic sense to manage your animals properly. The males should also be in optimum condition to improve fertility rates and his libido. Depending on his age and health, he should be able to service up to 25 females during the breeding period.

Once the breeding season has started, place the male in the pen with the female for at least 2 estrous cycles (42 days). If the doe or ewe is not bred during the first cycle (21 days), hopefully she will be bred during the second estrous period. After 42 days, remove the male and continue to monitor the females. During the first few weeks of pregnancy, check for signs of abortion (bloody discharge) and continue checking the BCS and the health of the animals. Increase supplements towards the last month of pregnancy, since 70% of fetal development occurs during this time, but don’t over-condition the animals (BCS 7 to 9 or BCS 4 to 4.5 depending on the scale you are using) and, last, but not least, be present during kidding/lambing.
Plan of Action for Postnatal Care

At birth, submerge the offspring’s navel cords in a 7% solution of tincture iodine to prevent infections such as navel joint disease. Also, make sure the offsprings nurse their mothers within the first 24 hours of life. If you have an orphan, try to see if another doe will adopt the kid or lamb. If this is not possible, use a lamb feeder to provide milk to the orphan. Ear tag the kids/lambs for identification purposes and weigh and record their weight. At 30 days and 60 days of age, vaccinate the offsprings with C&D tetanus toxoid. Castrate the bucks/rams before 45 days of age, depending on your market objectives, wean your offspring between 60 to 120 days of age, and record their birth and weaning weights.

Culling the Herd or Flock

At the end of each breeding season, develop a list of those animals you wish to cull from your farm. Culling is the process of removing any animals from your farm that does not meet your specific selection criteria. The practice of culling will allow you to reinforce certain desirable characteristics or to remove certain undesirable characteristics from your herd or flock. Thus, culling is an excellent management tool for improving reproduction and production efficiency on your farm. The decision to cull should be based on the goals you have set for your farm and culling should lower your production risks. One reason for culling that is worth mentioning is when the female produces single births more than once. The reason is simple, one offspring should pay the cost (i.e., feeding, health care) of caring for the mother and her kids or lambs and the other offspring should be your profit. Other reasons for culling are the weaning weights of the offspring are the lowest in the herd or flock or the animal has reoccurring health problems which will eventually increase your production cost. Unthrifty adults or offspring (i.e., stunted, poor muscling or weight gain) can also increase your production risks since they generally have a lower market value. You should also considering getting rid of any doe or ewe that is not pregnant during the kidding or lambing season, if her offspring are born with birth defects, if she...
has reproductive problems such as a prolapsed uterus or a retained placenta, the mother is a poor milk producer, the animal is difficult to manage, the female has poor mothering ability or if her reproduction performance has declined over the years (i.e., singles instead of twins, low milk production).

The buck or the ram should be culled if his reproduction performance has declined (i.e., low kidding or lambing crop), to prevent inbreeding, if he is consistently sick, if he’s very difficult and dangerous to handle and manage, or he possesses any other characteristics that might affect his performance. Holding on to nonproductive animals not only increases your production risks, but it will also increase your financial risk because you are consistently investing money (i.e., feed, medications, veterinarian expenses) into your animal, and receiving nothing in return.

The rate in which an animal is culled from the herd or flock will vary from farm to farm and even from year to year. It will mostly depend upon the goals and objectives (i.e., improve twinning rates, improve milk production) you have established for your farm. If you are looking to make fast improvements in your herd or flock, you may want to cull as much as 10% per year or as low as 5% per year if you want the change to occur over a longer period of time.

**Heritability Estimates**

When selecting animals to begin a herd/flock or to upgrade an existing breeding program, there are some traits of economic importance (i.e., birth and weaning weights, milk production) that you should consider when making genetic improvements in your breeding program. One way to make genetic improvements in the herd or flock over a shorter period of time is by becoming familiar with heritability estimates to determine to what degree a characteristic will be passed on to the offspring. It is based on the premise that related animals are more alike than unrelated animals. Numeric values that are assigned to heritability estimates can be expressed in percentage or in decimal form. A heritability trait less than 20% is considered low, a heritability trait between 20% to 40% is considered moderate, and a trait that is greater than 40% is considered highly heritable. The stronger the heritability trait, the faster you can achieve progress in your breeding program. The heritability values of some economically important traits are shown in Table 4 for goats and Table 5 for sheep. In Table 4, birth weights, mothering ability, weaning weights, feed conversion and structural soundness are moderate heritability traits in goats, while mature weight, milk yield and milk fat were found to be high heritability traits. Sheep were
also found to have several moderate heritability traits such as birth weight, 100-day weaning weight and mature weight. Face cover, retail cut weight and loin eye area are highly heritable traits in sheep.

Table 4. Heritability for Goats

<table>
<thead>
<tr>
<th>Trait(s)</th>
<th>Heritability, %</th>
<th>Trait(s)</th>
<th>Heritability, %</th>
<th>Trait(s)</th>
<th>Heritability, %</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Birth to Mature Weights</strong></td>
<td></td>
<td><strong>Fleece Weight and Grade</strong></td>
<td></td>
<td><strong>Carcass Traits</strong></td>
<td></td>
</tr>
<tr>
<td>Birth Weight</td>
<td>30</td>
<td>Face Cover</td>
<td>56</td>
<td>Lean Weight</td>
<td>39</td>
</tr>
<tr>
<td>Weaning Weight (60 days)</td>
<td>10</td>
<td>Skin Folds</td>
<td>40</td>
<td>Loin Eye Area</td>
<td>53</td>
</tr>
<tr>
<td>Weaning Weight (100 days)</td>
<td>30</td>
<td>Grease Fleece Weight</td>
<td>38</td>
<td>Fat Thickness over the Loin</td>
<td>23</td>
</tr>
<tr>
<td>Mature Body Weight</td>
<td>40</td>
<td>Clean Fleece Weight</td>
<td>40</td>
<td>Grade</td>
<td>12</td>
</tr>
<tr>
<td>Rate of Gain</td>
<td>30</td>
<td>Staple Length Cut (weaning)</td>
<td>39</td>
<td>Retail Cut Weight</td>
<td>50</td>
</tr>
<tr>
<td>Multiple Births</td>
<td>15</td>
<td>Staple Length Cut (yearling)</td>
<td>47</td>
<td>Dressing Percentage</td>
<td>10</td>
</tr>
<tr>
<td>Lean Weight</td>
<td>39</td>
<td>Fleece Grade</td>
<td>35</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weight per day of age</td>
<td>22</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>


Tables 4 and 5 list some production and reproduction traits that you may want to consider when selecting replacements or breeding stock for your herd or flock. It may not be easy to select for all of these traits at one time, but select for the characteristics that are the most important for your breeding program. Try to select animals that are born as twins and come from parents that are twins, select animals that have good growth rates (top 10% in the group), select animals that have good muscling characteristics and are structurally sound. Select replacement animals that are rarely ill, easy to handle, the offspring’s mother has done well in the herd or flock, and the previous litters are worth a high dollar value.
Breeding males should have a proven performance record, have no structural anomalies (i.e., Cryptorchidism – undescended testicles), the scrotum circumference should be large (> 30 cm), which is a good indicator of his fertility, and libido. Therefore, his offspring should also be high performers.

**Purchasing Breeding Stock: What are the Risks?**

The best advice when it comes to buying breeding stock is to find a reputable animal breeder. You can start by checking the Web sites (i.e., Florida Meat Goat Association, Meat Sheep Alliance), newspapers and magazines (i.e., Goat Rancher) for a listing of animal breeders. Word of mouth is often the best way of finding good breeding stock. Avoid purchasing animals from livestock auctions, from farms that have questionable management practices or from farms that have a reputation for selling inferior animals. Imagine

---

### Table 5. Heritability for Sheep

<table>
<thead>
<tr>
<th>Trait(s)</th>
<th>Heritability, %</th>
<th>Trait(s)</th>
<th>Heritability, %</th>
<th>Trait(s)</th>
<th>Heritability, %</th>
<th>Trait(s)</th>
<th>Heritability, %</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Birth to Mature Weights</strong></td>
<td></td>
<td><strong>Milk Properties and Feed Conversion</strong></td>
<td></td>
<td><strong>Conformation and Temperament</strong></td>
<td></td>
<td><strong>Carcass Traits</strong></td>
<td></td>
</tr>
<tr>
<td>Birth interval</td>
<td>5 – 10</td>
<td>Milk yield</td>
<td>25</td>
<td>Stature (Conformation &amp; Frame)</td>
<td>45 – 50</td>
<td>Ribeye (loin) area</td>
<td>40 – 45</td>
</tr>
<tr>
<td>Birth weight</td>
<td>30 – 40</td>
<td>Milk fat %</td>
<td>55</td>
<td>Rear legs</td>
<td>15</td>
<td>Cutability</td>
<td>25 – 30</td>
</tr>
<tr>
<td>Number born</td>
<td>15</td>
<td>Milk protein %</td>
<td>50</td>
<td>Wither height</td>
<td>40</td>
<td>Muscling</td>
<td>40 – 45</td>
</tr>
<tr>
<td>Motherability</td>
<td>40</td>
<td>Udder support</td>
<td>20</td>
<td>Cannon bone circumference</td>
<td>45</td>
<td>Carcass weight</td>
<td>45 – 50</td>
</tr>
<tr>
<td>Weaning weight</td>
<td>20 – 30</td>
<td>Teat placement</td>
<td>30</td>
<td>Scrotal circumference</td>
<td>50</td>
<td>Quality grade</td>
<td>40</td>
</tr>
<tr>
<td>Yearling weight</td>
<td>40</td>
<td>Feed conversion</td>
<td>40</td>
<td>Temperament</td>
<td>25</td>
<td>Fat depth</td>
<td>40 – 45</td>
</tr>
<tr>
<td>Mature weight</td>
<td>65</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: Massey and Vogt, 1993

Sore Mouth (Contagious ecthyma).
the amount on money you could spend if you had an outbreak of Caseous Lymphadenitis (a chronic reoccurring infectious disease), Foot Rot or Sore Mouth (a highly contagious virus that can be passed on to man) on your farm. What if you brought home an animal that was heavily infested with *Haemonchus contortus*, the bloodsucking worm. What if the parasites were resistant to every known dewormer on the market today? What would you do? What could you do?

**Plan of Action for Purchasing Breeding Stock**

Learn how to become a wise shopper. Don’t be in a hurry to buy the first animal you see. Take your time to find a reputable breeder. Contact your local extension agent or extension specialist for advice. Get in touch with your local goat or sheep organizations for assistance. Attend as many training classes as possible on small ruminant production and management and visit several farms before you make your final decision. Hopefully by the end of this process, you will be able to select quality animals for your herd/flock that are the best buy for your money. Can you still make mistakes when selecting animals for your farm? Yes, there is still a chance that you can make a few mistakes even if you are a prudent shopper. Everyone makes mistakes from time to time, but just be careful about where you purchase your animals and start small. Purchase a small group of animals (1 male to 25 females or less) to begin with and don’t purchase the most expensive animals on the market at first. Raising animals for production can be quite a learning curve for the first two to three years and even possibly longer. Fortunately, most people will learn from their mistakes, but the consequences can become financially devastating if you are heavily invested in your new business adventure. By starting small, you will be able to learn if your feeding, breeding and herd health programs are suitable for your animals without major repercussions, thus lowering your production as well as your financial risks. When you are ready to expand your herd/flock, you will have gained several new skills and acquired a lot of new knowledge to identify potential problems, weaknesses and strengths in your business. Furthermore, you will be better equipped to handle potential problems in the future.
Selecting Animals for Meat Production

Animals selected for meat production must be able to move around freely to forage. They should be deep-bodied and rectangular in shape when viewed from the side. They must also show superior growth and muscle development. The best indicators of muscling are thickness through the rear, muscling in the forearm area and muscling thickness in the loin area. The buck/ram should be masculine in appearance and the female should be feminine. Both sexes should also be structurally correct and sound in feet and legs. In both species, the legs should move with front feet pointing straight ahead and not turned inward or crooked as shown in Appendix 1. Therefore, small ruminants that have strong legs are usually more hardy and agile. Strong pasterns with well-formed feet and tight toes are also essential for mobility. This may prevent possible injuries, infections and the hooves are easier to trim. Any deformities in the pasterns may cause the animal to become lame. The correct leg and feet positioning are shown on Appendix 1. Ideally, the hair should be smooth and glossy for goats. Rough hair is generally an indication of disease or nutritional deficiencies. Skin that is loose and pliable with flesh evenly covering the body helps the goat and sheep adapt to various climatic conditions and may provide possible resistance to external parasites. Signs of potential problems in both species include continuous coughing, limping, diarrhea, and mucous discharge from mouth, eyes, nose or rectum. Animals should be healthy, well-fleshed and have bright and clear eyes (McKenzie-Jakes, 2007).

Sheep may be a little more difficult to appraise their merits or defects because some meat breeds are covered in wool. If this is the case, use body condition scores to appraise the condition and care of the animal. As mentioned earlier, meat sheep are generally evaluated on a scale from 1 (emaciated) to 5 (obese) with a score of 1, the sheep is emaciated and a score of 2 indicates the animal is too thin. Body condition scores of three is average while a score of 4 is fat and 5 is obese.

The spinous process (spine) of a sheep with a BCS of 1 will be sharp and prominent. The loin eye muscle will be shallow and no fat will be covering...
this muscle. The transverse process will also be sharp and you will be able to feel the ends of each process. The spinal process of a sheep with a BCS of 2 will still be sharp, but the loin area will have a little fat cover, but not full. The spine of a sheep with a BCS of 3 is smooth and rounded and one can actually feel the individual bony processes when adding a little pressure. The transverse process is smooth and covered and firm pressure is required to feel over the ends. A condition score of 4 indicates that the animal has a spinous process that can only be felt if firm pressure is applied. The transverse process cannot be felt and the loin muscle is full with a thick cover of fat. A condition score of 5 indicates that the animal is obese. The spinous process cannot be detected, nor the transverse process. The loin area is covered with a thick layer of fat.

For breeding purposes, the ewes should have a BCS between 3 and 3.5. During early to mid gestation the BCS should range between 2.5 and 4. Body condition scoring is a subjective tool that can be used to evaluate the condition of livestock and used as a tool to assist producers to increase production efficiency in their farm animals (Thompson and Meyer, 1994).

**Enterprise Diversification to Improve Resilience**

Diversification is a frequently used risk management strategy that involves operating more than one business activity at one time. The advantage for diversifying is to be able to provide income from more than one activity, especially when it may take longer to see a return from one enterprise than it does another. For instance, the gestation length of the doe or ewe is approximately five months. It will acquire an additional three months depending on what age you plan on marketing your livestock to begin to generate some income from the sale of your animals. Therefore, it may be to your benefit to add crop production or another enterprise to your farm business that will enable you to generate income until your animals are ready for market. However, before entering into any new enterprise don’t forget about assessing the potential risks a new enterprise may carry. Diversifying requires a broader range of management expertise than it does in producing only one commodity and you must be prepared to handle and to mitigate those risks you may potentially face. To further assess potential risks on your farm refer to Appendix 2.
A FINAL NOTE

Operating a small farm enterprise for goats or sheep can have some risks. These risks are often associated with marketing, financial, human, legal or production risks. Sources of production risks may include nutrition, health, reproduction and breeding management. Fortunately, most risks can be controlled by sound production and management practices. Effective management strategies should include establishing a bio-security program to prevent the introduction or transmission of disease on the farm, culling nonproductive animals to reduce production as well as financial risks, purchasing quality animals to ensure production and marketing goals are met, establishing a good nutritional program to prevent nutritional deficiencies and other nutritional-related problems and diversifying your farm business to generate income year-round to increase economic returns. By identifying and mitigating those risks you may potentially face should help you to become less vulnerable to production and, ultimately, financial losses.
Appendix 1. Leg Positions

**Leg Positions**

**Front View**
- correct
- bowlegged
- knock-kneed
- splayfooted (toed-out)
- pigeon-toed (toed-in)

**Rear View**
- correct
- bowlegged
- cow-hocked
- correct
- buck-kneed
- calf-kneed
- weak pasterns
- correct
- sickle-hocked
- post-legged

Source Unknown
## Appendix 2: Assessing Production Risks on Your Farm

<table>
<thead>
<tr>
<th>RISKS</th>
<th>LOW RISKS</th>
<th>LOW-MED RISKS</th>
<th>MED-HIGH RISKS</th>
<th>HIGH RISKS</th>
<th>YOUR RISK</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sanitation and safety</td>
<td>All pens, equipment, feeding troughs, housing units, tubs, etc., are disinfected routinely. No debris in the field.</td>
<td>All pens, feeding troughs, housing units, tubs, etc., are disinfected regularly. Facility has minimal, debris in the field.</td>
<td>Minimal cleaning of facilities. Facilities are never cleaned. I leave types of garbage and debris on the farm.</td>
<td>Facilities are never cleaned. I leave types of garbage and debris on the farm.</td>
<td>Low</td>
</tr>
<tr>
<td>Quarantine and sick pen</td>
<td>Animal are in separate pens and at least 200 ft. away from the other animals for the next 4 to 6 weeks.</td>
<td>Animal are in separate pens and at least 200 ft. away from the other animals.</td>
<td>Animals are in separate pens, but they can almost touch noses through the fence line.</td>
<td>Animals are in separate pens, but they can almost touch noses through the fence line.</td>
<td>Low</td>
</tr>
<tr>
<td>Traffic on farm</td>
<td>I have a designated area where traffic can enter my farm and I provide disinfectant baths, or &quot;PolyBoo&quot; to all visitors.</td>
<td>I have a designated area where traffic can enter my farm.</td>
<td>I have all delivery trucks and animal brokers enter into my animal areas with their vehicles.</td>
<td>I have all delivery trucks and animal brokers enter into my animal areas with their vehicles.</td>
<td>Low</td>
</tr>
<tr>
<td>Quality Assurance</td>
<td>I always clean the injection site, change needles between every 10 animals and use clean needles in the bottle.</td>
<td>I always clean the injection site, change needles between every 10 animals and use clean needles in the bottle.</td>
<td>I use the appropriate size needle, but I never clean the site of the injection and sometime I use clean needles.</td>
<td>I use the same needle to treat the animals with and aspirate the medication from the bottle.</td>
<td>Low</td>
</tr>
<tr>
<td>Diseases and Parasites</td>
<td>I always check my animals routinely for parasites and other diseases. I only deworm or treat when needed.</td>
<td>I always check my animals for worms or diseases. They look pretty good.</td>
<td>I sometimes check my animals for worms or diseases. They all look kind of sick.</td>
<td>I never check my animals for worms or diseases. They all look very sick.</td>
<td>Low</td>
</tr>
<tr>
<td>Animal Injections</td>
<td>Injections are given SQ in the neck, as labeled, and given when absolutely necessary.</td>
<td>Injections are all given in the neck.</td>
<td>Injections are mostly given in the neck, unless it is inconvenient. Injections are mostly unnecessary.</td>
<td>Injections are mostly given in the neck, unless it is inconvenient. Injections are mostly unnecessary.</td>
<td>Low</td>
</tr>
</tbody>
</table>
| Handling of Biologicals and
Pharmaceuticals                      | I always read the labels on how to properly use and store biologicals or pharmaceuticals. | Sometimes I read the labels on how to properly use and store biologicals or pharmaceuticals. | Most of the time, I don’t read the labels on how to properly use and store biologicals or pharmaceuticals. | I never read the labels on how to properly use and store biologicals or pharmaceuticals. | Low       |
| Predators                          | My perimeter fence and gates are very secure, I purchased a guardian animal, and my animals are secured at night. | My perimeter fence is secure, but the gates are hanging slightly off the ground. | My kids can get out of the perimeter area with ease. My neighbor’s dogs are always barking at my goats. | My kids can get out of the perimeter area with ease. My neighbor’s dogs are always barking at my goats. | Low       |
| Disasters                          | I have a disaster plan for most storms or problems that generally occur in your area. | I would have a disaster plan for most storms or problems that generally occur in your area. | I have a disaster plan for most storms or problems that generally occur in your area. | I have no disaster plans because the tornadoes always touch down in the other communities. | Low       |
| Nutrition Program                  | I have a nutritional program for my animals and I feed them according to their stage of development. | Most of the time I feed my animals according to their physiological stage of development. | When the ground is bare, I sometimes supplement my animals with a grain or a concentrate. | When the ground is bare, I sometimes supplement my animals with a grain or a concentrate. | Low       |
| Withdrawal Periods                 | I always medicate my animals according to the label instructions. I keep them according to their stage of development. | I always medicate my animals 20 days before I sell them to market. | I always medicate my animals on the day before I sell them to market. | I always medicate my animals on the day before I sell them to market. | Low       |
| Disposal of dead animals and
manure disposal                      | I follow the proper dead animal and manure disposal that is required in my county. | Most of the time, I follow the proper dead animal and manure disposal that is required in my county. | Sometimes, I follow the proper dead animal and manure disposal that is required in my county. | Sometimes, I follow the proper dead animal and manure disposal that is required in my county. | Low       |
| Food Safety                        | Food safety starts on the farm, so I do my part to ensure the safety of the products produced on my farm. | Food safety starts on the farm, so I will try to do my part to ensure the safety of the products produced on my farm. | Food safety starts on the farm, but my animals are healthy. Foodborne illness starts with unhealthy animals. | Food safety doesn’t start on the farm, so why should I worry about it? | Low       |
### Appendix 3. Body Condition Scoring

<table>
<thead>
<tr>
<th>BCS</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td><strong>THIN CONDITION (1-3)</strong>&lt;br&gt;&lt;br&gt;Emaciated - Goats extremely thin; no fat covering the spine and hip bone area. The tail bone and hip bone are quite pronounced and the individual ribs can be seen without palpation.</td>
</tr>
<tr>
<td>2</td>
<td>Poor - The goat is fairly thin. There is a little fat covering the spine and hip bone regions. The hips, ribs and tail bone are less prominent.</td>
</tr>
<tr>
<td>3</td>
<td>Thin - Ribs are still individually identifiable. There is little fat covering the tail and spine areas.</td>
</tr>
<tr>
<td>4</td>
<td><strong>BORDERLINE TO MODERATE CONDITION (4-5)</strong>&lt;br&gt;&lt;br&gt;Borderline - The spine and the ribs can be individually identifiable by palpation. The ribs feel rounded rather than sharp. Some fat is over the ribs.</td>
</tr>
<tr>
<td>5</td>
<td>Moderate – The goat has a good overall appearance. Fat is over the ribs, hips and tail bone area and feels spongy to the touch.</td>
</tr>
<tr>
<td>6</td>
<td><strong>MODERATE TO FAT CONDITION (6-7)</strong>&lt;br&gt;&lt;br&gt;High Moderate - Firm pressure is required to feel the spinal process. Fat is observable and palpable over the ribs and tail head area.</td>
</tr>
<tr>
<td>7</td>
<td>Good - Animal appears fleshy and obviously carries a considerable amount of fat. Fat covers the ribs and tail head area.</td>
</tr>
<tr>
<td>8</td>
<td>Fat - The goat is very fleshy and over-condition. The spinal and transverse processes are almost impossible to palpate.</td>
</tr>
<tr>
<td>9</td>
<td>Extremely Fat (Obese) - The goat appears blocky. The tail head and hips are buried in fatty tissue. The bone structure is barely viable and is not palpable. The animal may have difficulty in giving birth and may experience may have increased chances of pregnancy toxemia.</td>
</tr>
</tbody>
</table>

REFERENCES


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