PROCEEDINGS OF THE 29th ANNUAL

GOAT FIELD DAY

April 26, 2014

&

Proceedings of the Mortality Composting Conference

April 25, 2014

Agricultural Research and Extension Program
Langston University
Langston, Oklahoma 73050

WELCOME

We deeply appreciate your attendance at this 29th Annual Goat Field Day of the E (Kika) de la Garza American Institute for Goat Research of Langston University. The Field Day is one of the most important things we do each year. The primary purpose of the Field Day is for education and extension in areas of greatest interest to clientele of the Institute. Thus, please share your thoughts with us on today's activities and suggestions for the Field Day next year. In addition to extension and education, the Field Day provides an excellent opportunity for the staff of the Institute to meet other people who work with goats. Such interaction helps make our program the most appropriate it can be for the people it serves. The proceedings of the Field Day is a very useful tool for the Institute beyond impact realized from the program today. First, there are reports on Field Day presentations. After this information, there are highlights of research, extension, and international activities of the Institute in the past year. This section is an aid to assess our recent progress, display current activities, and contemplate future directions to be followed. This year's general theme is "Kidding and Kid Management".

Here is the exciting program planned for today that has developed from your input.

The morning program consists of:

- **Goat Kidding and Kid Management: Your Opportunity to Improve Your Herd** — *Ms. Jan Carlson*
- **Low-input Kidding: Tips for Pasture-based Kidding** — *Dr. Charlotte Clifford-Rathert*

The afternoon workshops are:

- **Goat Kidding** — *Ms. Jan Carlson*
- **Goat Kidding Procedures** — *Ms. Jan Carlson*
- **Goat Kid Raising** — *Ms. Jan Carlson*
- **Internal Parasite Control** — *Dr. Charlotte Clifford-Rathert*
- **Diseases of Concern during Pregnancy and Kidding** — *Dr. Charlotte Clifford-Rathert*
- **Abortions and Their Diagnosis** — *Drs. Keith Bailey and Lionel Dawson*
- **Nutrition for Health and Production** — *Dr. Steve Hart*
- **Goat Farm Budgeting** — *Mr. Roger Sahs*
- **Sketching Goats in the Field** — *Mr. Ken Williams*
- **DHI Training** — *Ms. Eva Vasquez*
- **Cheesemaking Overview** — *Dr. Steve Zeng*
- **USDA Government Programs** — *Mr. Dwight Guy*
- **Pack Goats** — *Mr. Dwite Sharp*
- **Mortality Composting** — *Dr. Karl VanDevender*
- **Fitting and Showing for Youth and Adults** — *Ms. Morgan Hallock*
- **Fun Tent** — *Ms. Sheila Stevenson*

On behalf of the staff of E (Kika) de la Garza American Institute for Goat Research, we thank you for your continuing interest and support.

Tilahun Sahlu
Director, E (Kika) de la Garza American Institute for Goat Research

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CURRENT PROGRAM SUMMARY

Kidding and Kid Rearing

Ms. Jan Carlson
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Introduction

Kidding time is probably the most exciting time of year for dairy goat producers. It is a time when your planned matings produce results and when your first-freshening does start production and can be evaluated on their merit as milking does. But kidding time is also the most busy and stressful time for producers. Since the dairy goat is a seasonal breeder, most kidding happens all at once, and producers must transition from a relatively quiet and routine time of management to an extremely busy time requiring long hours in the barn and involving many tasks that must be accomplished at once. The demands are great, but the rewards can be even greater and have a long-lasting impact on the herd if producers are willing to plan for kidding and kid-rearing and give the does and kids the time, attention, and resources they deserve.

From a herd health standpoint, kidding time is the perfect opportunity to break the cycle of disease in a herd. Many diseases can be transmitted at kidding time and/or during the first few days and weeks of a kid's life. Caprine arthritis encephalitis, Johnes, mycoplasma, salmonella and e-coli can be transmitted via milk and colostrum. Scrapie, Q-fever and Chlamydia are transmitted via birth fluids from the dam and other freshening does in the kidding environment. Neonates (young kids) are especially susceptible to exposure to coccidia, cryptosporidiosis, *Corynebacteria pseudoteburculosis* (CL), soremouth and other diseases in the kidding environment, which can have severe consequences in a newborn. If the herd owner is invested in preventing or eliminating these types of infections from the premises, the perfect opportunity is to start as soon as kids are born and manage them in such a way as to prevent exposure. In this way, a producer can actually begin a new "clean herd" and add each year's cleanly-raised kid crop to the "clean" segment of the herd.

Preparation for Kidding

Planning for kidding season should actually start at or before breeding time. Goats are "seasonally polyestrus" and will cycle every 21 days throughout the breeding season, or until they are pregnant. Within that breeding season, producers can choose when to breed in order to have a kidding season that is manageable. It could be a good idea to breed a certain number of does early, take a break for a few weeks, then another break later in the season. This allows producers to have breaks during kidding to catch up on management duties (disbudding, tattooing, cleaning, etc.) before the next group of kids is expected. Before a producer decides on breeding, it is a good idea to count ahead five months and see if the calendar is open. If you breed does on July 25th, you can expect kids on Christmas day. That may or may not be compatible with your schedule.

At breeding, it is very useful to record breeding dates and the service sire whenever possible and, later, to have a veterinarian ultrasound does to determine pregnancy and the number of kids each doe is carrying. This information is invaluable at kidding time and necessary to manage the nutritional needs of does during late gestation. In order to have the most reliable ultrasound results, especially for counting fetuses, it is best is to have your does scanned between 42 to 75 days of gestation.

Planning for the kidding season involves making a series of decisions and then, based on those choices, getting supplies, spaces, and people ready for the season. The decisions to be made include:

1) Kidding process:
    a. Location of kidding?
    b. How/who/how often will does be observed?
    c. How will kids be handled at birth?
    d. How will difficult births be handled?
    e. A plan for emergency care?
2) Kid processing at birth:
    a. Will kids be removed from dams?
    b. Where will newborns be located?
    c. How will they be processed?
    d. Colostrum source?
3) Kid rearing and housing:
    a. Housing, first 2 weeks?
    b. Housing, after 2 weeks?
    c. Type of milk to feed?
    d. Method of feeding?
    e. Age or weight at weaning?

Adequate care of does in the last 50 to 60 days of gestation is vital to the success of the kidding season. Does that have been scanned (via ultrasound) with three or more kids should be managed differently from does with singles. It is a good idea to learn how to use a body condition scoring system in your herd. The typical "cycle" of body condition of a year in a doe's life starts at kidding, when she should be at a body condition score of about 3.5 to 4. During lactation, does will naturally lose body condition as their ability to consume nutrients will not be able to keep up with the demands of peak lactation. As peak lactation tapers off, does will be able to regain body condition and should be back up to a score of 3.5 to 4 by the time of dry-off. It should be the goal of producers to ensure that pregnant does do not lose or gain body condition during the 60-day dry period. Does carrying triplets and quads are at risk of pregnancy toxemia during late gestation. As the fetuses in a pregnant uterus take up more space in the abdominal cavity, less room is available for the rumen to hold roughage feedstuffs. Therefore, does with triplets should be fed high-quality roughage and offered supplements that are high in nutrient density for her to maintain adequate energy through gestation. Unless pregnancy toxemia is diagnosed in the earliest stages, the outcome is seldom good, so the key is to manage your herd to prevent its occurrence.

In the last 30 days before kidding, does should be vaccinated against *Clostridium perfringens* C&D (enterotoxemia) and tetanus. When vaccinated at this time, does will increase their level of antibody production and will in turn produce colostrum that is higher in antibody. This increases the benefit to the kids that consume the colostrum.

Kidding Process

Producers should first decide where late-term gestation does will be housed at kidding time. It should be an area that is clean, has adequate space to house does so they are not stressed or crowded, should be well lit, and be an area where people can easily observe the expectant mothers. Baby monitors and barn-cams can be very useful in this area. Depending on how many does will be kidding, and if exact breeding dates are known, producers will need to organize a schedule for the does to be observed or a regular basis. Data

from a study conducted in the 1980s (Lickliter, 1985) showed that does most often kid in the daylight hours, usually midday and early afternoon. This does not mean all does will follow that pattern. Personal observation tells me that does that are used to being milked on an exact schedule will sometimes kid at milking time (presumably the noise from the vacuum pump and the routine of milking will stimulate an oxytocin release). It is not uncommon that difficult births (dystocia) will be noticed in the evening or late night hours. In these cases it may be likely that the first stages of labor started in the daylight hours, but progress was interrupted by the dystocia. Therefore, the more often the animals are observed by experienced managers the more likely it is that kidding will proceed without significant trouble. When difficult births are noticed and corrected early, it can be a simple process. When dystocias are not corrected early, there is greater risk to both the doe and the kids.

Before kidding season begins, producers will need to decide how the newborn kids will be handled. Will they be taken from their dams or allowed to nurse their dams, will they be bottle- fed colostrum or allowed to nurse colostrum from their dams? Early planning will also include making arrangements for veterinary care should problems arise that producers are not knowledgeable enough to handle. If the farm does not already have a veterinarian, it is recommended that a veterinary/client relationship be established with a local veterinarian. This can be accomplished by scheduling a farm visit during which he/she will visit the herd and talk about herd health and management programs, make recommendations, and discuss veterinary needs. Once established, veterinarians are able to answer questions over the phone, prescribe drugs, and teach you to perform routine tasks. Your veterinarian will be able to help you plan for kidding season by making drugs and supplies available and developing a plan for emergency care. It is important that you plan for emergencies before they happen. Your veterinarian can help you establish a set of protocols for various circumstances, including when to call for help. This is important, because producers can sometimes start with the wrong treatment or diagnosis and complicate the situation. Talk with your veterinarian about after-hours care. Is he/she is willing to be on call, or will you be referred to an emergency practice? Have the phone numbers of all emergency contacts readily available.

Kidding Supplies to Have on Hand

Following is a list of supplies to have ready at kidding season. It is a good idea to be sure you have enough supplies to get you through a kidding season. Sometimes trips to the suppliers are not possible during the busy days and weeks of kidding.

Kidding kit:

- Obstetrical lube -- unless you are kidding only a few does, it is best to have gallon containers of lube. The small tubes are small and much more expensive.
- OB sleeves (sterile)
- Disposable exam gloves
- Disinfectant
- Vaginal speculum and sterile lube (be sure to clean and disinfect (or sterilize) the speculum between uses)
- Speculum light
- Umbilical tape
- Scissors
- Iodine or disinfectant for umbilical cord (7% tincture, Povidone Iodine (Betatdine®) or Chlorhexidine (Nolvasan®))
- Clean towels or newspapers or other ways to clean off newborns
- Plastic tubs or containers big enough to hold three to four newborn kids; the containers should be disinfectable.

The Process of Parturition (Kidding)

Gestational length of does is approximately 150 days. "Normal" kidding usually occurs between 143 and 157 days of gestation. If does are showing signs of parturition outside this window, first double check the breeding dates.

The process of normal parturition (birth) in goats is as follows:

1) Stage 1 labor: Does show signs of impending parturition, In stage 1 labor, uterine contractions help position the kid to be born, and cause the cervix to dilate.
    a. Pelvic ligaments loosen
    b. Restlessness
    c. Pawing, nesting behavior
    d. Vocalization
    e. Isolation from herd/other animals
    f. Can last up to 12 hours in first-freshening does, older does usually proceed faster.
    g. Cervical mucus plug sometimes visible.
2) Stage 2 labor:
    a. Cervix is fully dilated; kid(s) are presented in the birth canal (pelvis), and born.
    b. Lasts up to two hours
    c. Is completed with the delivery of the last kid
3) Stage 3 labor:
    a. Does pass placenta
    b. Usually within four hours
    c. Postpartum discharge (lochia) can be seen for up to four weeks.

During the normal birth process, as stage 1 labor progresses, the cervix will dilate enough to allow a kid to pass through and to be further pushed through the pelvis and expelled. Kids should be positioned in such a way that they can be delivered. The normal positions are called anterior and posterior. Anterior positioning is most frequent. The two feet and nose are presented, and the kid should be born in a diving position. In a posterior position, the back feet are presented, and the kid is born backwards. The first distinguishing feature you will see in a posterior position are feet that are upside down. This is considered a normal presentation, and a kid can be delivered this way, but it is best to help deliver a kid in this position because the umbilical cord will be compressed when it enters the birth canal and the kid may be without oxygenated blood, which may cause it to breathe before it is fully delivered.

At the end of stage 2 labor, it is important to determine that all kids are delivered. Even with ultrasound diagnosis, it is always possible that an additional kid is retained. Since each kid has its own placenta, the delivery of one placenta is not an indication that all kids have been delivered.

Stage 3 labor consists of expelling the placenta. Placental membranes can be expelled as quickly as within an hour of birth or can be a prolonged process. Placental membranes are considered to be "retained" after 12 hours. Never pull on placental membranes to remove them. If you pull on the membranes, they may tear, thus leaving placental tissue in the uterus that could cause infection. If a retained placenta occurs, it is best to consult your veterinarian or to follow the recommended protocol that he/she has prescribed for your herd. Complete uterine involution is usually complete within 28 days postpartum.

Aftercare of the doe is an important consideration in order to help ensure a productive lactation and an increased likelihood that she will rebreed. If the birth was unassisted and the doe did not have a retained placenta, she will not need further treatment but it is a good idea to offer post-partum does a bucket of warm water, and milk her out soon after kidding. The raw colostrum can be heat-treated, labeled, and frozen in bottles for feeding future kids. If the kidding involved invasive procedures and/or the doe has retained the placenta, consult with your veterinarian about administering antibiotics. Students learn in veterinary school the 4 "M"s that may be of concern after parturition of any animal:

- Mastitis (infection of the mammary gland)
- Metritis (infection of the uterus)
- Musculoskeletal (problems with bones, muscles, tendons, or ligaments)
- Metabolic (problems such as hypocalcemia (milk fever), pregnancy toxemia (hypoglycemia – low blood sugar))

Producers should learn to observe for these signs and consult their veterinarians for treatment recommendations.

Dystocia

An abnormal birth presentation is called a dystocia, a term meaning "difficult birth". The severity of a dystocia can range from a mild malpresentation that can be easily corrected, to an impossible situation that can only be delivered via surgery (caesarian section). Producers can learn to deliver many dystocias but must keep in mind the dangers to the doe and the kid(s) and take precautions to avoid an unwanted outcome. The two major risks associated with correcting dystocias are 1) introducing pathogens (mainly bacteria) into the uterus of the doe, thereby causing infection and 2) causing a vaginal, cervical, or uterine tear, which can result in infertility and/or the death of the doe.

It is always difficult to determine when intervention is warranted. Some of the indications are as follows:

1) If hard labor continues for ½ to 1 hour without a birth
2) If placental membranes have been showing for ½ to 1 hour
3) If there is yellow staining of the mucus. Yellow staining is caused by fetal meconium (feces), an indication of stress on the fetus. In this case assistance should be provided.

Before attempting to assist a doe in labor, the following precautions should always be taken:

1) Clean the vulva of the doe with a mild disinfectant such as dilute Nolvasan®. Do not use detergents (mild soap is OK). Alcohol wipes are also acceptable.
2) Have someone hold the doe if possible, or tie her loosely to the fence. She needs to be able to get up and lie down if she wants to.
3) Wear a sterile OB sleeve. Not only will this protect the doe from bacteria, but will protect the person from possible diseases that can be transmitted from goats to people during parturition.
4) Make sure you do not have long fingernails or jewelry that could damage the doe's reproductive tract.
5) Cover your hand and fingers with sterile lube
6) Proceed slowly and gently.
7) Learn to recognize the anatomy as you go.
8) If you are not experienced enough to proceed, arrange for a veterinarian or other experienced breeder to help you at first until you gain knowledge and confidence.
9) Never be overconfident. This is when mistakes are made.

10) Tips for recognizing kid anatomy in utero:

a. To tell a front leg from a back leg, bend the joints. A foreleg has two joints (the knee and the pastern) that both bend the same way. A rear leg has two joints (the hock and the pastern) that bend different ways.

b. If you feel a tail being presented you know it is a breech presentation

c. If you see upside down feet being presented, it is a posterior presentation

d. When you feel a head and neck, trace down the shoulder to the front legs to ensure that the legs being presented belong with the head and are from the same kid.

11) An excellent reference with photos and drawings of both normal and abnormal kidding is "Kidding with Confidence" "A Kidding Season Mentoring Program for Northeast Meat Goat Producers" sponsored by Cornell Cooperative Extension (Cornell Sheep & Goat Extension Program, 2012). It can be ordered through the Cornell Sheep and Goat Extension Program, Room 114, Morrison Hall, Dept of Animal Science, Cornell University, Ithaca, NY 14853. As of this writing it could be downloaded at: http://www.ansci.cornell.edu/goats/Resources/GoatArticles/GoatHealth/KidCare/KiddingHandbook.pdf

Kid Rearing

The three most important factors in raising healthy replacement kids are:

- ✓ Keep them WARM! (or cool, depending on climate and time of year).
- ✓ Keep them FED!
- ✓ Keep them CLEAN! (free from exposure to disease-causing organisms)

Best Practices for Dairy Kid Replacements (birth to 2 weeks of age)

Kidding should take place in a clean area.

If necessary, tape the teats of does to help ensure the kids cannot nurse.

Observe every birth, do not allow kids to nurse the doe, or the doe to clean off the kids.

Consider inducing does to kid during a time and day when they can be observed.

Remove kids from does immediately.

Assure kids are breathing, cleaned off, and in a warm location.

Navels should be dipped with an iodine or chlorhexidine solution (Nolvasan®).

Kids should be immediately identified:

Dam information

Date of Birth

Kid ID/tattoo number

Paper collars work well temporarily, but ink comes off easily and kids outgrow them so it is recommended that kids be tattooed at the same time as disbudding.

Colostrum Feeding

Kids should be fed at least 8 ounces of heat-treated colostrum (10% of body weight) within 8 to 12 hours of birth (for smaller kids, they can be fed in two meals), but it is preferred they get the first feeding of colostrum within 2 to 3 hours. If kids are born compromised (weak, cold, or in an unclean environment) they need to be fed colostrum as soon as possible, and warmed as soon as possible. If kids are born weak and have a weak suckle reflex, their suckle reflex will not improve until they are warmed and receive nutritional energy from

warm colostrum. It may be necessary to tube feed colostrum to very weak kids. An excellent publication, "Tube Feeding Neonatal Small Ruminants" by Kerr (Kerr, 2005), can be found at http://cru.cahe.wsu.edu/CEPublications/eb1998/eb1998.pdf Farming the Northwest series, Washington State University Extension, Small Farms Team, Washington State University Bulletin Office 1-800-723-1763 or http://pubs.wsu.edu

Upon consultation with your veterinarian, it may be beneficial to give some vitamin and/or mineral supplementation to kids at birth.

Sources of Colostrum

"Colostrum" is the first milk a doe produces after she freshens. This first milk is rich in nutrients and contains antibodies that can be absorbed by the gut of newborn kids up until about 24 hours of age, but is most effectively absorbed within the first 12 hours. Antibodies in colostrum are large molecules and cannot pass through the gut wall after the kids are a day old. Therefore, most producers keep frozen colostrum on hand for use as soon as kids are born. Even though does are apparently healthy, it is recommended that producers heat-treat all colostrum before feeding it to replacement kids.

To heat-treat colostrum:

- ✓ First, determine that colostrum is of good quality. Colostrum should be fairly thick and yellowish in color. For an accurate measurement of colostrum quality, a "colostro-meter" can be purchased from a dairy or livestock supply company. Colostrum from only the first milking should be used. If does have been leaking milk, or been milked before kidding, it is not recommended that their colostrum be used.
- ✓ To adequately heat-treat colostrum it should be heated to 135°F (56 to 57°C) and held at that temperature for one hour. Higher temperatures will denature the antibodies in colostrum, and should be avoided.
- ✓ The most convenient way to accomplish this is to use a water bath. It is possible to buy thermostat controlled canning pots (one brand is called "Weck"). If you pour the colostrum into canning jars with lids, heat it to 135°F (check internal temperature of the jars) and hold it one hour, then check to make sure the colostrum in the jar has not gone below 130°F, it should be properly heat-treated.
- ✓ Pour the heat-treated colostrum into 8 to 24 ounce bottles
- ✓ Label the bottles "Heat-treated colostrum (HTC)", doe number or numbers, date, and amount.
- ✓ Put the tops on the bottles and freeze them.

Producers should always have frozen colostrum on hand for immediate use. It is simplest to freeze colostrum in 8 to 24 ounce bottles, so the amount needed can be thawed. The most effective and safest colostrum to use is heat-treated colostrum from does in the resident herd. It is also suggested that does be immunized against tetanus and *Clostridium perfringins* (entertoxemia), three to four weeks before kidding, so their antibody level is high when the colostrum is harvested. Never thaw colostrum in a microwave oven.

Additional sources of colostrum (in order of most to least recommended):

- ✓ Heat-treated goat colostrum (from tested clean does in a different herd)
- ✓ Heat-treated cow colostrum (1st milking from 2nd-freshening and higher cows)
- ✓ Raw colostrum from dam
- ✓ Raw goat or cow colostrum
    - o Commercial colostrum substitutes based on bovine plasma (effective in lambs, not tested in goats)
        - ▪ Other commercial "colostrum substitutes". Not recommended. These preparations do not provide the necessary antibodies.

After the initial processing of kids is accomplished, kids should be placed in a clean area dedicated to the purpose of raising kids through the first two weeks of life. The ideal kid-rearing area should be at an appropriate temperature, keep kids isolated in small groups, kept clean, and not used to raise previous kids. An unconventional but highly effective method of raising kids for 10 days to 2 weeks is to use cardboard boxes. Appliance boxes and newly purchased boxes of approximately 3 feet by 3 feet are easily obtained and may be disposed of after each group of kids is old enough to go into older groupings. An additional advantage of the disposable boxes is to provide instant isolation. If the kids in a particular box show signs of infectious disease the entire box of kids can be moved to a separate location and fed/handled last.

Disbudding & Tattooing

During the first two weeks of age, replacement kids should be disbudded and tattooed. Humane disbudding can only be accomplished early in life. Swiss breeds and Lamanchas should be disbudded before 7 to 10 days of age, depending on birth weight and sex. Nubians can be effectively disbudded at a slightly older age (14 days is normal). Tattooing assures kids have permanent identification for the lifetime of the animal. In order to effectively manage dairy animals it is essential they be identified. Without legible, permanent ID, the various performance programs available to dairy goat producers, like registration/recordation, production testing, linear appraisal, show accomplishments, progeny records, and DNA testing are impossible. The American Dairy Goat Association has fact sheets on disbudding and tattooing on their website at www.ADGA.org. Appropriate goat ID needs to be both visible and permanent. Electronic implants may be useful in some cases, but an approved implantation site needs to be agreed upon. Implants are permanent ID, but not visible without a reader. When using electronic implants, it is recommended that visible ID be used for daily management records.

Early kid feeding

After the initial colostrum feeding, kids should be fed a safe source of milk in increasing amounts to accommodate their nutrient needs for growth. In order to prevent the transmission of certain pathogens like caprine encephalitis arthritis, Johnes, mycoplasma, and others, it is recommended that kids be fed one of the following "safe" sources of milk:

- ✓ Pasteurized goat milk, preferably from clean (tested) does
- ✓ Pasteurized cow milk
- ✓ Milk replacer (a formula intended for goat kids)

The author has little experience with kid milk replacers, so producers may have to try different products in order to find a brand that works best with their management. Recommended milk replacers are 20 to 28% protein and 16 to 24% fat. Choose a milk replacer with a whey or milk-based protein rather than soy-based protein. Some milk replacers are expensive, so a less expensive alternative may be to obtain cow milk at wholesale prices from a commercial cow dairy. In this case, the producers should not buy "hospital" milk and should pasteurize all milk before feeding kids. A U.S. study in dairy calves found a 23% increase in average daily gain, a 275% decrease in the number of animals treated for disease, and a 500% decrease in calf mortality for calves fed pasteurized milk vs. milk replacer (Godden, 2008). Experience has shown that kid goats grow just as well on cow milk as they do on goat milk. Some other options for obtaining cow milk, especially if a small number of kids are being raised, is to buy pasteurized whole milk from a grocery store. Depending on the resources available to producers, milk from the above-listed sources could be combined in various ways to ensure the least cost to producers. Producers must be careful not to change the milk or combination of the milk too quickly as a rapid change may result in kid diarrhea.

Conclusion

For goat producers, whether they manage commercial herds or raise seed stock, the series of events from mating to raising replacement herd animals is the time at which you may make the greatest impact on your herd's health and performance. Even though the process requires a major commitment of time and resources, the benefits can make the process worthwhile. It can be a source of financial gain and of pride for producers to manage a herd of healthy, high-performing dairy goats.

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Low-input Kidding: Tips for Pasture-based Kidding

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Low-input kidding would be defined just as it sounds, low cost and low labor resulting in successful live kid births to weaning. low-input kidding commonly requires minimal management on pasture settings, in the fall or late spring. Decisions are made to how little labor will be invested by ultimately exercising herd improvement by natural selection. Routine tasks are scheduled at the same time each day.

The success of pasture birthing is dependent on planning ahead for several factors such as location, visibility of does, available resources, stocking rate, parasite control, predator control, and marketing. A survey of producers conducted by Cornell University has shown that spring and fall kidding or lambing require far less hours of labor than winter.

Tip #1: Location

- Birthing pastures are close to the farm house and easily observed from the house, truck or yard
  - Provides ease of checking animals
- Pastures have easy access to the barn or a road
- Easy access to available water

Tip #2: Visibility

- Dams are clearly marked ahead of time with spray paint or paint brands and offspring will be identified to match the dams
- Grouped by gestational age
- Cull candidates can be marked for easy identification

Tip # 3: Organization

- Recognize specific potential problems before kidding starts
- Streamline feeding and watering
- Divide does into small groups that are due at the same time
- Organize equipment in totes, buckets, tool belts
- Develop a Kidding SOP (Standard Operating Procedure) detailing in outline form all tasks that need to be done, so that all persons working herd consistently handle problems, and labor is focused to a minimum
- Prepare for losses
- Keep good records
- Plan for inclement weather

Tip #4: Be Resourceful

- Bedding is discarded hay from mangers
- Children can take feed bottle kids
- One barn serves as ‘special needs’ animals
- Cull does that experience dystocia, mastitis, or poor mothering

Tip #5: Stocking Rate

- Dependent on forage availability
- Animal density: number of animals in a paddock based on forage, number will increase gradually as kidding progresses
- Consider livestock guardian animals
- Number of subdivisions
- Type of fencing
- Water source
- Shelter
- 'Set Stocking' or 'Drift Stocking'

Tip #6: Parasite Control

- Spring and Fall - seasons of concern
- Genetic selection - herd records
- Minimal forage height 3-6 inches
- Rotate does out of pastures within 5 days and not returning for at least 60 days.
- Evasive grazing: move goats fast enough to prevent infection from feces deposited during current grazing period
    - Allow 60-105 days rest period for substantial L3 die off

Tip #7: Predator Control

- Remove afterbirths and dead offspring
- Livestock guardian animal: Dog, donkey, llama
    - Avoid running young dogs with does and kids
    - Young female donkey or gelded jack - must be bonded to herd
- Dusk-Dawn lamp

Tip #8: Seasons

- Will depend on marketing
- Loafing areas for does to kid in out of the wind, rain, snow
    - Hedgerows, cedar groves, or dead drops (fallen trees)
    - Portable loafing sheds
- Does may mob shelters during bad weather
    - Provide wide entrances to avoid trampling and overcrowding

Tip #9: Marketing

- Prices vary each year
- Ethnic holiday calendar- market 2-3 weeks prior to holidays
- Winter prices tend to be higher
- On farm sales vs sale yard
- Breeding stock vs market animals

When processing a litter, wait several hours to ensure bonding and first nursing. Processing at this time should include tagging/branding, weighing, navel dipping. Save the more painful procedures (castration) after kids are older and able to keep up with dam.

Other important point to consider is nutrition of pregnant does. Water becomes extremely important nutrient. Spring kidding does will be at peak lactation during the hotter months of the summer, so water availability is essential as lactating goats water intake can increase 2-12X normal (1-4 gallons per day) depending on the temperature. Locate tanks centrally under a shade tree or shelter in large paddocks. Shading the water source will keep the water cooler, problems with this set up are obvious as the animals will loaf here and the fecal contamination will become a concern.

Spring born kids tend not to grow as well as winter kids. These kids may require creep feeding to grow at maximum potential, depending on the producers goals. Creep hopper feeders provide minimal labor to maintain, but not necessarily cost efficiency.

Forages in the spring need to be managed for optimum quality. Cutting for hay and/or multispecies grazing will keep forage growth nutritious and vegetative. Brush will provide forage and shade in the hotter months of summer once pastures are exhausted. The brush also helps control gastrointestinal parasites in hot humid summers.

Resources

- Dr. Tatiana Staton, State Small Ruminant Extension Specialist, Cornell University, Ithaca, NY "Low-Input birthing" www.ansci.cornell.edu/goats/lowinput_birthing
- Dr. An Peischel, State Small Ruminant Extension Specialist, Tennessee State University
- www.luresext.edu/goats
- www.extension.org/goats
- www.sheepandgoat.com

Diseases of Concern during Pregnancy

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This talk will focus at first on conditions producers ask about during pregnancy. Then we will discuss diseases that are associated with abortion that have the potential to infect humans (zoonotic). This is intended to be informative, not scary. My intention is to bring awareness to producers about situations we often take for granted and forget to be careful.

Pregnancy Toxemia (Ketosis)

- A nutritionally based condition
- Final 6 weeks of gestation
- Overweight/ underweight does, carrying multiples
- Brought on by stress, storms, transport, fasting, excessive heat, and poor nutrition
- Causes hypoglycemia leading to ketosis, and liver failure.
- Symptoms:
  - Decreased appetite or refusal to eat
  - Swollen pasterns
  - Ketones in urine
  - Reluctant to stand and move
  - Depression
  - Head pressing
  - Coma
  - Death
- Treatment:
  - PREVENTION, PREVENTION, PREVENTION
  - Early detection
  - Treatment not always successful
  - Increase exercise
  - Propylene glycol, maple syrup
  - Yogurt, calcium drench, CMPK (oral), bicarb
  - Dextrose IV with IV fluids – requires vet's help
  - End pregnancy - Induce labor or c-section
- Prevention:
  - Proper management of weight during early pregnancy; monitor body condition scores (2-3.5)
  - Good nutrition that supplies adequate energy especially during the last 6-8 weeks of gestation;
  - Exercise
  - Avoid stress

Caprine Arthritis Encephalitis Virus (CAE)

- Common in dairy goat
- Several clinical forms
  - Neurological disease common is young kids (2-6 mo)
  - Decreased lactation or no milk at all (young does)

  - Arthritis (2 yrs & older) –front legs
  - Respiratory Disease Complex (adults at any age)
  - Chronic weight loss
- Lifelong infection
- Transmission: oral consumption of infected colostrum or milk – not heat treated
  - Contaminated milking machines
  - Contaminated needles, tattoo pliers
- Diagnosis
  - Serological testing (ELISA)
- Prevention
  - Isolate infected animals (seropositive)
  - Remove kids at birth (do not allow to suckle)
  - Feed newborn kids heat treated colostrum & milk
  - Heat treat colostrum to 132.8℉ for 60 min
  - No maternal antibody protection
  - Kids infected at birth can show an active antibody response as early as 4-10 weeks of age. These antibodies are present for life.
  - Test kids fed virus-free colostrum/ milk at 12 weeks of age
  - ELISA – test of choice
- Treatment: NONE
- Control:
  - Periodic serological testing
  - CAE free kids
  - Cull, cull, cull
  - No vaccine available

Mastitis

- Inflammation of the mammary gland or udder of the doe
- Gland is painful, hot, and hard. Will not allow lambs/kids to nurse
- Kids from infected does nurse on other does spreading the bacteria to others in the herd.
- Control and Treatment:
  - Primary control = good management practices
  - Good milking hygiene, clean equipment
  - Clean and dry bedding material, when does lie down to rest with a full udder the bacteria in dirty bedding can easily enter the teat
  - Isolate infected animals - helps to control the incidence.
  - Milk these does last.
  - Peppermint oil helps relieve inflammation
  - Antibiotics and pain medication
  - Culture milk sample- proper antibiotic
  - Antibiotics and pain medications must be prescribed by a veterinarian
  - Mastitis can get serious enough to cause irreparable damage to the mammary gland, rendering the gland scarred and unable to produce milk
  - Can cause sepsis and death of doe in acute cases

Abortion Diseases

- What is a Zoonotic disease?
  - A disease agent is transmitted from animals that causes disease in humans
- Zoonotic diseases from small ruminants:
  - Infectious abortion agents
  - Some infectious agents from neonatal diarrhea (scours)
  - Some skin diseases
  - Infectious agents in raw milk
- How do humans get these diseases?
  - Handling of placentas, birth fluids, or fetuses
  - Handling sick animals
  - Drinking raw milk
- Prevention
  - Wear dedicated barn clothes
  - Don't wear in the house
  - Includes barn hat, coat and boots
  - Wear disposable gloves
  - Wash hands and arms with disinfectant soap after done
  - Avoid aborting animals if pregnant women or very young and very old person
  - Immuno-compromised people
  - Raw milk concerns
- What about children?
  - Keep young children out of the barn if abortions are occurring
  - Keep infants out of the barn!
  - Keep people with compromised immunity out of barn
  - Make sure children helping with chores follow same rules as adults:
  - Clothing
  - Wash hands and arms

Chlamydophila abortus - Enzootic Abortion

- Most common cause of abortion in North America
- Zoonotic potential- placenta, uterine fluids, feces and lungs
- Affects both goats and sheep
- Infected at 30-120 day gestation
- If infected during last month of gestation, will have a normal birth then abort next pregnancy.
- Recovered females are immune but carriers
- Control and Prevention
  - Isolate affected ewes/does
  - Vaccinate, Colorado Serum Co. (labeled for sheep)
  - Extra-label for goats- requires veterinary prescription
  - Vaccinate 60 days prior to breeding
  - Booster 30 days later
  - Withdrawal for slaughter = 60 days
  - Booster annually
- Zoonosis
  - Not common but IMPORTANT

- Pregnant women assisting with birth
- Mucus membrane contact
- Severe illness

Coxiella burnetti - Q-Fever

- Zoonotic abortion disease
- *Coxiella burnetti*
- Ticks are the primary reservoir
- Organism can survive in the environment for extended periods (dust in barn)
  - Shed in placenta, uterine fluids, raw milk, colostrum, urine, feces, and semen
  - Goats shed for up to 4 months in vaginal secretions, 1 month in feces, and 52 days in milk
- Abortion or stillbirth in the last trimester, but second trimester abortion can occur, may occur in successive pregnancies
- Abortion storm up to 80%
- Causes inflammation of placenta (placentitis), failure to dilate cervix, ruptured uterus, stillbirths, weak kids.
- Infected animals may seroconvert, recover, clear infection or be persistently infected
- Zoonosis:
  - Highly infective
  - 1 organism inhaled can infect a human
  - Outbreaks associated with assisting with dystocia, handling placentas and aborted fetuses, dusty conditions + small ruminants
  - Group "B" Bioterrorist organism
  - Incubation 2-3 weeks
  - Some infected people seroconvert and become asymptomatic
  - Acute flu-like illness- mild to severe, 1-2 weeks duration
  - More severe = hepatitis and atypical pneumonia

Toxoplasmosis

- Cats become infected by eating infected rodents, birds, and aborted material
- Cats shed oocysts in feces
  - Oocysts survive a long time in the environment
  - Fecal contamination of feed, hay, and pastures
- Non-pregnant does develop an immune response
  - If pregnant – organism infects placenta and fetus
- Goats more susceptible than sheep
- Placenta is infected 14 days after ingestion
  - Infection: <40 d gestation = fetal death/ reabsorption
  - 40-120 d gestation = fetal mummification and abortion
  - 120 d gestation = premature, stillborn or weak
  - Abortion late pregnancy = 15-20%
  - Fetuses within same litter affected differently
- Infected does likely to be resistant to reexposure and abortion in following pregnancies
- Found in goat semen but venereal transmission unlikely
- Seropositive ewes gain immunity but organisms persist in cysts in brain and muscle
- May still transmit organism to placenta at lower rate
- Zoonosis

  - Pregnant women
  - New infection
  - Premature birth or underweight
  - Damage to brain and eyes
  - Milder damage not apparent until older
  - Infection postnatal
  - Healthy humans- mild illness with fever and enlarged lymph nodes
  - Infection lifelong
- How do Humans get Toxo?
  - Consumption of live spores from poorly cooked meat
  - Infected kid meat, mutton
  - Consumption of sporulated oocysts from food or handling objects contaminated with cat feces
  - Fresh vegetables
  - Unwashed hands after cleaning litter box
  - Consumption of unpasteurized goat's milk and unripened cheeses
  - Contamination in barn
  - Cat / kitten feces

Campylobacter - Vibrio

- *Campylobacter fetus* and *Campylobacter jejuni*
- More common in sheep
- Ingestion of organisms
  - Can have carrier state 20-70%
- Abort late gestation, last 6-8 weeks
- Lambs/kids born weak or dead
- Ewes/does are sick and can die,
  - IF they recover will be immune next year but become carriers
- Diagnosis: Placenta & fetus (stomach fluid & liver)
  - Fetus is edematous ("Water belly babies")

Listeriosis

- Causes abortion, septicemia and encephalitis in goats
- Abortion form and encephalitic form do not usually occur at the same time.
- Commonly associated with poorly prepared silage
- Environmental contaminant
- Fecal shedding peaks in winter
- Found in soil, water, poorly prepared silage (pH >5.0) and digestive tracts of ruminants and humans
- Organism can survive in soil and feces for long time
- Incubation 10-21 days
- Intermittent shedding through milk of healthy does
- Organism is shed in milk – human risk
- Control:
  - Remove source of infection
  - Long acting Oxytetracycline in face of outbreak (Extra-label use in small ruminants)
  - Do not feed hay on ground
  - Silage needs to be good quality and low acidity
- Zoonosis:

- Shed in milk
- Unpasteurized mild and unripened cheeses are most important source of organism
- Grows in refrigerated foods
- Septicemia in elderly, young, and immunocompromised
- Severe illness
- Encephalitis
- Abortion in women
- Death
- Mild disease causes diarrhea
- Can cause severe disease in healthy humans too!

Salmonella

- Two species associated with abortion
  - *Salmonella enterica enterica* (7 serovars)
  - most important cause of systemic disease and abortion in small ruminants
  - *S. enterica arizonae* – small ruminant abortion
- Transmission by oral ingestion of contaminated feed, aborted fluids by goats in herd, cattle, dogs, rodents, birds and wildlife
- Abortions peak at 100-120 days gestation
- Causes abortion, metritis, septicemia and subsequent death of doe / ewe
- Aborting does may not show signs of illness
- Diagnosis:
  - Bacterial culture of aborted placenta, fetus, or uterine discharge
  - PCR of fecal or vaginal swabs – rapid test
- Treatment:
  - Antibiotic therapy based on antibiotic sensitivity
  - Prevention and control
  - Limiting contamination by vectors
  - Clean environment
- Zoonosis:
  - Handling aborted placenta, fetus, fluids
  - Shed in milk
  - Killed by pasteurization

Leptosporosis

- Several strains
- Sheep considered relatively resistant, can become maintenance host
- Goats more susceptible
- Degree of losses is unknown
- Infection occurs as result of exposure to an environment contaminated by urine of other species
- Recovered goats can continue to shed organism in urine
- Organism shed in milk Not a common cause of abortion in small ruminants in United States
- Diagnosis : paired serum samples from aborting dams
- More concern in cattle
- Zoonosis:
  - Skin contact with infected aborted placenta and fetus, urine (dogs)
  - Can cause severe illness resulting in renal and liver failure in humans

Brucellosis

- Not common in US
- *Brucella melentensis* – goats (Middle East, So. America)
- *Brucella ovis* – sheep (western North America)
- Transmitted in milk, urine, feces, semen, vaginal discharge, and placental membranes
- Malta fever in humans

Extra-label Drug Use

- Only FDA labeled approved drugs can be used legally without restrictions as indicated on label, otherwise it is considered "extra-label" use and subject to specific regulations as outlined by the FDA
- Must have a valid Veterinary Client Patient Relationship (VCPR)
- Goats are a minor livestock species (AMDUCA)
- Very few drugs approved for use in goats

References

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- Sheep and Goat Medicine, Dr. David Pugh
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Internal Parasite Control - Sustainable Internal Parasite Control

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The ongoing task of controlling gastrointestinal parasites in goats and sheep continues to be daunting. To make control of these microscopic parasites sustainable is even more challenging, but we are here today to discuss what we know and the recommendations made by those that dedicate their professional lives to methods for control.

Introduction to Small Ruminant Parasites

Of all the gastrointestinal parasites infecting small ruminants on pasture, the Haemonchus-Ostertagia-Trichostrongylus-Coccidia (HOTC) complex is most likely to have the most economic impact on production. Different sections of the gastrointestinal system are affected by specific parasites. Understanding this may help in understanding the problem overall.

- Abomasum (4th stomach):
  - *Haemonchous contortus* (Barberpole worm)
  - Ostertagia (Brown stomach worm)
- Small Intestinal parasites:
  - *Trichostrongylus* (Bankrupt worm)
  - Coccidia (Eimeria spp.)
- Other parasites with lesser pathology but can still cause losses under optimum conditions:
  - Cooperia
  - Nematodirus,
  - Oesphagostomum
  - Bunostomum

It is important to understand the general lifecycle of parasites in order to effectively control them. The eggs of the parasites are encased in the fecal pellets, deposited onto the pasture where it will continue two stages of larva development (L1, L2) outside the host animal. The infective larva (L3) migrates out of the pellet and up the first 3-4 inches along the stem of forages utilizing the water film present from dew, rain or irrigation. Therefore early mornings can be the time of day when most ingestion of larvae takes place. After the water film dries from the forage, the larvae migrates back down into the top of the soil or mulch litter seeking protection from drying during the day. Once ingested by the animal, the larvae enter the rumen and travel with ingesta to the 4th stomach, the abomasum. During this time the larva matures into adult parasites and once in the abomasum the adult worm attaches to the mucosa of the abomasal lining and begin feed and multiply.

Trichostrongylus and coccidia populate the first section of small intestine just past the abomasum. Trichostrongylus is a nematode that attaches in the small intestine. Coccidia, a protozoan, invades the mucosal cells of the lining of the small intestine, causing an inflammatory reaction during times of stress, interfering with absorption of nutrients and water causing diarrhea, malabsorbtion and dehydration in kids and lambs.

Coccidia must complete a portion of its sporulation in the environment (outside host) it prefers dark moist conditions to complete this cycle. So the dark corners of barns or loafing sheds are areas of potential infection. Coccidia is resistant to most cleaning solutions, except sunlight. Exposing dark areas to direct sunlight is the best way to control coccidia.

Once understood, the life cycle of these serious parasites can be used in management strategies. Disruption of the conditions of which these parasites rely on to complete the life cycle will be advantageous in controlling the infective stages.

In addition to management changes, it is also important to realize what has caused these parasites to become so resistant. In past years chemical dewormers have been used to essentially eliminate the parasite populations, these compounds were used frequently and all animals were treated whenever the threat of infection was suspected. Years of research has shown that this management has created very resistant parasites that are no longer affected by medical treatment. Modification of management practices can contribute to reversing the resistance of parasites, but it will not be a quick fix.

Management will be the primary topic of discussion to look at recommendations that are doable and affordable ("sustainable").

General Management

Problems were created by too frequent rotation, underdosing, overstocking, and retaining susceptible genetics. Understand there is NO SILVER BULLET. Years of genetically resistant parasites will take years to undo, but it can start with a few management changes.

1. Don't feed on the ground or allow animals to climb in feeders, leaving behind infected feces in the trough where parasite laden fecal material can be ingested at feeding.
2. Expose loafing areas to sunlight and drying, portable shelters
3. Drylot animals overnight until dew has dried
4. Good nutrition is essential for healthy animals with healthy immune systems
5. 5-point check : Eyes (FAMACHA), back (BCS), tail (diarrhea), hair coat (appearance), and jaw (bottle jaw) http://www.slideshare.net/schoenian/the-five-point-check
6. Utilize FAMACHA to identify anemic animals most affected by *H. contortus*. Be mindful that this is one tool and is only intended to evaluate those animals most affected by *H. contortus*.
7. Utilize fecal egg counts as often as possible. Learn to do this on your own
8. Monitor weights, and body condition scores (BCS)
9. Maintain good records to identify susceptible animals to cull
10. Practice good pasture management
    a. Utilize diversified forages containing tannins in pasture
    b. Maintain 3-6 inch height of pasture forages. Plants will be healthier too.
    c. Allow grazed areas to rest a minimum of 60 days or more
    d. Utilize brush as available forage as much as possible
    e. Don't allow animals to graze close to manure piles
    f. Harvest hay (exposes eggs and larva in soil to drying and sunlight)
    g. Integrate other grazing livestock in rotation
11. Market kids before peak parasite seasons
12. Reserve the use of dewormers for those animals that absolutely need it
13. Genetic Selection – select to keep those animals that are least affected by parasites
    a. Parasite resistant animals will routinely have low FAMACHA scores(1-2), maintain body condition scores (2-3.5), weight and low FEC counts

b. Meet your production expectations
c. Heredity of parasite resistance is moderate 0.25-0.36
d. Understand that some breeds have this ability better than others
e. Resistance: consistently low fecal egg counts; Resilience: Not physically affected by parasite load regardless of fecal egg count
f. Don't be afraid to CULL, 80:20 Rule: 20% of the animals carry 80% of the parasites, cull the animals in this 20%

Alternative Control Recommendations

- Nematode trapping fungi
- Cooper oxide wire particles
- Herbal treatments
- Tannin containing forages
- Vaccine

Integrate multiple recommendations

- Utilize current methods
- 5-point check
- Reduce overall dewormer usage
- Integrate alternative recommendations
- Identify problem animals: FAMACHA/FEC
- Adopting smart drench procedures
- Maintain good nutrition for healthy animals
- Establish good on and off farm biosecurity practices

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Pregnancy Losses in Does

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Introduction

Abortions or premature kidding in does are caused by different factors. Most common causes are infectious, malnourishment, environment, stress, hormonal and trauma. Late term abortions are usually due to stress or infectious. It is important to remember that many of the infectious causes of abortions in goats are zoonotic and can be transmitted to humans. Gloves, protective clothing, and boots should always be worn when collecting samples from the abortion and hands should be cleaned carefully after handling potentially infectious material. Pregnant women or immune compromised people should not assist with kidding or handling of aborted material. Always isolate the doe and dispose of all aborted material (fetus, placenta and fluids) by burning or burying them.

Chlamydophilosis is the most common cause of infectious abortion in goats, and the causative agent is *Chlamydophila abortus*. Clinical signs are late term abortions, high number of stillbirths and weak kids. Naive yearling does that have been recently introduced into an infected herd are usually the animals that abort. *Chlamydophila* can also cause conjunctivitis (pink eye), and polyarthritis (arthritis in multiple joints). And they are usually shed in the feces. The exact strains of the *Chlamydophilosis* bacteria causing these diseases differ from those causing abortions. Does exposed to the abortive strain through direct contact with the aborted fetuses, placenta, infected vaginal discharge, or orally ingesting contaminated feed. After ingestion, the bacteria colonize intestinal epithelium, spread systematically to the uterus. Infected bucks may transmit the infection through natural service.

A history of late term abortions, stillbirths and birth of weak kids is suggestive of Chlamydophilosis. The aborted fetus may be fresh or decomposed in appearance. Female kids infected with the organism at birth may abort in their first pregnancy. Does exposed to this bacteria during the first half of gestation, may abort in the last trimester of that pregnancy. Does exposed in the last half of gestation may abort in the subsequent pregnancy or have high incidence of stillbirths or weak kids. Once abortion has occurred, does appear to have immunity as affected animals seldom abort more than once due to Chlamydophilosis. Although immune, they can shed the bacteria in the vaginal secretions when in heat, potentially infecting the other does that may be pregnant at the time.

Isolate aborting does from the herd for at least 3 weeks. Placentas and fetuses should be removed, burned or buried. To minimize exposure, ensure that all feed and water sources are protected from contamination. Treating all does in an abortion outbreak with tetracycline may reduce additional abortions by up to 50%. There is a vaccine approved for use in sheep in the US. Vaccine should be administered four weeks before breeding.

Toxoplasma gondii is a protozoan parasite that can infect goats, and is second in importance only to Chlamydophila as a major cause of infectious abortion in the mid-west. Cats are the primary or definitive host for toxoplasmosis, becoming infected by eating infected rats or mice. Most warm blooded animals (birds and mammals) are intermediate host. The parasite matures in the intestine of the cat and infective eggs or oocytes are passed in the feces which can infect goats and other animals if consumed. Other than cat feces, the only source of infection for does is by consuming the infected placenta or birth fluids from aborting does. Younger cats are more of a threat to spread the disease than older cats. Less than 4% of persistently infected animals will transmit the parasite vertically through transplacental transmission. Cats develop immunity as they get older, neutered adult males and adult females are less likely to be a source of infection.

Does infected early in gestation, fetal death and resorption usually occur. Infection late in gestation results in mummification, stillbirths, and birth of weak neonates. Not all fetuses presented from the infected dam may demonstrate the organism. Aborted fetuses do not have significant lesions. Presentation of twin and triplet abortions often reveals fetuses in variable postmortem conditions - mummified to fresh. Diagnosis maybe based on the appearance of the placenta, small greyish white foci of necrosis, "rice gain" lesions typically found on the cotyledons. Another common finding is focal necrosis in the cerebral white matter in the brain of stillborn and weak kids.

During gestation, all cats should be kept away from pregnant does. Remove all feed which may have been contaminated with cat feces and prevent cats from defecating in feeders, on hay bales, water trough, bedding, etc. There are no vaccines available in the U.S. for toxoplasmosis. Feeding decoquinate or monensin throughout pregnancy has been shown to have some protective effect and may reduce the incidence of abortion.

Q-fever is a bacterial infection (*Coxiella bumetti*) that causes fetal resorption, stillbirths, and late term abortions (5% to 35%). Abortions tend to occur in naive animals. Transmitted through the air and inhaled or is consumed via infected aborted material, feces, urine, milk, or grazing contaminated pastures. Tick bites may also be a source of transmission. *Coxiella burnetti* remains viable in the phagosome of free living amoeba. The ability of this organism to survive in the protozoa, along with the organism's resistance to dessication, may play a role in maintaining the organism in the environment. Q-fever's primary significance is its zoonotic potential. Q fever infects a wide range of hosts including cattle, goats, sheep, pig, cats, dogs, and wildlife.

Some does will be carriers of the disease without showing any signs. Carrier animals will shed the disease in milk, feces and uterine fluid at the time of parturition. Intense agriculture practices that place large numbers of naive animals in small compact areas can result in exposure and reinfection of pregnant animals. Signs include stillbirths and late term abortion. Aborted fetuses are often fresh with little evidence of in utero autolysis. The placenta is often the only tissue affected and is extremely useful in confirming a diagnosis. Cotyledons are often diffusely thickened and multiple areas thickened, leathery, covered with greyish/white to brownish/red exudate. Some aborted goats will have a retained placenta. There has been conflicting information on whether treatment of pregnant does during a Q fever abortion storm has an effect on the course of the disease. Manure should be composted for at least 5 months and spread only on still, non-windy days. The organism is resistant to drying which means it aerosolizes and can be inhaled. This is a zoonotic disease meaning it can be contracted by humans so a mask should be worn when scraping manure or sweeping the area. Colostrum and milk have high levels of organisms so all milk should be pasteurized before drinking. There is currently no effective vaccine available.

Brucellosis can cause abortions in does and orchitis in bucks. While brucellosis in goats is usually caused by *Brucella melitensis*, they can also become infected with *Brucella abortus*. Historically, the number of *Brucella melitensis* abortions has been extremely low in North America, but more recently, sporadic outbreaks have been reported in goats in Texas and Colorado. *Brucella abortus* is rare in the United States, but can cause late term abortions, stillbirths and weak kids. Does may develop systematic illness and show fever, depression, diarrhea, lameness, mastitis, and weight loss. There is no effective treatment and infected animals should be slaughtered. Wear protective gloves, clothing, and boots when assisting with birthing problems or abortions. Any brucellosis cases must be reported to state veterinarians. The disease is spread to humans by direct contact or by drinking unpasteurized milk or consuming products made from infected milk.

Camylobacter fetus subsp. Fetus, *Camplobacter jejuni subsp.Jejuni*, and *Campylobacter lari* can infect goats. *Campylobacter* (vibriosis) can cause late-term abortions; however they are rare in goats. The organism colonizes the intestinal tract of the adult animal usually without showing any signs of diarrhea. A bacteremia may occur in susceptible pregnant animals leading to infection of the uterus, fetal septicemia prior to abortions. *Campylobacter* is transmitted via ingestion of feces, vaginal discharge, aborted fetus and placenta of

infected does. A common sign is a bloody, pus-like vaginal discharge before or after abortion. Cotyledons are enlarged, yellowish, and covered with a brownish/red suppurative exudate. Intercotyledonary areas are often edematous and hyperemic and usually lack any exudate. Variable amounts of serosangunious fluid with fibrin are present in both the thoracic and peritoneal cavities. Liver may show multiple multi focal areas of necrosis. Diagnosis is cultures of the internal organs. There is a vaccine available labeled for sheep.

Other bacteria can cause abortions like Leptospira, Listeria,and Salmonella etc. *Leptospira hardjo*, *Leptospira pomona*, *Leptospira castellonis* and *Leptospira icterohaemorhagiae* have caused abortions in goats. Leptospira is usually subclinical in goats. But during the bacteremic phase they may show fever and develop a renal disease. Leptospira is usually transmitted by the urine of infected does. Ensure that feed and water sources are not contaminated with feces or urine. Control rodents and other animals may be a source for these diseases. Listeriosis caused by *Listeria monocytogenes* can cause mid-to late-term abortions. They are mainly spread by ingestion and inhalation. Metritis and septicemia is seen does after abortions. Salmonellosis can cause mid to late term abortions. They can cause systemic signs and uterine infection after abortions. Does become infected following ingestion of the bacteria which is shed in the feces of various animals including cattle, bird, dogs, cats, rodents, and some wildlife.

Viruses can also cause abortions in goats. Viruses causing abortions in does are BVD, Caprine Herpes, Blue tongue and Cache Valley Virus. See the table for their clinical signs, diagnosis, prevention and control.

Summary

Late term abortions are usually due to stress or infectious in nature. It is important to remember that many of the diseases causing abortion in goats are zoonotic and can be transmitted to humans. Good management practices of the pregnant does, with adequate housing, good nutrition.

Disease	Transmission	Clinical Features	Diagnosis	Diagnostic Aids	Control
1. Enzootic Abortion (EAE, Chlamydial or Chlamydophila abortion): Caused by *Chlamydophila abortus* that affects sheep, goats, occasionally cattle and humans. They cause late term abortions. Abortion strains differ antigenically from strains producing polyarthritis (sheep and cattle) and conjunctivitis in sheep and goats (pinkeye).	Transmission is mainly by ingesting contaminated feed, water and the environment with vaginal secretions, placenta and aborted fetuses. Spread is more rapid when does are confined. Many carriers are seen in endemic herds. Infection at birth in kids kept as replacement does may be carriers through to their first pregnancy.	Late term abortions, stillbirths and birth of weak infected progeny are the most common clinical sign seen. Fetal mummification is occasionally seen. Female fetuses exposed in utero may abort during their first pregnancy; does infected in the last month of pregnancy may not abort until the next gestation period. Does seldom abort more than once.	A chorionitis with chlorionic epithelial cells packed with elementary bodies appears to be the essential lesion. Cotyledons are pale, greyish white and are necrotic with a dark brown exudate. Intercotyledonary areas are necrotic, thickened, opaque and leathery.	Impression smears of the cotyledon, placenta and vaginal discharge (but not fetal stomach) stained by the modified Ziehl-Nielsen or Gimenez stain. Organisms can be cultured in yolk sac of embryonating chicken eggs. PCR techniques on placental trophoblasts, spleen and liver are useful. Serology on the dam is unrewarding. But detecting antibodies in the fetal fluids is also useful.	Vaccine available; must be given to breeding, or use 150 mg of tetracyclines per head per day in the feed for 2-3 weeks prior to breeding: may continue this in their feed through the first half of gestation. Controlling abortion outbreak with tetracyclines (limited success): (1) 400 mg/head/day in feed or water for the last 60 days of gestation. (2) Use slow-release tetracycline (LA 200) 20mg/kg injectable to start during the last 60 days of gestation. Owing to their long incubation period, once-a-week protocol may be adequate to decrease losses and is much less expensive. (3) Treat weak newborns with tetracycline. (4) Isolate aborting females and also those with weak born kids. Prevention: 1)LA oxytetracycline, 90 days and 120 days of gestation is very effective in preventing abortions. Onset of therapy after the start of abortions will only reduce abortion rate. 2) OTC or Aureomycin 4 gm Crumbles at the rate of 1 lb/8 ewes (500 mg/hd/day).

Disease	Transmission	Clinical Features	Diagnosis	Diagnostic Aids	Control
2. Toxoplasmosis: *Toxoplasma gondii* affects a wide range of animals as well as man. It is widespread and has been reported in Australia, New Zealand, Britain, Turkey, USSR, and North America. Cats and other Felidae are considered the primary host and excrete oocysts; species such as goats and man are regarded as secondary hosts. In these species, the organism is found in two forms: tachyzoites, which are actively multiplying and invasive, and found in the acute state of the disease, and cysts containing bradyzoites found in the chronic phase of the disease.	Oocysts excreted in cat feces are thought to provide the major source of infection. Congenital transmission from does to kids is also established. Further epidemiologic knowledge is required to establish how the disease spreads during an epidemic.	Does infected in the earlier stages of pregnancy either resorb the embryo, or fetal death and under-go mummification (often only one of a twin pair) may occur. Twin or triplet abortions, have variation in fetal ages —mummification to fresh fetus. Infection in late pregnancy leads to abortion and perinatal losses of kids. Many congenitally affected kids survive. Disease in the adult is generally asymptomatic, occasionally CNS signs develop. In endemic areas only younger does usually are affected, and may show the above clinical signs.	Placental changes may be the only gross lesions observed. Gross lesions of the cotyledons (numerous grey-white foci 1 to 3 mm in diameter) are indicative of the disease. Not all cotyledons are equally affected, and such lesions should be differentiated from nonspecific calcification. Focal leukoencephalomalacia in the CNS of stillborn kids, or kids dying shortly after birth is a common fmding.	Histology of the cotyledon to demonstrate local areas of necrosis, mineralization and the organisms. Histology of fetal brain to demonstrate foci of glial cells and leukoencephalomalacia. Microscopy of the brain and cotyledonary villi sections to see tachyzoites and immuno histochemistry for antibodies is necessary to confirm your diagnosis. Precolostral serology of the kids is useful. But maternal serology is unrewarding.	Prevent exposure to barn cats. Don't allow cats to consume aborted fetuses in a Toxoplasma abortion. Treatment: Decoquinate 2mg/kg/day or Monensin 15-30 mg/kg/head/day throughout gestation

Disease	Transmission	Clinical Features	Diagnosis	Diagnostic Aids	Control
3. Salmonellosis (Paratyphoid Abortion): *Salmonella abortus ovis, S. typhimurium and S. dublin* has been associated with abortion in does.	Ingestion of contaminated food and water usually shed from carrier animals. Does in later pregnancy appear more susceptible? Overcrowding and other forms of stress favor an outbreak. Unless the infecting dose is large or the strain exceptionally virulent, infection seldom causes clinical disease in the absence of some other predisposing factors resulting in stress.	Abortions, stillbirths, births of weak infected progeny that usually die within 7 days of birth. Does may show high fever before aborting; most recover, but some die from metritis and/ or septicemia. Some does and newborn kids show diarrhea; in the kids this is usually fatal. Kids up to two weeks of age may show bronchopneumonia. When infection is endemic, abortions tend to be confmed to the younger does.	No specific placental lesions seen. Swollen, pale hemorrhagic cotyledons with necrosis. Aborted fetuses show usual signs of intrauterine death. Septicemia lesions may be seen in those kids dying during or shortly after birth.	Culture of organisms from fetus, placenta and uterine discharge.	Antibiotic treatment on flock basis is not effective and is very expensive. Avoid overcrowding or stressing of does. Do not feed on the ground unless a new area can be used each day. For valuable individuals, supportive therapy (fluids) and antibiotics are recommended.
4. Brucellosis: *Brucellosis melitensis* affects goats and sheep and other species including man. It is seen in Europe, Mediterranean countries, Africa, Central America and rarely in the United States. *B. abortus* occasionally affects does. *B.ovis* affects rams – epididymitis, can cause infertility, early and late term abortions, still births and weak kids.	Ingestion is the main method of transmission, especially during the kidding period. Droplet inhalation and entry both through the conjunctival membrane and broken skin occasionally occurs. Venereal transmission following natural mating is rare.	Abortions in late pregnancy, stillbirths and birth of weak infected kids may occur. Congenital infections may persist throughout life (especially B. melitensis). Systemic effects may be seen in the dam with fever, lameness (associated withjoint swellings), sometimes central nervous system (CNS) signs.	The essential lesion is placentitis, with edema and necrosis of cotyledons. The intercotyledons membrane may be thickened, yellow-brown necrotic areas, often with adjacent hemorrhage. Mucopurulent material may be adherent to the allantochorion. Fetus shows usual signs of intrauterine death.	Culture and direct microscopy are used to identify organisms that are plentiful in the placenta, fetal stomach and vaginal discharge of the doe. Modified Ziehl- Nielsen technique is satisfactory for staining for direct microscopy. Complement fixation ELISA, CF and PCR are available on sera of aborting does.	Test and slaughter policy can be used when the disease is prevalent. Testing of replacement animals. General hygiene at kidding.

Disease	Transmission	Clinical Features	Diagnosis	Diagnostic Aids	Control
5. **Listeriosis** (*L. monocytogenes* or *L. ivanovii*)	Mainly ingestion.	Abortion,stillbirths and weak kids Autolysed fetuses seen. Abortion occurs from day >50 of gestation. Some born alive but die. Metritis and septicemia common in females. Placentitis, around the cotyledon and intercotyledon areas. Kids grafted to the borting females can contract Listeriosis through the milk, develop septicemia and die.	Necrotic, greyish white foci (1 or 2 mm diameter) is seen in in the liver, spleen, kidneys, lungs, heart and adrenals. Leathery placenta.	Culture from fetal stomach, liver and placenta. Fluorescent antibody test on the placenta.	**Isolation** of aborting females. Do not feed spoiled silage or poorly fermented silage. During outbreak administration of long acting tetracycline at 20 mg/kg every 72 hours. Chlortetracycline in the feed
6. **Leptospirosis** (*L. icterohaemorrhagiae*, *L. grippotyphosa*, *L. pomona*, *L. hardjo*, *L.canicola*, *L.castellonis* and *L. bratislava*) Have been reported as primary causes of abortions in goats.	Secreted in the urine. Transmission is through skin or mucousal abrasions.	Clinical signs seen primarily in primiparous does. They include metritis after abortions, anorexia, anemia, jaundice, hemoglobinuria and death.	Fetal organs will be hemosiderin stained due to autolysis. Some edema of the intercotyledonary regions.	Dark field microscopy, Immunofluorescence testing and silver stains on placenta, fetal tissue and fluids. FA on the kidney. PCR on the urine. Paired serum samples from aborting does.	**Vaccine** **Rodent control** **clean water supply** **Isolation** of aborting females. During outbreak administration of long acting tetracycline at 20 mg/kg every 72 hours. **Chlortetracyclin in the feed** 300 to 500 mg/herd/day during the outbreak.
7. **Q-Fever** (*Coxiella burnetii*): It affects sheep, goats, cattle and other wild life. This organism is shed heavily in placentas, birth fluid, colostrum and milk.	Inhaling dust, grazing contaminated pastures and tick bites Infected does can shed in the feces after parturition.	Abortion primarily in the naive animals. Late term abortions. Fresh fetuses. Some kids born alive. Aborting does usually retain their placenta.	Late term abortion and stillbirth. Placentitis with intercolyedonary areas thickened and leathery. Cotyledons are diffusely thickened with multiple areas of necrosis, covered with grayish/ white to brownish/ red exudate.	Serological testing is of little use. Paired serum samples may give a retrospective study of the flock. IFA is commonly used. ELISA along with IFA would strongly suggest Coxiella infection.	Producers should burn or bury the placenta. **Oral chlortetracycline** 200 mg/head/day for 3 weeks. Long acting tetracycline 20 mg / kg given s/c or ilm every 3 days for 5 treatments.

Disease	Transmission	Clinical Features	Diagnosis	Diagnostic Aids	Control
8. Caprine Herpes Virus	Direct – nasal and genital routes. Latent infection in adults and spread during stress.	Kids – viremia and enteritis. Ulceratic and necrotic lesions the entire GI tract. Adults -Vulvovaginitis, balanoposthitis, respiratory disease and abortions.	Clinical signs. Multifocal white necrosis in liver, spleen, kidney and lungs, mesenteric lymph nodes, thymus and liver.	BoHV-1 positive virus isolation on nasal and vaginal swab. PCR- Blood and swabs. Intranuclear iclusion bodies in the placenta and internal organs of the aborted fetus.	Avoid stress. Buy animals from a clean herd. Avoid commingling with calves and sheep. BoHV-1 Infect sheep and goats but they are subclinical. CpHv-1 can infect sheep and calves and become latent. Reactivation has not been successful in sheep and calves.
9. Border Disease (Hairy Shaker Disease). The cause is infection of the pregnant ewe and doe with a pestivirus closely related to, if not identical with bovine viral diarrhea (BVD) virus. The disease has been described in Britain, North America, New Zealand, Austrailia, Greece and Ireland. Several strains appear to be involved.	Vertical transmission from ewe to lamb during gestation is well established, and venereal spread of the disease seems likely. Surviving lambs can transmit the virus both vertically and laterally for years. Most of the more obvious clinical signs result from infection of pregnant ewes in the first half of gestation. Severe loss is likely if susceptible pregnant ewes are introduced to infected flocks or if infected ewes are mixed with resident ewes having no immunity to the disease.	A loss of potential progeny at any stage during pregnancy and in the postnatal period occurs. Infertility with a marked increase in barren ewes, fetal mummification and/or maceration, abortions, stillbirths and losses of lambs born alive are all features of the disease. When the fleece has developed, it tends to be hairy and may be pigmented. If born alive, lambs may show muscular tremors causing incoordination and difficulty in nursing.	Cotyledons tend to be small for fetal age; they occasionally show areas of focal necrosis (1 to 3 mm). Fecal mummification; hairy pigmented coats if the wool has developed; fetus small for gestational age; muscular tremors and incoordination if lambs are born alive. When late gestation fetuses or young lambs encounter the disease, nodular periarteritis, which is slow to resolve, may occur.	CNS shows hypomyelinogenesis and the skin shows characteristic lesions on histologic studies. BVD- neutralizing antibodies in the serum of dam or lamb to virus isolation PCR.	Prevent commingling of pregnant does and ewes with cattle.

Disease	Transmission	Clinical Features	Diagnosis	Diagnostic Aids	Control
10. Bovine Viral Diarrhea A pestivirus has been implicated pigs, alpacas, sheep, goats and deer. Causes abortion in sheep and goats.	Commingling with cattle. Persistent infection of lambs, kids and calves born when mothers were infected during pregnancy.	Still births. Weak kids do not survive. Shaker kids with no changes in hair coat. Abortions at any stage. Skeletal defects on aborted fetus - arthrogyposis, anasarca and mummified fetuses. PI kids possible when a pregnant doe exposed to PI calf-Swiss symposium.	Necrotizing placenta	Virus isolation PCR Serology – ELISA or SN	Prevent commingling of pregnant does with cattle.
11. Cache Valley Virus and Akabane Virus Cache Valley Virus is common in the U.S.	Arthropod borne disease – mainly by mosquitoes and flies (Culicoides)	Infection in early pregnancy can result in wide range of deformities in the fetus, microencephaly, hydrocephalus, arthrogryposis and muscle atrophy. Joint malformation may cause dystocia. Late gestation can cause premature and stillborn kid.	Clinical signs Serology_ precolostral serum or fetal serum for antibodies.	Serology on the doe. Virus isolation on the aborted kids may be difficult.	Control. Fly and mosquito control.

Late-Term Reproductive Failure in Goats

Dr. Keith L. Bailey
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Late-term reproductive failure in goat herds is characterized by the expulsion of aborted or stillborn fetuses. Abortions or stillbirths may have a sporadic occurrence or may involve many does in the herd. Sporadic abortions occur commonly, with a reported incidence of 2-5% in apparently healthy goat herds. Not unlike other animal species, sporadic abortions are often attributed to a variety of non-infectious causes such as stress, genetic alterations, placental defects, nutritional issues, metabolic disturbances in does, and intercurrent disease.

Infectious causes of abortions and stillbirths pose more significant economic and herd-health risks and should be taken seriously by goat producers. During abortion outbreaks (so-called abortion storms), it is critical that producers and herd managers quickly take necessary steps to identify the cause and prevent further spread of disease.

The main objective of this presentation is to provide guidance to producers and herd managers on how to utilize their veterinarian and diagnostic laboratory to thoroughly investigate late-term reproductive failure in goat herds. Common infectious causes of goat abortion will be covered, along with how to maximize the odds of identifying the precise cause.

Meat Goat Nutrition

Dr. Steve Hart
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Introduction

Proper nutrition is essential for the health and productivity of all animals and is the basis of successful production systems. A well planned and executed preventive health program cannot overcome problems that are created by poor nutrition. Nor can advanced reproductive technologies overcome nutritional limitations of reproduction. Therefore, nutrition of the goat is of paramount importance for successful goat production. Nutrition is the science of providing nutrients to animals in adequate amounts and in forms that the animals will consume. For sustainable and profitable production, these nutrients must also be provided in a cost-effective manner.

The ruminant stomach

Goats are ruminants, animals with a four-compartment stomach, as are cattle, sheep, and deer. The compartments are the reticulum, rumen, omasum, and abomasum (true stomach). Monogastric or simple-stomached animals such as humans, dogs, and cats consume food that undergoes acidic breakdown in the stomach and enzymatic digestion in the small intestine where most nutrients are absorbed. In ruminants, feed first undergoes microbial digestion in the reticulum and rumen (together often called the reticulo-rumen) prior to acidic digestion in the abomasum and enzymatic digestion and nutrient absorption in the small intestine. It is the microbial digestion in the reticulo-rumen that enables ruminants to consume and utilize grass, hay, leaves, browse, etc.

The reticulum and rumen form a large fermentation vat that contains microorganisms, mainly bacteria, that breakdown and digest feedstuffs, including the fibrous component of grass, forbs, and browse that cannot be digested by monogastric animals. Some of the breakdown products produced through digestion of feed by bacteria are absorbed by the animal through the rumen wall and can supply a large part of the energy needs. The rest of the byproducts of digestion, undigested feed, and ruminal microorganisms flow out of the reticulo-rumen into the omasum where large feed particles are trapped for further digestion and water is reabsorbed. Material then flows into the abomasum where acidic digestion takes place and then to the small intestine for further enzymatic digestion and nutrient absorption.

The rumen provides several advantages to the goat in addition to digestion of dietary fiber. The bacteria in the rumen are capable of synthesizing all B vitamins needed. Bacteria can also synthesize protein from nitrogen recycled in the body, which may be advantageous on low protein diets. For proper ruminal function, goats require a certain level of fiber (measured as crude fiber, acid detergent fiber, or neutral detergent fiber) in the diet. Goats have bacteria in the rumen that can detoxify antinutritional factors, such as tannins. This enables goats to better utilize feedstuffs containing high tannin levels such as those found in browse. There are very few situations in which a goat will not consume adequate fiber, but one is when a very high grain diet is being fed. Inadequate fiber consumption can then lead to several disease conditions. The most important disease condition is acidosis or an extremely low pH in the rumen, causing decreased feed consumption.

When ruminants are born, the first three compartments of the stomach are underdeveloped and the stomach functions similar to that of a monogastric animal. This enables absorption of antibodies in colostrum and efficient utilization of nutrients in milk. As the young ruminant consumes solid feed, especially high in fiber, and the microbial population is established, the rumen is stimulated to develop. The rumen must have an acceptable degree of development for successful weaning.

The greatest asset of goats is the ability and tendency to utilize woody plants and weeds, not typically consumed by other species of animals (e.g., cattle and sheep), converting them into a saleable product. Therefore, these plant species can be inexpensive sources of nutrients and make for a very profitable goat enterprise. Goats typically consume a number of different plant species in any one day and can utilize some poisonous plants because they do not consume enough to be toxic. Similarly, goats are believed to have a relatively high ability to detoxify absorbed anti-nutritional factors. Goats are more resistant to bloating than other ruminants, and after a brief adaptation may graze alfalfa without bloating.

Nutrients

Nutrients are defined as substances that aid in the support of life. The six classes of nutrients include protein, carbohydrate, fat, vitamins, minerals, and water. Nutrients are often classified as organic (carbon-containing) or inorganic (minerals).

Energy is not considered a nutrient, but can be derived from the breakdown of several nutrients including fat, protein, and both simple and complex carbohydrates. Energy is required to propel the biochemical processes that are necessary to sustain life. A deficiency of energy will cause weight loss, low productivity, and ultimate death of an animal. An oversupply of energy will usually result in excessive fatness, which is also unhealthy. A simple unit of measurement of energy is pounds of total digestible nutrients (TDN). A lb of TDN, equivalent to a pound of digested carbohydrate, equals 2,000 Kilocalories (or Calories as used in human nutrition) of digestible energy. There are a number of other measures of energy used, but they are less easily understood.

Water

Water is an essential nutrient for all animals and is sometimes overlooked. While goats require less water than cattle, they do need water and require additional quantities when lactating or coping with hot weather. A 110 lb goat will require 1 to 3 gallons of water per day depending upon diet, intake, and weather, toward the lower range in winter and toward the upper range in the hottest days of summer. A lactating goat will require an additional 1 quart of water for every 1 pint of milk produced. If a goat is producing 5 pints of milk at peak lactation while raising twins, 2.5 gallons of water are required each day. If goats are eating green material, a substantial part of their water requirement can be met by water contained in the plant material. However, if dry feed such as hay is consumed, water must be supplied to meet the requirement.

Water should be kept clean to encourage intake. This usually involves regular cleaning of the waterer. It is important that the area around the waterer not be muddy, as this is a good environment to spread foot rot and internal parasites. Placing some rock or gravel around the waterer can help keep feet dry and reduce disease problems. Water cleanliness is especially important for bucks on high grain diets. Their water needs to be shaded in summer and warm in the winter to encourage intake and reduce the risk of urinary calculi.

Carbohydrates

Carbohydrates usually provide the majority of energy to goats. Carbohydrates can be classified as simple, such as sugars (easily identified by their sweet taste; maybe 1, 2, or 3 sugar molecules linked together), or complex, such as starch (found in grains) or cellulose (i.e., fiber). Grass, forb, and browse plant species generally contain high levels of cellulose, which must be digested by rumen bacteria to provide energy.

Cellulose is often referred to as fiber, although the term fiber also pertains to other substances such as hemicellulose and lignin. Fiber in young plants may be highly digestible and provide a high level of energy, but fiber in older, mature plants is often poorly digested and may only provide half the energy of other carbohydrates. Fiber in the diet may be characterized chemically in several ways, such as crude fiber (CF), acid detergent fiber (ADF), and neutral detergent fiber (NDF). These abbreviations are used in hay analysis

and may appear on feed tags. In general, the lower the fiber level, the higher the level of digestible energy. However, a certain minimum fiber level is required for healthy rumen function.

Goats do not adapt as easily to high concentrate diets as cattle and sheep and are more likely to get acidosis, founder, urinary calculi, and enterotoxemia. To avoid these problems, very gradually increase the concentrate level in the diet when placing goats on high concentrate diets and maintain a minimum of 12% crude fiber in the diet or about half of the diet as grass, browse, or hay. Goats are typically not feed efficient, except for some rapidly growing Boer goats, and may require 7 lbs or more of feed per pound of gain. Also, one must be very alert for health problems with goats on high grain diets.

Fats

Fats, also called lipids, are very high in energy, providing more than twice the energy of carbohydrate on a weight basis. The fat content of ruminant diets is generally low, as plants have a low fat content. Plant waxes are fats that goats consume as they graze and browse, but they are not digested. Fat may be added to diets to increase the energy content. However, high levels of added fat depress fiber digestion unless treated to be inactive in the rumen. These fat sources are termed "bypass" and may be used in dairy goat diets but are generally not used in meat goat diets.

Protein

Protein is composed of building blocks called amino acids that the body uses to produce all of the different proteins required for growth, production, and maintenance. Protein is required in the diet for accumulation of new body mass (growth) and for replacing protein lost by normal wear and tear.

Ruminant animals are usually fed supplemental protein to make up for dietary shortfalls. In the rumen, bacteria degrade much of the consumed protein and use the amino acids to form bacterial protein. Bacteria can also form protein from nonprotein sources such as urea and, if provided with sufficient energy, can form significant quantities of protein. To prevent breakdown and digestion by ruminal bacteria, some protein sources are protected from degradation by coating or other means. Some natural proteins are also resistant to ruminal degradation by bacteria. These types of proteins are referred to as "bypass protein" as they bypass digestion in the rumen. Other common terms for bypass protein are "ruminal escape" and "rumen undegraded." Bypass protein sources are very important in dairy cow nutrition, but have lesser significance in most meat goat production systems.

Urea is the main nonprotein nitrogen source fed to ruminants. However, goats are not commonly fed urea as frequently as cattle. This may be because goats are more subject to urea toxicity than cattle. Goats appear more efficient than other species at recycling nitrogen in the body to the rumen where it can be used to form microbial protein, given that sufficient energy is available. This recycling of urea to the rumen helps to reduce the amount of protein required in the diet. When animals are consuming a low quality forage, a grain supplement may also improve protein status by providing additional energy for protein synthesis by ruminal microbes.

Vitamins

Vitamins function as critical chemicals in the body's metabolic machinery and function as co-factors in many metabolic processes. A deficiency of a vitamin will slow or block the metabolic process in which that vitamin is involved, resulting in deficiency symptoms. Vitamins are divided into those that are fat soluble (i.e., A, D, E, and K) and those that are water soluble (i.e., B vitamins and C).

The bacteria in the rumen of the goat can synthesize adequate amounts of the water soluble vitamins. Thiamine, or vitamin B1, may become deficient under some conditions (e.g., feeding a high concentrate diet, especially those with high sulfur which may come from a high level of molasses) and cause the disease polioencephalomalacia. Sometimes, however there are other unexplained causes of polioencephalomalacia.

Another situation that could lead to thiamine deficiency is improper feeding of the coccidiostat Corid®. The coccidiostat ties up thiamine, making the coccidia unable to reproduce. Feeding Corid® longer or at higher levels than recommended could lead to polioencephalomalacia. Polioencephalomalacia is a nervous disorder where the animal becomes blind, depressed, presses with his head, and the pupil slit in the eyes becomes up and down rather than the normal side to side profile. Treatment requires immediate injection of large quantities of thiamine.

Fat soluble vitamins must be supplied to the goat because the body cannot directly make them. The recommended levels of vitamins in formulated feed is 5,000 IU (international units, a measure of the potency of vitamins) of vitamin A per lb, 2,000 IU/lb of vitamin D, and 80 IU/lb of Vitamin E. The liver can store significant amounts of the fat soluble vitamins.

Vitamin A can be synthesized from carotene, the pigment that gives grass and hay their green color. As long as sufficient green feed is consumed, vitamin A intake will be adequate. Vitamin A is necessary for normal epithelium (skin) development and vision. A deficiency of vitamin A causes many symptoms, including tearing of the eyes, diarrhea, susceptibility to respiratory infection, and reproduction problems. Vitamin A is often supplied to animals not consuming green forage such as in winter months. Many mineral and vitamin supplements contain vitamin A.

Vitamin D is called the sunshine vitamin because animals can synthesize the vitamin with the help of the sun. Ultraviolet light in sunshine converts pre-vitamin D found in the skin to a pro-vitamin D form that is used by the animals. Usually, even limited sunlight exposure is adequate to provide a day's supply of vitamin D. Sun-cured hay contains Vitamin D. Vitamin D is necessary for calcium absorption and metabolism by the body. A deficiency of vitamin D, called rickets, results in lameness, weak bones, and bowed and crooked legs. The liver is the main Vitamin D storage site in the body. Vitamin D is normally present in mineral supplements and often added to complete feeds.

Vitamin E functions as an antioxidant in conjunction with the mineral selenium. The requirements for one can be partially met by the other. Thus, vitamin E is very important in areas with marginal or deficient levels of selenium. A common vitamin E deficiency disease, particularly in newborn or young animals, is white muscle disease, where white spots are seen in the heart and skeletal muscle due to oxidation damage. A marginal deficiency of vitamin E can depress the immune system and cause reproductive failure. Green grass and green sun-cured hay have high levels of vitamin E. Most mineral supplements and complete feeds contain vitamin E, especially in areas that are deficient in selenium. Vitamin E is expensive and minimal supplemental levels are used in contrast to vitamins A and D that are less expensive and often included at generous levels.

Vitamin K is technically required by animals and functions in the clotting of blood. Vitamin K is produced by bacteria in the lower digestive tract and absorbed. Generally, goats do not need to be supplemented with vitamin K.

Minerals

The inorganic nutrients are called minerals. Minerals are further subdivided into macrominerals, those required at 0.1% or more in the diet (macro means large), and microminerals, those required at the part per million (ppm) level (micro means small). A ppm is the weight of a paperclip in a thousand pounds of feed. A hundred ppm is equal to 1.6 ounces in a thousand pounds of feed. Macrominerals include calcium, phosphorus, sodium, potassium, chloride, sulfur, and magnesium. Microminerals include iron, copper, cobalt, manganese, zinc, iodine, selenium, molybdenum, and others. Minerals function in many ways in the body. Some such as calcium and phosphorus are major structural components of bones and teeth, as well as having other functions. Other minerals facilitate nerve functioning or fulfill a role as electrolytes. The mineral requirements

for goats are not as well known as they are for other livestock species and have often been extrapolated from sheep or cattle requirements due to a lack of studies in goats. As such, mineral recommendations for goats often have a wide range because of lack of accurate goat-specific information.

Macrominerals

The macrominerals are listed below, followed by the abbreviation, normal dietary range, function, deficiency symptoms, and major dietary sources.

Calcium (Ca) 0.3 - 0.8%

The major biological function of calcium is for bones. Bones contain 99% of the calcium in body. Calcium is also necessary for muscle contraction, nerve conduction, and blood clotting. The main deficiency symptoms are seen in the skeletal system. Bones can become soft and weak and may be deformed resulting in lameness. This condition is called rickets or osteomalacia. Vitamin D deficiency causes similar symptoms due to the role of vitamin D in the absorption and metabolism of calcium. Calcium is relatively high in milk and lactating goats need adequate levels of calcium for milk production. Does can get hypocalcemia (milk fever) while lactating due to a metabolic disorder which results in a shortage of calcium in the blood due to calcium being used for milk production. Urinary calculi is a condition brought about in part by an imbalance in the calcium to phosphorus ratio in the diet. Generally, about twice as much calcium as phosphorus should be in the diet of ruminant animals. An excess of calcium can cause abnormal bone growth. Major common dietary sources of calcium include forages, limestone and dicalcium phosphate.

Phosphorus (P) 0.25 - 0.4%

Approximately 80% of the body's phosphorus is found in bones, with the remainder in the blood and other tissues. In addition to skeletal structural functions, phosphorus is essential in energy metabolism, acid-base balance, and is a constituent of enzymes and genetic material. The major symptoms of phosphorus deficiency include reduced growth, listlessness, unkempt appearance, depressed fertility, pica (depraved appetite-eating wood, rocks and bones), and decreased serum phosphorus. Phosphorus is the most commonly encountered mineral deficiency and also the most expensive macromineral. Sources of phosphorus include protein supplements, cereal byproducts, mineral supplements, and dicalcium phosphate.

Sodium (Na) 0.2%

Potassium (K) 0.8 - 2.0%

Chloride (Cl) 0.2%

All three of these minerals function as electrolytes in the body. Electrolytes are mineral ions, carrying a positive or negative charge that the body uses for osmotic balance, pH balance, and water movement. They are also essential in transmission of nerve impulses. These minerals are highly water soluble and are easily lost with diarrhea. Electrolyte solutions used to treat animals with diarrhea contain all three of these minerals. A deficiency of potassium could occur on high concentrate diets, with symptoms including poor appetite, urinary calculi, body stiffness progressing from front to rear, and pica (depraved appetite as described above). A deficiency of chloride depresses growth. A deficiency of sodium causes reduced growth and feed efficiency. Salt provides both sodium and chloride. Most forages have adequate levels of potassium.

Sulfur (S) 0.2 - 0.32%

The major biological function of sulfur is as a component of sulfur-containing amino acids. Therefore, sulfur is important in protein synthesis, milk and hair production, enzymes, hormones, hemoglobin, and connective tissue, and is a component of the vitamins biotin and thiamine. The major deficiency symptoms include poor animal performance, hair loss, excessive salivation, tearing of eyes, and weakness. Major source of sulfur is protein which contains sulfur as a component of some of the amino acids. Therefore, sulfur is important in

diets where nonprotein nitrogen (e.g., urea) is used to substitute for some protein. Sulfur-containing mineral blocks are often used for control of external parasites in goats. Excessive sulfur in high concentrate diets can contribute to polioencephalomalacia as discussed for the water soluble vitamin thiamine.

Magnesium (Mg) 0.18 - 0.4%

Magnesium is found in bones (60 to 70% of that in the body), liver, muscle, and blood. It is required for normal skeletal development, and nervous and muscular system functions, as well as for enzyme systems. It is also closely associated with metabolism of calcium and phosphorus. In ruminants, a major magnesium deficiency disease is grass tetany, often seen in animals grazing fast-growing, lush, cool season pastures. Affected animals have low blood magnesium levels, exhibit a loss of appetite, are excitable, stagger, have convulsions, and may die. High fertilization rates, cool temperatures, and high levels of plant potassium and(or) rumen ammonia may contribute to the disease. A major supplemental source of magnesium is magnesium oxide, which is often supplemented on winter wheat pasture and mixed with a protein source to encourage consumption.

Micro or trace elements

The first level after the mineral name is what is thought to be the minimum requirement in the diet, while the second is the value above which the element can become toxic. Most supplemental trace minerals are provided by trace mineralized salt or mineral mixes that are designed to provide 25 to 50% of requirements. This is adequate if the animal's diet is marginal in a mineral but inadequate if that mineral is severely deficient. Unless a documented deficiency exists, it is best not to provide 100% of a trace mineral, because an excess of one mineral may depress the absorption of another creating a deficiency. Excess supplementation of some minerals can cause toxicity problems, especially with copper and selenium.

Iron (Fe) 35 - 500 ppm

The major function of iron is as a component of hemoglobin, required for oxygen transport. It is also a component of certain enzymes. The major iron deficiency symptom is anemia. Anemia can also be caused by blood loss due to several factors, including injury, internal parasites (barberpole worm or liver fluke), and a bad case of external parasites such as lice. Iron is stored in the liver, spleen, and bone marrow. Milk is very low in iron; therefore, kids raised for a long time on milk alone will develop anemia. Soil contamination on forages can provide significant levels of dietary iron. Iron sulfate is a common means of adding iron to the diet. Forages in some areas have excessively high levels of iron that suppress utilization of other trace minerals.

Copper (Cu) 10 - 50 ppm

Copper is essential in formation of red blood cells, hair pigmentation, connective tissue, and enzymes. It is also important in normal immune system function and nerve conduction. Deficiency symptoms include anemia, "bleached" looking (lighter color) and rough hair coat, diarrhea, and weight loss. Young goats may experience progressive incoordination and paralysis, especially in the rear legs. High dietary molybdenum can depress absorption of copper and cause a deficiency. There should be at least four times as much copper as molybdenum in the diet.

Sheep (both hair and wool types) are sensitive to copper toxicity, whereas goats require copper levels similar to beef cattle. Angora goats may be more sensitive to copper toxicity than meat and dairy goats. There are differences in copper requirements for several sheep breeds, and this could be true for meat goats, but no data are available. Although most of the United States has adequate copper levels (Figure 7), many areas have high levels of molybdenum (Figure 6) due to soil geology and, therefore, require copper supplementation. The liver stores copper, which can protect against toxicity in the short term. However, when liver capacity is exceeded, animals can die rapidly from a hemolytic crises caused by stress, such as being chased.

Cobalt (Co) 0.11 - 25 ppm

The only well accepted biological function of cobalt is as a component of vitamin B_{12}. Rumen microbes utilize cobalt for growth and produce vitamin B_{12}. Cobalt deficiency symptoms include loss of appetite, anemia, decreased production, and weakness. Most natural feedstuffs contain adequate levels of cobalt. There are cobalt-deficient areas in the United States (Figure 1).

Zinc (Zn) 40 - 500 ppm

Zinc is found in all animal tissue and is required by the immune system and for normal skin growth. Zinc is also essential for male reproduction. Deficiency symptoms include dermatitis (thick, dry patches of skin), hair loss, skin lesions, swollen feet, and poor hair growth. The bran and germ of cereals contain high levels of zinc.

Manganese (Mn) 40 - 1000 ppm

Manganese is important for bone formation, reproduction, and enzyme functioning. Deficiency symptoms include a reluctance to walk, deformity of forelegs, delayed onset of estrus, poor conception rate, and low birth weight. It is unusual to have a manganese deficiency.

Selenium (Se) 0.1 - 20 ppm

Selenium functions with vitamin E as an antioxidant, protecting cell membranes from oxidation. Selenium also affects reproduction, metabolism of copper, cadmium, mercury, sulfur, and vitamin E. Deficiency symptoms include poor growth rate, kids being unable to suckle, white muscle disease (cardiac and skeletal muscles have white spots), sudden death by heart attack, progressive paralysis, and retained afterbirth. Selenium is deficient in many areas because of low soil levels (geological factors; Figure 8); however, there are a few regions of high selenium soils leading to high to toxic levels in plants. Toxic levels of selenium cause shedding of hair, diarrhea, and lameness. Most plants that are not grown in selenium deficient soils will have adequate selenium levels. It is more effective to provide selenium supplementation through feed than by injection.

Molybdenum (Mo) 0.1 - 5 ppm

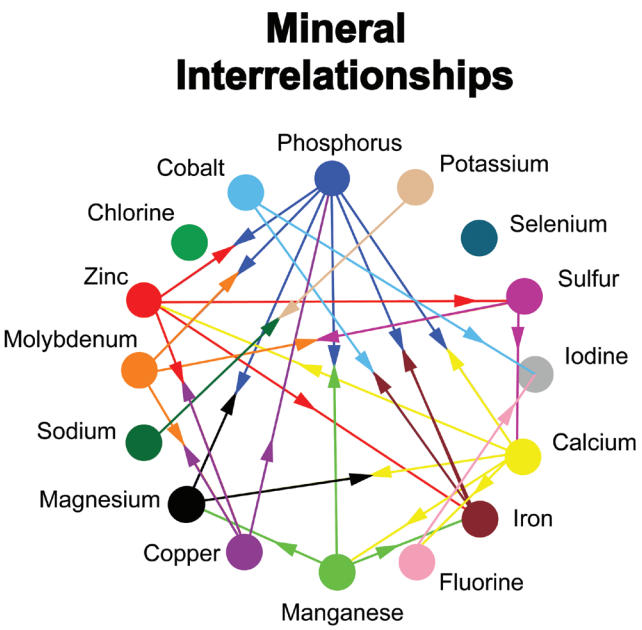
Molybdenum deficiencies are very rare. Toxicity occurs above 3 ppm due to reduced copper absorption, resulting in a copper deficiency. The copper level must be four times the molybdenum level to overcome this effect. High dietary levels of molybdenum are usually related to soil content. Molybdenum (as ammonium tetrathiomolybdate) is often used to treat copper toxicity in animals (Figure 6).

Iodine (I) 0.5 - 50 ppm

The only proven biological function of iodine is as a component of thyroid hormones that regulate energy metabolism and reproductive function. The major iodine deficiency symptom is goiter - a swelled or enlarged thyroid gland in the neck. This should not be confused with the thymus gland in the neck on young animals (the thymus gland is especially pronounced in Nubian kids, but shrinks after several months of age). Also, iodine deficiency causes reduced growth and milk yield, pregnancy toxemia, and reproductive problems such as late term abortion, hairless fetus, retained placenta, and weak kids. Most of the southern U.S. has adequate iodine in the soil and most minerals and trace mineralized salts contain iodine. A number of areas in the northern U.S. are deficient in iodine due to soil geology.

Mineral nutrition considerations

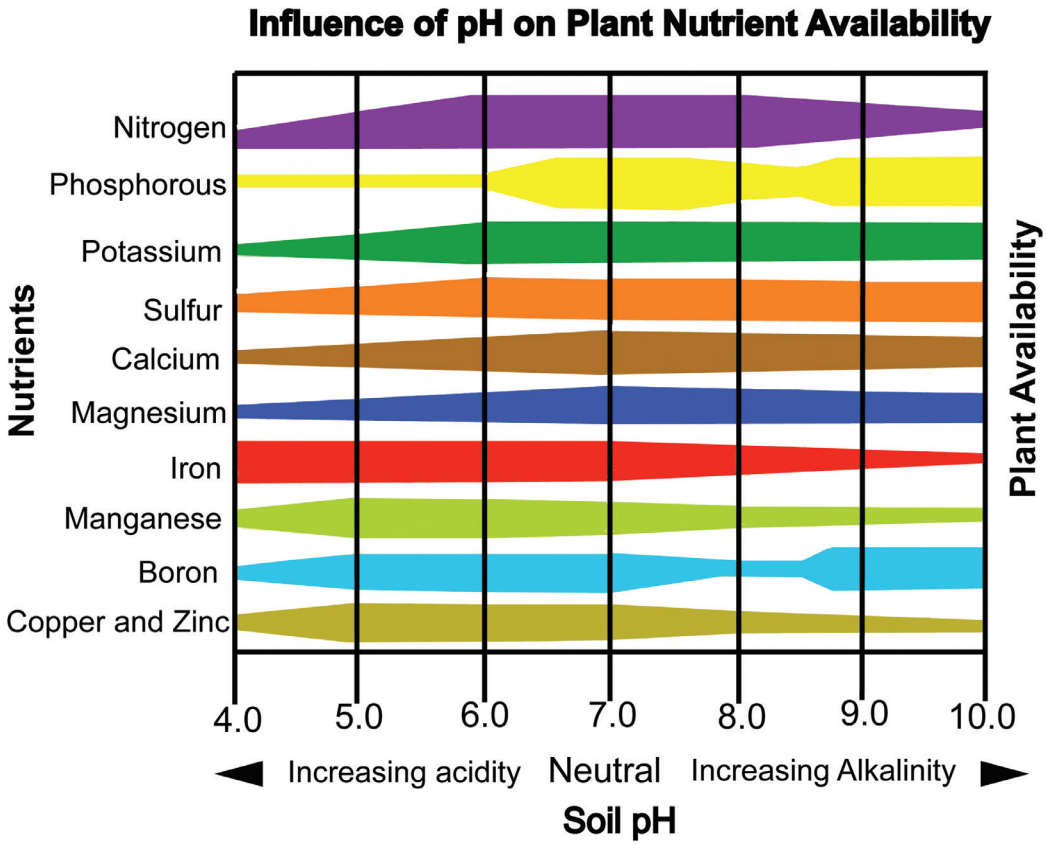
Plants are a major source of minerals for the goat, requiring all minerals that goats require except iodine. However, plant requirements for minerals, such as cobalt and selenium, may be much lower than the level required for animals. Some soils are inherently deficient in some minerals such as iodine and selenium due to soil geology. Plants grown on soils deficient in a mineral are likely to be deficient in that mineral. However,



Drawing by K. Williams.

some plants have an ability to concentrate the minerals available in the soil. Maps of mineral deficient areas of the U.S. are available. However, consulting local extension agents is a better method of determining soil mineral deficiencies or toxicities that could affect mineral levels in local forages. Soil maps showing deficient areas of selenium, copper, molybdenum, and cobalt are located at the end of this article.

Various factors other than soil mineral level can interact to influence the mineral content of forages. Soil pH is one factor that affects mineral uptake by plants. Under acidic soil conditions, many trace minerals are less available for plant uptake. Environmental temperature at certain times of the year may also affect mineral uptake. Interactions among minerals after soil fertilization can also affect their availability for incorporation into plant material. Season of the year affects plant mineral concentrations, mainly due to a



Influence of pH on availability of plant nutrients.
Redrawn from S.S.S.A.P., 1946. 11:305 by K. Williams.

dilution effect, with decreasing mineral levels as plants mature. Different plant species will also have varying contents. Browse and forb plant species may have higher mineral concentrations than do some grasses. As goats eat a variety of plants, they are less likely to have mineral deficiencies than other species of animals that eat predominantly one plant species.

To determine plant mineral content a producer can collect and send samples for analysis. Parts of plants that are being consumed throughout the day and growing season should be sampled. Analysis of a sample will cost a minimum of $25.00. To obtain enough data to formulate a custom mineral supplement would require sampling several times over a growing season and over more than 1 year if possible. This could be worthwhile for a large goat herd but too expensive for most producers. The alternative is to use a commercially prepared mineral block or loose supplement. Some mineral mixes are formulated for regions and are more appropriate to use than a mineral formulated for the whole United States. Many state extension specialists know what minerals are likely to be deficient in given areas of a state and know what levels of calcium and phosphorus are appropriate for beef cattle production. Those recommendations are a good place to start for goat mineral nutrition.

Mineral supplements should not be overfed. Mineral supplements are formulated for goats to consume a sufficient quantity. Many minerals interact with one another (interactions shown on opposite page) and excess consumption of one mineral may decrease absorption and(or) utilization of another. For example, it is well known that excess iron depresses absorption of zinc, copper, manganese, and selenium. There are several regions of the United States that have high enough levels of iron to depress absorption of these other minerals, requiring them to be supplemented. Feeding a regional mineral with no supplemental iron would be preferable to feeding an all-purpose mineral containing high levels of iron that would further depress absorption of these minerals.

The range between safe supplementation and toxic levels is narrow for many of the trace minerals. Do not overfeed trace minerals or mix additional minerals in a diet if another source of trace minerals, such as a trace mineral block, is present. Formulation of mineral supplements requires considerable expertise since the addition of high levels of one mineral may depress the utilization of another, causing a deficiency. Also, some trace minerals can be toxic in excess.

Calculation of supplemental levels for feed formulas requires a certain amount of technical expertise and specialized scales for weighing, along with sophisticated mixing equipment. Most common farm mixing methods are inadequate, resulting in “pockets” of dangerously high mineral levels in a batch of feed.

Choosing a mineral supplement

The most important consideration in choosing a mineral supplement is the level of calcium and phosphorus. Some mineral mixes are designated 12 - 8, which means they contain 12% calcium and 8% phosphorus. The levels of these two minerals should be the same that is being fed to cattle in your area (contact your county agent or livestock extension specialist). Phosphorus is expensive, so a 12 - 12 mineral will cost more than one that is 12 - 8. However, most forages are low in phosphorus, making it the most common mineral deficiency.

The mineral supplement should also contain trace minerals that are deficient in the area. Levels of trace minerals used in local cattle supplements can provide a guide for goats. Most mineral supplements are formulated to provide less than half the trace mineral requirements due to toxicity concerns. A mineral supplement should be provided in the loose form to maximize consumption. The salt level in the mineral drives intake; therefore, no other sources of salt should be available. A mineral feeder should be used to protect from rain and keep the supplement clean. Replenish minerals frequently to keep them fresh.

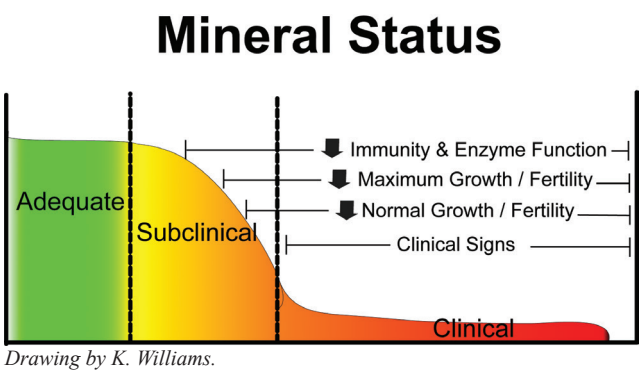
Current approximate wholesale costs for supplying 100% of mineral needs of a 150 lb goat for various minerals in 1 year are as follows:

Calcium	$1.15
Phosphorus	$4.50
Salt	$0.40
Magnesium	$1.11
Potassium	$1.50
Trace minerals	$0.45
Other minerals	$0.65
Total	$9.70

Feedstuffs will normally provide at least half of all minerals and in some cases all required. It should be noted that phosphorus alone accounts for half the mineral cost.

Diagnosing mineral deficiencies or toxicities

The proper procedure for diagnosing a mineral deficiency or toxicity depends on which mineral is being considered. Secure the assistance of a local veterinarian and extension animal nutritionist in the state who are familiar with minerals in the region.



Drawing by K. Williams.

1. Deficiency or toxicity symptoms usually provide initial indications of mineral status (e.g., manganese and "knuckling over"). However, deficient animals do not always show classic symptoms and the major symptom may only be a 'poor doing' animal.
2. Blood tests are adequate for some minerals such as magnesium, calcium, and phosphorus, and for other blood factors that give an indication of mineral status. Examples of these factors include: glutathione peroxidase for selenium, hemoglobin for iron, zinc binding protein for zinc, and thyroid hormones for iodine.
3. Hair analysis has been used for zinc and selenium but in general is a poor diagnostic test.
4. The liver is a good tissue to test for iron and copper adequacy. Liver samples can be obtained via biopsy or from animals that are slaughtered or die.

Take home lessons on mineral nutrition

1. The diet should contain adequate levels of calcium and phosphorus and have close to a 2:1 calcium to phosphorus ratio.
2. Provide a free-choice loose mineral supplement with appropriate levels of calcium and phosphorus that contains trace minerals deficient in the region.
3. Monitor intake of the mineral to make sure the animals are eating an appropriate amount.
4. Avoid excessive feeding of any supplementation.

Body Condition Scoring

The adequacy of a nutritional program can be assessed by observing changes in body weight and condition of the animal. If animals lose weight, body condition will be reduced (animal is thinner), alerting an observant manager to a problem. Body condition is particularly responsive to energy and protein adequacy.

Body condition scoring is a system of assigning a numerical score based on physical characteristics indicative of fatness. These include the amount of muscle and fat covering the spine in the loin area and ribs and fat pad at the sternum. Body condition scores range from 1 (very thin) to 5 (obese) in one-half score increments. Langston University has information on the American Institute for Goat Research website describing Body Condition Scoring of Goats (see following section on BCS or http://www2.luresext.edu/goats/research/bcshowto.html) and Examples of Body Condition Scores in Goats (see following section on BCS or http://www2.luresext.edu/goats/research/bcs.html).

Animals should achieve a certain body condition during specific periods of the production cycle. For example, animals should have a body condition of at least 2.5 but no more than 4.0 at the beginning of the breeding season. Prior to entering the winter a minimum score of 3.0 is desirable. Also, if body condition score is 4.5 or greater, pregnancy toxemia prior to kidding is likely, as also is the case with a score of less than 2.0.

Using the Langston Interactive Nutrient Calculator

Practical goat nutrition involves providing sufficient nutrients for a desired level of productivity (milk, meat, or kids) at a reasonable cost. Nutrients are supplied via a combination of pastures, hay, supplements, and other feedstuffs; adequate amounts are required for animals to produce at an economically viable level. For commercial meat goat production, the economics of nutrition are of paramount importance due to their great impact on cost of production and subsequent profit. For show, purebred, and companion goats, the economics of nutrition may be of lesser importance.

Applied nutrition involves determining nutrient requirements and then working with available feedstuffs, including pasture, hay, or supplemental feeds, to provide the required nutrients in proper amounts. Nutrient requirements are affected by an animal age, weight, and production type and stage. For example, pregnancy, number of fetuses, etc. will affect the amount of nutrients needed by a doe.

Calculating nutrient requirements by hand can be difficult, but the Langston Interactive Nutrient Calculator (LINC) makes the task easy, only requiring answering several questions. In addition, it is linked to a nutrient balancer program that allows selection and use of pastures and feeds to meet the requirements. The calculator will determine not only protein and energy requirements, but also calcium and phosphorus needs.

Getting started

To teach you to use LINC, we will go through an example. Here is the assignment, calculate the nutrient requirements for a nonpregnant 3 year old mature ½ Boer cross doe that had twins 6 weeks ago. The doe has a 32 inch heartgirth and is under intensive grazing management. Her body condition score is 2.5.

First, go to the Langston web site http://www2.luresext.edu/goats/research/nutritionmodule1.htm.

Question 1 asks the biotype of goat. A drop down menu will give the choices of Boer, Boer cross, Spanish or indigenous (native) goat, dairy goat, or Angora goat. For Kiko goats, use the selection for Spanish and indigenous. Select "Boer cross."

Question 2 asks the class of goat, and selections include suckling, growing goat less than a year and a half of age, mature goat including late gestation, and lactating goat including meat and dairy goats. If a lactating goat is selected, another drop down menu asks information needed to predict milk production. This information includes litter size (number of kids), week of lactation (weeks since she kidded), and age of doe at kidding in years. Milk production, along with fat and protein percentages, are then predicted. These figures can be edited, which is useful for dairy goat producers who are more likely to know the amount of milk produced and its fat and protein contents.

For the example, select "lactating goat". Then in the subsequent menu, select the number of kids (twins) and input week of lactation (6) and age at kidding (2 - 3 years). The program predicts that the doe will produce 3.6 lbs of milk containing 3.6% fat and 3.3% protein.

Question 3 asks the gender of the goat, and the drop down menu has choices of doe, buck, and wether. Select "doe."

Question 4 asks the body weight of the goat. If the weight is known or a good estimate is available, it should be entered in the box. If the weight is unknown, the heartgirth (chest circumference) can be measured to predict body weight. Check the box to estimate weight via heartgirth and enter heartgirth in inches. A menu will appear with choices of genotype (breed) of goat (Alpine, Angora, Boer, ½ or less Boer, ¾ or ⅞ Boer, LaMancha, Nubian, Oberhasli, Saanen, Toggenberg, and Spanish). Some breeds require input of body condition score. Body weight is then estimated. Input "32" inches for a "½ or less Boer" and the estimated weight of the doe is 105 lbs. This can be used for estimating bodyweight for medicine dosage or weights for management purposes.

Question 5 asks the desired amount of weight gain or loss expected in a 1 month period, with selections ranging from losing 5 pounds (-5) to gain of 30 pounds. This gain is in addition to any pregnancy weight gain. Select 0 lbs per month.

Question 6 adjusts nutrient requirements for the energy expended during grazing if goats have access to pasture. The drop down menu includes choices of stable feeding, intensive management, semi-arid grazing (goats on extensive ranges), and arid (desert) grazing. For the sample calculation select "intensive management, temperate or tropical range." This selection will be used in all the examples that follow.

Question 7 asks the percentage TDN of the diet being fed and uses a default value of 60. If the TDN level in the feed is known, this value can be adjusted. For dairy goats, the default value is 65%. Use the default of 60%. If you know the value of the feed you plan to use put it in here. This value is important in prediction of intake.

Question 8 asks the percent protein in the diet and the default is 10%. For dairy goats, the default is 14%. Use the default of 10%. If you know the value of the feed you plan to use, put it in here. This value is used to help predict intake.

Click on the "Calculate Requirements" button to calculate the energy and protein requirements, estimated dry matter intake, and calcium and phosphorus requirements. In this example, the requirements should be 2.5 lbs of TDN for energy, 0.34 lbs of crude protein, 6.65 grams of calcium, and 4.65 grams of phosphorus, with a predicted intake of 3.65 lbs of dry matter.

Providing needed nutrients

After calculating the nutrient requirements for goats, those nutrients must be provided using feedstuffs such as pasture, hay, concentrate, and minerals. For most goats throughout much of the year, nutrient requirements can be met by available pasture, a mineral supplement, and water. During times of limited forage availability or quality such as winter, or feeding poor quality hay or stockpiled forage, a supplement will be needed to supply deficient nutrients. The level of supplemental feeding should be adjusted with changes in animal requirements, such as increased needs of late pregnancy. Sometimes it may be preferable to put an animal in a lot and feed a complete diet or one high in concentrate such as with dairy goats.

There may be periods when nutrient requirements cannot be met, resulting in loss of body weight. This is acceptable at certain times in the production cycle if body condition is sufficient for the animal to draw upon body reserves and maintain the desired production level. An example would be weight loss during early lactation because sufficient nutrients cannot be consumed. However if the doe is in poor body condition, is a growing yearling, or has severe weight loss during this time, milk production will be depressed. During a

drought, it may be acceptable for open or early pregnant animals that are not lactating to lose weight. During late pregnancy, inadequate nutrition can have adverse effects on pregnancy outcome and subsequent lactation. We can estimate what the projected bodyweight losses would be by reducing the bodyweight gains in question five and then calculating nutrient requirements until the energy and protein requirements match intake of those nutrients. Severe undernutrition can cause abortion, reduced livability of the kid(s), reduced milk production and adversely affect maternal behavior.

Feeding Different Classes of Goats

The feeding suggestions that follow are oriented to commercial goat producers. Purebred, show, and companion animals are often fed more for larger frames and better body condition, but excessive body condition can be deleterious to the animal health.

Feeding bucks

Mature bucks can obtain most of their nutrients from pasture. However, yearling and 2 year old bucks have greater nutrient requirements since they are still growing. Bucks need to be in good body condition (BCS greater than 3) before the breeding season because feed intake may be relatively low during that time, with loss of body weight. Thus, body condition should be evaluated 3 months before the breeding season. Decisions can then be made on the supplemental nutrition needed for the buck to achieve the desired BCS.

Whenever bucks cannot meet nutritional needs from pasture, supplementation is necessary. Under most conditions, whole shelled corn or sweet feed at 0.25 to 0.5% of body weight will be adequate (0.5 to 1 lb of feed for a 200 lb buck). Feeding bucks high levels of grain (greater than 1.5% of body weight) for a long period of time makes them prone to urinary calculi. The levels of grain recommended above are safe for bucks. When pasture is scarce, bucks can be fed medium quality hay free-choice (all they can eat).

Using LINC, calculate the nutrient requirements for a 3 year old, 200 lb Boer cross buck, gaining no weight, and on pasture (intensive management). The calculated requirements are 2.39 lbs of TDN, 0.26 lbs of crude protein, 5.05 grams calcium, and 4.09 grams phosphorus, with predicted dry matter intake of 3.55 lbs. However, it is important to note that the estimated dry matter intake is influenced by the dietary TDN and CP concentration inputs. Therefore, if the default values are used and a forage, which makes up all or most of the total diet other than a mineral supplement, has different levels, then the predicted dry matter intake may not be close to the actual amount. In the example above, default values were assumed. To determine if these nutrient requirements can be met by native range with a mineral supplement, click on "Select Feed Ingredients" at the bottom of the page. A page listing different feeds will appear. In the "Forages" section below "Concentrates," click on "range, early summer," and under "Minerals" choose a 12-12 mineral supplement. Go to the bottom and click on "Input These Feed Ingredients into the Ration."

The ration window will appear that lists each ingredient chosen. Intake figures should be entered in the column labeled "Amount, lbs as fed." The estimated intake for this buck is 3.55 lbs dry matter (lbs of diet not including the water content of the feedstuffs), whereas in this window the consumption amount is entered as the "as fed" form. Because feedstuffs vary in water content (compare the water content of fresh, green pasture to the same forage dried and harvested as hay), nutrient requirements and intake estimations are calculated on a "dry matter basis." Dry matter basis means that all water has been removed. However, animals eat feed in an "as-fed" form. This calculator will determine the amount of dry matter intake for each ingredient from the as-fed figures entered. This relieves the producer from having to estimate dry matter, allowing the amount fed to the animal to be entered, with the program performing the needed dry matter calculations.

The mineral supplement bag label predicts intake of 0.5 to 1 lb/month/hundred lbs of body weight. At that rate, the 200 lb buck will consume 2 lbs/month or 0.067 lbs/day (2 lbs ÷ 30 days), roughly 1 ounce. Some supplements estimate an intake such as 1 to 1.5 oz/day, but this can vary with the size of the goat. Enter 0.07

lbs for the mineral. Therefore, in this example it can be assumed that forage dry matter intake is 3.55 lbs. The value of 3.55 is entered into the "Amount, as-fed" column for range forage. Clicking in the "Amount, lbs DM" column will calculate the amount of DM and nutrients provided (Running total) compared with the Requirements. The amount of as-fed native range grass provided should be increased until the forage dry matter provided equals the 3.55 lbs previously calculated. This is done by trial and error method until a correct answer is found. In this case, the correct amount is 3.95 lbs of as-fed native range, which will provide 3.55 lbs of dry matter. Therefore, the estimated daily ration for this buck is 3.95 lbs of native range grass hay, or an equivalent amount of pasture, on a dry matter basis plus 0.07 lbs of mineral per day.

Comparing the Running total with the Requirements shows that this diet did not meet the requirement for TDN (2.12 lbs provided vs a requirement of 2.39; 89%). Crude protein, calcium, and phosphorus are supplied in excess of requirements. Because the equations used in these predictions include a small safety margin (i.e., requirements are most likely slightly greater than actual), if the deficiency is not marked the diet could be used as is with careful monitoring of performance measures, most notably BCS. In addition, one should consider that the diet actually consumed could be higher in quality than the 'book' composition values used. In this regard, when taking plant samples, plants are often cut at the ground level, such as for hay. Conversely, goats select certain plant parts (especially leaves) that have higher nutrient contents. Therefore, the composition analysis used in the calculations might not have matched what was actually eaten. For example, if a TDN concentration in consumed forage of 65% and a crude protein level of 12% are assumed, the predicted TDN intake is 95% of that necessary to satisfy the TDN requirement.

Accurate and abundant data on the nutrient content of plant parts consumed by goats are lacking. When hay is fed and animals are 'forced' to consume most of it, the hay analysis will closely match what is consumed. The same applies to supplemental feeds that are totally consumed. One way to more accurately determine the true composition of diets of grazing goats is to follow the animals for a couple of hours and hand pluck the portions of plants consumed and send the sample in for analysis. However, plant composition and plant parts selected vary over time, making it desirable to sample plants monthly or more frequently.

In the absence of feed nutrient analysis, it is important to try to match the description of feeds or pasture as closely as possible to that in the LINC feed tables. If actual analysis has been determined, it can be entered into LINC at the bottom of the feed library. Information required includes concentrations of TDN, crude protein, calcium, and phosphorus. Hopefully in the future, more applicable data will be available for herbage grazed by goats.

Feeding replacement bucks and does

Replacement bucks and does must gain sufficient weight from weaning to breeding to be of adequate size and sexually mature. A Spanish doe weaned at 12 weeks of age would be expected to weigh 40 lbs and gain 5 lbs per month to achieve a minimum breeding size of 60 lbs at 7 months of age. A Boer doe weaned at 12 weeks of age would be expected to weigh 50 lbs and would need to gain 7.5 lbs per month to be 80 lbs at breeding. These are minimum weights, and it is advantageous for animals to be slightly heavier. Some purebred breeders wait to breed their doelings at 19 months of age because a doe with a bigger frame size is desired. Most commercial goat producers cannot afford the cost of an extra year of maintaining an animal with no production.

Does will generally gain sufficient weight if an adequate amount of a moderate quality forage is available. If doelings are not gaining adequate weight (as measured by a scale or through the heartgirth conversion program), they could be supplemented with whole shelled corn at 0.5 to 1% of body weight per day (¼ to ½ lb of corn per head per day for 50 lb doeling). Feeding excessive grain to does causes an overly fat condition. Fat may be deposited in the udder, leading to reduced formation of milk secretory tissue. The doe is also more likely to have pregnancy toxemia and birthing problems. If sufficient good quality pasture is not

available, growing doelings will need good quality hay and a supplement such as whole shelled corn, sweet feed, or range cubes or pellets at 0.5 to 1.0% of body weight.

Bucklings must gain more weight than doelings to reach puberty. While there are no available recommendations for weight of meat goat bucklings at first breeding, these animals need to reach an adequate size to achieve puberty. Like doelings, body condition should be monitored and supplemented at 0.5 to 1% of body weight per day (¼ to ½ lb of corn per head per day for 50 lb buckling). Most bucks do not let a lack of body weight interfere with breeding, but some body reserves are necessary to maintain fertility and mating activity throughout the breeding season.

Feeding does throughout their life cycle

The four production periods of does are dry nonpregnant, pregnant, late gestation, and lactating. Does that are open (nonpregnant) or in the early stage of pregnancy (< 95 days) have fairly low nutrient requirements. For open does, the goal is to gain a little weight to be in good condition for breeding. A medium quality pasture, such as in late summer, or a medium quality hay is sufficient to prepare for breeding and the early stage of pregnancy. However, adequate quantities of feed are necessary.

Use the LINC to calculate the nutrient requirements for a 130 lb nonpregnant, mature Boer doe without change in body weight and with intensive pasture grazing. The requirements are 1.50 lbs of TDN, 0.18 lbs of crude protein, 4.03 grams of calcium, and 2.82 grams of phosphorus, with an estimated dry matter intake of 2.31 lbs (based on the composition of fall bermudagrass; 50% TDN and 9% CP). Feeds used are fall bermudagrass and a mineral supplement. A 130 lb doe is expected to consume the mineral at 0.1% of body weight per month = 1.3 lbs/30 days = 0.04 lbs of mineral per day. The estimated 2.27 (2.31-0.04 = 2.27) lbs dry matter intake of fall bermudagrass (3.25 lbs as-fed) provides 1.14 lbs of TDN (76% of requirement) and 0.20 lbs of crude protein (111% of requirement). In this example, it appears questionable as to whether or not body weight of the doe could be maintained with this forage (i.e., 50% TDN). The goat's ability to select higher quality plant parts, as noted above, might enable them to maintain their body weight. In this regard, if they are able to select a diet with a TDN concentration of 60% rather than 50% then the amount of TDN supplied is (2.27 × 0.60 = 1.36 lbs) which is 91% of the required amount, somewhat close to her requirements. Again, it is important to monitor body condition.

Calculate the nutrient requirements for a Boer doeling weighing 70 lbs, gaining 5 lbs per month, and with intensive pasture grazing, using LINC. The requirements are: 1.3 lbs TDN, 0.25 lbs crude protein, 2.98 grams of calcium, and 2.08 grams of phosphorus with a dry matter intake estimate of 2.06 lbs. If we adjust estimated TDN and estimated protein for the forage (questions 7 and 8 in LINC) since the 50% TDN of fall Bermudagrass is different than the 60% assumed, and use 9% CP instead of the 12% assumed, predicted dry matter intake is 2.32 lbs. Using the same feeds, fall bermudagrass and mineral, with a mineral consumption of 0.02 lbs (1% of body weight /month, divided by 30) and using fall bermudagrass for the remainder of her intake (3.3 lbs as fed), both TDN (1.16 lbs intake, 89% of requirement) and crude protein (0.21 lbs intake, 84% of requirement) are inadequate. To achieve the desired growth rate, supplementation may be necessary. By trying sweet feed as a third feedstuff it is determined, through trial and error, that 0.75 lbs of sweet feed along with 2.0 lbs of fall pasture will provide most of the energy requirement but only 0.19 lbs of crude protein (76% of requirement), which is inadequate. By deleting the sweet feed and changing to a 16% dairy ration to supply the needed crude protein, it is finally determined that 0.75 lbs of a 16% crude protein dairy ration, 2.0 lbs pasture, and 0.02 lbs of mineral will provide 1.3 lbs of TDN (100% of requirement) and 0.25 lbs of protein (100% of requirement). The weight gain to achieve adequate breeding size should continue to be monitored with possible feeding adjustments made. The lesson here is that this doeling, because of the need for growth, has higher requirements than a mature doe and needs extra nutrition.

Flushing meat goats

Some people advocate "flushing" of meat goats prior to breeding. Flushing refers to the practice of providing extra nutrition to does approximately 2 weeks prior to breeding and for a variable portion of the breeding period (e.g., 1-2 weeks) to increase the number of ovulations and have a greater proportion of twins and triplets. This is widely advocated with sheep producers and Angora goat producers. Producers have extrapolated the practice to meat goats. However, several controlled studies with Spanish goats in reasonable body condition (BCS 2.5 – 3.5) have shown no response in kidding or conception rate of meat goats to flushing with extra protein, energy, or both. The practice may have utility for meat goats in poor body condition, but there does not appear to be justification for flushing does in acceptable body condition.

Winter feeding of does

Early to mid-winter is a time when does should be in early pregnancy. The goal of a wintering program is to economically provide the necessary nutrients to maintain a reasonable body condition, lose no weight, and keep them warm. In general, most wintering programs consist of both forage and supplement components. The forage component can consist of hay, stockpiled forage, or a cheap byproduct roughage feed. The supplement usually contains energy, protein, and often vitamins and minerals, although these may be provided separately as a mineral mix. Commonly utilized supplements include whole shelled corn (inexpensive source of energy), range cubes (inexpensive source of energy and protein), sweet feed, protein blocks, molasses blocks or tubs, and liquid feed.

Stockpiled forage is forage that is grown during the summer or fall upon which animals are not allowed to graze, reserving it for the winter months. In drier areas, the forage is well preserved, but in a more humid climate quality declines rapidly, making the practice less satisfactory. Stockpiled forage is a very inexpensive forage source since it does not have to be mechanically harvested (baling forage doubles the cost of forage); animals harvest stockpiled forage by grazing. Animals make much more efficient use of stockpiled forage when strip grazed (using temporary electric fence to limit animal access to an area containing a 1 to 3 day supply of forage) to minimize trampling. Fescue is used in many temperate regions for stockpiling and retains its quality well into late winter even in humid areas. Most recommendations for stockpiling fescue include late summer fertilization, clipping, and deferred grazing. Warm season grasses such as native range and bermudagrass can be stockpiled. The amount of deterioration is dependent on grass species and rain. If local cattlemen are using stockpiled forage it will probably work for certain classes of meat goats. Consult your state forage extension specialist for further information.

Calculate the requirements for wintering a 95 lb mature Kiko doe (use Spanish biotype) in early pregnancy gaining no weight and with intensive pasture grazing, using LINC. The requirements are 1.19 lbs TDN, 0.14 lbs protein, 3.13 grams of calcium, and 2.19 grams of phosphorus, with 1.86 lbs of dry matter intake estimated (based on default dietary TDN and CP levels). Feedstuffs that can be used include stockpiled (winter) bermudagrass and a 16% molasses lick. The estimated intake from the molasses lick label is 4 ounces or 0.25 lbs. Assume the remainder of dry matter intake is from the stockpiled bermuda pasture.

The molasses lick is not in the feed library so must be entered manually as a new feedstuff. Click on "Add/ Delete Ingredient to Feed Library," to bring up a table to be filled out. First, the feedstuff class is selected. This molasses lick is in the "concentrate" class. Then the name "16% molasses lick" is entered, and remaining values are entered. These values can be obtained from the feedstuff tag or label or by calling the manufacturer. If a value is unknown, leave it blank. For this example, enter dry matter of 85%, 16% crude protein, 75% TDN, 2.8% calcium, and 0.45 % phosphorus. Click on "Add Feed Ingredient to Library" and the Select Feed Ingredient page appears. If needed, click on refresh feed library and 16% molasses lick appears under "Your Feed Ingredient Library." If you have a dry hay or feed, 85% dry matter is a good assumption.

To continue formulating the ration, select the 16% molasses lick and winter bermudagrass, then click on "Input these Feed Ingredients to the Ration." Enter 0.25 lbs for the 16% molasses lick under the "Amount, as-fed" column and guess at 1.5 lbs of winter bermudagrass. Through trial and error a total of 2.0 lbs bermudagrass is selected to fulfill intake requirement. The table shows that this diet provides 0.91 lbs of TDN (76% of requirement), 0.12 lbs CP (86% of requirement), 4.74 grams of calcium, and 1.52 grams of phosphorus (deficient). The diet is quite deficient in energy. To provide additional energy, add whole shelled corn. The diet is then reformulated to contain 0.6 lbs whole shelled corn, 1.4 lbs winter bermudagrass, and 0.25 lbs of lick molasses. This provides 1.15 lbs TDN (97% of the energy requirement) and meets the CP needs. Phosphorus is slightly deficient (13%), but if the bermudagrass is better than average the requirement can be satisfied. Mineral supplements vary in their phosphorus levels as phosphorus is an expensive ingredient. If a mineral supplement with a high phosphorus level is selected for feeding, the requirement would be met but likely at a high monetary cost.

Feeding does in late gestation

Energy requirements increase dramatically in late pregnancy (Figure 4). Using LINC, calculate the nutrient requirements for a 130 lb mature Boer doe, 140 days pregnant (10 days from kidding), gaining no weight, other than that due to pregnancy, and carrying twins. Under question 3, after clicking on the box for greater than 95 days pregnant, a form drops down for pregnancy number (twins), breed (predicts birth weight, can enter yours if known), and days of pregnancy (140). The requirements are 2.45 lbs TDN, 0.45 lbs crude protein, 3.97 lbs intake, 6.03 grams calcium, and 4.22 grams phosphorus.

A ration can be balanced using bermudagrass hay and 20% range cubes to meet the requirements by feeding 1.5 lbs of range cubes and 3.0 lbs of bermudagrass hay. This illustrates the high level of nutrition that is needed, especially in the last 3 weeks of pregnancy. High quality hay as well as supplementation is usually required. The range cubes contain a mineral supplement so no additional mineral mixture is needed.

Doelings require more supplementation than mature does, as the doelings are still growing. The nutrient requirements for a 95 lb growing Boer doeling with a predicted intake of 3.37 lbs, gaining 1 lb per month in addition to pregnancy weight gain and 140 days pregnant with a single kid are 1.77 lbs TDN, 0.36 lbs CP, 5.23 grams calcium, and 3.66 grams of phosphorus. If the same ingredients are used as those for the mature doe, how much of each will be required? The doeling could be fed 3.8 lbs of bermudagrass hay alone to meet the nutrient requirements for pregnancy with a single kid. However, if the doeling is carrying twins and is 140 days pregnant, her requirements are 2.27 lbs TDN and 0.47 lbs CP. This doeling will require 1.0 lbs of range cubes and consume 3.3 lbs of hay. If an abundance of high quality pasture is not available, the doeling will need some type of supplementation. If the forage (or hay) of adequate quality is available, only 1 to 1.5% of body weight of whole shelled corn may be needed as an energy supplement. This is important in that feed intake may be reduced in the last 4 to 6 weeks of gestation by the growing kids that reduce available abdominal space.

Feeding the lactating doe

The lactating doe has very high nutrient requirements. Calculate the requirements for a 4 year old 110 lb Boer cross doe nursing twins in week 4 of lactation. When lactating is selected under question #2 on LINC, a form drops down. Select litter size (twins), week of lactation (4), and age at kidding (4). The program then predicts production of 4.5 lbs of milk per day with 3.6% fat and 3.3% crude protein. Nutrient requirements are 2.65 lbs of TDN, 0.41 lbs of protein, 7.61 g of calcium, and 5.33 grams of phosphorus, with 4.14 lbs of dry matter intake predicted (based on default dietary TDN and CP concentrations). During lactation, the doe can consume nearly enough nutrients if an abundant supply of high quality pasture is available, such as in spring or early summer. If "Range, early summer" is selected and fed at 4.7 lbs, the diet meets protein and calcium requirements, and 90% of energy requirement. However, phosphorus is deficient (3.76 vs. 5.33)

and needs to be supplemented. However, does will likely lose some bodyweight due to the high demands of peak lactation (weeks 3 to 8 of lactation) and an inability to consume an adequate quantity of feed. Kidding should take place when there is an adequate supply of high quality pasture. If there is not adequate pasture, supplemental feed will be required. Inadequate nutrition will decrease body condition, reduce milk production, reduce kid weaning weight, and increase kid mortality.

If feeding bermudagrass hay and a 16% dairy ration, 2.6 lbs of hay and 2.0 lbs of the ration are required to fulfill requirements. However, the doe will still lose 2.0 lbs of bodyweight per month. When feeding high levels of grain such as the amount in this example, the animal should go through an adjustment period of two to three weeks during which time the grain portion of the diet is gradually increased to prevent digestion and other problems from occurring. Feeding a dairy ration and hay to a doe during late gestation and the lactating period will cost approximately $30 per animal. Utilizing available pasture as a feed source is a much cheaper alternative.

Kids are usually weaned at about 12 weeks of age. Milk production of the doe begins to decrease after the 6th week of lactation and is quite low by the 12th week. Nutrient requirements decline as stage of lactation advances, enabling the doe to maintain or even increase body condition on pasture alone. Kids may be creep fed while nursing to increase growth rate of the kids and reduce nutrient demands on the doe for milk production.

Creep feeding

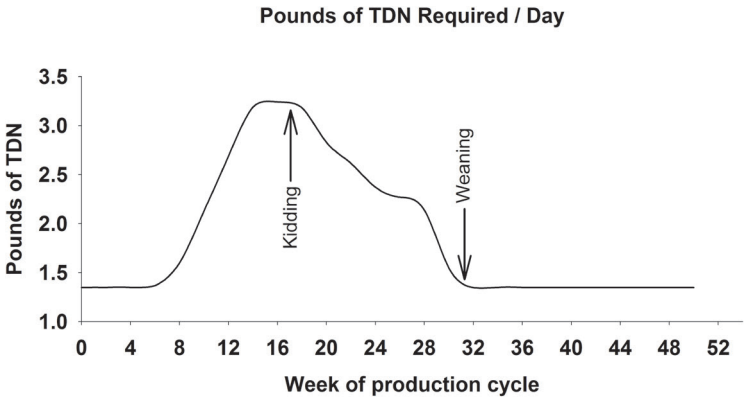
Creep feeding is a method of providing feed for the kids only. This is accomplished by fencing around a feeder and using a creep gate that has holes about 5 inch wide by 1 ft high. These holes are small enough so that kids can enter the feeder, but adults are excluded because they are too big to go through the hole. Creep feeding will provide extra growth for the kids and train them to eat feed, facilitating weaning. A commercial creep feed with at least 16% crude protein that is medicated with a coccidiostat should be used. It requires about 6 lbs of feed to produce 1 lb of animal gain. The more rapid growth from creep feeding may be beneficial for producing show prospects.

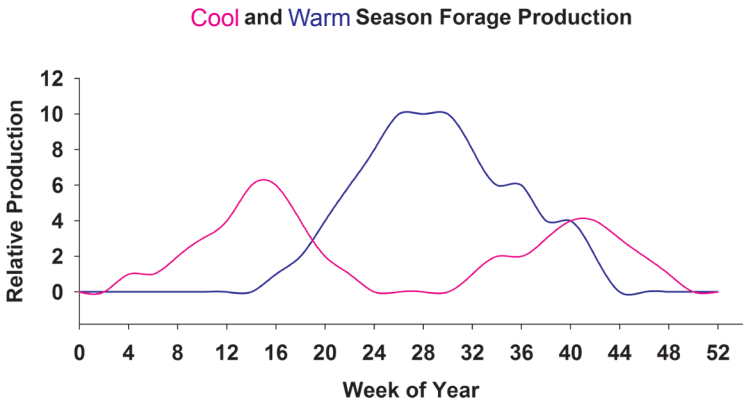
An alternative to grain-based creep feeds that is used in the beef cattle industry is to creep graze calves, using a creep gate that allows calves access to ungrazed high quality pasture. This may have application for goats using high quality pastures (crabgrass or sudangrass that is planted for the kids). In rotational grazing of cattle, the calves are often allowed to creep graze the next pasture before cows so that they have relatively high nutrient intake. Those pastures often have less parasites and disease organisms because of the time since last grazing.

Effect of Kidding Season on Nutrient Requirements

Nutrient requirements of does change dramatically with stage of production. Requirements increase dramatically the last 6 weeks of gestation due to increasing fetal growth and remain high in early lactation (kidding occurred on week 18 in chart). During the month prior to kidding and for the following 3 months (assuming weaning at 12 weeks of age), the doe will consume nearly as much nutrients as in the remaining 8 months of the production cycle. Thus, during that time it makes sense to supply nutrients from an inexpensive source, typically pasture. The cost of providing the same nutrients as hay is more than twice that of pasture, and supplying through purchased feeds may be four to five times greater than for pasture.

Kidding should be planned for a time when pasture is rapidly growing. This period corresponds to late spring for pastures comprised of warm season forages such as bermudagrass or native range, browse, and forbs, but could be either fall or early spring for cool season grasses such as ryegrass, wheat, orchardgrass, and fescue. Cool season grasses usually produce less forage per acre than warm season forages, but generally are higher in energy and protein. The accompanying figure shows the relative production of cool and warm





season forages for central Oklahoma. Consult a local pasture extension specialist or livestock extension specialist for local forage growth patterns. Rapidly growing pasture is high in protein and energy. A major consideration in determining the date to kid is level of forage production at that time. However, there are other considerations in selecting kidding date, such as parasites and market opportunities. Some markets provide a substantial price premium from kidding at a specific time of the year, such as producing prospect show wethers or registered animals. However, it may take a considerable market premium to cover the cost of purchased feed, so general reliance on pastures and forages is best.

Artificial Raising of Kids

Sometimes it is necessary to bottle feed young kids due to death of the mother or the mother refusing to take them. Milk feeding of commercial meat goats is usually not economical. It may be avoided by cross-fostering kids onto another doe as described under the goat management section. If a bottle raised kid is with other kids and does, they may learn to 'steal' sufficient milk to raise themselves. Kids can be raised on cow milk replacer, goat milk replacer (expensive) or, if none is available, cow milk from the store may be used.

It is very important that kids receive colostrum within 12 hours of birth. After 12 hours, antibodies absorption decreases. Colostrum may be milked from another doe that recently kidded. Colostrum contains antibodies that strengthen the immune system for the first months of life. A kid should be fed one ounce of colostrum per lb of weight (average birthweight 7 lbs, therefore, 7 ounces of colostrum) at each of three feedings in the first 24 hours. If the kid is too weak to nurse, it is appropriate to provide the colostrum via stomach tube. This does take some practice, but obtaining colostrum is critically important to kid survival.

Initially kids can be fed using a baby bottle or a nipple such as the Pritchard teat which fits on a plastic soda bottle. Kids can be bottle fed twice a day, although three times a day the first 4 to 6 weeks of life may increase growth rate. Kids are very susceptible to bloating and other gastrointestinal problems from milk replacers that contain a high level of lactose due to use of dried whey in their formulation. Reduced lactose milk replacers will reduce bloating problems.

A calf starter feed (with a coccidiostat such as Rumensin or Deccox, sometimes called medicated) and high quality hay should be made available the second week of life. Deccox can be used in the milk from week 2-6 to prevent coccidiosis. After 4 weeks of life, kids can be limit fed milk at one pint in the morning and also in the afternoon. This will stimulate consumption of starter feed and facilitate weaning.

Kids can be weaned after 8 weeks of age if they are consuming 2 ounces of starter per day and weigh two and a half times their birth weight (about 18 lbs). Weaning shock can be reduced by going to once a day milk feeding for several days to encourage consumption of the starter.

Considerations in Ration Formulation

Rations should be balanced not only for protein and energy, but calcium and phosphorus contents should be calculated, macrominerals supplemented, and a trace mineralized salt used to provide microminerals. A vitamin premix should be used to provide at least vitamin A and E.

If the diet is being fed at high levels to bucks or wethers, there is risk of urinary calculi. To prevent urinary calculi, the ration should be formulated with a minimum of phosphorus, over twice as much calcium as phosphorus, and a urine acidifier such as ammonium chloride at 0.5-1.0 % of the diet. Salt can also be included in the diet, such as at 1%, to reduce incidence of urinary calculi.

If the ration is being fed at high levels, sufficient fiber should be included in the diet to prevent acidosis. Dried brewers yeast and probiotics are often used in rations fed to animals at high levels to help prevent them from going off feed.

Feeds may have a coccidiostat included in the formulation to prevent coccidiosis. There are a number of coccidiostats, but Food and Drug Administration approved drugs commonly used include Deccox and Rumensin. Since goats are very susceptible to coccidiosis when stressed, such as at weaning or shipping, many starters and show feeds contain coccidiostats and have the term 'medicated' on the feed tag. Management considerations to reduce coccidiosis incidence include sanitation, cleanliness, and dry housing.

Feeding Systems

There are many methods of feeding goats. Feeds should be offered in such a way to minimize mold growth or fecal contamination that reduces intake. Mineral mixes must remain dry and should be replenished at 2 week intervals to avoid caking. Feed troughs should be designed to facilitate removal of feces and leftover feed. Troughs generally require a bar running above the length of the trough to keep goats from defecating in them.

Self feeders can be used for feeds containing sufficient roughage for use as a complete feed or for feed that has a built-in intake limiter. For large range operations, feeds such as whole shelled corn or range pellets or cubes are often fed on the ground. The feeding area is moved each day to have clean ground upon which to feed.

Round hay bales should be fed in a rack off the ground. Feeding round hay bales on the ground results in hay wastage and leaves a mess that is difficult to clean. Hay can be fed in a manger or hay feeder with keyhole slots, but horns may cause problems preventing access to feed. For large operations, unrolling round bales on the ground works well.

Nutritional Disorders

There are several diseases associated with nutritional management. These include acidosis, founder, enterotoxemia, pregnancy toxemia/ketosis, polioencephalomalacia, and urinary calculi.

Acidosis, founder, and enterotoxemia are all related to either feeding high levels of grain or a rapid increase in the level of grain in the diet. Acidosis is associated with the production of high levels of lactic acid in the rumen from a large supply of starch that the animal consumed. Endotoxins may also be produced by ruminal bacteria that exacerbate the problem.

Founder refers to problems that occur with the feet of the animal as a consequence of acidosis. The blood vessels in the hoof constrict and in the long-term cause the hoof to grow rapidly, necessitating weekly hoof trimming.

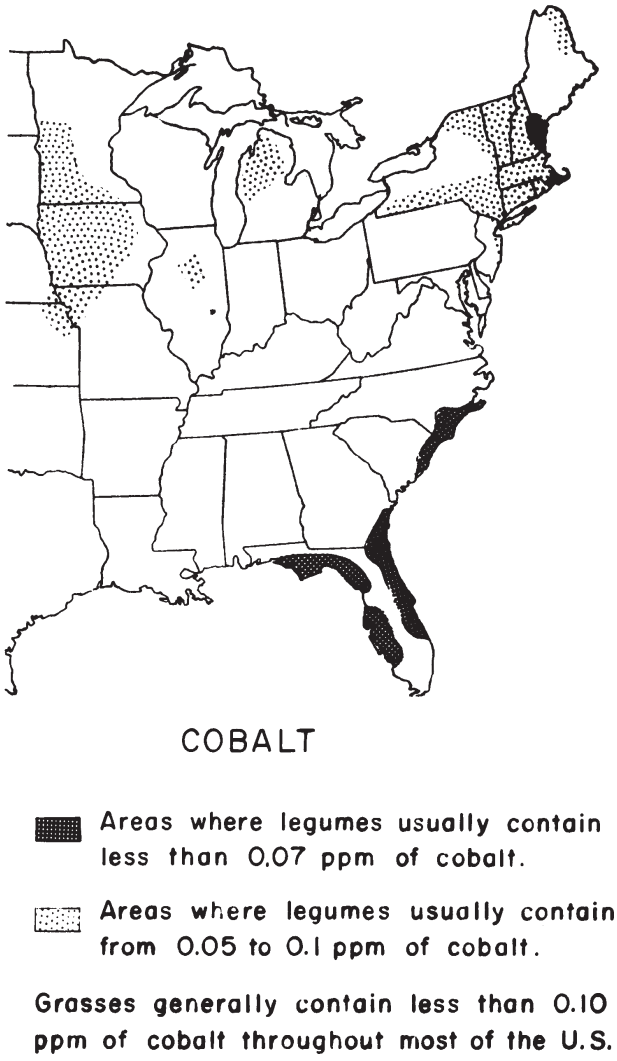
Enterotoxemia is caused by bacteria in the intestine that grow rapidly and produce an endotoxin in response to high levels of starch (grain) in the diet. Animals are in extreme pain from the effect of the endotoxin and often die quickly. Vaccination will help prevent this disease.

High levels of grain in the diet and stress are associated with polioencephalomalacia, which is a thiamine deficiency. High dietary levels of sulfur (such as from molasses in the diet) can increase incidence of the condition. The animals appear drunk, may not be able to stand, become blind, and slowly die. There is often a dramatic response to a large dose of thiamine (5 mg/lb), which may need to be repeated. These diseases can be best prevented by increasing the grain level in the diet slowly and maintaining 50% forage in the diet. Thiamine can be added to high concentrate diets at 0.25 lb/ton to aid in the prevention of polioencephalomalacia.

Pregnancy toxemia is a metabolic disease usually caused by animals being too fat (body condition score greater than 4) prior to kidding; although very thin animals (body condition score less than 2) are subject to the disease also. It is caused by a high demand for nutrients by the growing fetus in late pregnancy that is not being met (excess fat in the body and the growing fetus limit room in the stomach for food, reducing intake of the diet). This unmet nutrient demand causes a rapid breakdown of fat reserves, forming ketone bodies at high levels which are toxic. Treatments include administration of propylene glycol, large doses of B vitamins, glucose given intravenously and possibly Caesarian-section (to remove the fetuses and immediately reduce energy demand; see the Goat Health section). Prevention of the disease is far easier and more effective than treatment. Simply monitor animal body condition and adjust nutrition, especially energy, to manipulate body condition. Do NOT sharply reduce feed in late gestation as this may cause pregnancy toxemia. Also, pregnant goats in the last third of pregnancy will need a more nutrient dense diet (higher quality) due to fetal growth and reduced intake because of reduced stomach capacity. Exercise will help. Does can be encouraged to exercise by separating hay, feed and water at a substantial distance, forcing them to walk more.

Soil-Related Nutritional Problem Areas for Grazing Animals

Figure 1. Geographical distribution of Co-deficient areas in the eastern United States (ppm = 1 $\mu g/ g^{-1}$). From Kubota and Allaway, 1972, by permission Soil Science Society of America.



All soil maps were taken from Kubota, Welch, and Van Campen. 1987. Adv. Soil Sci. 6:189-215.

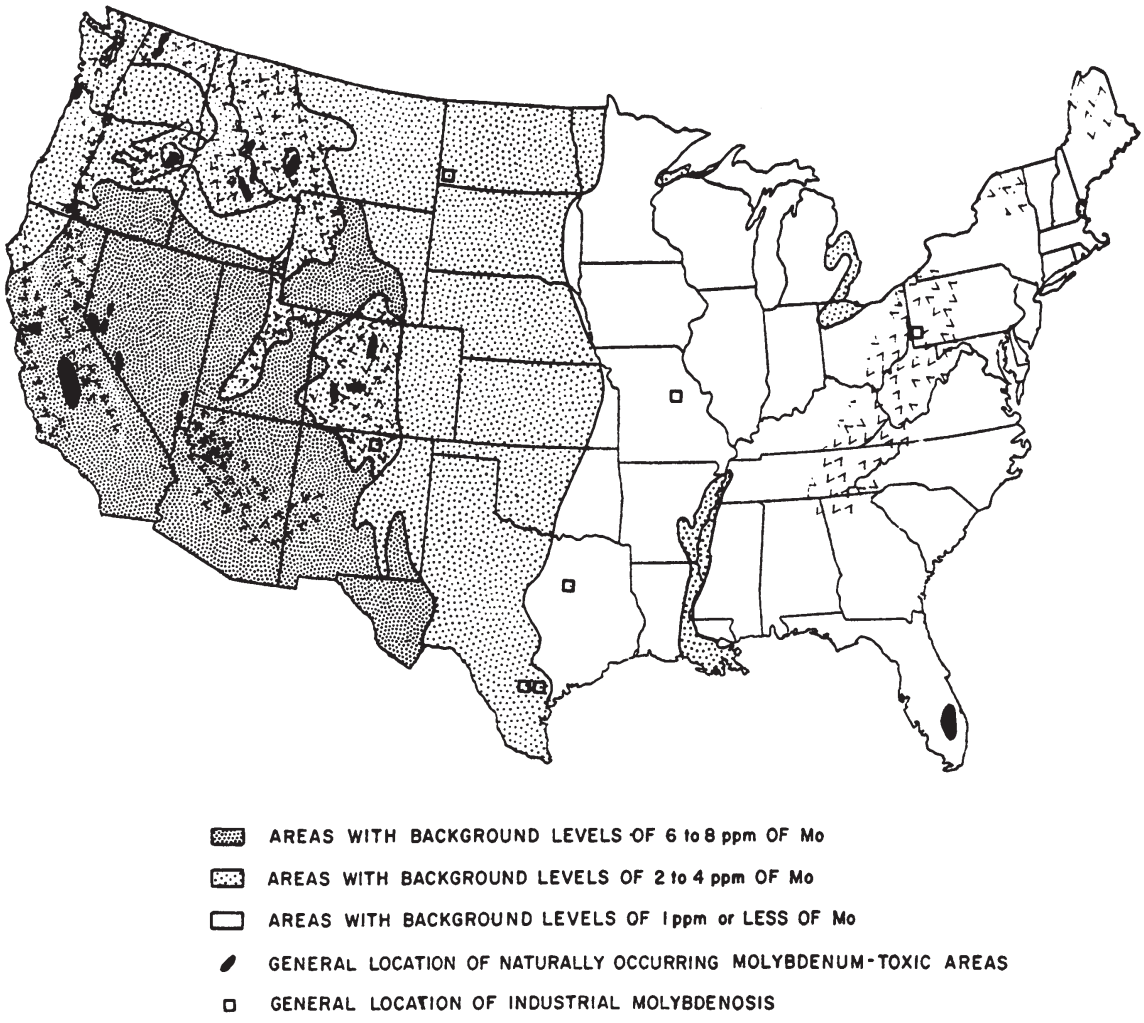


Figure 6. Generalized regional pattern of molybdenum concentration in legumes of the United States (ppm = 1 $\mu g/ g^{-1}$). From Kubota, 1977, by courtesy Marcel Dekker, Inc.

All soil maps were taken from Kubota, Welch, and Van Campen. 1987. Adv. Soil Sci. 6:189-215.

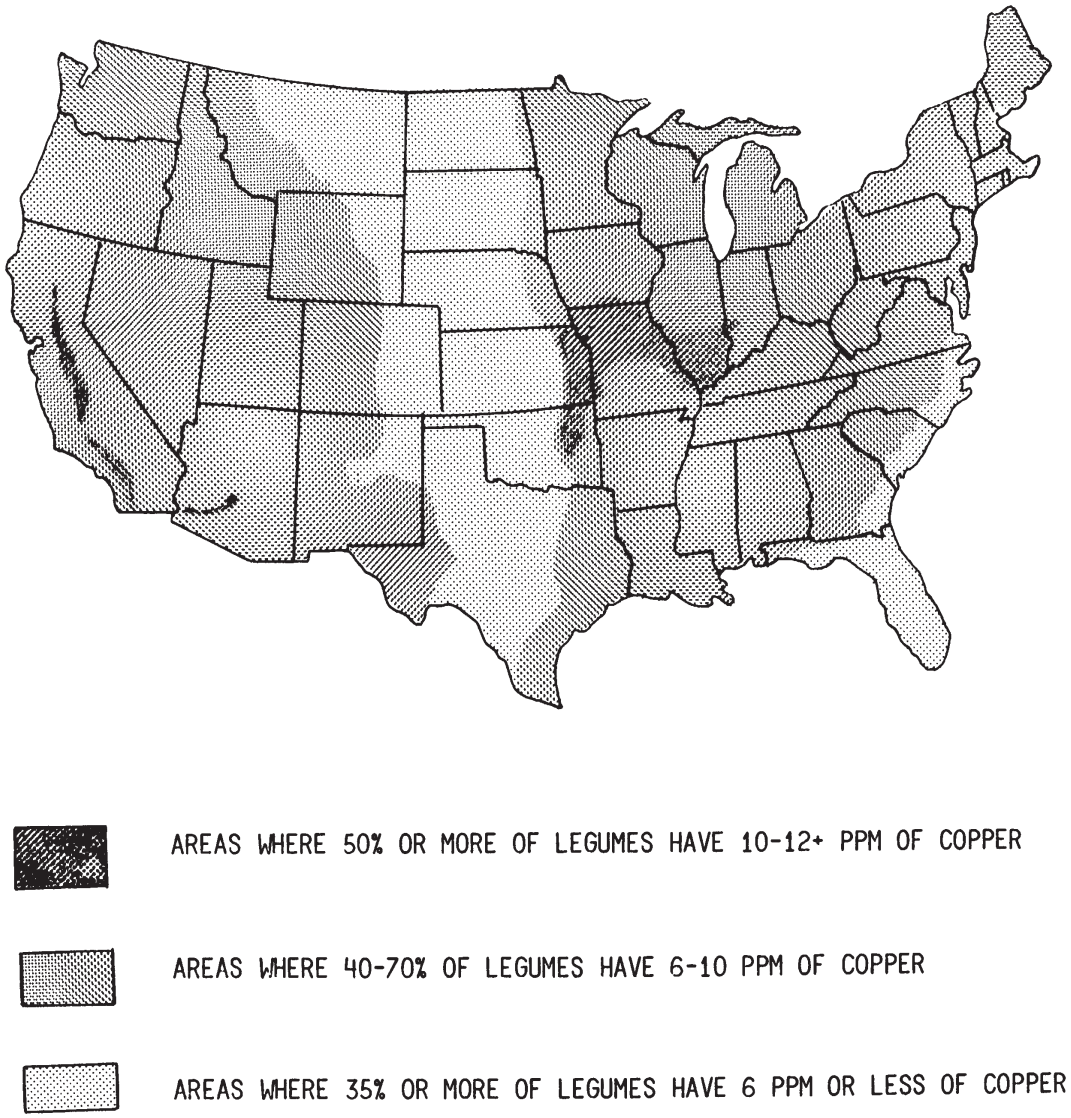


Figure 7. Generalized distribution of copper concentration in legumes of the United States (ppm = 1 $\mu g/ g^{-1}$). From Kubota, 1983a, by permission Amer. Society of Agronomy.

All soil maps were taken from Kubota, Welch, and Van Campen. 1987. Adv. Soil Sci. 6:189-215.

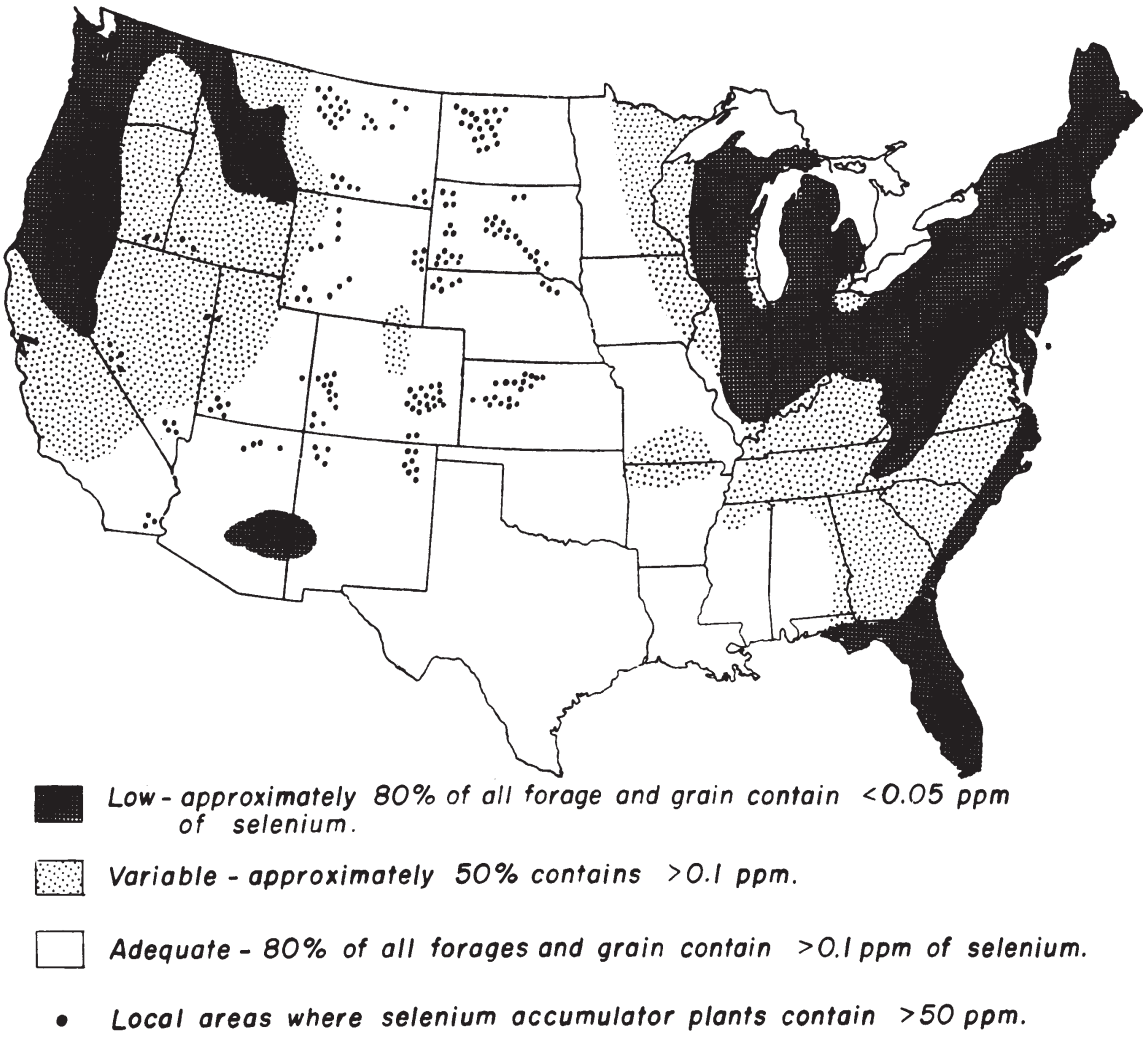


Figure 8. Geographical distribution of low-, variable-, and adequate-Se areas in the United States (ppm = 1 μg/g). From Kubota and Allaway, 1972, by permission Soil Science Society of America.

All soil maps were taken from Kubota, Welch, and Van Campen. 1987. Adv. Soil Sci. 6:189-215.

Definitions useful for this section

Acidosis - A disease usually caused by feeding too much grain or increasing the level of grain in the diet too rapidly. It results in the rumen having very acid conditions, and endotoxins may be produced that adversely affect various parts of the body.

Body condition score - Abbreviated BCS. Applying a numerical score to describe the amount of muscle and fat cover on an animal. Usually performed by feeling along the backbone in the loin area, over the ribs, and at the breastbone (sternum). Scores range from 1 (extremely thin) to 5 (extremely obese).

Browse - Vegetative parts of woody plants, primarily leaves and twigs, that typically contain high levels of tannins.

Carbohydrates - The major energy source found in most feedstuffs. Carbohydrates contain twice as many hydrogen atoms as carbon and as many oxygen atoms as carbon, commonly designated as CH_2O. They include substances such as sugar, starch, fiber, cellulose, and hemicellulose.

Cellulose - A major structural carbohydrate in plants. A component of fiber that is poorly digested by nonruminant animals. Cellulose is composed of glucose molecules chemically linked by a "beta" linkage that is only digested by bacteria such as those in the rumen and(or) cecum.

Coccidiosis - An infectious intestinal disease caused by protozoan organisms (coccidia). The disease causes diarrhea and damages the lining of the intestine. Moisture, stress, and unsanitary conditions are conducive to coccidiosis.

Concentrates - A feed with less than 20% crude fiber and usually more than 60% TDN on an as fed basis. Often a mixture of feedstuffs with added minerals and vitamins.

Crude fiber - The more fibrous, less digestible portion of a plant primarily consisting of cellulose, hemicellulose, and lignin. A method of estimating the fiber content of a feedstuff through sequential extraction with acid and alkaline solutions.

Enterotoxemia - A disease caused by an overgrowth of bacteria (*Clostridia perfringens*) in the intestine usually due to fermentation of a large quantity of starch, with production of endotoxin. Usually causes rapid death of animals.

Fiber - A component of the feed that consists of cellulose, hemicellulose, and lignin. It is necessary for normal rumen health.

Forage - The edible part of the plant, other than separated grain, that can provide feed for grazing animals.

Founder - Refers to a consequence of acidosis, resulting in rapid growth of the hoof.

Mineral - The inorganic group of nutrients including elements such as calcium, phosphorus, copper, etc.

Nutrient - One of six classes of chemical compounds having specific functions in the nutritive support of animal life.

Nutrient requirements - The level of specific nutrients required to keep an animal healthy and productive.

Nutrition - The study of nutrients, determining what nutrients are required, what levels of nutrients are necessary for various levels of productivity, and how to provide those nutrients.

Polioencephalomalacia, PEM, or 'polio' - A neurological disease of goats caused by thiamine deficiency. The rumen normally produces adequate levels of thiamine, but under some conditions such as a high grain diet, high sulfur in the diet, stress, or being 'off feed,' the thiamine is degraded, thus causing the disease.

Stockpiled forage - Forage that is allowed to accumulate for grazing at a later time.

Supplement - A feed designed to provide nutrients deficient in the animal's main diet.

TDN - Total Digestible Nutrients, a measure of digested energy. A lb of TDN equals 2,000 Calories (kilocalories).

Vitamins - Specific organic substances required for various metabolic functions.

Goat Farm Budgeting

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Introduction

Investing in a farm is often an expensive undertaking and can be financially stressful. Land ownership in particular is costly. Historical rates of return to agricultural assets average 3 to 5% making it difficult to make principal and interest payments on land notes with farm income only. Hence, business planning is especially important in ranching operations even if the decision to produce goat meat is a lifestyle choice or hobby rather than strictly an economic one. An expensive hobby may create a serious financial drain on the producer's checking account.

The agricultural producer or farm manager is challenged when organizing and managing farm resources to maximize economic returns to owned or controlled resources. Resources include land (owned and rented) and associated improvements, capital (borrowed and owned), and labor (hired, farm operator, and additional family). The manager is responsible for combining available resources and knowledge to best achieve the desired goals and objectives of the farm business.

As a key component of a business plan, budgeting is a management tool that helps the beginning producer evaluate the feasibility of a proposed venture and helps established producers identify areas for improvement. Budgets identify financial resources needed for both farm investment and annual operating costs. With budgets, management can begin to answer such questions as:

- How may the available resources best be used?
- What enterprises (crops and/or livestock) can be produced and which will contribute most to returns to owned resources?
- How much of the controlled land should be devoted to each enterprise?
- What equipment and machinery will be needed to produce the potential enterprises?
- What production practices should be used to produce each of the enterprises?
- How much labor (both family and hired) will be needed on the farm?
- What are the capital requirements?

Budgets help ensure that investors make decisions based on realistic data, not just emotions. Knowledge of budgeting and the ability to use them will help make the right decision.

Enterprise Budgets

Questions may arise as to whether goats will help supplement farm income or if a larger operation is even technically feasible. In an enterprise with seasonal and cyclical price changes, sensitivity to variable grain and hay prices, and a vulnerability to weather, appropriate management practices and an identification of key cost components are important. Circumstances over which the producer has no control can wreak havoc in the short run if a producer neglects strategic planning and risk management.

An enterprise budget estimates the full economic costs and returns projected to accrue to an activity - raising livestock or producing grain - for some period, generally one year. Enterprise budgets incorporate information about the specific resources, management practices, and technology used in the production process. Budgets help provide a decision framework for assessing both short- and long-range economic analyses of production agriculture. Budgeting allows producers to evaluate options before committing resources. Budgets can also be used to estimate potential income and the size of farm needed to earn a specified return

or to compare the profitability of two or more systems of production. Budgets provide the documentation necessary to project cash flows and obtain/maintain credit-worthiness. Budgets can also be used to estimate the amount of rent that can be paid for land or machinery.

A goat enterprise budget is a statement of what is generally expected from a set of particular production practices, listing the expected revenue and expenses incurred. It is designed to show profitability, not just cash flow. Profit is shown as residual earnings after resources utilized in the operation have been assigned a payment. The enterprise budget shown in Table 1 lists anticipated costs of operating inputs plus fixed costs (interest, depreciation, taxes, and insurance) on machinery, equipment, and livestock along with expected production per doe. Since the budget documents variable and fixed costs, it is useful in calculating profitability, break-even values, and the potential return on an investment.

An enterprise budget should contain several components. A detailed description should include a production goal, the production techniques to be employed, the land resource required, and even something about the capital and labor requirements. An enterprise budget should include all costs and all returns associated with the defined enterprise.

Production

Historically, a lack of a developed nationwide marketing system in the United States caused seasonal price fluctuations and wide variations by location. Goat meat is favored by a number of ethnic groups who have immigrated to this country and many producers have traditionally supplied goat meat to these populations on an individual basis. However, with goat meat demand steadily increasing and domestic producers raising more goats to meet this growing appetite, market outlets such as livestock sales auctions are becoming more common. Slaughter prices are still higher in the early spring months, but this seasonality is not as pronounced as it once was.

A sample budget considering a herd size of 50 does and two bucks is shown in Table 1. The kids are marketed at four months of age. The total quantity of production is multiplied by the actual or expected price to determine value of production. Gross or total receipts are the sum of production values for individual items. For example, the expected returns in the budget are averaged for reporting on a per doe basis. A herd technically does not market 40.5 male kids for sale. This is a statistical result of the averaging process for the herd. The averaging process yields a realistic estimate of the budget unit (doe) returns to the entire herd given the assumed kid crop percentage, death loss, and cull doe replacement rates.

Table 1 – Meat Goat Budget, 50 Head Unit, 180% Kid Crop, 10% Kid Death Loss, 20% Doe Replacement Rate, Central Oklahoma Native Pasture, Per Doe Basis.

Market kid and culled buck prices reflect 2009-13 OK averages.

	Weight	Unit	Price/Cwt	Quantity	Total	$/Head
PRODUCTION						
Male Kids	70.0	Lbs.	$135.34	40.50	$3,837	$76.74
Female Kids	70.0	Lbs.	$135.34	30.50	$2,890	$57.79
Cull Does	85.0	Lbs.	$78.71	7.00	$468	$9.37
Cull Replacement Doe Kids	70.0	Lbs.	$150.00	0.00	$0	$0
Cull Bucks	135.0	Lbs.	$107.04	0.00	$0	$0
Total Receipts					**$7,195**	**$143.89**
OPERATING INPUTS		**Unit**	**Price**	**Quantity**	**Total**	**$/Head**
Pasture		Head	$1.60	1	$80	$1.60
Hay		Head	$12.60	1	$630	$12.60
Grain		Head	$0.00	1	$0	$0.00
Protein Supplement		Head	$38.62	1	$1,931	$38.62
Salt/Minerals		Head	$0.57	1	$29	$0.57
Vet Services/Medicine		Head	$2.03	1	$101	$2.03
Vet Supplies		Head	$3.25	1	$163	$3.25
Marketing		Head	$8.50	1	$425	$8.50
Mach/Equip Fuel, Lube, Repairs		Head	$8.39	1	$420	$8.39
Machinery/Equipment Labor		Hours	$11.00	0.90	$495	$9.90
Other Labor		Hours	$11.00	2.00	$1,100	$22.00
Annual Operating Capital		Dollars	6.50%	49.91	$162	$3.24
Total Operating Costs					**$5,535**	**$110.70**
Returns Above Total Operating Costs					**$1,660**	**$33.19**
FIXED COSTS		**Unit**	**Rate**		**Total**	**$/Head**
Machinery/Equipment						
Interest at		Dollars	6.40%		$96	$1.91
Taxes at		Dollars	1.00%		$26	$0.51
Insurance		Dollars	0.60%		$9	$0.18
Depreciation		Dollars			$206	$4.11
Livestock						
Interest at		Dollars	6.40%		$376	$7.51
Taxes at		Dollars	1.00%		$81	$1.62
Insurance		Dollars	0.60%		$35	$0.70
Depreciation		Dollars			$78	$1.56
Land			$0			
Interest at		Dollars	0.00%		$0	$0
Taxes at		Dollars	0.00%		$0	$0
Total Fixed Costs					**$905**	**$18.10**
Total Costs (Operating +Fixed)					**$6,440**	**$128.80**
Returns Above all Specified Costs					**$755**	**$15.09**

Source: OSU Enterprise Budget Software.

Production Costs

Three general types of costs comprise the total cost of producing any type of farm commodity. They are variable (operating), fixed, and overhead expenses. Overhead expenses (also known as indirect costs) are difficult to allocate among individual enterprises. Examples include telephone, electricity and accounting services. Overhead expenses are included in whole-farm budgets, but are generally excluded in enterprise budgets.

Variable Costs

Variable costs are those operating inputs that vary as the level of production changes. They are items that will be used during one operation year or one production period. Examples include feed, fuel, vet medicine and supplies. They would not be purchased if production were not undertaken.

Variable costs may also be classified as cash or non-cash in nature. For instance, labor expenses are included in the operating input section of Table 2.1. No differentiation between owner supplied or hired labor is assumed. If the farm operator or a family member supplies labor, a wage rate or salary that represents earnings if employed elsewhere would be shown. This illustrates one of the most important concepts in economics – opportunity costs. Every resource used in the production process has one true cost, its opportunity cost. The opportunity cost of labor is the return the resource can earn when put to its best alternative. If the operator decides not to assign a charge to the labor item, residual earnings (as defined by Returns Above Total Operating Costs) includes labor income. The producer can then determine whether the return is adequate compensation for his/her labor efforts.

Fixed Costs

Fixed costs are not affected by short-term enterprise decisions and do not vary with the level of production. Generally, fixed costs are those ownership costs associated with buildings, machinery, and equipment that are pro-rated over a period of years. Fixed costs may also be cash or non-cash in nature. Real estate taxes, personal property taxes, and insurance on buildings are examples of cash fixed costs. Non-cash costs include depreciation and interest on capital investment.

The interest charge for capital assets such as machinery, equipment, and breeding livestock used in the goat operation is based on the average amount of capital invested over the ownership period, usage per year, and an interest rate. It is important to note that money invested in purchased capital assets has an opportunity cost as well – the return they can earn from their best alternative use. This interest on investment reflects a payment to a farmer's owned resources.

Depreciation represents an attempt to spread the investment costs or purchase price of durable assets over their productive lifetime. It is typically the largest cost associated with asset ownership. For example, when a tractor is worn out, it should have been completely "paid for" by depreciation. A producer must, in effect, save this much every year or reinvest it in machinery and equipment, or he/she will eventually end up with worn out items and no cash reserves to replace them.

Taxes vary by region but are generally a function of average value. In the goat budget, the annual charge for taxes is based on 1% of the purchase price.

Insurance policies are usually carried on more expensive machines while the farmer generally assumes the risk of loss on the simpler, less expensive assets. The insurance costs are based on the average amount of capital invested times an insurance rate.

Returns Above Total Operating Costs

The return to fixed costs, risk, and management (that is, the returns above total operating costs) is computed by subtracting total operating costs from total receipts. When returns above operating costs are positive, production is economically rational for an established enterprise. Positive returns above total operating costs (as shown in Table 2.1) indicate that the enterprise generates enough revenue to cover all variable costs and some portion of fixed costs. If returns above total operating costs are negative, the enterprise is not generating enough revenue to cover even variable costs. Unless the producer is willing to subsidize the operation (for instance, by contributing off-farm income), eliminating this enterprise will increase profits or decrease losses on the overall farm business. The return above total operating costs is also known as gross margin.

Returns Above All Specified Costs

In determining overall enterprise profitability, fixed costs also have to be part of the profit equation. The return above all specified costs is calculated by subtracting total variable and fixed costs from operating revenues. This amount represents residual earnings for management, risk, and to land (because land costs can have a large variation within a region, land costs are excluded). A positive return above all specified costs indicates that the operation is self-supporting and shows an amount available for reinvestment in the business or family living. Each individual must decide whether this return is a sufficient reward for management skills, risk exposure, and to land devoted to the enterprise. Will returns earned in the long run be sufficient to replace breeding livestock and the machinery/equipment devoted to the enterprise while also contributing to family living and overall farm maintenance? While a loss may create cause for concern, it may only be temporary. The operator should monitor this "bottom line" periodically to determine whether this enterprise has the ability to survive in the long-run. It should be noted that since non-cash items may be included in fixed costs, operating profits are not the same as net cash or operating receipts as shown in a cash flow statement.

Building on budgets to determine break-even prices or yields and view sensitivity analysis is helpful in evaluating the financial risk associated with an enterprise. The break-even price is the price at which all costs will be covered given average production; the break-even yield is the level of production needed to cover all costs given average market prices. Break-evens above variable costs and above all costs both provide useful information. With sensitivity analysis, income variability due to price and production risk is demonstrated, typically with tables of numbers showing returns under different price and yield scenarios. This information helps the managers assess their willingness to assume the risk of these variations.

One of the most important keys to successful goat operations is to be as cost effective as possible. As mentioned previously, one needs to periodically evaluate the contributions of all resources used in the operation. Look at possibilities for improving cost control through new technologies or cultural practices. Identify key leverage points that can generate the "most bang for the buck". Are there ways to reduce the number of trips to the feed store while still meeting nutritional requirements? Try to minimize harvested or supplemental feedstuffs with improved grazing management. A goat is a forage harvesting machine and grazing will always be cheaper than providing harvested forages. There is no single management practice that affects livestock profitability more than stocking rate. Can you do a better job of animal husbandry instead of regular visits from the veterinarian? Benchmark what other producers are doing. Spending dollars wisely given the appropriate management practice can generate major dividends that impact the bottom line. After all possibilities to improve the budget have been exhausted and long-run earnings still appear unsatisfactory, the best decision may be to exit the enterprise and employ resources in a different enterprise or investment.

OSU software is available to develop a customized budget for an individual operation (http://agecon.okstate.edu/budgets). The Microsoft Excel-based software provides users access to important agricultural references during an "interactive" budget building process. Through a series of links and pop-up menus, users

may override defaults with their own values to customize the budget if their experience and farm records indicate different values and production practices. Where possible, web-links are built into the spreadsheets to provide users important economic and agricultural science information on the Internet. Link examples include OSU Extension publications, Oklahoma Agricultural Statistics Service data, and Langston University goat information.

The software is designed to be flexible and user-friendly. After specifying a base livestock budget setting via a start-up form, the budget (as shown in Table 2.1) may be further customized by clicking on any budget item which links to a corresponding supporting sheet within the workbook. For example, to access and change the default kidding percentage for the herd, one may click on any of the production items linking to the Production sheet. The Production sheet summarizes herd information, kid retention and sales, culling and replacement practices, and herd buck information. Default values for kidding percentages, kid death losses, and average sale weight are based on information from the E. (Kika) de la Garza Institute for Goat Research at Langston University. Kidding percentages can then be tailored to match a particular operation on the screen.

Other Aids to the Process

Education

The producer needs to know what they are doing or raising goats will be a painful lesson in the pocketbook. You will need to have an eye for detail, be able to follow set procedures, and understand the risks involved. Use the best information available and include all decision makers in the business planning process. Talk to local producers and Extension personnel. Other sources of information are books/periodicals on meat goat production and industry, commodity organizations, and meat goat websites such as Langston University . The National Ag Risk Education Library provides risk management education on a variety of topics including goats. Focus on financial management as much as production performance. Realize that alternatives that appear profitable for one producer may not work for another. Everyone's experience levels, managerial abilities, and willingness to assume risk is different. Do your homework!

Financial Records

Records are the foundation for accurate budgets, financial statements, and tax reports. While tax reporting is the primary motivation for record keeping for many producers, research has shown positive returns to investments in record keeping and analysis in support of farm and ranch decisions. The sample budget previously discussed may be tailored to fit an individual producer's operation, but its reliability as a planning tool is only as good as the quality of the data.

Since budgets should be based on the best information possible, the producer's own records are a good place to start. A variety of tools are available to assist producers in keeping financial records. The record-keeping system that a farm manager should use depends on the cost - time, effort, and cash – in obtaining a system, maintaining it, and the value of the output as a decision tool. Farm record systems vary in the amount of information collected, the method of entering data, and the structure of final reports. Goat producers should choose the method appropriate to the size and complexity of their operation.

Computerized record-keeping systems are affordable and especially useful for manipulating data for different types of reports. Although a computerized system may not reduce the amount of time spent keeping records, computerized records make financial summaries simple, more efficient and effective for management needs. For instance, an annual or monthly cash flow statement based on actual income and expenses can be generated in a matter of seconds. Income and expenses can be sorted by enterprise so that farm managers know where "profit centers" are on the farm. Whole farm or enterprise budgets can be prepared and compared to actual transactions so that financial progress can be monitored at regular intervals. Graphs prepared with

a few keystrokes can show where cash is coming from and where it is going and are invaluable in getting a quick feel for the farm's financial situation.

A number of user-friendly commercial software products are now available that can be adapted for farm use. One such software program that is appropriate for farms and ranches requiring only cash records is Quicken®. Quicken® is user-friendly, widely available, and inexpensive. More information on using Quicken® for farm financial record keeping is available from the OSU Department of Agricultural Economics at http://agecon.okstate.edu/quicken/. Producers who need a payroll system plus the ability to invoice and maintain accounts payable and receivable may want to use QuickBooks®, which is a small business double-entry accounting system, or a comparable package. Cash flow features and investment tracking are lacking in QuickBooks.

Hand record books are available through the Oklahoma Cooperative Extension Service and from many lenders. The OSU Agricultural Economics website offers a book from which individual pages are available to be printed as needed: http://agecon.okstate.edu/farmbook/.

Oklahoma farmers and ranchers can call on the Intensive Financial and Management Planning Support (IFMAPS) program to receive free, confidential assistance in farm business planning, including analyzing the potential for a new farm business. Trained financial specialists work with families one-on-one to develop financial statements and evaluate alternative plans. The plans typically include budgets for the farm enterprise(s), a cash flow plan, income statement, balance sheet, debt worksheet, and financial measures. Contact your local agricultural Oklahoma Cooperative Extension Educator or call the IFMAPS Center at 1-800-522-3755.

Budget Limitations

Although "best estimates" should be used to develop budgets for use in farm business analysis, it is important to remember that projections are influenced by production and price uncertainty. Such variability creates risk to the operator and puts pressure on the reliability of the estimates used in the enterprise budgets. Everything doesn't proceed just like you planned it. Even under careful use, errors can compound themselves to the point where budgets can have little or no value. This element of risk should be considered and evaluated by the manager when determining the solutions that best meet the goals and objectives of the farm family. Successful farm managers adjust their numbers throughout the year at regular intervals by comparing actual outcomes versus planned. This internal evaluation will help identify existing or potential problems and will result in fewer unpleasant surprises.

Budget preparation is time consuming, but it can pay major dividends. It requires pencil and calculator activity as well as searching data sources for information to be used in preparing the budget. Software is also available to assist in budget calculations. Not only is it important to work hard, but also to work smart.

Conclusion

Budgets are management tools to help evaluate the farm business. Like a puzzle, each budget brings to the table an important piece that will help address how available resources best fit together on the farm. Specific questions such as how and what to produce, production levels, and achieving goals can be answered once the puzzle is completed.

Business management requires that producers focus on financial management as much as production performance. For an enterprise with seasonal and cyclical price changes, sensitivity to variable grain and hay prices, and a vulnerability to drought, successful managers discover that life is a whole lot easier saving money through budget planning. Goat producers interested in being profitable should expect to do no less.

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DHI Training

Ms. Eva Vasquez
Langston University

STANDARD OPERATING PROCEDURES FOR DAIRY GOAT PRODUCTION TESTING

Effective January 1, 2004

CONTENTS

STANDARD OPERATING PROCEDURES

1.0 SCOPE & APPLICATION

1.1 This Standard Operating Procedure (SOP) is applicable to the systematic collection of data documenting milk yield including the measuring milk fat and protein for participants in DHI. The application of these procedures is to provide the framework for a uniform, accurate record system to be used for (1) making farm management decisions; (2) educational programs and research, including the genetic evaluation of does and sires; (3) breed association(s); and (4) the promotion and sale of animals.

2.0 SUMMARY OF PROGRAM

2.1 Sampling should be done in accordance with the National DHIA Uniform Operating Procedures (UOP). All UOP procedures, unless specific to dairy cows only, are to be followed. For purposes of compliance, the use of the terms “cows and heifers” is synonymous with “goats and kids”.

2.2 Procedures outlined in this document are specific to dairy goat production testing only. These basic and minimum standards are to be uniformly followed. They serve to ensure that records will provide the accuracy, uniformity, and integrity essential to dairy goat production records.

3.0 AUTHORITY

3.1 A Memorandum of Understanding exists between the ADGA and the Agricultural Research Service of the United States Department of Agriculture (USDA) to ensure the flow of DHIA records for industry purposes including genetic evaluation programs.

4.0 RESPONSIBILITY

4.1 DHIA dairy goat test supervisors and herd owners as well as persons in their employ are individually and collectively responsible for adherence to these Procedures.

4.2 To participate in this dairy record keeping program, herdowners must agree to conform to these procedures, registry requirements, the NDHIA Uniform Operating Procedures and the associated Code of Ethics.

5.0 DEFINITIONS

5.1 **Dairy Goat -** any goat from which milk production is intended for use or sale, or which is kept for raising replacement dairy kids and is an integral part of the dairy herd.

5.2 **Test Supervisor (TS) –** Any person authorized to collect milk weights and samples for inclusion in the Goat Genetic Evaluation Program (interchangeable with ‘tester’, ‘field sampler/technician’ or ‘supervisor’).

5.3 **Group Testing** – Must meet registry requirements. Each member of the test group is trained to perform supervisor responsibilities when weighing and sampling milk in the herds of other group members. All group testing is conducted under the jurisdiction and supervision of the DHIA.

6.0 PERSONNEL QUALIFICATIONS

6.1 All Test Supervisors are required to be approved by the DHIA of record prior to engaging in any field collection activities.

6.2 Training should be done in accordance with the Council on Dairy Cattle Breeding (CDCB) QCS Field Service requirements with the following being specific to dairy goat testing.

7.0 MINIMUM PERSONNEL TRAINING REQUIREMENTS

7.1 The minimum requirements for new test supervisors (TS) to test non-commercial herds (as determined by the herd's DHIA) without immediate supervision include demonstrated knowledge of (1) barn and parlor techniques, (2) data entry, (3) the *Code of Ethics* and *Uniform Data Collection Procedures, and (4) the Standard Operating Procedures for Dairy Goat Testing*. Commercial herds must have testers meeting the criteria of the CDCB auditing guidelines.

7.2 Documentation of the initial training must include (1) the name and date of training of the new TS, (2) the name and credentials of the trainer, and (3) a list of the topics covered during the training.

7.3 Continuing Education (CE) or refresher sessions should be provided in accordance with the CDCB Auditing guidelines. In addition, newsletters, videos, attendance at an ADGA annual meeting training session can serve as meeting CE requirements. Documentation must include (1) the name of each TS, (2) the name and credentials of the trainer, and (3) a list of the topics covered during the training.

7.4 TS other than those approved to test cowherds or commercial herds (as determined by the herd's DHIA) must obtain CE or attend an initial or a refresher session every 3 years. This is an exception to the CDCB auditing guidelines as it applies to those testers supervising herds using 'pail and scale' techniques. This exception is allowed as this type of test plan is subject to little change over time. Documentation of CE/Refresher must include (1) the name of each TS, (2) the name and credentials of the evaluator, (3) a list of the topics covered during the evaluation, and (4) a performance assessment based upon the CE/Refresher information provided.

8.0 EQUIPMENT AND SUPPLIES

8.1 Equipment needed for collection of dairy goat milk samples includes:

- sample vials or whirl paks*
- approved meter*, or
- sampling device (dipper) and scale*
- sample preservative
- field data sheets

*The appropriate sampling and measuring devices must be of proper composition. See Section 10 for SOP Meters and Scales

9.0 SAMPLE COLLECTION – PREPARATION

9.1 Determine the extent of the sampling effort, the sampling methods to be employed, and which equipment and supplies are needed.

9.2 Obtain necessary sampling and/or weighing equipment.

9.3 Coordinate with herdowner and partner agencies, if appropriate.

10.0 SAMPLE COLLECTION - METHOD OPTIONS

10.1 Meters **-** All portable weighing and sampling devices being used for the generation of certified data must be of a National DHIA approved type. Meters for goat milk sampling must be calibrated in conformance to manufacturer specifications.

GOAT METERS

Manufacturer	Device	ICAR Approved	DHIA Approved
Tru-Test Limited - New Zealand	Goat Meter model 50000		Yes
Waikato - New Zealand	Goat Meter		Yes

10.2 Scales being used for the generation of milk weights to be included in the *Goat Genetic Evaluation Program* must meet the following weight tolerance ranges at each specified weight:

Pounds	Minimum	Maximum
1	0.9	1.1
2	1.9	2.1
5	4.8	5.2
10	9.7	10.3
20	19.4	20.6

10.3 All scales must be checked for calibration by a certified meter technician or an individual approved by the DHIA prior to being placed in active service. The field technician or the herdowner may own Scales. Approved individuals must calibrate scales using certified weights.
10.4 Scales should be identified with a unique identification number.
10.5 All scales must be submitted for an approved routine calibration check by a certified meter technician or an individual approved by the local DHIA on an annual basis.
10.6 All scales receiving repairs that may have affected accuracy must be checked for calibration by a certified meter technician or an individual approved by the local DHIA before returning to active service.
10.7 Each scale must be identified with a tag, sticker, engraving, or other marking indicating the last calibration year and meter center used.
10.8 Documentation of scales must include (1) the make and unique identification number of the scale, (2) the meter technician's or approved individual's name, (3) the meter center used, (4) the date of calibration check, and (5) the final calibration check readings.
10.9 Dip Sampling must be done in a manner that assures a representative sample from the entire milk volume collected.

11.0 SAMPLE HANDLING AND PRESERVATION

11.1 Use pre-preserved sample vials.
11.2 Samples should be kept at room temperature and out of direct sunlight.
11.3 Keep samples in control of the tester – ***EXCEPTION*** – for group tests, samples may also be in control of the group leader, or person designated to ship the samples/data to the laboratory.
11.4 Record all pertinent data on a field data sheet.
11.5 Samples should be shipped so that they arrive at the lab no later than 6 days after the test is performed.

12.0 DATA COLLECTION AND RECORDS MANAGEMENT

12.1 When a breeding date is available, and a doe freshens less than 10 days prior to the expected kidding date, it will be considered a normal kidding and the record initiated will be used for buck and doe evaluations. Does freshening 10 days or more prior to the expected kidding date, whether in milk or dry, will be coded as abnormal and the record initiated will not be used for buck and doe evaluations.
12.2 If a doe aborts while in milk and has carried a kid less than 80 days, her current record will continue without interruption. If a breeding date is not available, and the doe aborts while in milk for less than 240 days, her current record shall continue without interruption. Except for specific situations stated above, the current record shall end and a new lactation will begin.
12.3 Verification tests may be a required condition of test type plan or registry recognition level. It is the herdowner's and/or test supervisor's responsibility to arrange for such tests dependent on registry or regional requirements. Verification testing should be done in accordance with registry policies.
12.4 All data and information must be documented on field data sheets
12.5 Minimum Suggested Record Retention

- Field Sheets – 2 years
- Record Center sheets – 2 years
- Verification Sheets – 2 years

13.0 QUALITY CONTROL (QC) AND QUALITY ASSURANCE (QA)

All field QC requirements of the ADGA QA Project must be followed.

14.0 REFERENCES

Dairy Goat Registry Guidelines, 2003
Uniform Operating Procedures, June 2002
California DHIA, Dairy Goat QC Program
Council on Dairy Cattle Breeding, Auditing Guidelines, June 2002

Drawing Goats in the Field

Mr. Kenneth Williams

Science Illustration and Graphic Design

Introduction

Outdoor sketching is fun and an interesting way to observe and note goat behavior. Sketching from live, moving animals can be a challenge but with the proper equipment and a few helpful tips you can enjoy many hours drawing goats, other animals and their environments. The suggestions given here are from my own experience and personal preferences. Over time you will adopt or develop your own ways of drawing and will chose the drawing tools that help you best express your personal creative vision.

Art Materials for the Field

Paper

The kind of paper used depends on the media chosen for sketching. Most of us will use a dry media such as a pencil, pen or crayon.

For dry media, a bound sketchbook is most convenient. The hard back provides a stable surface to draw upon. Any size is suitable although a portable size is most useful from 3.5 x 5 inches up to 11 x 16 inches or larger.

Useful papers include watercolor papers, sketchbook pads of varying weights or smooth or vellum bristol board.

Toned paper sketchbooks are particularly useful when sketching outdoors because the sun does not reflect off the paper into your eyes as much as white papers can do. Glare can be more of a problem than is often assumed. Also, colored paper provides a medium tone for drawings, allowing the artist to draw only the shadows and highlights, and so speed the sketching process.

Toned paper

Tan papers are best for warm, sunny or earthy moods. Warm blacks, sanguine, sepia, tans, browns, yellow ochre and other warm colors work harmoniously for sketching in monochrome or limited pallets. White works for the highlights. Cream papers are similar to tan and well suited to outdoor subjects.

Grey and tan toned papers.

Grey papers can enhance the mood for rainy days, grey stone architecture, or to add an overall cool tone to the sketch such as that found in shade or deep forest. It also works well for portraiture of people and animals depicted in a quiet or moody atmosphere. Cool colors are effective with grey paper. Blues, blue grey, cool blacks, deep, cool reds and dark greens work well for limited pallets or monochromes.

Watercolor paper

Watercolor paper can be useful not only for the watercolorist but also for watercolor pencils. Cold pressed 140 lb paper is a good choice as it will not wrinkle with light paint applications. Hot press 90 lb paper will buckle a bit but is useful because it seems better for details when sketching and painting small drawings.

Bristol board

Bristol paper is smooth and works well for a variety of media. Used with graphite, it has the advantage of making darker marks with harder grade pencils. This is convenient because softer pencils can easily smear if fixative is not used regularly in the sketchbook.

Bristol is a good choice for colored pencil if you prefer dense painterly layers of color. It is idea for pen and ink and also work as well for small watercolors and multi-media applications.

Sketchbooks

Sketchbooks of various size and kinds of paper.

Keep several sketchbooks handy and select one or more that are appropriate to the media that will be used. Individual sketchbooks can also be used for individual subjects. I keep one sketchbook just for use in state parks that I frequently visit.

It is very useful to make your own sketchbooks with paper that suits your needs. Often favorite papers are not available in sketchbook formats. Several kinds of paper can be bound into a single book. When traveling, I make a sketchbook special to the trip. It may contain a selection of watercolor paper, tan and grey toned paper, bristol board drawing paper and scratch paper which can be useful for trying colors and mixing painter. Select papers and cut them to any size that is suitable. Save old sketchbook backs or other rigid cardboard to use for a back on you home-made sketchbook. Use bristol or other heavy paper for a cover. It can be decorated or labeled to indicate the purpose or what is in the book.

If you like crafting you may bind the papers into a book or what is easier, take them to a copy shop or office store and have them bound. Spiral binding works well however, other options exist.

Pencils and Pens

Pen and pencils available for sketching are numerous, try as many as you can. A change of pencil or media on occasion can spark your creativity and interest in sketching. You will often be pleased with the results.

Graphite pencils

In general, the humble graphite pencil works as well as anything. Pencil hardness selected can depend on the paper you choose to use. I tend to use 4H-4B on bristol board, although 2H and HB leads will often provide a sufficient tonal range. Use softer leads in the range of HB to 9B on sketch or drawing papers. Softer leads, 2B to 9B make the darkest marks however, softer leads also require fixatives to prevent smearing. Soft leads can add a lot of expressive texture and sparkle to sketches and are often used to that purpose.

Sketching pencil selection. A - colored pencil. B - Watercolor pencil. C - Soft drawing pencil. D - Water-soluble graphite pencil. E - Graphitint pencil. F - Woodless graphite pencil.

A large diameter lead with a blunted or chisel shaped point can be preferable to a finely sharpened or small diameter lead. Large, blunt leads discourage fussing over small details when sketching rapidly or when initial marks are being made. The chisel point is useful because the flat part of the point can be used for broad strokes, the edge is used for fine strokes. Make the chisel tip by holding the pencil at a natural drawing angle and rubbing the tip to an angled, flattened edge on a piece of sand paper, rough drawing paper or even a convenient stone.

The woodless, solid graphite pencil offers the most versatility of any pencil design. The advantages of the chisel tip on a pencil are combined with the ability to create large swaths of tone with the side of the pencil.

Some artists prefer a mechanical 0.05 mm pencil for sketching as it does not require sharpening. Disadvantages include lack of stroke variability, smaller hardness range, and more likely to cause excess fussiness with the drawing. That said, it is convenient to use for detailing an initial sketch with a larger pencil or for water colors.

Colored pencils of many types are excellent for sketching. Faber Castell, Prismacolor and Derwent all make colored pencils well suites for field sketching. Some companies also have specialty drawing pencils I like to use large diameter, soft drawing pencils in earth tone colors for much of my sketching.

Watercolor pencils behave much like regular colored pencils but can be washed over with a brush and water to create watercolors. Watercolor pencils are excellent tools for sketching, their only disadvantage is that they are not waterproof. If you are likely to get rain or water splattered, they may not be the best choice for that day's use.

Pens

Pens are good sketching tools. They cannot be erased and so force the artist to judge carefully where lines are to be placed. They equally lend themselves to a loose, style of sketching. Pen selection is a

Sketching pens. A - fountain sketch pen. B - Permanent fiber tip pen. C - Watersoluble roller ball.

personal choice. I favor fiber tipped permanent pens and roller ball pens with water soluble ink. Water soluble pens will create water color-like wash effects when wetted with a paint brush.

Use permanent pens when water color or water color pencil will be used to color the finished sketch.

Colored inks can also lend an expressive note to field sketches. Sepia works particularly well with tan or cream colored papers. Blue and red inks look good with grey paper.

Bring a spare pen because you never know when they might run out of ink.

Watercolor sketch of a Boer goat.

Drawing board

Unless you are using large or loose sheets of paper, a drawing board is not usually necessary. If you do use one be sure to bring large rubber bands, tape or bull dog clips to keep the paper in place, especially if it is a windy day. The board should be light and portable.

Watercolor sketch box and other tools

A small watercolor sketch box can be used for sketching or for adding color to drawings made with other media. Small ones such as the Windsor Newton Compact or the Van Gogh traveling box are ideal for most purposes. They provide room for plenty of colors and areas for mixing paint.

I prefer to replace some of the pans of paint with personal choices and change them occasionally to try various color combinations.

Small watercolor sketch boxes.

The small plastic pans can be divided with a thin piece of plastic to increase the number of paints the box will hold. Cut a strip of plastic to size from a triangular guitar pick, bread wrapper fastener or other bit of thin plastic. Glue into the pan or easier, use a small bit of Blu-tac® or other brand of sticky wall fastener putty. This is useful to do with paints that are infrequently used but desirable to have along with you.

200 ml water bottle.

Water bottle

A water bottle will be necessary to use water color while sketching. I prefer a plastic, 200 ml vodka bottle. Its flat shape packs easily into a bag and the size is sufficient for most small sketches likely to be done in the field. It can be used as a drinking water bottle as well although you

Small watercolor brushes. A - 3/8 inch flat bristle brush. B - No. 4 tsable ravel brush. C - No. 8 synthetic round brush. D - Medium sized round waterbrush.

may receive interested glances from onlookers.

Brushes

Bring one or two inexpensive brushes. Travel sized brushed work well. You can cut down the handles of regular brushes to make your own custom travel brushes.

I prefer number 4 and number 8 round synthetic brushes and a 3/8 inch flat bristle brush for travel sketching. The bristle brush is used for stippling tree leaves and making grasses.

A waterbrush is also very useful not only for water color but also water color pencil. It can replace all other brushes for most sketching purposes.

Miscellaneous items

Plastic eye dropper.

A small plastic eye dropper works well for making small washes of color.

A collapsible 5 ounce cup filled from your water bottle is also convenient for rinsing brushes.

Carrying bag

A shoulder bag of some kind is useful for carrying and organizing your materials. A shoulder bag is especially useful while traveling as other daily necessaries can be carried along with your art supplies.

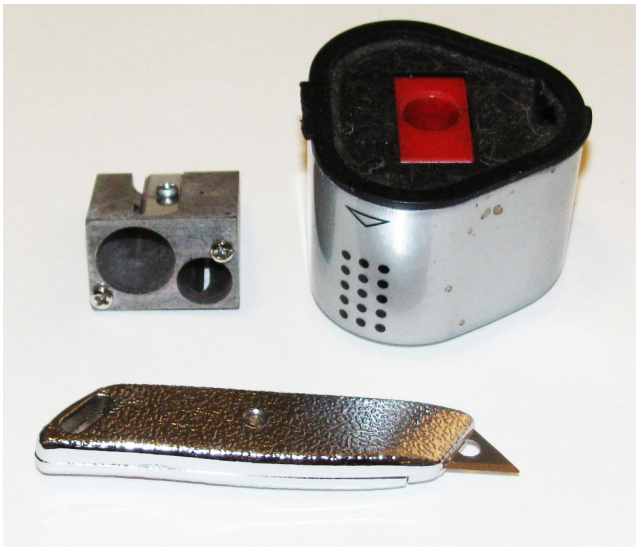
Field bag for sketching supplies.

Sharpeners and erasers

A pencil sharpener or small knife is necessary for maintaining a proper point on most drawing tools. It is easy to forget to pack them when you go to the field. For that reason I keep at least one sharpener in every bag that I carry.

Erasing while sketching slows down the whole drawing process and leads to fussiness. The old saying " Do not let the perfect become the enemy of the good" comes to mind. Rather than erase, just re-state the lines over the top of the old ones or start another drawing if you must. Begin initial lines very lightly and darken them as the drawing takes shape. Drawings that look "bad" in the moment can look better when viewing them the next day.

Erasers are more useful for cleaning smears from the paper or when doing finished drawings. Use a very soft, rectangular, soft plastic or vinyl eraser for cleaning the paper. A stick or pen shaped eraser works well for general line erasing and for erasing white lines into a toned drawing.



Pencil sharpeners.

Erasers. A - Soft plastic. B - Triangular pen style. C - Round Pen style. D Small round pen style.

Paper towels

A few paper towels are often useful for various watercolor techniques and to clean your hands or pencils.

Large plastic sack

A large garbage bag is portable and has many uses. It can be spread on the ground to protect clothing from dirt and damp. It can also cover your sketchbook in a rain shower or be cut into a makeshift rain coat.

Plastic bag

A small ziplock bag can be used to carry pencil sharpening waste, or used wet paper towels.

Folding Chair

Use a light folding chair for extended drawing periods. It is usually more comfortable than sitting on the ground.

Personal items

Always take a hat to shade your eyes and protect yourself from the sun. Sunglasses, bug spray, drinking water and snacks are also items that are often welcome.

Be prepared for the weather. It can become chilly when you are in one position for a long time as you sketch. On any sunny day, winter or summer, sunburn is a possibility. Winds can make mild weather uncomfortably cold with hypothermia a possibility. Try finger less gloves for cold weather sketching. Bring plenty of water to avoid dehydration in the summer.

Watch out for thunderstorms and severe weather. Lightning can strike long before a storm is directly overhead.

Camera

A camera is useful for recording lighting conditions that you wish to incorporate into your drawings at a later time. It can be used to record details of animals and the landscape. Cameras are also useful for taking notes on color for future drawings or paintings.

Photos are often used for examining common animal poses and for practice drawing these poses. I use a digital zoom camera as a pair of binoculars. Difficult areas can be photographed while sketching. Details can emerge with much more clarity and quickly viewed or enlarged further on the back of the camera.

When used with photo enhancing software and a printer, digital photos can be enlarged or pieces from several photos combined to produce pleasing compositions for subsequent art work.

Folding camp stool.

Go light

Keep materials to a manageable size and quantity. A hundred pencils spilled in the grass can become awkward to manage, although many people do enjoy the color selection. In most circumstances a single pen or a few pencils and small

sketchbook are all that is required. These materials can be kept in a purse or small travel bag that is convenient to carry.

Location

Choose a location for drawing that allows observation of the goats from a useful distance. If you are too close, the curious goats will be helping themselves to your art supplies. If too far away you will not be able to see them well enough to draw. I like to be across the fence from the goats in an area where the goats are likely to remain long enough to make drawings. An area near a watering trough, hay or feed trough works well.

Shade is often welcome but not always available to the artist so do not forget your hat.

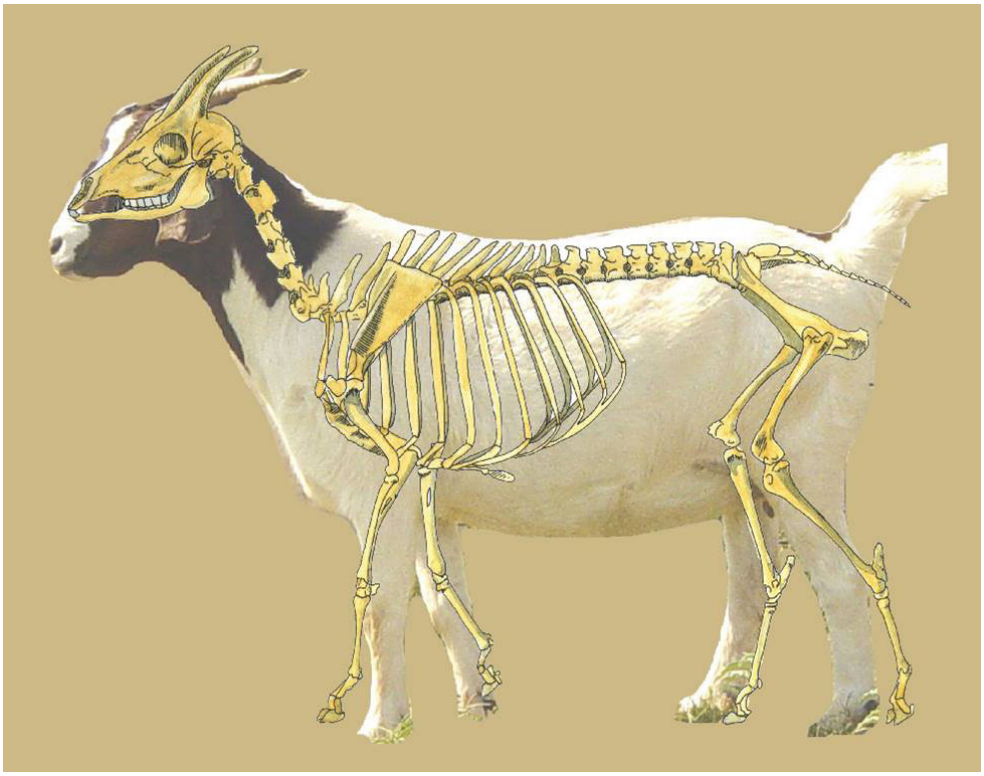
Consider sun and shadow on your subjects. In general, it is usually best to avoid flat lighting such as all shade or a grey, cloudy day if possible.

Morning and evening light provide the best contrasting shadows and highlights. Sketching during these times of day also avoids times of peak sun intensity and the heat of the day which is often necessary in the summer months.

Barns and stalls can work during inclement weather. However, lighting may not be idea in these circumstances.

Basic Shapes of the Goat

Goats are generally observed in a limited number of poses, the most common being front, rear, side and lying down. Some combination of these are observed and the head and neck can be in various positions. Each position has a common shape that can help rapidly build the basic structure of the goat. It is often unnecessary to draw feet on goats in pasture because the grass covers them.



Skeletal anatomy of the goat.

It is helpful to familiarize yourself with basic goat anatomy at home or as you draw goats. Practice and repetition are always the best ways to improve your work. Some may find it helpful to draw from photographs initially to gain an understanding of basic shape. Observe the skeleton shown below and note how the bones relate to what is seen on the surface of the goat. Hind legs and neck length are problem areas for some artists. Anatomical study can clarify these structures. Pelvic bones can be prominent, particularly on thin goats and produce shadow areas as does the shoulder.

Decide the basic shape of the animal before beginning

Blocking in the initial drawing with a geometric shape.

the drawing. Use this geometric structure as a starting point to which other features can be added depending on the angle from which the goat is observed.

Side view - square

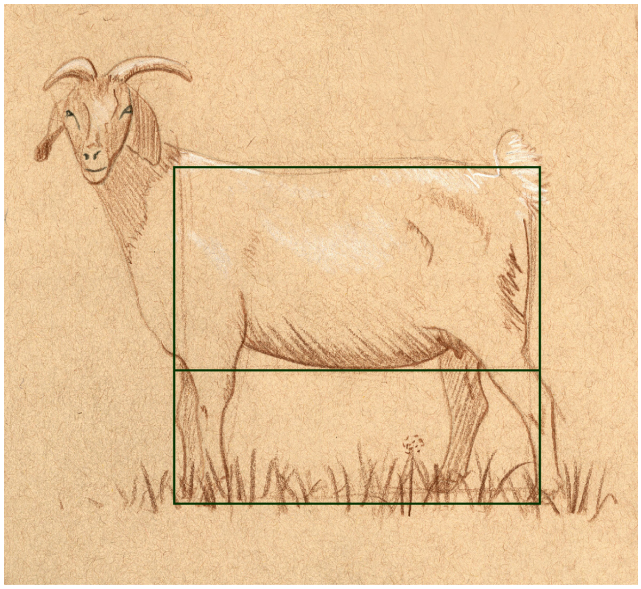
• The side view of the goat is square shaped. A line horizontally placed through the square is approximately the location of the chest floor and abdomen.

• The front shoulders and legs can be thought of as a narrow, elongated triangle.

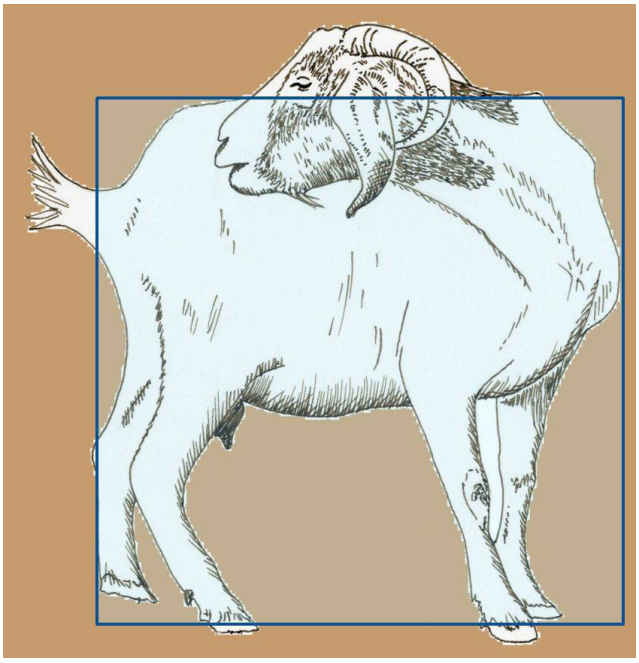
• The head and neck also each fit into triangles. Observe neck length compared to head and body length.

• Give attention to the hind legs, particularly the back edge. This area often causes trouble when drawing the goat. Note where the hind leg crosses the abdomen and its relationship with the udder.

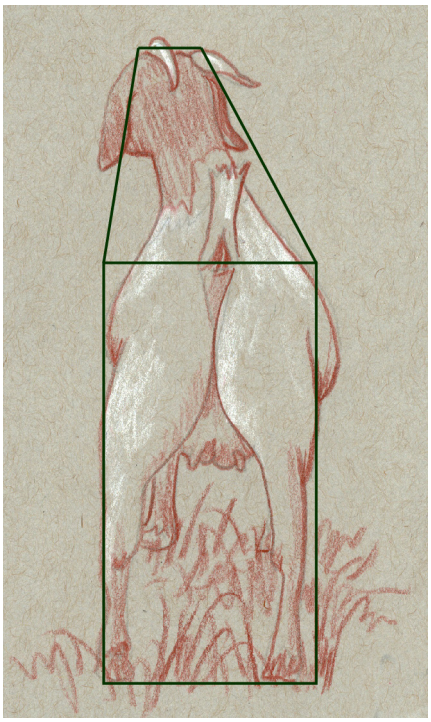
• Adjust the contours of the back and stomach. The hip bone is commonly visible and should be placed in the sketch. Don't forget the tail.



A quick sketch started with a divided square.



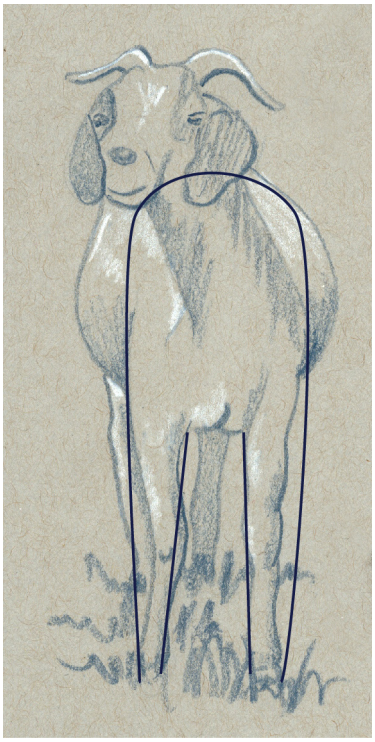
Side view of a goat showing how the body fits into a square.



Rectangle and polygon describing the rear view shape of a goat.

Rear view - rectangle

The rear view is rectangular in basic shape. Legs may appear as elongated triangular shapes within the rectangle. The horseshoe shape also works for a rear view of many goats.

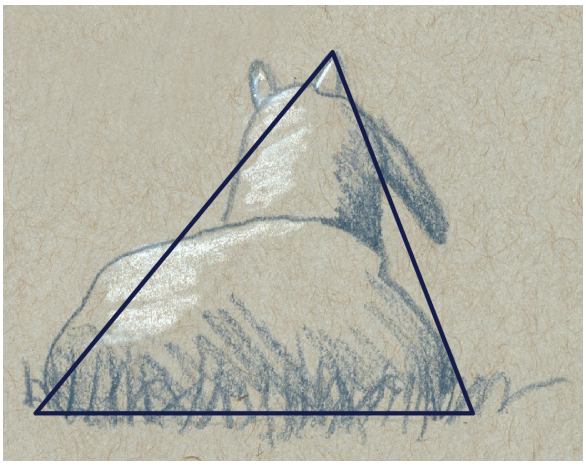


Horseshoe shape describes the front view of a goat.

A double horseshoe shape fits a goat from an angled view point.

Front view - horseshoe shape

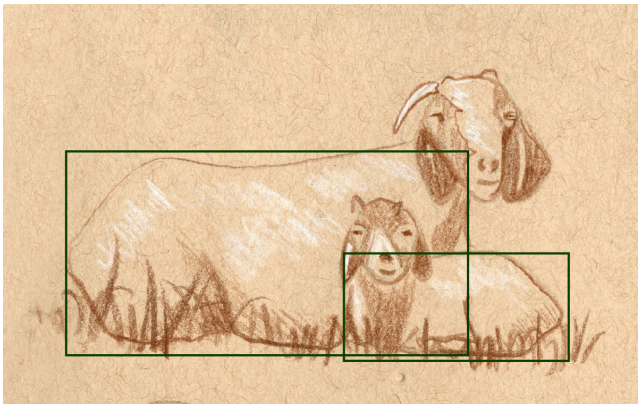
- The front view can be thought of as a horseshoe shaped rectangle with the curve on the upper edge.
- Dividing the rectangle in half will locate the chest floor.
- The neck attaches near the chest floor at the lower edge and the shoulder girdle on the upper edge. If the head is up the shoulder attachment will not be seen. If the head is in a grazing position, the lower attachment point may be hidden.
- The neck is triangular in shape.
- The head will appear as a triangular shape.



A goat lying down fits into a triangular shape.

Lying down from front or rear - triangle

- The rear or front view of the goat as it lies in the field resembles a rounded triangle.
- Note how hip bones may protrude.
- Legs may not be visible.



Goats lying down fit into a rectangle.

Lying down from the side - rectangle

•Draw as in the side view of the goat except that legs may not be visible.

•The spine may be humped or curved.

•The head is usually erect.

Fast Sketching Techniques

•The best fast sketching technique is regular practice and familiarity with the subject. However there are some methods that speed the learning process.

Make mistakes!

Give yourself permission to fail miserably! Sketches we make are not likely to hang in a museum. No one need ever see them. You can destroy them if you like however, it is valuable to look at old drawings to note progress and changes in your art work over time. I hesitate to say improvement because it is such a subjective judgement in art. Keep drawing until you are pleased. Even though the goal posts tend to move in different directions over time.

Do not excessively restate lines

Do not get into the habit of restating lines, even misplaced ones, repeatedly. One confident mark is sufficient. If it is not correct to your satisfaction, try another on top of it. Remember to make initial lines light.

Do not criticize yourself while drawing

Do not use critical language while sketching such as "This looks bad". Instead say things like "This line needs to be more curved". Better yet, think very little to yourself and just draw. Relax and enjoy the whole process. Be amazed at what you have put to paper. No one else can draw like you do. Its like your handwriting. Drawing is fun for its own sake regardless of the out come. Its not a competition.

Mass shading is a rapid way to draw over all form.

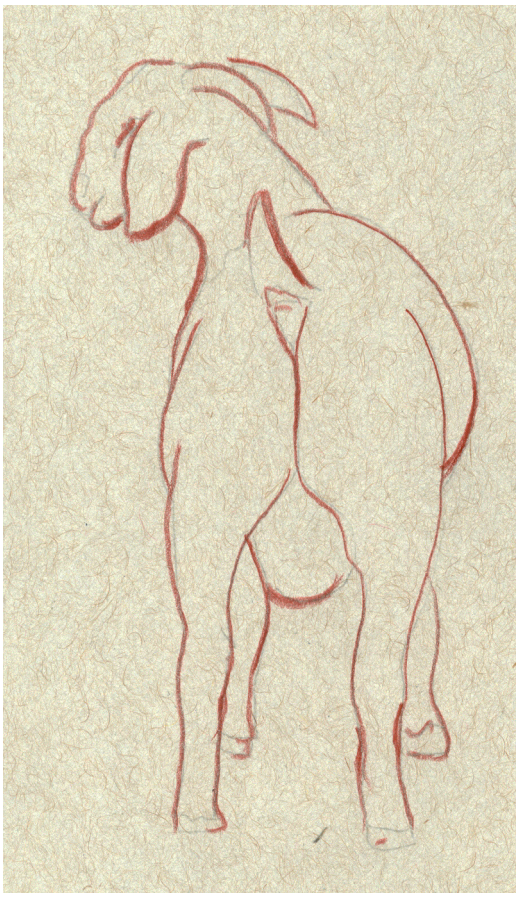
Draw quickly

The faster you draw, the less time your rational mind has to get in the way. Analyze later.

Look at the subject much more than your drawing. Try drawing as you are looking at the goat, glancing at the paper only infrequently.

Mass

Artists with a more painterly temperament may prefer mass drawing technique as they sketch. This is similar what is done with a paint brush. Start in the center of the goat and shade in until the shaded outline looks about like a goat. Refine the shape after a general mass is constructed. A square crayon is a good tool for this technique.



A few gesture lines are enough to portrait most subjects.

Gesture

This technique uses a minimum of lines to express the essence of a subject. State the most important lines first. These lines should express the motion and inner tension of the subject. The back and neck are good places to begin. Get the curve of the hind legs and shadows of underlying muscle mass with a few well placed lines.

Start several drawings

Start several drawings in different poses when sketching active animals. The animal will return to common poses and more can be added to each sketch as the animals' movement allows. This method works best with larger sketchbooks. It is inconvenient and wastes time to continually flip through pages looking for the right drawing to work on.

Draw several sketches of a single body part to begin to understand the structure of the goat.

Concentrate on one body part and its connections with the rest of the animal

If drawing the entire animal seems too intimidating in the beginning, it can be helpful to break the structure of the animal down into more easily drawn parts. The tail is a good starting point. Include its attachment to the rear of the animal. The head and neck may seem more difficult so just draw the square body of the goat until it becomes more comfortable.

These suggestions should get the novice drawing in the field with the least hinderance. Remember to pack light, have a small drawing kit with you whenever you go out and use it frequently. The more you draw the more comfortable and rewarding it will become.

Pack Goats

Mr. Dwite and Mrs. Mary Sharp
Paradise Ranch

Introduction to Dwite and Mary Sharp

Dwite and Mary Sharp have raised and trained pack goats for over 13 years. They own and operate Paradise Ranch in the Flint Hills near the historical town of Council Grove, Kansas. Their family has lived in Morris County for eight generations. Although they grew up in southern California they have returned to the Flint Hills several times to live. The last time they moved to the Flint Hills was in 1997 when they moved from Charlotte, North Carolina; this time to stay.

In 2000 Dwite retired from auto racing where he had been a Design and Fabrication Engineer for over 30 years. Involved with NASCAR's Winston Cup Division he designed and built cars for Felix Sabotos, Rick Hendricks, Richard Childress and many others.

Mary had been in restaurant management for many years before returning to Kansas and after returning to the Flint Hills she opened her own café. After a year she called it quits and decided to stay home and raise pack goats. Since 1999 Mary has been the working force at Paradise Ranch tending to the chores on a daily basis.

In 2001 Dwite took a job with BNSF Railway in the engineering department, but his true passion now is the creatures of Paradise Ranch. There they raise pack goats, high end Boer goats, Mammoth Donkeys, guineas, and Doberman Pinschers.

Introduction to Goat Packing

Goat packing was first invented in 1972 out of necessity by John Mionczynski, a scientific researcher for the U.S. Forrest Service. His job was to follow and stay close to a band of Rocky Mountain big horn sheep and to observe and record their food habits and behavior in the wild. The sheep had been fitted with radio collars. John was on his own and at first he used horses to carry his equipment and supplies. The horses didn't work very well, they did a good job getting to base camp, but they couldn't get near the terrain where the sheep lived. There wasn't enough grass in that country to leave them picketed out for more than a day. He would have to come back once a day to move and water them. This was not going to work.

So the horses went and he started backpacking. Carrying a backpack in that terrain was dangerous enough but after weighing his pack it weighed over one hundred pounds.

He was at a high level of desperation, after a particularly difficult day in the mountains, he imagined a goat packed up like a horse. At first he laughed at the idea, but he was desperate. Several days later he returned home for a few days off. He had several goats, he liked goat milk. One was an eleven year old wether named Wethervane that he harnessed and used to haul water on a travois from a creek to a cabin. He knew Wethervane could haul a couple hundred pounds on a travois using an old upside down horse halter for a harness. He had no idea how he would react to carrying a load on his back. He started slowly using a saddle bag, adding a little weight at a time, leading him around. Wethervane acted as though he was carrying nothing. So John got some bigger bags and loaded them with his gear. He slung them over Wethervane's back, using a horse saddle pad for padding. It worked, this was becoming exciting. After a day of walking Wethervane around and increasing the weight, it became evident that with a few refinements he could probably take Wethervane back to the mountains with him. He made the first pack goat saddle out of some 1"x6" boards and cross bucks from a sawed up shovel handle. It became clear that with the saddle to help distribute the load more evenly, Wethervane could easily carry even more weight.

Back in the mountains Wethervane followed faithfully and silently. He was so quiet John let him stay at camp and even at the observation posts. Wethervane's true test came the day the sheep decided to migrate. Could he keep up? It started before daybreak. The radio signals were clear; they were on the move. Wild sheep can go thirty miles in one move and you have no idea where they will end up. John and Wethervane hiked for several days along escarpments and over mountains. Although Wethervane had a few new things to learn, he performed beautifully. John was ecstatic. You can teach and old goat new tricks!

Each day Wethervane worked and became stronger and could carry more weight. John could see Wethervane's muscles growing and firming up. In time John was packing Wethervane, a doe named Jessie (a milk goat), and several kids as trainees. John's greatest pleasure came from seeing how healthy, alert, and handsome a goat can look when it's being worked. Also how much like a wild animal it can act; testing the air for scents, twitching the ears, looking around ,curious about every new sound, scent, and movement. They were a different animal entirely from the sloth like, pot bellied barn potatoes.

Several years later Wethervane, the first pack goat, was killed by a hunter in the opening day of deer season.

John went on to run his own goat-centered outfitting/guide service, building and selling custom pack saddles, and raising pack goats. John Mionczynski is known as the father of goat packing.

Facts about Goats

1. Goats are quite picky about what they eat.
2. Goat's eyesight is seven times better than a human.
3. Goats can smell with their mouth (called the Flehman response), using an organ in the roof of their mouth called the Jacobsens organ. When they curl up their upper lip with their mouth slightly open, they are smelling.
4. Goats can be very social animals making them wonderful companions.
5. Goats will follow with out being led.
6. Goats are the most surefooted animal on the planet.
7. Goats are one of the most intelligent creatures on the planet.
8. Goats are thought to have been domesticated more than 10.000 years ago. 5,000 years before the horse and probably the first wild animal to be domesticated.
9. Goat's primary diet consists of weeds and brush.

10. Goats are browsers not grazers.
11. Goats can go 3 or 4 days without water. The only animal better is a camel.
12. While in the desert a large wether can carry enough water for you and itself to last a week.
13. Goats can adjust their metabolism as the need arises.
14. An exercising goat has up to 12% heat loss through their horns. (They are like radiators)
15. Generally there is no need to carry feed for goats on a pack trip.
16. Goats are herd animals and should be kept with at least one other goat.
17. Goats have the ability to regain all their natural instincts when taken into the wilderness.
18. Goats have the widest variety of food preferences.
19. When danger approaches pack goats will surround you and face the danger. They will not flee.
20. Horned goats are capable of killing predators, and will if forced to do so.
21. Wildlife has been known to follow and get extremely close to pack goats in the wild. This makes for great photo opportunities.
22. When given a large selection of plants in a pasture a goat is capable of eating the correct amount of the right plants to be at optimum health. A nutritionist can not compete with this ability.

Preparing the Facilities for Pack Goats

So as not to get the cart in front of the goat, we must get the facilities in order before bringing the goats home. Packgoats are no different than other goats as far as their needs.

Their needs are:

1. Goats need housing that will protect them from rain and wind, but is not so tight as to be unventilated. Goats are susceptible to respiratory problems, because they will urinate and defecate in their living quarters. Their housing should be well ventilated. A three sided structure will work just fine. Face the opening so the wind doesn't blow in. You can even build a wall in front of the opening 3'-4' out. Leave the eaves under the roof open so the air can circulate. Use your imagination. There is no set rule as to what the goathouse should look like, so lots of different buildings will work. If you have one goat that is aggressive you might want to have an escape door on each end. The size of the house will depend on the number of goats to be housed. A minimum of 15 square feet per goat is needed and more if you have horned goats.

2. Pens and Pastures; the goat house should have a pen or corral on the side or sides that are open, so you can contain the goats as needed. I recommend using 2"x4" woven wire or even 2"x4" horse panels. These two are five feet tall. My reasoning for this is to protect the goats inside the pens from predators. The 2"x4" openings will not allow the small kids to get their heads through the fence and be grabbed by something on the other side. This is a very common way for goats to be killed. We have had very bad luck using cattle panels and woven field wire (sometimes called hog wire) which have 6"x6" openings. Newborns have been known to crawl through these fences and as they get older and have horns they get their heads stuck in the fence and then they are at the mercy of what ever is on the outside. The wire with the 6"x6" opening is cheaper but don't take the chance! Spend the money at the beginning before you loose something precious to you! Also don't use welded wire. The welds will eventually break loose and your fence will come apart. We use T posts everywhere we use panels. With the woven wire you must have braced, hedge corner posts. The reason for this is because the wire must be stretched and if they are not cemented and braced the tension of the wire will pull the posts over. We use 4 12' round tubular gates and cover the side the goats are on with 4' chain link. You could also use chain link gates. All the materials can be bought at a farm and ranch store. Remember to put the fence on the side of the post that will be pushed on most. For example, if you have cows on one side and goats on the other, then the fence should be on the side the cows are on. If you have nothing on the other side the fence should be on the goat side. Let the post support the fence not the wire

that is holding the fence to the post. When putting the T posts in the ground do not forget to face the T post the correct way for the side the fence will be on.

Pasture fence can be a real challenge for keeping goats in. No other animal will point out your fence building short comings faster than a goat. It is said that if you build a 10' high solid wood wall all the way around the pasture and then go 3' inside that wall and build another one just like it. Now fill the 3' space between the walls full of cement. After it dries fill the pasture with water all the way to the top of the walls. If it holds water it might hold a goat!

My experience with goat fencing is vast. I've made every mistake I think I could have. I think I finally have it under control. Goats are brilliant escape artists and eating machines. These two attributes make them tough to fence. You might think you've beat them but you'll only know for sure when the eating looks better on the other side of the fence. That is why they will show you your deficiencies in fence building. I have had way more Boer goats over the years than pack goats but it seems to be the trained pack goats that instigate the major break outs. These very large goats have escaped through the places I would not have believed if I had not seen it with my own eyes. They have shorted out electric fences and led one hundred goats into the neighbor's bean field. They have done this more than once.

If you have no pasture fencing at all and must start from scratch I recommend not using electric fences. If you have existing fences and can't afford to replace all of them electric fences are usually the cheapest option.

If you are putting up a completely new fence I would use goat and sheep woven wire. There are two kinds of this wire. The best is the one with 4"x4" openings. The other has 6"x12" openings. The 4"x4" wire will actually keep the goats heads on your side of the fence. The 6"x12" wire will allow the goats to put there heads through the fence but the opening is large enough to allow them to remove their heads easily. The 4'x4' wire is my first choice but because it has so much more wire, it is also more expensive. I use the 48" width. Both of these products are manufactured by Oklahoma Wire and Steel and come in 330' rolls.

I space the T post 10' to 15' apart and use cemented braced hedge posts on the corners. If the fence goes down into a low spot and then back up, you will probably need to cement a hedge post on both sides of the low areas to keep the tension of the fence from pulling the T post out of the ground (specially when it rains).

If you have an existing fence and you need to goat proof it you have several options. If it is barbed wire you can add more wires to the fence. Goats almost always go under the fence so adding wires to the bottom will help. Then stretch a wire (it can be the barbless wire) about 3" to 4" off the ground. Space it so they are closer together at the bottom and a little wider as they go up. If the wires are stretched tightly and spaced correctly, seven wires will work.

The next option is to install an electric fence on the inside of the existing fence. I've had a lot of experience with this. The first thing to do is select the fence charger. I highly recommend using a low impedance charger. Although the testers for electric fences test in volts, it is not the voltage that shocks. It is the amps that shock. A low impedance charger turns up the amperage (makes it hotter) as the fence is contacted by vegetation or wet grass. If you tested it with a tester it would show the voltage has dropped but, actually the fence is very hot. With the non low impedance fence charger the fence would have been colder. Low impedance chargers use joules to measure the power. I suggest at least 6 joules for goats. To get this you will need a charger that is rated for about 100 miles of fence. Battery operated fence chargers will not be hot enough. The lesser ones will work for a while and then the pack goats will figure it out and they will escape. I use a 100 mile low impedance Zareba fence charger. Orschlins and Tractor Supply sell them. My pastures are only about 25 acres total.

We attempted to place insulators on the same T posts that the existing barbed wire was on. This failed miserably. The pack goats went between the fence posts. They seemed to be able to tell when the fence surged. In between the surges they used their horns to push the hot wire over and hooked it on the barbwire. This shorts the fence out. They then kneel down and push their nose under the bottom wire of the barbed wire fence, which is about 6" off the ground, and they escaped. Once again there were one hundred goats in the bean field! All of this took about 30 seconds. I counter attacked! I bought ½" rebar and cut it into 4' lengths. I placed the rebar 20' to 25' apart and 1' inside the barbed wire fence. I then placed one 14 gage galvanized steel wire about 8" to 10" above the ground and another one 16" above the first. I stretched the wire as tight as a banjo string. I then released the goats from the corral. They slowly walked out of the corral and headed to the scene of the crime. Remembering the taste of the bean field, they broke into a full run. As they approached the new electric fence they skidded to a halt, looked up and down the new fence, and then turned and walked away. That was about six years ago and I haven't had a goat out since.

The bad part about electric fences is that they need constant attention. You must walk the fence to make sure that the insulators haven't broken and fallen off, or moved up or down the rebar. We have learned to use ceramic corner insulators. The plastic ones pull through and short out in time, killing the fence. Tree branches fall on the hot wires and push the fence to the ground stretching the wire. We have had our Anatolian Shepherd chase coyotes through the fence, damaging it. So if you can fence your goats with less maintenance you will make it easier on yourself.

Choosing Your Pack Goats

Not everyone who would like the benefits of a pack goat should actually own one. If you are short on patience and aren't a big fan of Mother Nature, then goat packing will not be for you. To find out how you feel about pack goats you might want to rent one for a small outing and see how it goes.

If you decide you would like to own a pack goat you need to get at least two. Goats are herd animals and need at least one other goat in their life to be emotionally healthy.

You can buy an experienced pack goat from a breeder/ outfitter. If you do you will miss out on all the fun and experiences of seeing these wonderful creatures mature and blossom with your interaction.

The majority of our pack goats started bonding with us at birth or within the first week. A few of our pack goats were actually purchased and restructured into pack goats at a much older age. Four of them were actually two years old before becoming pack goats. I would not recommend this for the beginner. Two of these four were completely wild animals and quite dangerous. These two have turned out quite well but the amount of time required was immense. I would be willing to say that we will probably not do that again.

If you don't have a lot of experience caring for baby goats you may opt to purchase you pack goat pre-trained at about six months of age. This way he has a head start in the right direction (That is if you purchase him from a good pack goat breeder; they are not all equal). You can continue his training and learn together.

You need to learn about good pack goat conformation. This will be beneficial in selecting a goat with good potential. Don't think that all Dairy goat breeders know about good pack goat conformation, because this is not likely. They breed for milk production, utter attachment, etc. They do not breed for pack goat conformation. If you are going to spend all the time, effort, and money on a quality pack goat let a reputable pack goat breeder help you get started.

It is possible to get good pack goat kids from outside the pack goat industry but without the knowledge it's difficult to make an accurate choice.

We do sell pack goat kids, but only in advance. Meaning we discuss what you want and then we breed the kid, to be delivered a few days after birth or at six months. We take our responsibility seriously.

Training

Training is something that is best if it begins shortly after birth. It's best for the bonding with humans aspect if the human becomes mom right away. That is not to say a good pack goat can't be achieved later. Removing the kid immediately after birth has a negative impact on the mental well being of the doe. Also the kids seem to learn about eating hay, grain, and minerals better with their mother. Mom really does know best. The sooner the kids start eating hay, grain, etc., the better they will grow. When you remove the kids from the doe you become their mother; you have to teach them the most important thing in a goats life, EATING! Sometimes it can be a real struggle to get them to eat enough. We have had bottle babies that at three months were eating very little grain. We feared they would starve if we weaned them. You must spend a lot of time with the kids and teach them by placing the grain in their mouth over and over again. You must do this before giving them their bottle. This seems sometimes like they aren't going to figure it out and then one day they finally get it. When you cut back the number of times a day they get a bottle they will think a little bit more about eating grain, hay, etc…

So why don't you just let the doe raise the kid? After all letting the doe raise the kid would be much easier. You would not have to get up in the middle of the night, get dressed, heat up the milk, go out in the cold, and feed the kids. When the doe does the work the kids tend to become wild goats and are not dependent on you. You want your pack goats to be completely dependent on you for food, water, and emotional support. Oh yes you have to become a goat!

You should spend a lot of time with the kids besides the feeding time. Go in to the pen, sit on a milk crate, talk to them, call them by name, pick them up, and hold them as long as you can. Soon they will be too large for this so do it while you can. For the first few weeks it is okay to let them jump on you. After a few weeks do not allow the goats to even put their front feet on the fence. Now start teaching them that it is not okay to jump on you, the gate, the fence, the car, or anything else. The word "down" should be taught at a young age.

Goats don't tolerate violence. Don't make the mistake of loosing your patience and yelling at or striking them. You will go from the top of the hill to the bottom, in their eyes. It could take weeks to regain their trust. Goats have a good memory and will get even. It may not be today or even tomorrow, but it will happen.

After a couple weeks you can put a small collar and leash on them. Let them get used to this slowly. Do not try to lead them until they are comfortable being tied (held by you). NEVER, NEVER, leave the collar on unless you are right there. Goats can strangle quickly. In time the goat and you will learn to deal with the safety issues of collars and horned goats.

Books

"The Pack Goat"
by John Mionczynski
Published by Pruett Publishing Co.
Boulder, Colorado

"Goat Medicine"
by Mary C. Smith & David M. Sherman
Published by Lea & Febiger

"Meat Goat Production Handbook"
Available from Langston University
www.luresext.edu/GOATS/mgph.html

"Practical Goat Packing"
by Carolyn Eddy for $17.95
"Diet for Wethers" by Carolyn Eddy for $14.95
Shipping for one or both for $3.50
Order from: Eagle Creek Pack Goats
PO BOX 755
Estacada, Oregon, 93023

"Field First Aid for Goats" $24.95
by Carolyn Eddy & Alice Beberness
"Packable Guide for First Aid for Goats" $16.95 by Carolyn Eddy & Alice Beberness
Order from: Alice Beberness
PO BOX 4
Alvadore, Oregon 97409
Check, money order, or pay pal ID # Carolyn@goattracks.com

Magazine

"Goat Tracks Journal of the Working Goat"
owned and published by Larry Robinson
13 Norwood Place
Boise, ID 83716-3283

To become a member of the "North American Pack Goat Association"
Log on to www.napga.org

Cheesemaking Overview

Dr. Steve Zeng
Langston University

GOAT CHEESE MANUFACTURE Workshop

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CHEESE?

- Concentrated form of milk

- Long shelf-life
- Utilization of surplus milk
- Big variety
- Lots of Flavor
- Value-added

Classification of Cheese

- **Very hard: <35% moisture, Parmesan, Romano**
- **Hard: 35-40% moisture, Cheddar, Colby**
- **Semi-soft: 40-50% moisture, Mozzarella, Blue and Roquefort**
- **Soft:50-80% moisture, Cream, cottage**

U.S. Cheese Championship

More than 1800 entries of
cheeses in 2013

- 2014 World Cheese Championship Contest
- March 16-18, 2012 in Madison, WI

American Cheese Society (ACS) Cheese Championship

Ever Popular Goat Cheeses!

- **1941** cheeses entered the 2012 World Cheese Championship Contest in Madison, WI
- **>300** goat cheeses

Cheese Demo Live-2008

in the Oklahoma State Fair

Goat Cheeses in the U.S.

Grade A Milk Standards

- Fresh:<4 d
- SPC< 100,000 cfu/ml (300,000 for commingle milk)
- Somatic cell count (SCC) from < 1,000,000 to **<1,500,000/ml (Goat Milk)**
- Antibiotic residue: Zero tolerance

Principles

Starter **Rennet**

Cheese Manufacturing

- **Acid Production** → **Lactic acid**
- **Proteolysis** → **Peptides Amino acids**
- **Lipolysis** → **Free fatty acids ketones**

Pilot Goat Creamery at Langston University

PROCEDURE

1. Set milk temperature

- **Cheddar cheese**
- **88-90 ºF**

PROCEDURE

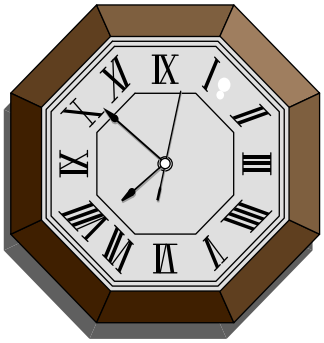
2. Add starter culture and coloring (optional)

- **Mesophilic: optimum growth at 80-90 °F**
  - **a.** ***Lactococcus lactis***
  - **b.** ***Lactococcus cremoris***
  - **c.** ***Lactococcus diacetylactis***

- **Thermophilic:optimum growth at 104-125°F**
  - **a.** ***Streptococcus thermophilus***
  - **b.** ***Lactobacillus helveticus***
  - **c.** ***Lactobacillus bulgaricus***
  - **d.** ***Lactobacillus lactis***

- **Single strain**
- **Mixed stains**
- **Powder form**
- **DVI (Direct Vat Inoculant)**
- **Stock-Mother-Production culture**
- **Culture rotation**

PROCEDURE

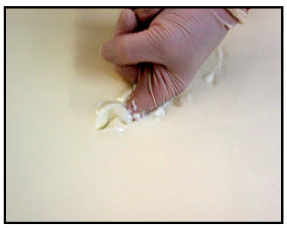


3. Add rennet

- **Proteinase**
- **Calf, microbial and vegetable sources**
- **1:40 dilution**
- **Keep temperature at 88-90 °F**

PROCEDURE
4. Cut curd

- **Check curd for clean break**
- **Use a curd knife and cut curd into 1/2 inch cubes**
- **Keep curds unstirred for 5 min**



Curd Knives


MEDIUM
SALT
DIAMOND CRYSTAL
SALT CO.
ST. CLAIR, - - MICH.
Bladed Curd Knives-
Wired Curd Knives-

PROCEDURE

5. Heat the curd

- **Use steam or hot water**
- **Heat the curd slowly and increase the temperature to 102 °F in 30 min**
- **DO NOT HEAT OVER 104 °F**

PROCEDURE

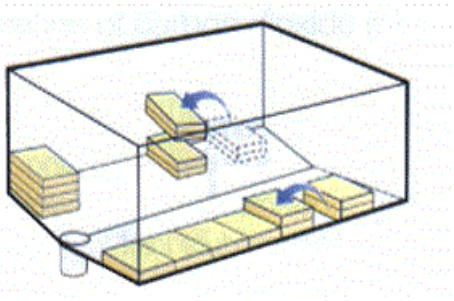
6. Cook the curd

- **Cook the curd at 102 °F for another 30 min while keep stirring**
- **Cook the whey (water) out**

PROCEDURE
7. Drain whey

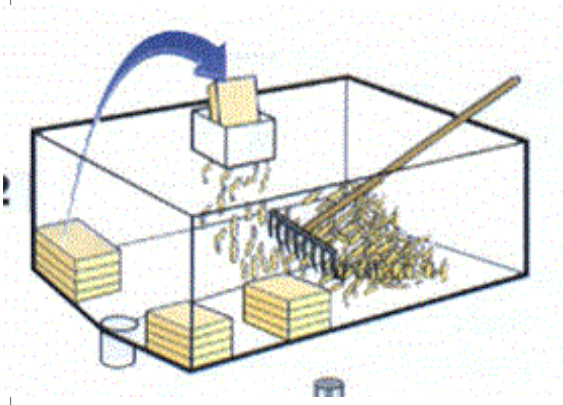
- **Drain the whey**
- **Pack the curd on the bottom of the vat**

8. Cheddaring



- **Let curd mat for 15 min**
- **Cut the curd in slabs**
- **Turn the slabs every 15 min for 2 h**
- **Keep the bottom of the vat at 90 ºF**

9. Mill the curd

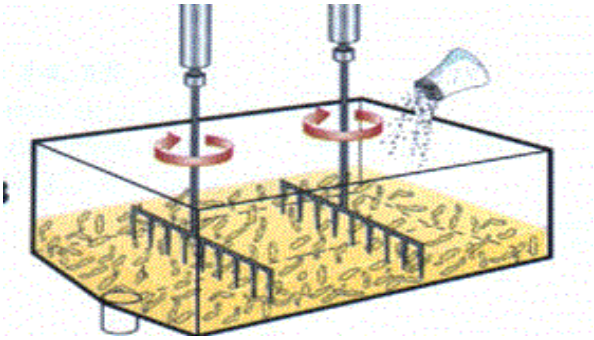


- **Acidity test: 0.50%**
- **Mill the curd into 3/4 inch cubes**

PROCEDURE

10. Salt the curd

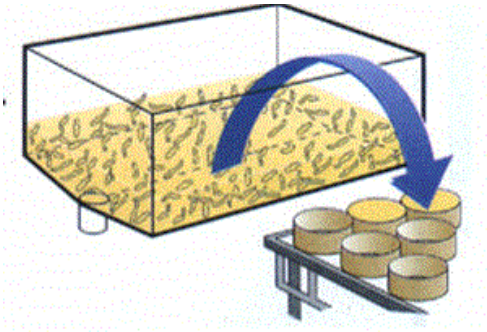
- 3.5% non-iodized salt
- Sea salt
- Pickling salt



PROCEDURE

11. Hoop the curd

- 300 lb, 40 lb, 10 lb hoops
- Round, rectangular shapes
- Stainless steel

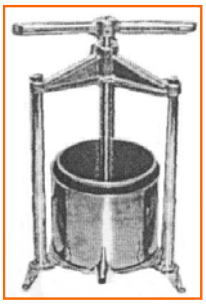


PROCEDURE

12. Press the curd

- Initial pressure: 30 psi for 1-2 h
- 50 psi overnight (14-16 h)

Commercial Cheese Presses



PROCEDURE

13. Pack the cheese

- Vacuum-pack
- Wax-coat

PROCEDURE

14. Age (ripen) the cheese

- **Age at ripening room (45-50 ºF with 90-95% relative humidity)**
- **3 Mon.**

Quality Control

- **Record keeping**
- **Acidity test**
- **Time and Temperature relationship**
- **Personal hygiene**

GOAT MILK SOFT CHEESE

Step-by-Step Procedure

Two gallon fresh goat milk:

Pasteurize at 145^{O}F for 30 minutes;

Cool down to 70 ^{O}F in tap water;

Add ¼ teaspoon of starter (MM100)*;

Add ¼ teaspoon of cheese rennet which is diluted with two table spoons of tap water;

Mix well and cover the container (not too tight);

Leave the container at room temperature (70^{O}F) for 12 to 16 hours (to form cheese curd);

Dip the curd into cheese clothes or cheese bags and hang them up;

Drain for 2 hours;

Move the cheese in cloth to a cooler or a refrigerator and drain for 24 hours;

Take the cheese out of cheese cloth;

Add 1% (approximately one tablespoon) salt; Optional: Spice up with herbs to taste;

Mix well;

Pack in cups or vacuum pack in Food Saver.

The shelf-life of soft cheese in refrigeration is about three weeks.

Goat Milk Cream Cheese Guidelines

Cream Cheese is a fresh cheese with at least 50% of fat in dry matter. It is consumed without any ripening. Cream Cheese may be with 40-42% of total dry matter. Cream Cheese is white to yellowish, the consistency smooth and pasty without being too dry and grainy, and it is easy to spread. The flavor is fresh and acidic, and the pH value is normally between 4.6 and 4.8.

SOP (50 L)

Milk	Whole raw goat milk (3% fat) is adjusted to 10% of fat by addition of goat milk cream (30% fat) (i.e., 37 L of 3% milk and 13 L of 30% cream)
Pasteurization	Pasteurize the 10% fat milk at 65°C (150°F) for 30 minutes
Homogenization	No homogenization due to small volume of milk
Cooling	The pasteurized milk is cooled to ripening temperature, i.e. 32°C (90°F).
Culture	Freeze-dried DVI mesophilic culture is added at 1-2 u/50 l of goat milk or according to the culture manufacturer's instruction
Ripening the milk	Ripen the milk at 32°C (90°F) for 4 h until pH reaches 4.0-5.0
Renneting	Add liquid rennet at10-15 ml/50 l of goat milk or according to the culture manufacturer's instruction; Liquid rennet which is diluted with water prior to addition (1:40); The curd should be firm and ready for cutting in around 50-60 min
Cutting	Cut the curd into 10-15 mm cubes
Heating	The curd is heated to 45°C (113°F) within 15-20 min by using hot water in the double-wall vat or by using steam
Draining whey	Drain most of the whey and the curd is poured into hoops/moulds or cheese bags
Turning	Turn the cheese at once and after 1 and 2 h; The cheese is kept at 20°C (68°F) overnight (The moisture content in 24 h old cheese should be around 52% and pH 4.7)
Salting	1% of salt is added to the cheese; Stabilizer is added at 0.5% and the cheese curd is heated by indirect heating to 78-80°C (172-176°F) for 5-15 min
Packaging	The heat-treated Cream Cheese is packed and stored to chill, or chilled and packed cold, especially for fruit-flavored Cream cheese The finished Cream cheese in the package should have at least 20% fat and pH at 4.6-4.8

Pricing Goats using USDA Market News Reports

Mr. Orlando Phelps
Training Officer
USDA, AMS, LPS, QAD

USDA Market News reports are an important tool when there is a need to set the baseline price for a commodity which may be referred to as price discovery. As you plan to market animals via direct market outlets or through the local auction barn, it is important to have several questions addressed:

- What is the lowest price you must have to sell your animal?
- What is the breakeven price? Or the price so that you recover your inputs?
- What is the ideal price you want for your animal? To maximize profits?

Knowing answers to each of these questions will allow you to begin identifying the ideal time to sell your animals.

There are several options you can use to discover how the market is performing at any given time. Those options range from: talking with friends and local farmers, which can be good sources, but the reliability varies to better sources such as local auctions, to buyers (which may vary) to marketing organizations to the USDA, which may often be the best source of information, depending on your location.

Each of these sources can be used for price discovery and some are more reliable than others. The key is to use some form of price discovery to help you evaluate the best time to market your animals. USDA Market News reports are based on actual livestock prices received when the animals are sold. Depending on the livestock market, reports may be available the same day of the market. Market reports are applicable to local markets, regional, and national marketing of livestock, making them a very good source for helping you determine the best time to market your animals. Market reports are available for past and present data and you can use reports from several surrounding states to get the best picture possible. Another common strategy is to market around specific ethnic holidays, which should be a part of your marketing plan. However, thought and consideration must be given to when is the best time to market your animals before the holiday? Using USDA Market News reports to determine the ups and downs of the market should allow you to make an informed decision about the best time to market your animals and provide price discovery information to help you set a base price for your animals. To learn more about and view USDA Market News reports, please visit www.ams.usda.gov and click on USDA Market News link on the top left side of your screen.

USDA Farm Bill

Mr. Phil Estes
USDA FSA

USDA
UNITED STATES DEPARTMENT OF AGRICULTURE
FARM SERVICE AGENCY

2014 Farm Bill

FACT SHEET

March 2014

What's In the 2014 Farm Bill for Farm Service Agency Customers?

The Agricultural Act of 2014 (the Act), also known as the 2014 Farm Bill, was signed by President Obama on Feb. 7, 2014. The Act repeals certain programs, continues some programs with modifications, and authorizes several new programs administered by the Farm Service Agency (FSA). Most of these programs are authorized and funded through 2018.

OVERVIEW

The Direct and Counter-Cyclical Program and the Average Crop Revenue Election programs are repealed and replaced by two new programs, Price Loss Coverage (PLC) and Agricultural Risk Coverage (ARC). Upland cotton is the only covered commodity that is no longer eligible to participate in these programs, but rather, becomes eligible for the new Stacked Income Protection Plan (STAX) offered by the Risk Management Agency (RMA). Until STAX becomes available, upland cotton is eligible for transition payments made by FSA for 2014 and 2015 crops.

The Marketing Assistance Loan program and sugar loans continue mostly unchanged. The Milk Income Loss Contract Program continues through Sept. 1, 2014, unless it is replaced by the Dairy Margin Protection Program prior to that date.

The Conservation Reserve Program (CRP), USDA's largest conservation program, continues through 2018 with an annually decreasing enrolled acreage cap. The contract portion of the Grassland Reserve Program enrollment has been merged with CRP. The Biomass Crop Assistance Program is extended and funded at $25 million per year.

The Noninsured Crop Disaster Assistance Program has been expanded to include protection at higher coverage levels, similar to buy-up provisions offered under the federal crop insurance program. The Livestock Forage Disaster Program, the Livestock Indemnity Program, the Emergency Assistance for Livestock, Honey Bees, and Farm-Raised Fish, and the Tree Assistance Program are continued, with modifications starting in October 2011, and succeeding years. The Supplemental Revenue Assistance Program (SURE), which covered losses through Sept. 30, 2011, is not reauthorized.

The credit title of the Act continues and improves the direct and guaranteed loan programs that provide thousands of America's farmers and ranchers the opportunity to obtain the credit they need to begin and continue their operations. The changes in the act provide FSA greater flexibility in determining eligibility including expanded definitions of eligible entities, years of experience for farm ownership loans, and allowing youth loan applicants from urban areas to access loans. FSA's popular microloan and down payment loan programs, important to furthering the Administration's objective of assisting beginning farmers, have been improved by raising loan limits and emphasizing beginning and socially disadvantaged producers. The act also provides greater enhancements for lenders to participate in the guaranteed conservation loan program and eliminates term limits for the guaranteed operating program, allowing farmers and ranchers the opportunity for continued credit in cases where financial setbacks may have prevented them from obtaining commercial credit.

ADJUSTED GROSS INCOME

Adjusted gross income (AGI) provisions have been simplified and modified. Producers whose average AGI exceeds $900,000 during a crop, fiscal, or program year are not eligible to participate in most programs administered by FSA and the Natural Resources Conservation Service (NRCS). Previous AGI provisions distinguished between on-farm and nonfarm AGI.

PAYMENT LIMITATIONS

The total amount of payments received, directly and indirectly, by a person or legal entity (except joint ventures or general partnerships) for Price

FACT SHEET

What's In the 2014 Farm Bill for FSA Customers March 2014

Loss Coverage, Agricultural Risk Coverage, marketing loan gains, and loan deficiency payments (other than for peanuts), may not exceed $125,000 per crop year. A person or legal entity that receives payments for peanuts has a separate $125,000 payment limitation.

Cotton transition payments are limited to $40,000 per year. For the livestock disaster programs, a total $125,000 annual limitation applies for payments under the Livestock Indemnity Program, the Livestock Forage Program, and the Emergency Assistance for Livestock, Honey Bees and Farm-Raised Fish program. A separate $125,000 annual limitation applies to payments under the Tree Assistance Program.

ACTIVELY ENGAGED IN FARMING

Producers who participate in the Price Loss Coverage or Agricultural Risk Coverage programs are required to provide significant contributions to the farming operation to be considered as "actively engaged in farming." The act requires the Secretary to promulgate regulations to define "significant contribution of active personal management" as part of this determination.

COMPLIANCE

The Act continues to require an acreage report for all cropland on the farm. The acreage report is required to be eligible for Price Loss Coverage; Agriculture Risk Coverage; transition assistance for producers of upland cotton; marketing assistance loans; and loan deficiency payments.

Compliance with Highly Erodible Land Conservation (HELC) and Wetland Conservation (WC) provisions continues to be required for participation in most FSA and NRCS programs. These provisions place restrictions on the planting of an agricultural commodity on highly erodible land or wetlands. Further, they prohibit the conversion of a wetland to make possible the production of an agricultural commodity.

The Act adds premium assistance for crop insurance as a benefit subject to compliance with HELC and WC provisions. New provisions are created for determinations, administration, and penalties relating to HELC and WC provisions that are unique to crop insurance. FSA will make HELC/WC eligibility determinations for crop insurance participants based on NRCS technical determinations of HELC/WC compliance.

PRICE LOSS COVERAGE (PLC) AND AGRICULTURAL RISK COVERAGE (ARC)

Base Reallocation and Yield Updates: Owners of farms that participate in PLC or ARC programs for the 2014-2018 crops have a one-time opportunity to: (1) maintain the farm's 2013 bases through 2018; or (2) reallocate base acres (excluding cotton bases). Covered commodities include wheat, oats, barley, corn, grain sorghum, rice, soybeans, sunflower seed, rapeseed, canola, safflower, flaxseed, mustard seed, crambe and sesame seed, dry peas, lentils, small chickpeas, and large chickpeas. Upland cotton is no longer considered a covered commodity, but the upland cotton base acres on the farm are renamed "generic" base acres. Producers may receive payments on generic base acres if those acres are planted to a covered commodity.

A producer also has the opportunity to update the program payment yield for each covered commodity based on 90 percent of the farm's 2008-2012 average yield per planted acre, excluding any year when no acreage was planted to the covered commodity. Program payment yields are used to determine payment amounts for the Price Loss Coverage program.

Price Loss Coverage: Payments are issued when the effective price of a covered commodity is less than the respective reference price for that commodity established in the statute. The payment is equal to 85 percent of the base acres of the covered commodity times the difference between the reference price and the effective price times the program payment yield for the covered commodity.

County ARC: Payments are issued when the actual county crop revenue of a covered commodity is less than the ARC county guarantee for the cov-

FACT SHEET

What's In the 2014 Farm Bill for FSA Customers March 2014

ered commodity and are based on county data, not farm data. The ARC county guarantee equals 86 percent of the previous five-year average national farm price, excluding the years with the highest and lowest price (the ARC guarantee price), times the five-year average county yield, excluding the years with the highest and lowest yield (the ARC county guarantee yield). Both the guarantee and actual revenue are computed using base acres, not planted acres. The payment is equal to 85 percent of the base acres of the covered commodity times the difference between the county guarantee and the actual county crop revenue for the covered commodity. Payments may not exceed 10 percent of the benchmark county revenue (the ARC guarantee price times the ARC county guarantee yield).

Individual ARC: Payments are issued when the actual individual crop revenues, summed across all covered commodities on the farm, are less than ARC individual guarantees summed across those covered commodities on the farm. The farm for individual ARC purposes is the sum of the producer's interest in all ARC farms in the state. The farm's ARC individual guarantee equals 86 percent of the farm's individual benchmark guarantee, which is defined as the ARC guarantee price times the five-year average individual yield, excluding the years with the highest and lowest yields, and summing across all crops on the farm. The actual revenue is computed in a similar fashion, with both the guarantee and actual revenue computed using planted acreage on the farm. The individual ARC payment equals: 65 percent of the sum of the base acres of all covered commodities on the farm, times the difference between the individual guarantee revenue and the actual individual crop revenue across all covered commodities planted on the farm. Payments may not exceed 10 percent of the individual benchmark revenue.

Election Required: All of the producers on a farm must make a one-time, unanimous election of: (1) PLC/County ARC on a covered-commodity-by-covered-commodity basis; or (2) Individual ARC for all covered commodities on the farm. If the producers on the farm elect PLC/County ARC, the producers must also make a one-time election to select which base acres on the farm are enrolled in PLC and which base acres are enrolled in County ARC. Alternatively, if individual ARC is selected, then every covered commodity on the farm must participate in individual ARC. The election between ARC and PLC is made in 2014 and is in effect for the 2014 – 2018 crop years. If an election is not made in 2014, the farm may not participate in either PLC or ARC for the 2014 crop year and the producers on the farm are deemed to have elected PLC for subsequent crop years, but must still enroll their farm to receive coverage. If the sum of the base acres on a farm is 10 acres or less, the producer on that farm may not receive PLC or ARC payments, unless the producer is a socially disadvantaged farmer or rancher or is a limited resource farmer or rancher. Payments for PLC and ARC are issued after the end of the respective crop year, but not before Oct. 1.

In 2015, producers in PLC have an additional option. Producers enrolling in PLC, and who also participate in the federal crop insurance program, may, beginning with the 2015 crop, make the annual choice whether to purchase additional crop insurance coverage called the Supplemental Coverage Option (SCO). SCO provides the producer the option of covering a portion of his or her crop insurance deductible and is based on expected county yields or revenue. The cost of SCO is subsidized and indemnities are determined by the yield or revenue loss for the county or area.

COTTON TRANSITION

For the 2014 crop year, transition payments are provided to cotton producers on farms that had cotton base acres in 2013. For the 2015 crop year, transition payments will only be offered in counties where STAX is unavailable.

MARKETING ASSISTANCE LOANS (MALS) AND SUGAR LOANS

The Act extends the authority for sugar loans for the 2014 – 2018 crop years and nonrecourse marketing assistance loans (MALs) and loan deficiency payment (LDPs) for the 2014 – 2018 crops of wheat, corn, grain sorghum, barley, oats, upland cotton, extra-long staple cotton, long grain rice, medium grain rice, soybeans, other oilseeds (including sunflower seed, rapeseed, canola,

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safflower, flaxseed, mustard seed, crambe and sesame seed), dry peas, lentils, small chickpeas, large chickpeas, graded and nongraded wool, mohair, honey, unshorn pelts and peanuts. Provisions are mostly unchanged from the 2008 Farm Bill, except marketing loan gains and loan deficiency payments are subject to payment limitations.

DAIRY PROGRAMS

The Act extends the Milk Income Loss Contract Program (MILC) from Oct. 1, 2013, through the earlier of the date on which the Secretary certifies that the Dairy Margin Protection Program is operational or Sept. 1, 2014. Dairy producers who were enrolled in 2013 do not need to re-apply. MILC payments are issued when the Boston Class I milk price falls below $16.94 per hundredweight (cwt), as adjusted by a dairy feed ration formula.

The Dairy Margin Protection Program replaces MILC and will be effective not later than Sept. 1, 2014, through Dec. 31, 2018. The margin protection program offers dairy producers: (1) catastrophic coverage, at no cost to the producer, other than an annual $100 administrative fee; and (2) various levels of buy-up coverage. Catastrophic coverage provides payments to participating producers when the national dairy production margin is less than $4 per hundredweight (cwt). The national dairy production margin is the difference between the all-milk price and average feed costs. Producers may purchase buy-up coverage that provides payments when margins are between $4 and $8 per cwt. To participate in buy-up coverage, a producer must pay a premium that varies with the level of protection the producer elects.

In addition, the Act creates the Dairy Product Donation Program. This program is triggered in times of low operating margins for dairy producers, and requires USDA to purchase dairy products for donation to food banks and other feeding programs.

Dairy Indemnity Payment Program (DIPP)

The DIPP provides payments to dairy producers when a public regulatory agency directs them to remove their raw milk from the commercial market because it has been contaminated by pesticides and other residues.

CONSERVATION RESERVE PROGRAM (CRP)

The Act continues CRP with modifications. The acreage cap is gradually lowered to 24 million acres for fiscal years 2017 and 2018. The requirement to reduce rental payments under emergency haying and grazing is eliminated. Rental payment reductions of not less than 25 percent are required for managed haying and grazing.

Producers also are given the opportunity for an "early-out" from their CRP contracts, but only in fiscal year 2015. The rental payment portion of the Grassland Reserve Program enrollment has been incorporated into the CRP.

The Transition Incentive Program (TIP) continues to allow for the transition of CRP land to a beginning or socially disadvantaged farmer or rancher so land can be returned to sustainable grazing or crop production. TIP now includes eligibility for military veterans (i.e., veteran farmers).

BIOMASS CROP ASSISTANCE PROGRAM (BCAP)

BCAP provides incentives to farmers, ranchers and forest landowners to establish, cultivate and harvest eligible biomass for heat, power, bio-based products, research and advanced biofuels. Crop producers and bioenergy facilities can team together to submit proposals to USDA for selection as a BCAP project area. BCAP has been extended through 2018 and is funded at $25 million per fiscal year.

NONINSURED CROP DISASTER ASSISTANCE PROGRAM (NAP)

NAP has been expanded to include buy-up protection, similar to buy-up provisions offered under the federal crop insurance program. Producers may elect coverage for each individual crop between

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50 and 65 percent, in 5 percent increments, at 100 percent of the average market price. Producers also pay a fixed premium equal to 5.25 percent of the liability. The waiver of service fees has been expanded from just limited resource farmers also to include beginning farmers and socially disadvantaged farmers. The premiums for buy-up coverage are reduced by 50 percent for those same farmers. Grazing land is not eligible for buy-up coverage. NAP is also made available to producers that suffered a loss to a 2012 annual fruit crop grown on a bush or tree in a county declared a disaster by the Secretary due to a freeze or frost.

RTCP FOR GEOGRAPHICALLY DISADVANTAGED FARMERS AND RANCHERS

The Reimbursement Transportation Cost Payment Program (RTCP) is re-authorized to provide assistance to geographically disadvantaged farmers and ranchers for a portion of the transportation cost of certain agricultural commodities or inputs.

EMERGENCY LOANS

A Secretarial disaster designation or a Presidential declaration provides producers with emergency loans to help cover the recovery costs for physical and production losses. Farm bill revisions expand the type of entities eligible for loans.

FARM OPERATING LOANS AND MICROLOANS

Farm Operating Direct and Guaranteed Loan Programs provide low-interest financing for producers to purchase farm and ranch operating inputs. The FSA is authorized to implement the program through the Consolidated Farm and Rural Development Act, also known as the Con Act. The 2014 Farm Bill revisions expand the types of entities eligible, provide favorable interest rates for joint financing arrangements, increase loan limits for microloans, make youth loans available in urban areas, and eliminate term limits for guaranteed operating loans.

FARM OWNERSHIP LOANS

Farm Ownership Direct and Guaranteed Loan Programs provide low-interest financing for producers to purchase farms and ranches and other real estate related needs. The FSA is authorized to implement the program through the Consolidated Farm and Rural Development Act, often referred to as the Con Act. The 2014 Farm Bill revisions expand the types of entities eligible, provide favorable interest rates for joint financing arrangements, provide a larger percent guarantee on guaranteed conservation loans, increase the loan limits for the down payment program, and authorize a relending program to assist Native American producers purchase fractionated interests of land.

DISASTER PROGRAMS

The following four disaster programs authorized by the 2008 Farm Bill have been extended indefinitely (beyond the horizon of the Act). The programs are made retroactive to Oct. 1, 2011. Producers are no longer required to purchase crop insurance or NAP coverage to be eligible for these programs (the risk management purchase requirement) as mandated by the 2008 Farm Bill.

Livestock Forage Disaster Program (LFP): LFP provides compensation to eligible livestock producers that have suffered grazing losses due to drought or fire on land that is native or improved pastureland with permanent vegetative cover or that is planted specifically for grazing. LFP payments for drought are equal to 60 percent of the monthly feed cost for up to five months, depending upon the severity of the drought. LFP payments for fire on federally managed rangeland are equal to 50 percent of the monthly feed cost for the number of days the producer is prohibited from grazing the managed rangeland, not to exceed 180 calendar days.

Livestock Indemnity Program (LIP): LIP provides benefits to livestock producers for livestock deaths in excess of normal mortality caused by adverse weather or by attacks

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by animals reintroduced into the wild by the federal government. LIP payments are equal to 75 percent of the average fair market value of the livestock.

Emergency Assistance for Livestock, Honey Bees, and Farm-Raised Fish (ELAP): ELAP provides emergency assistance to eligible producers of livestock, honeybees and farm-raised fish for losses due to disease (including cattle tick fever), adverse weather, or other conditions, such as blizzards and wildfires, not covered by LFP and LIP. Total payments are capped at $20 million in a fiscal year.

Tree Assistance Program (TAP): TAP provides financial assistance to qualifying orchardists and nursery tree growers to replant or rehabilitate eligible trees, bushes, and vines damaged by natural disasters.

FEEDSTOCK FLEXIBILITY PROGRAM (FFP)

FFP is continued through fiscal year 2018. Congress authorized the FFP in the 2008 Farm Bill, allowing for the purchase of sugar to be sold for the production of bioenergy in order to avoid forfeitures of sugar loan collateral under the Sugar Program.

NON-FARM BILL PROGRAMS

The following programs continue under laws other than the 2014 Farm Bill.

Emergency Conservation Program (ECP)
ECP is authorized by Title IV of the Agricultural Credit Act of 1978, Section 401 (P.L. 95-334)(16 U.S.C. 2201). ECP provides emergency cost-share assistance to farmers and ranchers to help rehabilitate farmland and ranchland damaged by natural disasters and to carry out water conservation measures during periods of severe drought. Cost-share assistance may be offered only for emergency conservation practices to restore land to a condition similar to that existing prior to the natural disaster.

Emergency Forest Restoration Program (EFRP)
EFRP is authorized by Title IV of the Agricultural Credit Act of 1978, Section 407 (16 U.S.C. 2206). EFRP was established to provide financial and technical assistance to owners of non-industrial private forest land damaged by natural disaster to carry out emergency measures to restore damaged forests and rehabilitate forest resources.

Farm Storage Facility Loan Program (FSFL)
FSFL provides low-interest financing for producers to build or upgrade farm storage and handling facilities.

Sugar Storage Facility Loan Program (SSFL)
SSFL provides low-interest financing for processors to build or upgrade farm storage and handling facilities for raw or refined sugar.

2011 Montana FSA Farmer & Rancher Handbook

Farm Service Agency

USDA United States Department of Agriculture

Fact Sheet

February 2008

Rural Youth Loans

Overview

The U.S. Department of Agriculture's Farm Service Agency (FSA) makes operating loans of up to $5,000 to eligible individual rural youths age 10 through 20 to finance income-producing, agriculture-related projects. The project must be of modest size, educational, and initiated, developed and carried out by rural youths participating in 4-H clubs, FFA, or a similar organization.

The project must be an organized and supervised program of work. It must be planned and operated with the assistance of the organization advisor, produce sufficient income to repay the loan, and provide the youth with practical business and educational experience in agriculture-related skills.

Who May Borrow

To qualify for a loan, the applicant must:

- comply with FSA's general eligibility requirements;
- reside in a rural area, city or town with a population of 50,000 or fewer people; and
- conduct a modest income-producing project in a supervised program of work.

How Loan Funds May Be Used

These loans can finance many kinds of income-producing agricultural projects. The loan fund may be used to:

- buy livestock, seed, equipment and supplies;
- buy, rent or repair needed tools and equipment; and
- pay operating expenses for the project.

What Details to Know

To apply, the applicant must submit completed plans and budgets signed by the project advisor and parent or guardian along with the FSA application for loan assistance. These loans:

- have a maximum loan amount of $5,000 (total principal balance owed at any one time cannot exceed this amount);
- have an interest rate which is determined periodically, based on the cost of money to the federal government,
  - after the loan is made, the interest rate for that loan will not change;
- will be secured, in addition to promissory notes, by liens on the products produced for sale and on chattel property, including livestock, equipment and fixtures purchased with loan funds; and
- have a repayment schedule which varies depending on the type of project for which the loan is made,
  - for example, if it involves raising livestock or crops, the loan is paid when the animals or produce are normally sold.

For More Information

To apply or find out more, visit your local USDA Service Center. A listing of centers, and more information about youth and other loan programs, are available on the FSA website at http://www.fsa.usda.gov. USDA Service Center offices are also usually listed in telephone directories under "U.S. Department of Agriculture.

USDA FSA

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UNITED STATES DEPARTMENT OF AGRICULTURE
FARM SERVICE AGENCY

October 2013

Loans for Beginning Farmers and Ranchers

Overview

The U.S. Department of Agriculture's (USDA) Farm Service Agency (FSA) makes and guarantees loans to beginning farmers who are unable to obtain financing from commercial lenders. Each fiscal year, FSA targets a portion of its direct and guaranteed farm ownership (FO) and operating loan (OL) funds to beginning farmers.

A beginning farmer is an individual or entity who:

- Has not operated a farm for more than 10 years;
- Meets the loan eligibility requirements of the program to which he/she is applying;
- Substantially participates in the operation and;
- For FO purposes, does not own a farm greater than 30 percent of the median size farm in the county.

(Note: All applicants for direct FO loans must have participated in the business operations of a farm for at least three years out of the 10 years prior to the date the application is submitted). If the applicant is an entity, all members must be related by blood or marriage, and all entity members must be eligible beginning farmers.

Maximum Loan Amounts

- Direct FO: $300,000
- Direct OL: $300,000; Microloan: $35,000
- Guaranteed FO or OL: $1,355,000 (Amount varies annually based on inflation).

Downpayment Program

FSA has a special loan program to assist socially disadvantaged (SDA) and beginning farmers in purchasing a farm. Retiring farmers may use this program to transfer their land to future generations.

To qualify:

- The applicant must make a cash down payment of at least 5 percent of the purchase price.
- The maximum loan amount does not exceed 45 percent of the least of (a) the purchase price of the farm to be acquired; (b) the appraised value of the farm to be acquired or; (c) $500,000 (Note: This results in a maximum loan amount of $225,000).
- The term of the loan is 20 years. The interest rate is 4 percent below the direct FO rate, but not lower than 1.5 percent.
- The remaining balance may be obtained from a commercial lender or private party. FSA can provide up to a 95 percent guarantee if financing is obtained from a commercial lender. Participating lenders do not have to pay a guarantee fee.
- Financing from participating lenders must have an amortization period of at least 30 years and cannot have a balloon payment due within the first 20 years of the loan.

Joint Financing Arrangement

Beginning farmers may choose to participate in a joint financing arrangement. With this arrangement FSA lends up to 50 percent of the amount financed and another lender provides 50 percent or more. The applicant will use funds from the joint financing arrangement along with FSA funds for any authorized FO purpose. The interest rates for such arrangements can be obtained from the local FSA office. The term of the loan will not exceed 40 years or the useful life of the security.

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Loans for Beginning Farmers and Ranchers

October 2013

Land Contract Guarantees

These provide certain financial guarantees to the seller of a farm through a land contract sale to a beginning or SDA farmer. The seller may request either of the following:

Prompt Payment Guarantee: A guarantee up to the amount of three amortized annual installments plus the cost of any related real estate taxes and insurance.

Standard Guarantee: A guarantee of 90 percent of the outstanding principal balance under the land contract.

The purchase price of the farm cannot exceed the lesser of (a) $500,000 or (b) the market value of the property. The buyer must provide a minimum down payment of five percent of the purchase price of the farm. The interest rate is fixed at a rate not to exceed the direct FO loan interest rate in effect at the time the guarantee is issued, plus three percentage points. The guarantee period is 10 years for either plan regardless of the term of the land contract. The contract payments must be amortized for a minimum of 20 years. Balloon payments are prohibited during the 10-year term of the guarantee.

Sale of Inventory Farmland

FSA advertises inventory property within 15 days of acquisition. Eligible SDA and beginning farmers are given first priority to purchase these properties at the appraised value. If one or more eligible SDA or beginning farmer offers to purchase the same property in the first 135 days, the buyer is chosen randomly.

Where to Apply

Applications for direct loan assistance may be submitted to the local FSA office serving the area where the operation is located. Local FSA offices are listed in the telephone directory under U.S. Government, Department of Agriculture or Farm Service Agency. For guaranteed loans, applicants must apply to a commercial lender who participates in the Guaranteed Loan Program. Contact your local FSA office for a list of participating lenders.

For More Information

Further information about this and other FSA programs is available from local FSA offices or on the FSA website at www.fsa.usda.gov.

USDA FSA

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UNITED STATES DEPARTMENT OF AGRICULTURE
FARM SERVICE AGENCY

August 2013

Microloans

Overview

The Farm Service Agency (FSA) developed the Microloan (ML) program to better serve the unique financial operating needs of beginning, niche and the smallest of family farm operations by modifying its Operating Loan (OL) application, eligibility and security requirements. The program will offer more flexible access to credit and will serve as an attractive loan alternative for smaller farming operations like specialty crop producers and operators of community supported agriculture (CSA). These smaller farms, including non-traditional farm operations, often face limited financing options.

Use of Microloans

Microloans can be used for all approved operating expenses as authorized by the FSA Operating Loan Program, including but not limited to:

- Initial start-up expenses;
- Annual expenses such as seed, fertilizer, utilities, land rents;
- Marketing and distribution expenses;
- Family living expenses;
- Purchase of livestock, equipment, and other materials essential to farm operations;
- Minor farm improvements such as wells and coolers;
- Hoop houses to extend the growing season;
- Essential tools;
- Irrigation;
- Delivery vehicles.

Simplified Application Process

The application process for microloans will be simpler, requiring less paperwork to fill out, to coincide with the smaller loan amount that will be associated with microloans. Requirements for managerial experience and loan security have been modified to accommodate smaller farm operations, beginning farmers and those with no farm management experience. FSA understands that there will be applicants for the ML program who want to farm but do not have traditional farm experience or have not been raised on a farm or within a rural community with agriculture-affiliated organizations. ML program applicants will need to have some farm experience; however, FSA will consider an applicant's small business experience as well as any experience with a self-guided apprenticeship as a means to meet the farm management requirement. This will assist applicants who have limited farm skills by providing them with an opportunity to gain farm management experience while working with a mentor during the first production and marketing cycle.

Security Requirements

For annual operating purposes, microloans must be secured by a first lien on a farm property or agricultural products having a security value of at least 100 percent of the microloan amount, and up to 150 percent, when available. Microloans made for purposes other than annual operating expenses must be secured by a first lien on a farm property or agricultural products purchased with loan funds and having a security value of at least 100 percent of the microloan amount.

Rates and Terms

Eligible applicants may obtain a microloan for up to $35,000. The repayment term may vary and will not exceed seven years. Annual operating loans are repaid within 12 months or when the agricultural commodities produced are sold. Interest rates are based on the regular OL rates that are in effect at the time of the microloan approval or microloan closing, whichever is less.

Obtaining Forms and Submitting an Application

FSA Microloan application forms can be obtained from the local FSA office or can be downloaded and printed from the USDA website. Applicants who are having problems gathering information or completing forms should contact their local FSA office for help. After completing the required paperwork, an applicant should submit the farm loan application to the local FSA office.
The following form must be completed:

FSA 2330 – Request for Microloan Assistance

(Instruction Form for FSA 2330)

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Microloans

August 2013

What Happens After a Loan Application is Submitted?

After a loan application is submitted, FSA reviews the application and determines if the applicant is eligible for the requested loan. The applicant will receive written notification of each step in the process, such as when the application is received, when more information is needed, when an eligibility determination is made, and when a final decision is made. If the application is approved, FSA makes the loan and funds are distributed as needed. If the application is denied, the applicant is notified in writing of the specific reasons for the denial, and provided reconsideration and appeal rights.

Eligibility Criteria and Additional Information

To qualify for assistance, the applicant must not be larger than a family-sized farmer, have a satisfactory history of meeting credit obligations, be unable to obtain credit elsewhere at reasonable rates and terms, and meet all other loan eligibility requirements. Additional information on the FSA microloan program may be obtained at local FSA offices or through the FSA website at www.fsa.usda.gov.

USDA FSA

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UNITED STATES DEPARTMENT OF AGRICULTURE
FARM SERVICE AGENCY

September 2013

How to Complete an FSA Loan Application

Overview

This fact sheet describes how farmers can apply for a direct farm loan with the U.S. Department of Agriculture's (USDA) Farm Service Agency (FSA). FSA must follow all relevant federal credit, environmental, and debt collection laws and policies when making farm loans.

Applying for a Loan

Farmers interested in applying for a loan should contact their local FSA office. FSA employees determine loan eligibility and approval. FSA direct farm ownership and operating loan funds can assist farmers with such needs as purchasing farmland, livestock, equipment, feed and other materials essential to farm operations; paying normal operating and family living expenses; and refinancing certain debts. FSA loans cannot be used to refinance personal debts, buy personal vehicles, or start and operate ineligible enterprises.

FSA employees at the local office can explain what information is needed and how to obtain it. In some areas, FSA can arrange for an outside organization to help the applicant gather the information and complete the forms. If available, this help is provided at no cost to the applicant. Providing all of the following information will help the loan application process flow smoothly. (Please note that other information may be required depending on each individual situation).

FSA Forms

The following forms must be completed:

- FSA 2001: Request for Direct Loan Assistance
  If the applicant is a cooperative, corporation, partnership, joint operation, trust, or limited liability company, additional information will be required of each member of the entity. Applicants will need to discuss the structure of the business with an agency official. (Applicants will need to provide a credit report fee, which will vary in amount depending on how many individuals are applying and/or the business structure).
- FSA-2002: Three Year Financial History
- FSA-2003: Three Year Production History
- FSA-2004: Authorization to Release Information
- FSA-2005: Creditor List
- FSA-2006: Property Owned and Leased
- FSA 2037: Farm Business Plan Worksheet-Balance Sheet
- FSA 2038: Farm Business Plan Worksheet-Projected Income and Expense
- FSA-2302: Description of Farm Training and Experience.

Additional Information

In addition to forms, an applicant must provide FSA the following information as part of the loan process (Note: If the applicant is already an FSA borrower, this information should be on file with the FSA):

- Proof that the applicant cannot obtain credit from private sources at reasonable rates and terms. A referral letter from a bank or other local lending institution serves as proof and may or may not be necessary depending on the applicant's financial situation.
- Three years of federal income tax returns.
- Copies of any leases, contracts or agreements.
- Documentation showing compliance with regulations governing certain environmental programs. The local FSA office can assist the applicant with meeting this requirement.

For information on the Microloan operating loans, see the Microloan fact sheet.

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How to Complete an FSA Loan Application

September 2013

Emergency Loans (EM)

EM loans help cover production and physical losses for producers in counties declared as disaster or quarantine areas. Applicants requesting an EM loan based on losses in declared areas should also provide the following forms:

- FSA 2309: Certification of Disaster Losses
- FSA 2310: Request for Lender's Verification of Loan Application

Actual Production History (APH) yields must be established by a producer's crop insurance company and will be used to calculate losses. If APH yields are not available, three years of the producer's production history will be used.
Obtaining Forms and Submitting Loan

Obtaining Forms and Submitting Loan Applications

FSA forms can be obtained from the local FSA office or can be downloaded and printed from USDA's E-forms website at http://forms.sc.egov.usda.gov/eForms/.

Applicants who are having problems gathering information or completing forms should contact their local FSA office for help. After completing the required paperwork, an applicant should submit the farm loan application to the local FSA office.

What Happens After a Loan Application is Submitted?

After a loan application is submitted, FSA reviews the application and determines if the applicant is eligible for the requested loan. The applicant will receive written notification of each step in the process, such as when the application is received, when more information is needed, when an eligibility determination is made, and when a final decision is made. If the application is approved, FSA makes the loan and funds are distributed as needed. If the application is denied, the applicant is notified in writing of the specific reasons for the denial, and provided reconsideration and appeal rights.

More Information

Visit FSA's website, www.fsa.usda.gov, for details on the types of loans and loan amounts offered, as well as for information about all FSA programs.

USDA FSA

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UNITED STATES DEPARTMENT OF AGRICULTURE
FARM SERVICE AGENCY

November 2012

Loans for Socially Disadvantaged Farmers and Ranchers

Overview

The U.S. Department of Agriculture's (USDA) Farm Service Agency (FSA) makes and guarantees loans to eligible socially disadvantaged farmers (SDA) to buy and operate family-size farms and ranches. Each fiscal year, the Agency targets a portion of its direct and guaranteed farm ownership (FO) and operating loan (OL) funds to SDA farmers. Non-reserved funds can also be used by SDA individuals.

An SDA farmer or rancher is a group whose members have been subject to racial, ethnic or gender prejudice because of their identity as members of a group without regard to their individual qualities. These groups consist of American Indians or Alaskan Natives, Asians, Blacks or African-Americans, Native Hawaiians or other Pacific Islanders, Hispanics and women.

The agency:

- Helps remove barriers that prevent full participation of SDA farmers in FSA's farm loan programs;
- Provides information and assistance to SDA farmers to help them develop sound farm management practices, analyze problems and plan the best use of available resources essential for success.

Types of Loans and Uses of Loan Funds

Direct farm ownership loans (FO) and farm operating loans (OL) are made by FSA to eligible farmers. Guaranteed FO and OL loans are made by lending institutions subject to federal or state supervision (banks, savings and loans, and units of the Farm Credit System) and guaranteed by FSA. Typically, FSA guarantees 90 percent of any loss the lender might incur if the loan fails. FO funds may be used to purchase or enlarge a farm or ranch, purchase easements or rights of way needed in the farm's operation, erect or improve buildings, implement soil and water conservation measures and pay closing costs. Guaranteed FO funds also may be used to refinance debt.

OL funds may be used to purchase livestock, poultry, farm equipment, feed, seed, fuel, fertilizer, chemicals, insurance, and other operating expenses. The funds also may be used for training costs, closing costs and to reorganize and refinance debt.

Terms and Interest Rates

Repayment terms for direct OL depend on the collateral securing the loan and usually run from one to seven years. Repayment terms for direct FO vary but never exceed 40 years.

Interest rates for direct loans are set periodically according to the government's cost of borrowing.

Guaranteed loan terms are set by the lender. Interest rates for guaranteed loans are established by the lender.

Downpayment Program

FSA has a special loan program to assist socially disadvantaged and beginning farmers in purchasing a farm. Retiring farmers may use this program to transfer their land to future generations.

To qualify:

- The applicant must make a cash down payment of at least 5 percent of the purchase price.
- The maximum loan amount does not exceed 45 percent of the least of (a) the purchase price of the farm or ranch to be acquired; (b) the appraised value of the

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Loans for Socially Disadvantaged Farmers and Ranchers November 2012

farm or ranch to be acquired or; (c) $500,000 (Note: This results in a maximum loan amount of $225,000).

- The term of the loan is 20 years. The interest rate is 4 percent below the direct FO rate, but not lower than 1.5 percent. The remaining balance may be obtained from a commercial lender or private party. FSA can provide up to a 95 percent guarantee if financing is obtained from a commercial lender. Participating lenders do not have to pay a guarantee fee.
- Financing from participating lenders must have an amortization period of at least 30 years and cannot have a balloon payment due within the first 20 years of the loan.

Land Contract (LC) Guarantees

These provide certain financial guarantees to the seller of a farm through a land contract sale to a beginning or socially disadvantaged farmer. The seller may request either of the following:

Prompt Payment Guarantee: A guarantee up to the amount of three amortized annual installments plus the cost of any related real estate taxes and insurance.

Standard Guarantee: A guarantee of 90 percent of the outstanding principal balance under the land contract.

The purchase price of the farm cannot exceed the lesser of (a) $500,000 or (b) the market value of the property. The buyer must provide a minimum down payment of five percent of the purchase price of the farm. The interest rate is fixed at a rate not to exceed the direct FO loan interest rate in effect at the time the guarantee is issued, plus three percentage points. The guarantee period is 10 years for either plan regardless of the term of the land contract. The contract payments must be amortized for a minimum of 20 years. Balloon payments are prohibited during the 10-year term of the guarantee.

Sale of Inventory Farmland

FSA advertises inventory property within 15 days of acquisition. Eligible SDA and beginning farmers are given first priority to purchase these properties at the appraised market value. If one or more eligible SDA or beginning farmer offers to purchase the same property in the first 135 days, the buyer is chosen randomly.

Where to Apply

Applications for direct loan assistance may be submitted to the local FSA office serving the area where the operation is located. Local FSA offices are listed in the telephone directory under U.S. Government, Department of Agriculture or Farm Service Agency. For guaranteed loans, applicants must apply to a commercial lender who participates in the Guaranteed Loan Program. Contact the local FSA office for a list of participating lenders.

For more information

More information is available from local FSA offices or on the FSA website at www.fsa.usda.gov.

USDA FSA

FACT SHEET

UNITED STATES DEPARTMENT OF AGRICULTURE
FARM SERVICE AGENCY

October 2013

Farm Loans

Overview

The U.S. Department of Agriculture's Farm Service Agency (FSA) makes and guarantees loans to family farmers and ranchers to promote, build and sustain family farms in support of a thriving agricultural economy. FSA maintains its headquarters in Washington, DC, with offices located in each state, usually in a state capital or near a state land-grant university, as well as in most agriculturally productive counties. Farmers may apply for direct loans at local FSA offices. Guaranteed loans may be available from commercial lenders who apply for loan guarantees from FSA. Although general information may be obtained from headquarters and state offices, all programs are administered through local offices.

The goal of FSA's farm loan programs is to graduate its borrowers to commercial credit. Once a farmer is able to obtain credit from the commercial lending sector, the Agency's mission of providing temporary, supervised credit is complete.

FSA Farm Loans

FSA's loan programs are designed to help family farmers to start, purchase or expand their farming operation. In many cases, these are beginning farmers who need additional financial and business acumen to qualify for commercial credit. In other cases, they are farmers who have suffered financial setbacks from natural disasters, or who need additional resources with which to establish and maintain profitable farming operations.

Some farmers obtain their credit needs through the use of loan guarantees. Under a guaranteed loan, a commercial lender makes and services the loan, and FSA guarantees it against loss up to a maximum of 90 percent in most cases. In certain limited circumstances, a 95 percent guarantee is available. FSA has the responsibility of approving all eligible loan guarantees and providing oversight of lenders' activities.

For those not yet meeting the qualifications for a loan guarantee from a commercial lender, FSA also makes direct loans, which are serviced by an FSA official. FSA has the responsibility of providing credit counseling and supervision to its direct borrowers by making a thorough assessment of the farming operation. FSA helps applicants evaluate the adequacy of the real estate and facilities, machinery and equipment, financial and production management, and the applicant's goals. FSA assists the applicant in identifying and prioritizing areas needing improvement in all phases of the operation. An FSA official then works one-on-one with the applicant to develop and to help strengthen the identified areas that ultimately result in the applicants graduation to commercial credit.

Unlike FSA's commodity loans, most farm loans must be fully secured and can only be approved for those who have repayment ability.

Farm Ownership Loans

Eligible applicants may obtain direct loans up to a maximum indebtedness of $300,000. Maximum indebtedness for guaranteed loans is $1,355,000 (amount adjusted annually for inflation). The maximum repayment term is 40 years for both direct and guaranteed farm ownership loans. In general, loan funds may be used to purchase a farm, enlarge an existing farm, construct new farm buildings and/or improve structures, pay closing costs, and promote soil and water conservation and protection.

Farm Operating Loans

Eligible applicants may obtain direct loans for up to a maximum indebtedness of $300,000 and a direct operating Microloan for up to a maximum indebtedness of $35,000. Maximum indebtedness for a guaranteed loan is $1,355,000 (amount adjusted annually for inflation). The repayment term may vary, but typically it will not exceed seven years for intermediate-term purposes. Annual operating loans are generally repaid within 12 months or when the commodities produced are sold. In general, loan funds may be used for

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normal operating expenses, machinery and equipment, minor real estate repairs or improvements, and refinancing debt.

Targeted Funds to Socially Disadvantaged and Beginning Farmers

Each year Congress targets a percentage of farm ownership and farm operating loan funds to socially disadvantaged (SDA) and beginning farmers. For more information, refer to the FSA Fact Sheet, "Loans for Socially Disadvantaged Farmers."

Downpayment Program

FSA has a special loan program to assist SDA and beginning farmers in purchasing a farm. Retiring farmers may use this program to transfer their land to future generations.

To qualify:

- The applicant must make a cash down payment of at least 5 percent of the purchase price.

- The maximum loan amount does not exceed 45 percent of the least of (a) the purchase price of the farm to be acquired; (b) the appraised value of the farm to be acquired or; (c) $500,000 (Note: This results in a maximum loan amount of $225,000).

- The term of the loan is 20 years. The interest rate is 4 percent below the direct FO rate, but not lower than 1.5 percent.

- The remaining balance may be obtained from a commercial lender or private party. FSA can provide up to a 95 percent guarantee if financing is obtained from a commercial lender. Participating lenders do not have to pay a guarantee fee.

- Financing from participating lenders must have an amortization period of at least 30 years and cannot have a balloon payment due within the first 20 years of the loan.

Rural Youth Loans

These are available as direct loans only and have a maximum loan amount of $5,000. Rural youth loans may be made to individuals who are sponsored by a project advisor, such as a 4-H Club, FFA or local vocational instructor. Individuals must be at least 10 but not more than 20 years old to be eligible and reside in a town or city with a population of 50,000 or fewer people.

Emergency Loans

These loans are available only as direct loans from FSA. Emergency Loans assist farmers who have suffered physical or production losses in areas declared by the President as disaster areas or designated by the Secretary of Agriculture as disaster or quarantine areas (for physical losses only, the FSA Administrator may authorize Emergency Loan assistance). For production loss loans, applicants must demonstrate a 30 percent loss in a single farming enterprise. Applicants may receive loans up to 100 percent of production or physical losses.

Loan purposes include operating and real estate, restoring/replacing essential property, production costs for disaster year, essential family living expenses, reorganization and refinancing certain debts.

The maximum indebtedness under the Emergency Loan program is $500,000.

Conservation Loans

Conservation loans are available as guaranteed loans only. Eligible applicants may use Conservation Loan funds to complete any conservation activity included in a conservation plan or Forestry Management Plan, and may be used to refinance debts related to implementing any conservation activity if refinancing will result in additional conservation benefits. Maximum indebtedness is $1,355,000 (amount adjusted annually for inflation) and the maximum repayment term is 30 years.

Note: The family farm and test for credit requirements are not applicable to Conservation Loans.

Land Contract Guarantees

These provide certain financial guarantees to the seller of a farm through a land contract sale to a beginning or socially disadvantaged farmer. The seller may request either of the following:

Prompt Payment Guarantee: A guarantee up to the amount of three amortized annual installments plus the cost of any related real estate taxes and insurance.

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Standard Guarantee: A guarantee of 90 percent of the outstanding principal balance under the land contract.

The purchase price of the farm cannot exceed the lesser of (a) $500,000 or (b) the market value of the property. The buyer must provide a minimum down payment of five percent of the purchase price of the farm. The interest rate is fixed at a rate not to exceed the direct FO loan interest rate in effect at the time the guarantee is issued, plus three percentage points. The guarantee period is 10 years for either plan regardless of the term of the land contract. The contract payments must be amortized for a minimum of 20 years. Balloon payments are prohibited during the 10-year term of the guarantee.

Loan Servicing and Supervised Credit

FSA's mission is not limited to providing just credit - it is to provide supervised credit. This means that FSA works with each direct loan borrower to identify specific strengths and opportunities for improvement in farm production and management, and then works with the borrower on alternatives and other options to address the areas needing improvement to achieve success. Learning improved business planning and financial acumen through supervised credit is the difference between success and failure for many farm families.

To help keep borrowers on the farm, FSA may be able to provide certain loan servicing benefits to direct loan borrowers whose accounts are distressed or delinquent due to circumstances beyond their control. These benefits include:

- Reamortization, rescheduling, and/or deferral of loans;
- Rescheduling at the Limited Resource (lower interest) rate;
- Acceptance of conservation contracts on environmentally sensitive land in exchange for reduction of debt; and
- Writing down the debt (delinquent borrowers only).

If none of these options results in a feasible farm operating plan, borrowers may be offered the opportunity to pay off their debt at the current market value of the security. If this is not possible, other options include:

- Debt settlement based on inability to repay.
- In some cases, where a feasible operating plan cannot be developed, FSA works with commercial lenders to help the borrower retain the homestead and up to 10 acres of land.

Farms that come into FSA ownership are sold at market value, with preference given to SDA and beginning farmers.

Who May Borrow

To qualify for assistance, applicants must meet all loan eligibility requirements including:

- Be a family farmer;
- Have a satisfactory history of meeting credit obligations;
- For direct OL loans, have sufficient education; training, or at least 1-year's experience in managing or operating a farm or ranch within the last 5 years. For direct FO loans, all applicants must have participated in the business operations of a farm for at least three years out of the 10 years prior to the date the application is submitted;
- Be a citizen of the United States, including Puerto Rico, the U. S. Virgin Islands, Guam, American Samoa, Commonwealth of the Northern Mariana Islands, Republic of Pallau, Federated States of Micronesia and the Republic of Marshall Islands, a U.S. non-citizen national, or a qualified alien under federal immigration law;
- Be unable to obtain credit elsewhere at reasonable rates and terms to meet actual needs;
- Possess legal capacity to incur loan obligations;
- Not be delinquent on a federal debt;
- Not have caused FSA a loss by receiving debt forgiveness (certain exceptions apply) and;
- Be within the time restrictions as to the number of years they can receive FSA assistance.

In the case of an entity, certain eligibility requirements apply. The entity must:

- Meet applicant eligibility requirements;

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- Be authorized to operate a farm in the state where the actual operation is located and;

- Be owned by U.S. citizens, U.S. non-citizen nationals or qualified aliens.

For SDA members, they must hold a majority interest in the entity applicant to receive SDA benefits.

If the individuals holding a majority interest in the entity are related by blood or marriage, at least one member or partner must operate the family farm. If they are not related by blood or marriage, the member holding a majority interest must operate the farm.

For More Information

Additional information may be obtained at local FSA offices or through the FSA website at www.fsa.usda.gov.

CURRENT PROGRAM SUMMARY

E (Kika) de la Garza American Institute for Goat Research
Langston University
Langston, Oklahoma 73050

- **EXTENSION OVERVIEW**
- **INTERNATIONAL OVERVIEW**
- **RESEARCH OVERVIEW**
- **USDA/CSREES PROJECTS**
- **EXPERIMENTS**
- **ABSTRACTS**
- **ARTICLE SUMMARIES**
- **VISITING SCHOLARS, GRADUATE STUDENTS, AND INTERNS**

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Research Overview

Dr. Arthur Goetsch
Goat Research Leader

There has been and is a wide array of research areas addressed by our program. All major types of goats produced in the US are considered, i.e., ones raised for meat, milk, and(or) fiber, both cashmere and mohair. The increasing demand for goat meat and decline in the mohair industry in recent years have resulted in an expansion of research topics with meat goats, but because the future is unknown, all goat industries will continue to receive attention. The Institute has and will in the future conduct research to increase levels and efficiencies of goat production, enhance utilization of goat products, and improve use of goats for specific purposes such as vegetation management. There is intent to increase economic returns to those raising goats or processing their products, as well as providing other benefits such as enhanced sustainability of livestock production systems.

A large proportion of the Institute's research program is made possible by grants, many of which are through USDA programs. Although dissemination of information generated from all of these projects occurs, some entail strong extension components. Likewise, there are projects listed in our international section that entail significant research components.

To provide an idea about our research program since the last Field Day, listed below are research projects and experiments we have been involved with in 2012, abstracts for 2013, and summaries of scientific articles that were published in 2012 or currently are "in press."

Standard Abbreviations Used

BW = body weight
CP = crude protein
dL = decaliter
DMI = dry matter intake
kg = kilogram
M = mole
MEI = ME intake
mm = millimeters
ng = nanogram
OM = organic matter
SE = standard error
wt = weight
vs = versus
cm = centimeters
d = day
DM = dry matter
g = gram
L = liter
ME = metabolizable energy
mL = milliliter
mo = month
NDF = neutral detergent fiber
P = probability
TDN = total digestible nutrients
vol = volume
μ = micro

Current Research Projects

Title:	Factors Influencing Goat Production and Products in the South-Central U.S.
Type:	USDA NIFA Evans-Allen
Project Number:	OKLXSAHLU2012
Period:	2012-2017
Investigators:	T. Sahlu, A. L. Goetsch, R. Puchala, R. C. Merkel, T. A. Gipson, S. P. Hart, S. Zeng, and Z. Wang
Institution:	Langston University
Objective:	Study goat feeding and management, relevant health issues, and milk product technologies in order to increase the level and efficiency of goat productivity for increased profitability from goat production and lower costs to consumers of goat products.

Title:	Effects of Selected Nutritional Components on Immunity to Haemonchus in Goats
Type:	USDA 1890 Institution Capacity Building - Research
Project Number:	OKLXWANG10
Period:	2010-2014
Investigators:	Z. Wang[1], A. L. Goetsch[1], S. P. Hart[1], T. Sahlu[1], and G. Chen[2]
Institutions:	[1]Langston University and [2]Oklahoma State University
Objectives:	Investigate immune regulation by H. contortus and reversing this regulation by nutritional components in small ruminants

Title:	Establishing a Langston University Testing Center for Electric Fence Modifications of Cattle Barb Wire Fence for Goat Containment
Type:	USDA 1890 Institution Capacity Building - Research
Project Number:	OKLXGOETSCH10
Period:	2010-2014
Investigators:	A. L. Goetsch[1], T. A. Gipson[1], T. Sahlu[1], and J. Burke[2]
Institutions:	[1]Langston University, and [2]USDA ARS Dale Bumpers Small Farms Research Center
Objectives:	Develop a repeatable method of testing effectiveness of the various means of cattle fence modifications with electric fence for goat containment

Title:	Sustainable Small Ruminant Production Through Selection for Resistance to Internal Parasites
Type:	USDA 1890 Institution Capacity Building - Integrated Extension and Research
Project Number:	OKLXSAHLU12
Period:	2012-2015
Investigators:	T. Sahlu[1], A. L. Goetsch[1], T. A. Gipson[1], S. P. Hart[1], Z. Wang[1], J. M. Burke[2], R. Mateescu[3], and E. DeVuyst[3]
Institutions:	[1]Langston University, [2]USDA ARS Dale Bumpers Small Farms Research Center, and [3]Oklahoma State University
Objectives:	1) Determine early progress in selection of small ruminants for resistance to internal parasitism 'on-station' and 'on-farm' 2) Characterize changes performance due to selection; develop and implement a new second generation central sire performance test for small ruminants at Langston University 3) Develop early-life genetic indicators of resistance and assess changes in physiological conditions affected by selection 4) Evaluate economic and management considerations of whole herd/flock selection; disseminate potential benefits of selection and associated economic and management considerations for adoption by small ruminant producers

Title:	Handbook for Livestock Research on Smallholder Farms in Developing Countries
Type:	USDA Scientific Cooperation Research Program
Period:	2012-2014
Investigators:	A. L. Goetsch[1], T. A. Gipson[1], R. C. Merkel[1], G. Abebe[2], A. Patra[3], D. Zhou[4], K. Al-Qudah[5], M. Huerta-Bravo[6], T. Sahlu[1], A. Degen[7], W. Getz[8], and Y. Tsukahara[1,9]
Institutions:	[1]Langston University, [2]Hawassa University, [3]West Bengal University and Animal and Fishery Sciences, [4]Northeast Institute of Geography and Agroecology, [5]Jordan University of Science and Technology, [6]Universidad Autónoma Chapingo, [7]Ben-Gurion University of the Negev, [8]Fort Valley State University, and [9]Kyoto University
Objectives:	A handbook for livestock research on smallholder farms in developing countries will be developed. Emphasis will be given to experimental design and data analysis. Input will be received from experts in different areas of the world (i.e., Ethiopia, India, China, Jordan, and Mexico), including regional cultural and social considerations.

Title:	Genomics of Resilience in Sheep to Climatic Stressors
Type:	USDA 1890 Institution Capacity Building
Project Number:	OKLXGOETSCH13
Period:	2013-2016
Investigators:	A. L. Goetsch[1], T. A. Gipson[1], R. Mateescu[2], S. Zeng[1], R. Puchala[1], M. Rolf[2], T. Sahlu[1], and P. Oltenacu[2]
Institutions:	[1]Langston University and [2]Oklahoma State University
Objectives:	1) Gain a better understanding of the genetic basis of adaptation in sheep to change in climate 2) Through a landscape genomics phase, document that some allele frequencies of otherwise genetically similar populations vary as a function of environmental climatic conditions 3) Evaluate traits expected to be important for resilience to climatic stressors under identical conditions with sheep of four breeds randomly selected from four different locations with varied environmental conditions 4) In a genome-wide association phase, ascertain if these resilience traits are genetically based and heritable 5) Compare and rank genomic breeding values for these resilience traits of oldest sheep of each location and bred to elucidate how different environmental climatic conditions affect the importance of these traits to fitness 6) Investigate change in the mean value of each resilience trait along environmental gradients, possibly consistent with climatic variation

2013/2014 Experiments Active

Title:	Sustainable small ruminant production through selection for resistance to internal parasites – on-farm and on-station selection and use of a small ruminant central performance test in year 1
Experiment Numbers:	YT-13-02 and YT-13-03
Project Number:	OKLXSAHLU12
Investigators:	Y. Tsukahara, A. L. Goetsch, T. A. Gipson, S. P. Hart, L. J. Dawson, Z. Wang, R. Puchala, and T. Sahlu
Objectives:	General: Determine early progress in selection of small ruminants for resistance to internal parasitism 'on-farm' and 'on-station' in the southeast and south-central US; characterize 'on-farm' and 'on-station' performance due to selection of small ruminants for resistance to internal parasites; and develop and implement a new second generation central sire performance test for small ruminants, focusing on resistance to internal parasites, but also retaining attention to feed intake, average daily gain, and efficiency of feed utilization Specific: Develop and implement first year activities of the second generation central performance test including larval challenge, female selection 'on-farm' and 'on-station,' establishment of breeding groups, and the first year breeding.

Title:	Methods of estimating the grazing activity energy cost of goats
Experiment Number:	ME-13-04
Project Number:	OKLXSAHLU2012
Investigators:	M.-E. Brassard, R. Puchala, T. A Gipson, Y. Tsukahara, T. Sahlu, and A. L. Goetsch
Objectives:	Compare and determine advantages and disadvantages of different methods of estimating the grazing activity energy cost of goats.

Title:	Development of a model to evaluate methods of modifying cattle barb wire fence with electric fence strands for goat containment – effects of mixing different breeds of mature and growing meat goats on behavior
Experiment Number:	YT-13-05 and YT-13-10
Project Number:	OKLXGOETSCH10
Investigators:	Y. Tsukahara, A. L. Goetsch, T. A. Gipson, J. Hayes, R. Puchala, and T. Sahlu
Objectives:	Determine if maintaining Boer and Spanish goats (mature and growing) together or separately during adaptation and evaluation periods affects behavior when exposed to different electric fence strand additions to cattle barb wire fence for goat containment

Title:	A series of trials evaluating various aspects of mortality composting conducted by three students from the University of Puerto Rico – Mayagüez Experiment 1 - Effect of ambient temperature and time before measuring surface temperature on infrared temperature measurement of reinforcing bar Experiment 2 – Evaluating the accuracy of using RB and an infrared thermometer versus long-stemmed thermometers in working mortality compost piles Experiment 3 – Evaluating the use of trash barrels as a vessel to compost kid mortality
Experiment Number:	UPRM-13-06
Project Number:	OKLXSAHLU2012
Investigators:	R. C. Merkel, T. A. Gipson, M. Negron, A. Reyes, and E. Pacheco

Title:	Effects of forage quality on feedstuff associative effects in growing and yearling meat goats
Experiment Number:	AT-13-07
Project Number:	OKLXSAHLU2012
Investigators:	A. Tera, R. Puchala, T. A. Gipson, Y. Tsukahara, T. Sahlu, and A. L. Goetsch
Objectives:	Characterize negative associative effects in meat goats of different ages of a concentrate supplement as affected by quality of the basal forage diet

Title:	Effects of *Haemonchus contortus* infection on nutritional status and peripheral blood immune cells in goats
Experiment Number:	ZS-13-09
Project Number:	OKLXWANG10
Investigators:	Z. Sun, Z. Wang, A. L. Goetsch, R. Puchala, K. Tesfai, S. P. Hart, and T. Sahlu
Objectives:	Compare the nutritional status (free amino acids and minerals in plasma) and immune parameters in goats with different nematode burdens, as determined by fecal egg counts

Title:	Applied model for evaluating resilience of sheep and goats to a limited nutritional plane
Project Number:	OKLXGOETSCH2013
Experiment Number:	AG-13-11
Investigators:	A. L. Goetsch, R. Puchala, A. Tera, T. A. Gipson, Z. Wang, T. Sahlu, and L. J. Dawson
Objectives:	Establish an applied model for evaluating resilience of sheep and goats to a limited nutritional plane.

Title:	Applied model for evaluating resilience of sheep and goats to a restricted water availability
Project Number:	OKLXGOETSCH2013
Experiment Number:	MU-14-01
Investigators:	M. Urge, A. L. Goetsch, R. Puchala, I. Portugal, T. A. Gipson, Z. Wang, T. Sahlu, and L. J. Dawson
Objectives:	Establish an applied model for evaluating resilience of sheep and goats to restricted water availability

Title:	Investigation of efficacy of Rumatel and copper oxide wire particles for control of anthelmintic resistant worms
Project Number:	OKLXSAHLU12
Experiment Number:	SH-14-03
Investigators:	S. P. Hart, T. A. Gipson, Y. Tsukahara, A. L. Goetsch, Z. Wang, T. Sahlu, and Y. Guo
Objectives:	1) Investigate if feeding Rumatel for an extended period is an essential component of a protocol of removing highly resistant worms from goats 2) Investigate the potential of copper oxide wire particles for component of a protocol to remove highly resistant worms from goats

Title:	Sustainable small ruminant production through selection for resistance to internal parasites – on-farm and on-station selection and use of a small ruminant central performance test in year 1
Experiment Numbers:	YT-14-04
Project Number:	OKLXSAHLU12
Investigators:	Y. Tsukahara, A. L. Goetsch, T. A. Gipson, S. P. Hart, L. J. Dawson, Z. Wang, R. Puchala, and T. Sahlu
Objectives:	General: Determine early progress in selection of small ruminants for resistance to internal parasitism 'on-farm' and 'on-station' in the southeast and south-central US; characterize 'on-farm' and 'on-station' performance due to selection of small ruminants for resistance to internal parasites; and develop and implement a new second generation central sire performance test for small ruminants, focusing on resistance to internal parasites, but also retaining attention to feed intake, average daily gain, and efficiency of feed utilization Specific: Specific objectives are to determine phenotypic diversity of resistance to internal parasitism, such as through FEC, FAMACHA score, and immunoglobulin concentrations in serum and growth performance among the resistant groups for each flock/herd established last year, in addition to implementation of the second generation central performance test including larval challenge, female selection 'on-farm' and 'on-station,' establishment of breeding groups, and the first and second year breedings

Title:	Evaluating the use of trash barrels as a vessel to compost kid mortality
Experiment Number:	RM-14-05
Project Number:	OKLXSAHLU2012
Investigators:	R. C. Merkel and T. A. Gipson

Title:	Effects of restricted periods of diet access on production by lactating dairy goats
Project Number:	OKLXSAHLU2012
Experiment Number:	NS-14-06
Investigators:	N. C. D. Silva, T. A. Gipson, R. Puchala, T. Sahlu, I. Portugal, A. Manley, E. Loetz, Y. Tsukahara, L. J. Dawson, and A. L. Goetsch
Objectives:	Determine effects of different types of restricted feed access on feed intake, milk yield and composition, efficiency of feed utilization, and feeding behavior of lactating Alpine dairy goats

Abstracts

2014 National Meetings of the American Society of Animal Science (Journal of Animal Science, Volume 90 ESupplement 2; the American Society of Animal Science has copyright ownership and the Journal of Animal Science is the source of this information). July, 2014. Kansas City, Missouri

GIS hot-spot analysis of pasture utilization of two separate herds of goats over time

T. A. Gipson[1], S.P. Hart[1], and R. Heinemann[2]

[1]American Institute for Goat Research, Langston University, Langston, OK
[2]Kiamichi Forestry Research Station, Oklahoma State University, Idabel, OK

An understanding of pasture landscapes that promotes or hinders efficient utilization is essential for proper management. The objective of this study was to characterize pasture utilization of two separate herds of goats utilizing the same pasture in different years. The study area was a 14.1-ha pasture of predominantly fescue, bermudagrass, panicums, bahia grass, and broomsedge bluestem but was reverting to a wooded area containing predominately pecan, elm, and honey locust sapling-size trees. In year one (Y1), the study area was stocked with 36 Spanish goats, of which 10 were fitted with GPS collars and in year two (Y2), the study area was stocked with 58 Spanish goats, of which 19 goats were fitted with GPS collars. Different goats were used in Y1 and Y2. For the first 2 wk of pasture introduction, goats wore the collars, which recorded a fix every 5 min. An average nearest neighbor analysis yielded a z score of -150.2 ($P < 0.01$) for Y1 and -150.1 ($P < 0.01$) for Y2, indicating highly clustered events for both years. A GIS point-in-polygon (PiP) analysis was conducted for each year using the same grid (1,792 10 × 10 m squares) for each year and with unique grid identifiers. Moran's I, a measure of spatial autocorrelation, indicated a peak at 30 m and that value was used in the hot-spot (Getis-Ord Gi* statistic) analysis conducted on the resulting PiP. Based upon the resulting z-scores from the hot-spot analysis, each square was classified as very low (VL), low (L), moderate (M), high (H), and very high (VH) usage. Y1 had greater ($\chi^2 = 13.89$, $P < 0.01$) VL and lower VH squares (82% and 1%, respectively) compared with Y2 (80% and 3%, respectively). Hot-spot analysis revealed two areas of H and VH usage for both years. One of the areas was a small grove of trees that had almost a 100% overlay for both years. The degree of similarity in pasture usage was high as indicated by a Spearman's rank correlation coefficient (0.76; $P < 0.01$) of the square z-scores for Y1 and Y2. Even though the two herds of goats never interacted and were separated by time, their pasture utilization was strikingly similar. Further work is needed to investigate the physical features of the pasture to understand the causes behind this similarity.

Effects of mixing different breeds to evaluate electric fence strand additions to barb wire fence to contain meat goats: mature females

Y. Tsukahara, T. A. Gipson, J. Hayes, R. Puchala, M.–E. Brassard, T. Sahlu, and A. L Goetsch

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Eighty Boer (B, 3.9 ± 0.17 yr and 56.3 ± 1.11 kg) and 80 Spanish (S) does (3.5 ± 0.18 yr and 37.6 ± 0.52 kg) were used to evaluate effects of method of grouping, separate (SEP) and mixed (MIX), on behavior (e.g., pen exit and shock) when exposed to barb wire fence with different electric strand additions. Five 2.4 × 3.7 m evaluation pens had 1 side of barb wire strands at 30, 56, 81, 107, and 132 cm from the ground. Fence treatments (FT) were electrified strands (6 kV) at 15 and 43 (LH), 15 and 23 (LM), 15 (L), 23 (M), and 43 cm (H). For adaptation, does were exposed in evaluation pens to no electric strands (NES), M at 0 kV, M at 0 kV, M at 4 kV, and NES in wk 1, 2, 3, 4, and 5, respectively. Then does were divided into 2 sets per grouping (2 B-SEP, 2 S-SEP, 2 B-MIX, and 2 S-MIX), each consisting of 5 pens of 4 does for 1-h exposure to FT while observing behavior visually and with video surveillance. Data were analyzed with the GLIMMIX procedure of SAS. There were significant main effects of grouping and FT and interactions ($P < 0.01$) between grouping and FT in the percentage of does exiting pens (0.0, 50.0, 50.0, 87.5, and 75.0% with B-MIX, 0.0, 12.5, 12.5, 50.0, and 62.5% with B-SEP, 25.0, 87.5, 100.0, 100.0, and 100.0% with S-MIX, and 75.0, 100.0, 62.5, 100.0, and 62.5% with S-SEP for LH, LM, H, M, and L, respectively; SEM = 14.28) and exiting without shock (0.0, 25.0, 25.0, 75.0, and 62.5% with B-MIX, 0.0, 0.0, 0.0, 12.5, and 37.5% with B-SEP, 12.5, 75.0, 62.5, 75.0, and 87.5% with S-MIX, 62.5, 100.0, 37.5, 75.0, and 62.5% with S-SEP, respectively; SEM = 14.91). That is, MIX decreased exit for S with LH and had no effect with B, whereas MIX increased exit by B with LM and H. Similarly, MIX increased exit without shock for B with M and decreased values for S with LH. In conclusion, presence of one breed of mature meat goats can affect behavior of another when evaluating effectiveness of various electric strand additions to barb wire fence, commonly used with cattle, for goat containment.

Effects of mixing different breeds to evaluate electric fence strand additions to barb wire fence to contain meat goats: growing kids

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A total of 159 kids were used, consisting of 38 Boer (B) wethers (6.3 ± 0.06 mo of age and 22.1 ± 0.95 kg BW initially), 41 B doelings (6.3 ± 0.06 mo and 21.4 ± 0.52 kg), 40 Spanish (S) wethers (6.7 ± 0.05 mo and 17.8 ± 0.53 kg), and 40 S doelings (6.8 ± 0.05 mo and 18.4 ± 0.46 kg), to evaluate effects of grouping, separate (SEP) and mixed (MIX), on behavior (e.g., pen exit and shock) when exposed to barb wire fence with different electric strand additions. Five 2.4 × 3.7 m evaluation pens had 1 side of barb wire strands at 30, 56, 81, 107, and 132 cm from the ground. Fence treatments (FT) were electrified strands (6 kV) at 15 and 43 (LH), 15 and 23 (LM), 15 (L), 23 (M), and 43 cm (H). For adaptation, kids were exposed in evaluation pens to no electric strands (NES), NES, LH at 0 kV, LH at 6kV, and NES in wk 1, 2, 3, 4, and 5, respectively. Then kids were divided into 2 sets per grouping (B-SEP, S-SEP, B-MIX, and S-MIX), with each set consisting 5 pens of 4 or 3 animals for 1-h exposure to FT while observing behavior visually and with video surveillance. There were no main effects of grouping. Fence treatment affected ($P < 0.01$) the percentage of animals receiving a shock (59.4, 44.5, 34.4, 22.8, and 6.2%; SE = 8.53), exiting with shock (37.5, 35.8, 31.3, 19.6, and 3.1%; SE = 7.63), and exiting without shock (0.0, 14.9, 50.0, 67.7, and 76.3% for LH, LM, L, M, H, respectively; SE = 7.56). There was an interaction ($P = 0.01$) between FT and grouping in pen exit (50.0, 25.0, 75.0, 85.7, and 42.9% with B-MIX, 12.5, 77.8, 87.5, 75.0, and 100% with B-SEP, 62.5, 62.5, 75.0, 87.5, and 75.0% with S-MIX, and 25.0, 37.5, 87.5, 100.0, and 100.0% with S-SEP for LH, LM, L, M, and H, respectively; SE = 14.83). In conclusion, these results do not provide clear evidence supporting notable effect of method of grouping growing meat goat kids for evaluating effectiveness of various electric strand additions to barb wire fence for goat containment, indicating appropriateness of either method.

Handbook for livestock research on smallholder farms in developing countries

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Resources for on-station livestock research in many developing countries are limited, and it is common for researchers to have little direct interaction with smallholders. On-farm research offers considerable attributes, which include attention to most significant production constraints, opportunities for meaningful studies, and greater adoption by smallholders of advantageous technologies. However, few researchers perform on-farm livestock research, at least partially because of inadequate training and knowledge of the design and conduct of on-farm experiments, statistical analyses and interpretation of resultant data, and preparation of reports suitable for peer-reviewed journals. Thus, a publication has been developed as a resource for training in methods of applied livestock research, with special attention to treatments, design, implementation, analysis, interpretation, and peer-reviewed articles. The target audience is junior to mid-level professionals (e.g., MSc) and graduate students in developing countries. In addition to US participants in the publication project, there are foreign collaborators and evaluators from Ethiopia, India, China, Jordan, Mexico, Israel, and Japan. Major sections of the publication include: introduction; on-station vs. on-farm research; topic identification; protocols; experimental design; treatment considerations; experiment implementation; statistical analyses; dissemination with an emphasis on preparation, review, and revision of scientific manuscripts; and literature cited. Furthermore, a key component is the design and analysis of numerous example study scenarios, such as: farmer research groups – missing data, nature of the data; individual smallholder households – household animals on one treatment, household animals on each treatment, missing data and household animals on one vs. each treatment, households with subplots; group or village as fixed vs. random; studies in different seasons or years; year-round performance monitoring – continuous and categorical variables; and crossovers, switchbacks, and Latin squares. There are also comparisons of P values from different analyses (e.g., SAS® GLM and MIXED and GenStat®). Appendices contain the relevant statistical analysis statements and inputs, results, and simulated data sets. Workshops based on the publication were held during 2013 and 2014 in Kenya, Ethiopia, China (two sites), Jordan, Malawi, Mexico, and India (two sites) to create awareness of the resource, train junior researchers, and receive feedback for publication enhancement, with well over 200 attendees. After external peer-review, in the fall of 2014 hardcopies will be distributed and the publication made available free on the Institute's website (www2.luresext.edu). The project was supported by the USDA Foreign Agricultural Service (grant/agreement number: 58-3148-2-175).

Behavior of Boer goat wethers grazing high quality forage and effects of two methods of determining energy used for activity

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Ten yearling Boer goat wethers (44.8 ± 0.95 kg) consuming fresh Sudangrass ad libitum while grazing a 0.8-ha pasture or confined in nearby 1.2 × 1.2 m pens were used in a crossover experiment. Heat energy (HE) was estimated from heart rate (HR) measured over 24 h in 5-min intervals and the ratio of HE to HR previously determined for each animal with a stationary calorimetry system for 24 h while consuming a moderate quality grass hay. A GPS collar and leg activity monitor were used when HR was measured to classify grazing activities into resting-lying (L), resting-standing (S), grazing (G), and walking (W). Behavior in confinement was assessed with the leg activity monitor as L or S. The grazing activity method (GAM) of estimating the activity energy cost of grazing (GAEC) was based on time spent in the different activities multiplied by their corresponding HE, whereas the confinement method (COM) entailed subtracting total HE while confined from that when grazing. For goats while grazing, there were differences among activities ($P < 0.01$) in time spent during the day (33.8, 53.9, 11.4, and 0.9%; SE = 2.44), HE per unit time (707, 598, 674, and 707 kJ/kg $BW^{0.75}$ on a daily basis; SE = 23.5), and daily HE attributable to each activity (241, 322, 75, and 6 kJ/kg $BW^{0.75}$ for G, L, S, and W, respectively; SE = 17.9). Total daily HE (642 and 482 kJ/kg $BW^{0.75}$; SE = 17.2) and HE while lying on a daily basis (598 and 450 kJ/kg $BW^{0.75}$; SE = 18.1) were greater for grazing vs. confinement ($P < 0.01$). The daily GAEC was considerably greater ($P < 0.01$) for COM vs. GAM expressed in kJ/kg $BW^{0.75}$ (165 and 46; SE = 14.0) and relative to HE when confined for COM and of the L HE on a daily basis for GAM (35 and 8%; SE = 3.5). In conclusion, method of estimating the GAEC can have substantial impact. Greater L HE per unit time for grazing than for confinement may contribute to lower GAEC for GAM vs. COM, although factors such as dietary and environmental conditions will influence accuracy of COM.

Effects of breed of hair sheep ram lambs on performance in a centralized test including artificial infection with *Haemonchus contortus*

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Twelve Dorper (D; 4.5 ± 0.44 mo, 31.9 ± 1.75 kg), 18 Katahdin (K; 3.8 mo, 24.3 ± 0.76 kg), and 12 St. Croix (C; 4.5 ± 0.17 mo, 19.7 ± 0.99 kg) ram lambs were used in the first year of a centralized test for growth performance and response to artificial infection with *Haemonchus contortus*. Rams were randomly selected from 3 commercial farms in Missouri and Oklahoma. The confinement test at Langston University entailed an adjustment period of 2 wk followed by 8 wk of data collection. Breeds were housed separately in adjacent pens with automated feeders allowing free-choice access to a 15% CP (DM) and 50% concentrate pelletized diet. During adaptation, anthelmintic treatment resulted in low fecal egg count (FEC; < 550/g), after which 10,000 infective larvae were administrated orally. Packed cell volume (PCV) was measured weekly and FEC was determined 4 times in wk 6-8. For analysis, initial BW and FEC were covariates, and the logarithmic transformation $\ln(x + 2{,}000)$ was used for mean FEC (MFEC). Variability in MFEC and mean PCV (MPCV) was homogenous among breeds. Breed affected ($P \leq 0.01$) DMI (2.5, 2.2, and 1.9 kg; SEM = 0.10), MFEC (3,431, 1,273, and 1,241 eggs/g, original scale; SEM = 90.7), and MPCV (29.1, 29.7, and 32.9% for D, K, and C, respectively; SEM = 0.68). Residual feed intake, ADG, and ADG:DMI were similar ($P > 0.05$) among breeds. Rams were categorized into 3 groups within breeds based primarily on MFEC and MPCV (High, Medium, and Low resistance) using the cubic clustering criterion of SAS, which resulted in unbalanced numbers in the groups (5, 5, and 2 for D, 12, 5, and 1 for K, and 8, 1, and 3 for C, respectively). Group means were similar ($P > 0.05$) in ADG, DMI, and RFI but varied ($P < 0.05$) in MFEC (627, 2,137, and 3,302 egg/g; SEM = 109.7) and MPCV (32.3, 30.2, and 29.2% for High, Medium, and Low, respectively; SEM = 0.72). In conclusion, based on MFEC in a standardized environment after an artificial challenge with *H. contortus* larvae, D appeared less resistant than C or K. However, there was sufficient variability in MFEC and MPCV for assignment to different classes that could be used in a breeding program to enhance flock resistance.

A simple method to estimate feed required for maintenance of small ruminants

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A simple means to estimate feed required for maintenance by Katahdin (K) sheep and Spanish (S) goats (initial BW = 30.6±0.40 and 21.8±0.27 kg, respectively; 8 mo old) by frequent BW measurement and adjustment of feed offered was evaluated. Ten K and S wethers in 1.05 × 0.55 m pens were fed grass hay (64.1% NDF, 10.4% CP, and 55.4% TDN; DM basis), initially at 58 and 55 g/kg $BW^{0.75}$ (air-dry basis; i.e., ME intake of 427 and 452 kJ/kg $BW^{0.75}$, respectively), at 0800 h for 5 wk. Three times weekly BW was measured at 1300 h in 50-g increments, and hay fed was varied thereafter by 0-5% (i.e., ≤ 40 g/d) to maintain BW. Breed (732 and 538 g for K and S, respectively; SE=11.5) and wk (625, 653, 632, 623, and 641 g for wk 1, 2, 3, 4, and 5, respectively; SE=9.4) affected daily air-dry intake (ADI; $P<0.001$), although breed × wk did not ($P=0.508$). Variation among days in ADI differed between breeds in wk 2 (SD=4.68 and 14.5 g; $P=0.002$) and 5 (SD=64.6 and 31.1 g for K and S, respectively; $P=0.044$). Body weights were smoothed using LOWESS and fitted by a segmented polynomial with the middle segment constrained to a flat line. Regression coefficients of the first and third segments and the two join points were estimated using nonlinear regression. The average of the first and second join points was 16 and 28 d, respectively, indicating BW stability between these times. Also, ADI of each wether was regressed against ADG in 2- and 3-day periods based on unsmoothed BW in wk 2-5, 3-5, 2-3, 2-4, 3-4, and 4-5. The only weeks without an intercept different from 0 ($P>0.10$) were 2-5 and 2-4. Hence, the intercept of wk 2-4 regressions was used to determine feed required for maintenance, with values of 727 and 538 g ADI (SE=11.6), corresponding to a ME requirement for maintenance of 447 and 426 kJ/kg $BW^{0.75}$ for K and S, respectively. Variability was homogenous between breeds ($P=0.867$), although intercept SE averaged 6.0 and 12.9 g ADI for K and S, respectively. In conclusion, after 2 wk of adaptation, frequent weighing and change in offered feed for 2 wk may offer a relatively simple means of estimating maintenance feed needs of small ruminants.

Evaluating the accuracy of using reinforcing bar and an infrared thermometer versus long-stemmed thermometers in monitoring mortality compost pile temperature

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Two mortality compost piles were constructed using a mixture of goat mortality and butcher waste with ground hay as the carbon source to compare core temperature recorded by long-stemmed thermometers (LST) vs. an infra-red thermometer (IR) to read temperature of a reinforcing bar (RB) thrust into the pile. One LST was inserted into the core of each pile along with a 3 m length of 0.95 cm thick RB so that tips of both the RB and LST were in close proximity. For 30 d following pile construction, LST temperature was recorded daily between 1500 and 1600 h. Each RB was then withdrawn from the pile and the tip's temperature determined using an IR. Data were analyzed using repeated measures in a mixed model containing treatment (T = LST and RB), date as a covariate (D), and the interaction to test for heterogeneity of slope. Compost pile was a random effect. Date ($P < 0.001$) and T×D ($P < 0.001$) showed differences, whereas T was not significant ($P = 0.48$; 57.8 and 54.5°C for LST and RB, respectively, SE=3.04). Date was used as a covariate as temperature in working mortality compost piles will spike soon after pile formation and slowly decline. As an example, LST recorded a temperature of 64.6°C on d 3 of data collection but only 50.4°C on d 30. The T×D test recorded a slope estimate of -0.320 for LST and -0.018 for RB (probability of slope > 0 of $P < 0.001$ and $P = 0.75$ for LST and RB, respectively). These results suggest that RB can be used to monitor mortality compost pile temperature but is not accurate enough to model the normal decline in temperature over time. Temperature of RB may have differed from LST due to location upon reinsertion into the pile (cooler or hotter spot than LST tip) and alignment of IR on RB to record accurate RB temperature and not temperature of surrounding material. Using an IR with RB may be an acceptable method for monitoring mortality compost pile temperature and would be a cheaper alternative for producers composting multiple mortalities than to purchase LST for each pile. However, RB is not appropriate for use when precise temperature measurement is needed.

Effects of method of determining heat energy:heart rate of confined and grazing Boer goats

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Heat energy (HE) of 11 yearling Boer goat wethers (43.4±1.4 kg) consuming fresh Sudangrass ad libitum while confined in 1.2 × 1.2 m pens (C) or grazing a 0.8-ha pasture (G) was determined in a crossover from heart rate (HR) measured over 24 h and the ratio of HE to HR (HE:HR) estimated two ways. The BARN method involved a prior period in metabolism cages with head-boxes of an indirect calorimetry system measuring oxygen production and emission of carbon dioxide and methane for 24 h (i.e., 96 individual measurements) while consuming a moderate quality grass hay. The SPOT method entailed a portable face mask system measuring oxygen consumption and carbon dioxide production for 5 min while standing near grazing and confinement areas at 0800, 1200, 1600, and 2000 h, after 30 min of adaptation. With both methods, HR, HE, and HE relative to $BW^{0.75}$ (HEMBW) were greater ($P<0.01$) for G vs. C. There was no difference ($P>0.05$) between methods for C in HR (76.4 and 70.0 beats/min; SE=2.68), HE (8.4 and 7.9 MJ/d; SE=0.20), HEMBW (485 and 455 kJ/kg $BW^{0.75}$; SE=10.7), or HE:HR (6.420 and 6.573 kJ/kg $BW^{0.75}$ per heart beat for BARN and SPOT, respectively; SE=0.1939). For G, HR (100.9 and 92.5 beats/min; SE=2.35; $P <0.01$), HE (11.2 and 9.7 MJ/d; SE=0.38; $P<0.01$), HEMBW (646 and 566 kJ/kg $BW^{0.75}$; SE=17.4; $P<0.01$), and HE:HR (6.335 and 6.114 kJ/kg $BW^{0.75}$ per heart beat; SE=0.1540; $P=0.046$) were greater for BARN vs. SPOT ($P<0.01$). There was a treatment × time interaction ($P<0.01$) in HR, HE, and HEMBW with SPOT, as well as a trend ($P=0.100$) in HE:HR. In accordance with greater ($P<0.01$) HE at 1600 vs. 0800 and 1200 h (C; 7.5, 7.6, 8.2, and 7.9; G: G: 9.2, 8.9, 10.7, and 10.3 MJ/d at 0800, 1200, 1600, and 2000 h, respectively; SE=0.33), HE:HR tended to be greatest at that time (C: 6.390, 6.643, 6.847, and 6.375; G: 5.988, 5.795, 6.562, and 6.158 kJ/kg $BW^{0.75}$ per heart beat at 0800, 1200, 1600, and 2000 h, respectively; SE=0.2299). In conclusion, though HE:HR differed between methods, the relatively small magnitude (i.e., 4.7%) indicates that both could be used to estimate HE based on HR in grazing or confined settings; however, multiple measurements would be beneficial with SPOT to address potential differences among times of the day.

Summaries of Recent Journal Articles
(2013 and In Press)

Effects of stocking rate and physiological state of meat goats grazing grass/forb pastures on forage intake, selection, and digestion, grazing behavior, and performance

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Livestock Science 154:82-92. 2013

Effects of forage conditions with different stocking rates on performance and grazing behavior of goats could vary with animal physiological state, as influencing nutrient demand and usage. Therefore, Boer goat does nursing two kids (D; 1 month after kidding), growing wethers (G; 4 month initial age), and yearling wethers (Y; 14 month initial age) grazed 0.4-ha grass/forb pastures, with one animal per type in each pasture (four per stocking rate; SR) for a low SR and two for the high SR. The experiment started in late spring and was 114 days in length, with four periods of 33, 28, 30, and 23 days (P1, P2, P3, and P4, respectively). Data were analyzed by mixed models with a repeated measure of period. Forage mass was 2517, 2433, 2506, and 2452 kg/ha for the low SR and 2680, 1932, 1595, and 1393 kg/ha for the high SR in P1, P2, P3, and P4, respectively (SE=335.1). Botanical composition of the diet determined from n-alkane concentration in simulated grazed forage samples and feces was similar among animal types (P>0.10). Likewise, chemical composition of forage samples did not differ between animal types (P>0.10), with average dietary levels of 11% CP and 53% NDF. Digestibility of OM, determined from the concentration of the n-alkane hentriacontane (C31) in forage samples and feces, was greatest for growing wethers (P<0.05; 63.5, 67.2, and 62.0% for D, G, and Y, respectively) and greater (P<0.05) for the low than high SR (66.1 vs. 62.3%). Intake of ME estimated from digestibility and fecal output was 1015, 855, and 692 kJ/kg $BW^{0.75}$ for D, G, and Y, respectively (SE=57.4) and greater for the low than high SR in P1 (1204, 789, 682, and 445 for high SR and 1732, 767, 683, and 531 kJ/kg $BW^{0.75}$ for low SR in P1, P2, P3, and P4, respectively; SE=93.5). There was an interaction (P<0.05) between animal type and period in ADG (13, -12, -44, -8, 83, 25, -28, 73, 127, 51, -43, and -7 g; SE=21.5) and time spent grazing (7.5, 5.3, 7.4, 8.6, 78.6, 5.6, 10.0, 9.1, 4.8, 5.9, 8.4, and 9.5 h/d for D-P1, D-P2, D-P3, D-P4, G-P1, G-P2, G-P3, G-P4, Y-P1, Y-P2, Y-P3, and Y-P4, respectively; SE=0.88). Rate of ME intake was greater (P<0.05) for D vs. G and Y (49.5, 21.9, and 33.9 kJ/min for D, G, and Y, respectively; SE=5.68) and differed (P<0.05) among periods (57.5, 45.3, 24.8, and 12.9 kJ/min in P1, P2, P3, and P4, respectively; SE=5.17). In conclusion, with this forage of moderate nutritive value, levels of forage mass above 1400 kg/ha would not be of benefit to performance of meat goats regardless of physiological state with different nutrient requirements.

Effects of level and length of supplementation on leather characteristics of yearling Boer and Spanish wethers

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Journal of the American Leather Chemists Association 108:139-145. 2013

Thirty Boer × Spanish and 29 Spanish wethers were used in a trial to determine the effects of goat breed, supplementation level, and age on the mechanical properties of chrome-tanned and glutaraldehyde-tanned goat skin. Six Boer and five Spanish wethers were harvested at the beginning of the trial with the remaining animals assigned to four groups, having equal breed numbers, receiving either a high or low supplement amount daily. Two groups were harvested after 110 days and the remaining groups after an additional 108 days. Skins were removed by hand, split down the dorsal midline, and salted. The left half of each skin was chrome-tanned and the right half was tanned using a glutaraldehyde based tannage. Tanning goat skins using chromium resulted in stronger leather than that produced using glutaraldehyde. Increasing age led to decreased % elongation and increased leather stiffness. The effects of supplementation level were of lesser importance than tannage or age upon the strength characteristics of leather produced. Boer goat leather was thicker than Spanish goat leather; although tensile strength was unaffected by breed. Goat skins were not shaved to an equal thickness during the tanning process, perhaps leading to some of the breed differences seen, notably in % elongation and fracture energy. Therefore, further research is needed to evaluate characteristics of shaved skins.

Effects of preliminary and washout treatments, experimental design, and meat goat breed in a model to evaluate methods of modifying cattle barb wire fence with electric fence strands for goat containment

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Growing meat goats of 4 types (Boer (B) and Spanish (S) of both wethers and doelings) were used to evaluate conditions for a method of testing efficacy of electric fence strand additions to barbed wire fence used for cattle to also contain goats. Animals were allocated to 8 sets, with each set consisting of 5 groups. There was 1 goat of each of the 4 types in a group. One side of 5 2.4 × 3.7 m evaluation pens consisted of barbed wire strands at 30, 56, 81, 107, and 132 cm from the ground. Evaluation pens were adjacent to a pasture with abundant vegetation. Fence treatments (FT) were electrified strands (6 kV) at 15 and 43 (LH), 15 and 23 (LM), 15 (L), 23 (M), and 43 cm (H). For adaptation, there were 4 weekly and sequential exposures to evaluation pens: wk 1 - no electric strands; wk 2 - 1 strand at 0 kV; wk 3 - LH; and wk 4 - LH. There were 6 periods for measurements, each separated by 1 wk. During the 1-wk intervals while on pasture, sets were exposed to 1 interval treatment without and another with 2 electric strands (6 kV) positioned next to supplement troughs, to potentially affect familiarity with electrified strands and influence subsequent behavior. All animal sets were used for measurements in period 1 in a completely randomized design (CRD). Four sets were also used in 4 weekly subsequent measurement periods for a 5 × 5 Latin squares (LS). All animal sets were exposed to the same FT in period 6 as in period 1. Behavior in evaluation pens was observed for 1 h with a video surveillance system in the 6 periods. There were no effects of gender and few and minor effects of preliminary and interval treatments. The percentage of animals that exited evaluation pens differed ($P < 0.05$) among FT with the CRD approach in period 1 (25, 47, 38, 66, and 84%; SEM = 8.0) and with repeated measures in periods 1 and 6 (6, 22, 22, 63, and 81% for LH, LM, L, H, and M, respectively; SEM = 4.9) and between breeds in periods 1 (34 and 70%) and 1 and 6 (28 and 50% for B and S, respectively). For the LS approach, FT affected exit (31, 23, 16, 35, and 30%; SEM = 5.3), and breeds differed ($P < 0.05$) as well (12 and 43%). Exit decreased as period advanced (60, 35, 23, 10, and 8 % for 1, 2, 3, 4, and 5, respectively; SEM = 5.3). In conclusion, breed should be considered in the model being developed. A LS approach was not suitable, but a CRD experiment after these adaptation procedures appears promising.

Supplements of lactating meat goat does grazing grass/forb pastures

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Lactating Boer does grazing grass/forb pastures were used in a 16-wk study starting 22 days after birth. Treatments were no supplementation (CO), access to a 20% crude protein supplement block (SB), and placement in a supplement pasture with mimosa (*Albizia julibrissin*) trees for 6 h 1 day/wk (1X) or twice weekly for 3 h/day (2X). Available forage dry matter in non-supplement pastures ranged between 2423 and 3477 kg/ha. Treatment did not affect doe average daily gain (ADG), although kid ADG in the first 12 wk differed ($P < 0.05$) between type of supplement and frequency of supplement pasture access (121, 111, 120, and 134 g for CO, SB, 1X, and 2X, respectively). Lactating Spanish does were used in a 12-wk study starting 66 days after kidding. The same CO and SB treatments were employed, but access to supplement pastures was for 24 h 1 day/wk (1X) or 2 days for 6 h/day (2X). Forage dry matter ranged only from 750 to 1530 kg/ha; thus, 0.6 kg/day (as fed) per doe of grass hay was fed after 4 wk. Kid ADG in wk 1-8 was not affected by treatment. Doe ADG was affected by supplementation ($P < 0.05$) and supplement type ($P < 0.09$) (-44, -33, -23, and -12 g for CO, SB, 1X, and 2X, respectively). In conclusion, use of the SB was not beneficial, and infrequent access to supplement pastures had relatively small effects on ADG, perhaps because forage availability and nutritive value were not severely limiting.

Use of a web-based nutrient requirement calculation system to assess potential influences of various factors on nutrient needs of goats while grazing

A. L. Goetsch and T. A. Gipson

Professional Animal Scientist (In press). 2014

Many factors affect the nutrition of goats while grazing, and their influences can be assessed with an interactive web-based nutrient requirement calculation system to determine the quantity and composition of supplement required for desired levels of performance. Among areas identified as being of special importance to goats in grazing settings are the activity energy cost and lack of methods to predict forage intake. Relatedly, goats can consume diets very different in nutritive value than the average of vegetation available, and there been insufficient research to accurately predict the quality of the actual diet ingested. Equations to project associative effects between feedstuffs have been proposed but not evaluated. Previous nutritional plane can have a substantial effect on energy requirements, with greater fluctuations in the nutritional plane and maintenance energy need during the year for grazing relative to confinement settings. Likewise, based on some findings with sheep, internal parasitism influences both energy and protein requirements, the impact of which may increase as the problem of anthelmintic resistance worsens. There are many plant secondary metabolites consumed by goats in varying quantities that can affect feed intake, digestion, metabolism, and other physiological conditions, with the nature of changes influencing nutritional conditions most limiting to performance. In summary, special attention should be given in future research to conditions affecting nutrition that differ between grazing and confined goats, although factors important to both grazing and confined animals also should be considered.

Effects of levels of Bore goats and Dorper sheep on feed intake, digestibility, growth, and slaughter characteristics in the central highlands of Ethiopia

M. Tilahun, K. Kefelegn, G. Abebe, and A. L. Goetsch

Tropical Animal Health and Production DOI 10.1007/s11250-013-0532-y. 2014

Objectives of this experiment were to compare feed intake, digestibility, growth performance, and slaughter characteristics of local genotypes of small ruminants in the central highlands of Ethiopia with Boer goat (B) and Dorper sheep (D) blood levels of 0%, 25%, and 50%. Male goats (27; 6-9 months of age) and sheep (27; 3-5 months) were housed individually in confinement during 90-day experiments. Grass hay (6% crude protein and 64% or 67% neutral detergent fiber) was consumed *ad libitum* together with concentrate (46% noug seed cake, 28% wheat bran, 24% sorghum grain, and 2% salt) supplemented at 2% of their body weight. Initial body weight was 18.1, 20.8, and 24.9 kg for Local, 25% B, and 50% B, respectively, and 14.8, 20.3, and 17.9 kg for Local, 25% D, and 50% D, respectively. Total dry matter (DM) intake by goats ranked Local < 25% B < 50% B, and hay intake was greatest for 50% B. Intake of hay and total DM by sheep ranked Local < 50% D < 25% D. Average daily gain by goats was greatest for 50% B and by sheep was least for Local. Empty body weight of goats at slaughter and carcass weights ranked Local < 25% B < 50% B. Body and carcass weights of sheep were lowest for Local. In addition to the difference between 25% B and Local goats, these results clearly show potential for greater meat yield with the 50% than 25% level of B. The findings also depict considerable opportunity to increase meat production by crossbreeding with D, although greater benefit was not realized with 50% than 25% D.

Effects of creep grazing and stocking rate on forage selection and nutritive value of the diet of meat goat does and kids on grass/forb pastures

M. D. Yiakoulaki, A. L. Goetsch, G. D. Detweiler, and T. Sahlu

Small Ruminant Research (In press). 2014

The effects of creep grazing and stocking rate (SR) on forage selection and nutritive value of the diet selected by ~~of~~ Spanish does with Boer × Spanish kids and Boer × Spanish does with 3/4 Boer–1/4 Spanish kids were determined using grass/forb pastures. There were four treatments, each replicated, with three stocking rate (SR) treatments and one treatment involving creep grazing. Goats of both types were equally represented in all treatments. Each group of does and kids was allocated to 0.4 ha pastures divided into four paddocks that were rotationally grazed in two cycles over a total of 76 days. The three SR were 4 does plus 8 kids (L), 6 does plus 12 kids (M), and 8 does plus 16 kids (H) per 0.4 ha pasture. The creep grazing treatment (C) was at the high SR relative to the pasture area common to the does and kids. In this treatment, however, the kids had access to an additional area of a similar 0.4 ha pasture sub-divided into four paddocks containing the leguminous tree mimosa (*Albizia julibrissin* Durazz) planted in rows. A direct observation and simulation method was used to characterize the diet selected by does and kids and obtain representative samples. These samples were evaluated in terms of their CP, NDF, ADF, and ADL concentrations and in vitro true DM digestibility (IVTDMD). There were no significant effects ($P > 0.10$) of stocking rate on botanical composition of the diet selected or its nutritive value. Does and kids selected diets of similar botanical composition and nutritive value for the three treatments without a creep area. When kids were in a creep grazing area, 52.8% of their diet consisted of mimosa leaves leading to an improvement in the overall nutritional value of the diet relative to times when in the base grass/forb pasture (CP 21.9 vs. 19.8%, NDF 34.1 vs. 53.8%, ADF 21.4 vs. 27.5%, and IVTDMD 85.7 vs.79.9%). It was concluded that stocking rate had no impact on diet selection and the nutritive value of the diet of does or kids when grazing forage of low to medium quality. Kids with access to creep areas including mimosa trees, however, preferentially consumed mimosa leaves, thus improving the nutritive value of their diet.

Visiting Scholars, Graduate Student, and Undergraduate Student Research Intern (2013)

Dr. Zewei Sun
Visiting Scholar
Native of China
Research Project: Effects of Selected Nutritional Components on Immunity to Haemonchus in Goats
Experiment: ZS-13-09

Dr. Yong-qing Guo
Visiting Scholar
Native of China
Research Project: Effects of Selected Nutritional Components on Immunity to Haemonchus in Goats

Ms. Erin Parkinson
Undergraduate Student Research Intern
Native of Washington
Research Project: Effects of Selected Nutritional Components on Immunity to Haemonchus in Goats

Ms. Amanda Manley
Graduate Student
Research Project: Boer Goat Selection for Residual Feed Intake

Dr. Yoko Tsukahara
Visiting Scholar
Native of Japan
Research Projects: Establishing a Langston University Testing Center for Electric Fence Modifications of Cattle Barb Wire Fence for Goat Containment; Sustainable Small Ruminant Production Through Selection for Resistance to Internal Parasites
Experiments: YT-13-02, YT-13-03, YT-13-05, YT-13-10, YT-14-03, YT-14-04

Ms. Marie Negron, Eva Pacheco, and Alexandra Reyes
Visiting Undergraduate Student Interns
Native of Puerto Rico
Research Project: Mortality Composting

Mr. Asrat Tera Dolebo
Native of Ethiopia
Research Project: Feedstuff Associative Effects
Experiment: AT-13-07

Ms. Marie-Eve Brassard
Graduate Student Research Intern
Research Project: Grazing Activity Energy Cost
Experiment: MB-13-04

Mr. Worede Zinabu Gebremariam
Ph.D. Student
Research Project: Sustainable Small Ruminant Production Through Selection for Resistance to Internal Parasites

Extension Overview

Dr. Terry A. Gipson
Goat Extension Leader

The year 2013 was a busy year for the Langston Goat Extension program. The goat extension specialists have answered innumerable producer requests for goat production and product information via the telephone, letters and e-mail, have given numerous presentations at several state, regional, national and international goat conferences for potential, novice and veteran goat producers, and have produced quarterly newsletters. They have also been busy with several major extension activities. These activities include the annual Goat Field Day, Langston Goat Dairy Herd Improvement (DHI) Program, grazing demonstrations, and various goat workshops on artificial insemination, tanning hides, and on internal parasite control.

Goat Field Day

In 2013, our annual Goat Field Day was held on Saturday, April 27, at the Langston University Goat Farm. That year's theme was Enhancing Goat Products. Featured speakers were Mr. Patrick Anglade and Drs. Ken McMillin, Jeffrey Gillespie, and Frank Pinkerton. Mr. Patrick Anglade is the owner/operator of Consultant of Formation en Fromagerie based in Pyrenees, France. Patrick holds a Master of Cheese Technology at the Milk Industry and Economy University of Rennes. Patrick is author of the reference book "La fromagerie à la ferme" [farmstead cheesemaking] and conducts workshops and training sessions on establishing an on-farm dairy processing facility that will comply with local and federal health guidelines. Patrick effectively guides producers through a maze of topics, including business plans, cheese ripening, production hazard analysis, troubleshooting manufacturing defects, and all other issues dealing with milk, yoghurt, lactic, soft and hard cow's, goat's and sheep's milk cheeses, and raw and pasteurized milk cheeses. Patrick has lead training sessions and/or consultations for organizations in France, Canada, Ireland, Italy, Spain, and the United States. Dr. Jeffrey Gillespie is the Martin D. Woodin Endowed Professor in the Louisiana State University Agricultural Center Department of Agricultural Economics and Agribusiness. Jeff conducts research on livestock and aquaculture production economics and farm management, including estimation of costs of production, adoption of technology, and farm efficiency. He teaches an undergraduate introduction to agricultural economics course and graduate courses on production economics and operations research. Jeff recently served as Editor of the Journal of Agricultural and Applied Economics and has published widely in both peer-reviewed agricultural economics journals and in the popular press. Awards at both the University and professional association levels have recognized his teaching and research contributions. Dr. Ken McMillin is the Mr. and Mrs. Herman E. McFatter Professor of Animal Science in the Louisiana State University Agricultural Center School of Animal Sciences and Department of Food Science. Ken conducts research in meat processing, packaging, food safety, and goat meat and instructs courses in meats, meat processing, contemporary issues in the animal sciences, and growth and development of meat animals. Ken speaks frequently to trade groups and professional organizations and is a contributor to the Goat Rancher Magazine. He also travels internationally on USDA and USAID projects, serves on the Meat Science Editorial Board, is a Professional Animal Scientist, and a Fellow in both American Meat Science Association and Institute of Food Technologists professional organizations. Dr. Frank Pinkerton, aka The Goat Man, started his goat career at the International Dairy Goat Research Center of Prairie View A&M University in 1978. In 1983, Frank relocated to Langston University to conduct extension work in dairy, Angora, and meat goats. Frank retired in 1993 to raise meat goats in east TX and do consulting work in goat management and marketing. During his 40+ year career, Frank has published numerous scientific articles and technical bulletins on dairy, Angora, and meat goats. Frank also conducted 13 international consultancies on livestock and goat

nutrition and 16 domestic consultancies on goat management and marketing, not to mention conducting 5 large-scale goat-grazing demonstrations for vegetative control in public forests and grasslands. Since March of 2005, Frank has written a monthly question-and-answer column for The Goat Rancher and also to share occasional articles on various facets of the industry..In the afternoon session, participants broke into small-group workshops. There were a total of eleven workshops; however, participants only had time enough to attend three. The afternoon workshops included:

- French Goat Cheeses - an overview of French cheesemaking with Mr. Patrick Anglade.
- Carcass Improvement - what every producer should know about carcass quality, consumer preferences, and tips to improve this valuable trait with Drs. Ken McMillin and Frank Pinkerton.
- Internal Parasite Control - sustainable internal parasite control program with Dr. Dave Sparks.
- Basic Herd Health - herd health program including vaccinations, injection sites, and approved drugs with Dr. Lionel Dawson.
- The Art of Drawing and Illustrating - basics of how to draw any type of goat with Mr. Ken Williams.
- Nutrition for Health and Production - calculations of feed intake and of energy and protein requirements with Dr. Steve Hart.
- Goat Reproduction - basics of goat reproduction and techniques and equipment for artificial insemination in goats with Dr. Erick Loetz.
- DHI Training - supervisor/tester training for dairy goat producers including scale certification with Ms. Eva Vasquez.
- Body Condition Scoring - practical application of body condition scoring and its use in herd management with Mr. Jerry Hayes.
- USDA Government Programs - overview of USDA Natural Resource Conservation Service's work with goats and its cost-sharing program with Mr. Dwight Guy.
- Mortality Composting - basic composting techniques and equipment for disposing of goat mortalities with Dr. Roger Merkel.
- Fun Tent Youth Activity: Ms. Sheila Stevenson hosted a full day of activities for youth ages 5-12 in the Fun Tent. This allowed the parents and older teens to enjoy the workshops knowing that their little ones are having fun in a safe environment. Last year, some activities included goat activities, pony rides, OKC ZooMobile, Oklahoma wood-turners, leather working, pot your own plant, OKC Science Museum, and many others.
- GPS Scavenger Hunt Youth Activity: Ms. Sheila Stevenson once again organized a ½-day GPS scavenger hunt on campus. Youth learned the basics of GPS and used a GPS unit to finds "hidden" objects.
- Fitting and Showing Youth Activity: In the afternoon, youth and interested adults were able to participate in a half-day clipping, fitting, and showing workshop conducted by Ms. Kay Garrett of the Oklahoma Meat Goat Association. Participants had the opportunity to have hands-on practice of clipping, fitting, and showing a goat.

Goat DHI Laboratory

The Langston Goat Dairy Herd Improvement (DHI) Program operates under the umbrella of the Texas DHIA. In February 1998, the Langston DHI program became the first DHI program to introduce forms and reports in goat terminology to dairy goat producers in the United States. A national Dairy Herd Improvement Association (DHIA) has been in existence for a number of years. However, until 1996 DHIA catered only to cow dairies. The Langston DHI program has been very popular with dairy goat producers and has grown significantly since its establishment in 1996. Goat producers are now able to get records for their animals that reflect accurate information with the correct language. Currently we are serving a 29 state-area that

includes a majority of the eastern states. Currently, we have 81 producer herds in these 29 states enrolled in the Langston Goat Dairy DHI Program. In 2013, the DHI laboratory processed more than 8,000 samples. Langston University continues to serve the very small-scale dairy goat producer. The average herds size on test with Langston University is 10 animals. This is significantly smaller than the herd size average for the five other processing centers.

For those interested in becoming a Langston goat DHI tester, training is available either in a formal classroom setting or through a 35-minute video tape (see additional information in the YouTube section). Every tester is required to attend the DHI training session or view the tape and take a test. Upon completion of the DHI training, the milk tester can start performing monthly herd tests.

Goat Newsletter

To date, the Goat Extension program published four issues of the 8-page Goat Newsletter in 2013. Interest in the newsletter has grown and we currently have over 2,400 subscribers to our free quarterly Goat Newsletter and the subscription list continues to increase every year. The Goat Newsletter is mailed to every state in the nation and to 10 countries overseas. Ninety-seven percent of the mailings go to American households. At least one newsletter is mailed to a household in every state in the nation. Fifty percent of the newsletters are mailed to Oklahoma households. An additional thirty percent of the newsletters are mailed to households to state adjacent to Oklahoma.

Artificial Insemination Workshop

The use of superior sires is imperative in improving the genetic composition of breeding stock. Artificial insemination has long been used in the dairy cattle industry and is a simple technology that goat producers can acquire. However, opportunities for goat producers to the necessary skills via formal and practical instruction are not widespread. Langston University has instituted a practical workshop for instruction in artificial insemination in goats. Producers are instructed in the anatomy and physiology of the female goat, estrus detection and handling and storage of semen. Producers participate in a hands-on insemination exercise. An understanding of the anatomy and physiology enable the producer to devise seasonal breeding plans and to troubleshoot problem breeders. An understanding of estrus detection enables the producer to effective time inseminations for favorable conditions for conception and to effectively utilize semen. An understanding of semen handling and storage enables the producer to safeguard semen supplies, which can be scarce and costly. The experience of actually inseminating a female goat enables the producer to practice the knowledge that they have gained. The acquisition of these inseminating skill will allow producers the use of genetically superior sires in their herds that they normally would not have access to. It also allows producers to save money by conducting the inseminating themselves instead of hiring an inseminator. In 2013, three AI workshops were held; two in September and October at the Langston University campus and one at Kansas State University. Forty-seven participants were trained.

Meat Goat Production Handbook

The first edition Meat Goat Production Handbook is sold-out and the revision of the second edition is underway. Even though Langston University has taken the lead in this revision project, this handbook is not the product of one person nor of a single university. Our collaborating project institutions/organizations, which include Alcorn State University, American Boer Goat Association, American Meat Goat Association, Florida A&M University, Fort Valley State University, Kentucky State University, Langston University, Prairie View A&M University, Southern University, Tennessee Goat Producers Association, Tennessee State University, Tuskegee University, United States Boer Goat Association, University of Arkansas Pine Bluff, and Virginia State University. Handbook contributing institutions/organizations include Allen Veterinary

Clinic, American Boer Goat Association, American Meat Goat Association, BIO-Genics, Ltd., Bountiful Farm, Cornell University, Fort Valley State University, Kentucky State University, Langston University, Law Office of Wheeler and Mueller, Louisiana State University, Louisiana State University AgCenter, NCAT / ATTRA National Sustainable Agriculture Information Service, North Carolina State University, Oklahoma State University, Texas A & M University, United States Boer Goat Association, and Virginia State University.

Controlling Internal Parasites Workshop

Internal parasites (Barberpole worm, *Haemonchus contortus*) is the leading cause of death in goats in the Southern US, accounting for as many deaths as the total of the next three leading causes of death in goats. Several factors contribute to the high mortality caused by internal parasites.

Goats which originated in dry areas where there was no internal parasite challenge have been brought to the humid South where there is great parasite challenge. Only a few animals have good genetic resistance against internal parasites. In addition, goats are forced to graze rather than browse which provides greater opportunity to consume infective larvae and especially so when animals overgraze. Producers are not familiar with monitoring animals for signs of parasitism and do not understand how animals get infected. In addition internal parasites have developed a high level of resistance to dewormers from the overuse of dewormers in goats. To address these concerns, Langston developed a parasite workshop to educate producers about internal parasites. It includes 3 hours of lecture on biology of the parasite, pasture management to avoid worms and monitoring parasite infection using the FAMACHA chart which assesses the degree of anemia. This is a cooperative effort with OSU Extension Veterinarian who addresses dewormer resistance and correct use of dewormers. Producers get hands-on instruction in use of the FAMACHA card, taking fecal samples and running fecal egg counts.

YouTube Channel

Created in 2005,YouTube is a video-sharing website on which users can upload, view and share videos. YouTube now has over 120 million videos, including movie clips, TV clips, and music videos, as well as amateur content such as video blogging and short original videos. The Goat Program at Langston University has created its own YouTube channel (https://www.youtube.com/user/taglu01) The following are the YouTube videos that are available and you can quickly access them on a mobile device by using the QR (2D barcode) to the right. Additional videos will be added to the channel in the future

Artificial Insemination (AI) in Goats (length 8:47)

This video describes the steps involved in artificial insemination in goats.

AI Kit (length 6:28)

This video describes the equipment needed for artificial insemination in goats.

Basic Hoof Care (length 10:48)

This video explains basic hoof care for goats.

Body Condition Scores in Goats (length 2:11)

This video describes how to evaluate body condition score in goats.

Buck Effect (length 1:53)

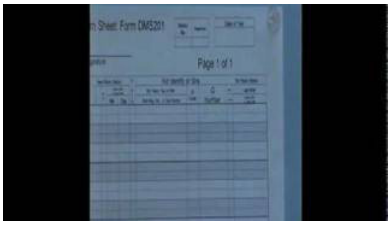
This video describes the buck effect and its use in estrus synchronization.

Estrous Synchronization in Goats (length 5:08)

This video explains estrous synchronization for artificial insemination in goats.

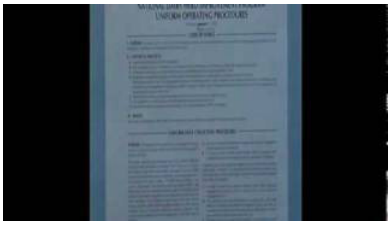
Langston DHI Tester Training - Part 1 (length 9:24)

This video describes how to conduct proper DHIA testing procedures for milk sampling.



Langston DHI Tester Training - Part 2 (length 9:48)

This video describes how to conduct proper DHIA testing procedures for milk sampling.



Langston DHI Tester Training - Part 3 (length 9:19)

This video describes how to conduct proper DHIA testing procedures for milk sampling.

Langston DHI Tester Training - Part 4 (length 8:28)

This video describes how to conduct proper DHIA testing procedures for milk sampling.

Semen Tank (length 6:39)

This video explains semen tank handling and semen storage for artificial insemination in goats.

Signs of Does (female goats) in Estrus (length 0:35)

This video shows an example of signs of estrus (flagging) in goats.

Nutrient Requirements of Goats

Under a research project which developed equations for energy and protein requirements for goats, as well as prediction of feed intake, an extension sub-project developed a website calculation system for "Nutrient Requirements of Goats" (http://www2.luresext.edu/goats/research/nutreqgoats.html). Most calculators were based on studies of the project reported in a Special Issue of the journal Small Ruminant Research. For calculators with score inputs (i.e., grazing and body conditions), pictures are available to aid in determining most appropriate entries. Realistic examples are given, as well as discussion of appropriate and inappropriate usage. However, for the experienced user there is an option to hide text and examples and to view only inputs and outputs.

In 2005, a calculator for calcium and phosphorus requirements was added to the existing calculators for metabolizable energy, metabolizable protein, and feed intake for suckling, growing, mature, lactating, gestating, and Angora goats. Also in 2005, the interface of the calculators was unified into a single calculator with the English measurement system used. This will encourage the use of the calculators by American producers. The least-cost ration balancer was modified so that it incorporates the least-cost feed percentage into the diet. Also, calculators are equipped with printable version commands to obtain inputs and outputs in hard copy format. In 2007, the calculators were continued to be updated.

In summary, for nutrient requirement expressions to be of value, they must be readily accessible and reasonably simple. Therefore, a web-based goat nutrient requirement system was developed based on findings of a recent project. It is hoped that this system will enjoy widespread usage and enhance feeding practices for goats.

Tanning Goat Hides

People express interest in tanning skins for a variety of reasons. Some sheep and goat producers wish to tan skins of animals they raise. Other people are hunters who wish to tan deerskins. Reasons for this interest

include: wanting to use as much of the animal as possible, disliking the waste of an animal's skin; ownership of an exceptionally pretty goat that they wish to tan after harvest for home use; learn new skills; wish to use tanning skills on other mammals such as deer; wishing to learn "old-time" skills, and some producers see a source of potential income through tanning goat skins and selling handicrafts. Some attendees already tan skins but want to expand their knowledge. All of these producers wish to learn to tan skins. There is no other tanning skins course in the nearby area. Langston University instituted a tanning goat skins course that teaches tanning skills to persons wishing to tan skins as a hobby. The workshop uses readily available chemicals and all processes are done by hand. Thus, it is a low cost process that producers can try at home. The hands-on nature of the course whereby participants work with actual skins in most of the tanning steps ensures skill transfer. This format allows students to work with and learn from each other and receive practical knowledge of the tanning process that will help them when trying tanning skins at home. In 2013, one tanning goatskins workshop was held at Langston University in March.

Internet Website

http://www2.luresext.edu

Capabilities of the new web site include a document library with the complete proceedings of the annual Goat Field Day for the past three years and the quarterly newsletter for the past several years. Both the proceedings and newsletters are also available in portable document format (pdf), which allows for the viewing and printing of documents across platform and printer without loss of formatting.

Information, recent abstracts and scientific articles of completed and current research activities in dairy, fiber and meat production are available for online viewing and reading. Visitors will be able to take a Virtual Tour of the research farm and laboratories, complete with digital photos and narrative. Visitors will also be able to browse a digital Photo Album. Visitors will also be able to subscribe to our free quarterly newsletter online. Visitors will be able to test their knowledge of goats with the interactive goat quiz which covers nearly all aspects of dairy, fiber and meat goat production. For those questions that are lacking in the interactive quiz database, visitors will be able to submit a question to be included in the database. Visitors will be able to read about research interests of faculty and will be able to contact faculty & staff via email.

Web-based Training for Meat Goat Producers

Meat goat production is one of the fastest growing sectors of the livestock industry in the United States. New producers, as well as some established ones, have an expressed need for current, correct information on how to raise goats and produce safe, wholesome products in demand by the public. As the meat goat industry grows and evolves, a quality assurance program is essential. Such a QA program ensures the production of a wholesome product that satisfies consumers and increases profit for the meat goat industry.

Langston University was awarded funding by the Food Safety and Inspection Service of USDA to develop training and certification for meat goat producers. Langston University organized and led a consortium of 1890 universities and producer associations in this project. The consortium identified the subject topics most pertinent and pressing for the instructional modules. The consortium then identified experts on the selected subject topics and pursued these experts as module authors. These authors represent the most qualified persons in their field in academia as well as in the industry. Langston University translated the sixteen instructional modules into web pages with accompanying images, and pre- and post tests for those producers wishing to pursue certification. All modules are also available in pdf for easy printing and the introductory module is available as a podchapter for downloading and listening on your favorite mp3 player. The web-site (http://www2.luresext.edu/goats/training/qa.html) was unveiled in late 2005.

Even though this web-site (http://www2.luresext.edu/goats/training/qa.html) was only unveiled in 2007, more than 1,500 producers have enrolled for certification and 292 have completed the certification process. These instructional materials will best serve meat goat producers in assisting them to produce a safe, wholesome, healthy product for the American consumer. Funding source for this project was USDA/FSIS/OPHS project #FSIS-C-10-2004 entitled "Development of a Web-based Training and Certification Program for Meat Goat Producers."

State/Country	***Number Certified***
UNITED STATES	
AL	5
AR	9
AZ	1
CA	6
CO	2
CT	1
FL	22
GA	13
IA	3
IL	5
IN	7
KS	8
KY	6
LA	3
MA	1
MD	2
MI	7
MN	3
MO	12
MS	2
MT	2
NC	9
NE	3
NH	1
NJ	2
NV	3
NY	6
OH	6
OK	31
OR	7
PA	5
SC	5
SD	2
TN	11

State/Country	***Number Certified***
TX	29
UT	1
VA	9
VT	1
WA	5
WI	2
WV	4
WY	3
CANADA	
AB	2
BC	4
MB	3
NS	1
ON	3
BOTSWANA	1
INDIA	1
MALAYSIA	4
MEXICO	1
PAKISTAN	1
SAUDI ARABIA	1
SOUTH AFRICA	1
SURINAME	1
UK	1
ZIMBABWE	2
Total	***292***

Current Extension Projects

Title: Enhancing Capabilities of Socially Disadvantaged and Underserved Farmers via Low Literacy Materials in English and Spanish

Type: USDA 1890 Institution Capacity Building Grants Program

Project Number: OKLX-GIPSON10

Period: 2010-2013

Investigators: T.A. Gipson[1], R.C. Merkel[1], M. Simon[2], J. Fernandez Van Cleve[3]

Institution: [1]Langston University; [2]Kentucky State University; [3]University of Puerto Rico - Mayaguez

Objective: 1) utilize existing core chapters from the Meat Goat Production Handbook to develop a low-literacy training manual for meat goat production;
2) translate the low-literacy meat goat production training manuals into Spanish;
3) develop supplemental explanatory and "how to" demonstration materials to the English and Spanish manuals in video format (DVD and web-based) for use by extension agents, outreach specialists and individual farmers.

Title:	Training Farmer Educators on Goat Mortality and Butcher Waste Composting, A Regional Approach
Type:	USDA 1890 Institution Capacity Building Grants Program
Project Number:	OKLXMERKEL10
Period:	2011-2014
Investigators:	R.C. Merkel[1], T.A. Gipson[1], M. Mackinzie-Jakes[2], A.B. Yousuf[3]
Institution:	[1]Langston University; [2]Florida A&M University; [3]Virginia State University
Objective:	1) host project collaborators and 1890 extension leaders to discuss mortality and offal composting 2) establish mortality composting teaching demonstration sites 3) train CES, NRCS and other outreach personnel and farmer group leaders in composting animal mortality and butcher waste 4) publish a manual on small-stock mortality composting 5. Develop a training module on mortality composting 6. Write a chapter on mortality and butcher waste composting

Title:	Extension Education Delivery Tools for Dairy Goat Producers: A Web-Based Certification Program and E-Book
Type:	USDA 1890 Institution Capacity Building Grants Program
Project Number:	OKLXMERKEL11
Period:	2010-2013
Investigators:	R.C. Merkel[1], T.A. Gipson[1], S. Hart[1], Y. Park[2], C.M. Mikolayunas[3]
Institution:	[1]Langston University; [2]Fort Valley State University; [3]University of Wisconsin
Objective:	1) develop scientific-based content for a dairy goat web-based certification program and e-book 2) design and construct a web-based certification program based upon the developed content 3) develop a printed handbook based on the web-based program 4. Develop an e-book version of the handbook

Title:	Rehabilitation of Under-Utilized Forest Land by Goats for Economic Benefits
Type:	USDA Renewable Resources Extension Act Program
Project Number:	OKLXRREA
Period:	2010-2013
Investigators:	T.A. Gipson[1], R.C. Merkel[1], S. Hart[2], B. Heinemann[3]
Institution:	[1]Langston University; [2]Kiamichi Forestry Research Station (Oklahoma State University)
Objective:	1) compare the biological treatment using goats in a pine forest to control invasive species with traditional methods of invasive species control and with no treatment and 2) monitor the beneficial and harmful insect populations on plant and animal species

International Overview

Dr. Roger Merkel
International Program Leader

Goats and goat products are part of the livelihood of a majority of the world's population and are an important resource for poor farmers in many countries of the world. Part of the mission of the American Institute for Goat Research is to effect positive change in goat production throughout the world. To fulfill this aspect, the Institute has developed and maintains many strong ties with research and academic institutions around the world. In addition to collaborative work with foreign institutions, the Institute has hosted visiting scientists from over 30 foreign countries to conduct research activities. Training for foreign livestock workers and scientists as well as for U.S.-based persons who will travel and work overseas are other ways in which the Institute is active in the international arena.

International research and training, hosting foreign scientists, and training those who will teach others are internationally-focused activities that give the Institute unique opportunities to not only increase knowledge of foreign production systems and constraints, but also to positively impact agricultural development in foreign countries and help alleviate poverty and hunger. General objectives of the Institute's international program are to: 1) increase our knowledge of goat production systems worldwide and current constraints to increased production; 2) build human capacity through training foreign scientists and agricultural workers in goat production, thereby allowing them to more effectively carry out their missions of teaching, research, and extension; 3) increase Langston University and the Institute's involvement in agricultural development and impact on human welfare; and 4) enhance the Institute's knowledge of development and development issues.

2013 Projects

Title:	Handbook for Livestock Research on Smallholder Farms in Developing Countries
Type:	USDA Scientific Cooperation Research Program
Period:	2012-2014
Investigators:	A. L. Goetsch[1], T. A. Gipson[1], R. C. Merkel[1], G. Abebe[2], A. Patra[3], D. Zhou[4], K. Al-Qudah[5], M. Huerta-Bravo[6], T. Sahlu[1], A. Degen[7], W. Getz[8], and Y. Tsukahara[1,9]
Institutions:	[1]Langston University, [2]Hawassa University, [3]West Bengal University and Animal and Fishery Sciences, [4]Northeast Institute of Geography and Agroecology, [5]Jordan University of Science and Technology, [6]Universidad Autónoma Chapingo, [7]Ben-Gurion University of the Negev, [8]Fort Valley State University, and [9]Kyoto University
Objectives:	A handbook for livestock research on smallholder farms in developing countries will be developed. Emphasis will be given to experimental design and data analysis. Input will be received from experts in different areas of the world (i.e., Ethiopia, India, China, Jordan, and Mexico), including regional cultural and social considerations.
Current Status:	Final draft developed and sent to collaborators for internal and external review for final publication and distribution.

Title:	Enhancing Capacity for Research, Extension, and Teaching Activities with Small Ruminants of Bunda College of Agriculture in Malawi and Egerton University in Kenya
Type:	USAID, with administration by USDA Foreign Agricultural Service
Period:	2012-2014
Investigators:	T. Sahlu, A. L. Goetsch, T. A. Gipson, K. Tesfai, L. J. Dawson, and S. Zeng
Objectives:	Bunda College of Agriculture: 1) improve the analytical capacity of the Department of Animal Science animal nutrition laboratory of BCA to determine the nutritive value of livestock feedstuffs, inclusive of equipment and supply procurement and associated training and 2) increase knowledge in areas of animal science to enhance the quality of undergraduate and graduate student teaching and increase capacity for research and extension activities. Egerton University: 1) create capacity at EGU in artificial insemination of goats, encompassing use of fresh and frozen semen and to collect and store frozen semen, by establishing an artificial insemination center and provide relevant training; 2) import live animals of three dairy goat breeds to use in natural breeding and artificial insemination for multiplication of purebreds as well as crossbreeding in a community development program; and 3) provide training in areas of animal science relative to management of exotic dairy goat breeds, such as breeding and record-keeping, health and internal parasite management, preparation of teaser bucks for heat detection, and dairy goat product technology.
Current Status:	Bunda College of Agriculture: Laboratory equipment and supplies have been ordered and shipped to Malawi. The laboratory has been set up and officially handed over to the university by USDA representatives. Staff have received training in standard operating practices. Egerton University: Animal were procured in South Africa, shipped to Kenya, and are actively involved in the crossbreeding program. Training activities in cheese making and artificial insemination have been conducted.

Training program for scientists from the Philippines

In November, 2013, the Institute hosted 11 people from the Department of Agriculture of the Republic of the Philippines for a week-long training and introduction to the American Institute for Goat Research. The Philippines Department of Agriculture is placing increasing importance on goat production because of the goat's high adaptability to a wide array of climatic conditions and feed resources. Goat production is also being highlighted due to the effects of global warming that have put increasing pressure on natural resources and livestock production. The Philippines Agricultural Training Institute is the arm of the Department of Agriculture that conducts livestock extension and training activities. Their goal is to expand such activities in the area of goat production.

Training and discussions with the group were held at the farm and in laboratory and group discussion settings. The group learned about the working of the Institute feed mill and rations used by the various classes and types of goats on the research farm. Goat management, handling, and identification procedures used in the research herd were explained. The group discussed goat breeding and management, record keeping, and farm procedures. The group then had the opportunity to view laparoscopic artificial insemination of some of the Institute's does done by personnel from Oklahoma State University's College of Veterinary Medicine. Demonstrations on milking procedures, milk handling, and mastitis prevention were given.

The group learned about goat nutrition and internal parasite control. Hands-on sessions on fecal egg counts and FAMACHA scoring allowed them to gain practical skills. They also discussed advanced techniques on worm identification and larval culture. Goat herd health procedures and prevention strategies as well as discussions on common diseases, causes, and treatment wee important topics. Climate change and current research being conducted to study the effect of climate change in goats was presented. Other topics covered included mortality composting, sources of extension information, and tanning goat skins. On the last day of their visit, the visitors toured the Oklahoma State University College of Veterinary Medicine, the Oklahoma Animal Disease Diagnostic Laboratory, and Reproduction Enterprises, Inc. of Stillwater, Oklahoma.

Other international visitors

Throughout the past year, the Institute has hosted several visitors from foreign countries. This included two persons from a commercial company in the Philippines who spent three days at the Institute and farm. The Institute was also honored to host Dr. C. Devendra, a world-renown scientist in the area of small ruminants and recipient of the International Animal Agriculture Award from the World Association for Animal Production in 2013. In January 2014, the Institute hosted Dr. Ai Thanda Kyaw) Farmer-to-Farmer Country Director of Burma and Ms. Nona Fisher, Asia Farmer-to-Farmer Program Director.

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