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Sheep Production and Management

Cooperative Extension Service
College of Agriculture and Home Economics

ACKNOWLEDGMENT

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NOTE

The recommendations contained herein are general recommendations only. Contact your county Extension office for recommendations specific to your operation.

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The original manuscript of Sheep Production and Management *was written by James M. Sachse, former Extension Sheep Specialist.*

Sheep Production and Management

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Many New Mexico livestock producers could profit by including sheep in their farm enterprises. Sheep are among the most efficient of all the domestic animals and have been for thousands of years. Different from cattle and swine, sheep are adapted to the most extreme environmental conditions. Sheep are very agile and graze easily in the most rugged of mountain terrain, where cattle choose not to feed. Furthermore, some sheep breeds are well suited to survive on sparse desert range that would not be used otherwise. Thus, sheep have the ability to convert the natural forage of these extreme habitats into protein for human uses. We use the proteins produced by sheep in the form of wool and lamb.

Sheep can use practically all types of forage, including crop residue and even ditch banks. An abundance of forage is one key to profitable sheep production. The successful producer also must have a genuine interest in business, management skills, and labor to care for the sheep.

Some Advantages of Producing Sheep

- Sheep are easy to handle and generally require little input.
- Sheep production does not require elaborate facilities and equipment.
- Sheep consume roughage as their primary feed.
- Sheep help control weeds.
- Sheep provide two sources of cash income: lamb and wool.
- Sheep require a minimum amount of supplemental feeding.
- Sheep can provide a quick return on investment.

Disadvantages of Producing Sheep

- A sheep enterprise must be well managed.
- Sheep are subject to predation by coyotes, eagles, bobcats, lions, bears, domestic dogs, etc.
- Sheep require better fencing than do cattle.
- Internal parasites can create health problems when sheep are intensively grazed on irrigated pastures.

Choice of Breed

The most appropriate sheep breed depends upon environmental conditions, the producer's desired management intensity, and personal preference. For accelerated sheep production, it might be necessary to use three or more breeds to develop a ewe flock that exhibits acceptable levels of desirable traits. Accelerated flocks must be able to lamb out of season, produce large lamb crops, reach sexual maturity at an early age, and grow rapidly.

If producers want to overwinter ewes for spring lamb production, then local breeds such as range-raised, fine-wool ewes are an excellent choice. Breeds of sheep are generally classified according to the breed assets.

Fine-Wool Breeds

The fine-wool breeds are chiefly Rambouillet and Debouillet. The fine-wool breeds can withstand heat, cold, and drought, and produce satisfactorily under harsh conditions. They produce a more desirable, finer grading fleece that is more uniform than fleeces from other breed types. Additionally, they are more likely to breed out of season than are many other breeds.

Medium-Wool Breeds

The medium-wool breeds are white-faced crossbreeds that include the Columbia, Corriedale, and Targhee. These breeds are very productive when feed supply is ample. However, their breeding season is more restricted than that of fine-wool sheep, and their fleeces usually vary more in fineness of grade.

Meat-Type Breeds

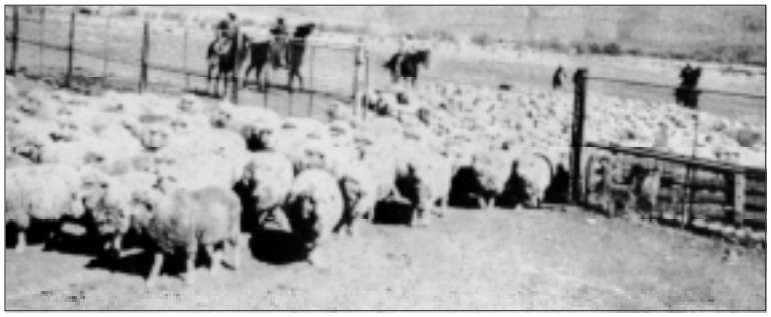
Suffolk, Hampshire, Dorset, Southdown, and Shropshire are some of the more common meat-type (or mutton) breeds, and they are best adapted to farm-flock production. Except for the Dorset, these are more restricted in their breeding season than fine-wool sheep. These breeds are commonly crossed with commercial white-faced ewes to produce market lambs.

Wool from these breeds lacks the fineness and often the length of staple found in fleeces from the fine- and medium-wool breeds. Quite often, wool from these breeds is discounted on the market because of poor purity (they contain black fibers).

Other Breeds

One breed with potential for use in accelerated sheep-production management systems is the Finnish Landrace. The greatest and perhaps only contribution of this breed is its reproductive capability and early maturity. Finnish Landrace are small, white-faced sheep that produce little wool. Additionally, the carcass quality of this breed is somewhat below standard. Finnish Landrace are used in crossbreeding programs to increase lamb crop percentages and to initiate out-of-season lambing.

The Polypay is sheep breed developed at the U.S. Sheep Experiment Station in Dubois, Idaho. The breed was developed from Finnish Landrace, Dorset, Targhee, and Rambouillet to optimize reproductive efficiency while maintaining growth and carcass quality.



Fine-wool ewes culled from the range because of age usually are productive for another two or three years under farm flock conditions.

Sheep Management Systems

Sheep can be produced under many production systems in New Mexico. Here are some things to consider when designing a sheep production system:

Available forage. Plan to make maximum use of seasonal forage because feed costs often amount to 50 to 60 percent of the total cost of producing lamb and wool. Feed consumption is the greatest during late gestation and lactation; producers may be able to reduce feed costs by grazing ewes on pasture at these times.

Available labor. When sheep are added to other farming enterprises, it may be advisable, from a managerial standpoint, to lamb when labor is not needed for other activities.

Lamb prices. Lamb prices normally fluctuate during the year, and it may be more profitable to produce lambs for the expected high market. Typically, that is during the late spring and early summer.

Size of flock. Small flocks, from 10 to 50 ewes, often are not profitable because they tend to be poorly managed. The primary reason is that mechanization is not feasible, so return per hour of labor is not maximized. Small farm flocks generally are used simply to control weeds on irrigation ditches or maintained as a hobby.

Purebred Sheep Production

Purebred sheep supply genetics for the development of commercial sheep production systems. In general, depending on the breed and availability, it is more expensive to start a purebred sheep business than a commercial one. Purebred sheep are often more expensive to produce, and more expense is involved in advertising and marketing. Ordinarily, purebred sheep are fed at a higher nutrition level than are commercial flocks. A well-fed purebred flock is more productive and more attractive to prospective buyers than are sheep maintained on lower nutrition levels.

To grow to maximum size, ewe and ram lambs must be born early. On most purebred sheep operations, breeding occurs in July and August. This usually results in a suboptimal lamb crop percentage because most ewes are more fertile during September and October.

A purebred sheep operation produces stud rams, commercial rams, and replacement ewes, usually for a price above their commercial value. Managing such an operation requires a thorough understanding of genetics, nutrition, reproduction, and health.

Commercial Sheep Production

Many management alternatives are available to the commercial sheep producer. One major distinction among these alternative production systems is the season in which lambing occurs.

Fall lamb production. For fall lambing, an abundant supply of fall and winter forage, small-grain pasture, alfalfa stubble, or other crop residue is necessary.

For ewes to lamb in October and November, breed them in May and June. The ewe flock must be of those breeds that tend to breed out of season. The fine-wools, Dorset, and crossbred ewes that are at least 50 percent fine-wool are best suited for fall lamb production.

Even so, the lamb crop percentage from May and June breeding is likely to be low. Ewes may need hormone therapy to induce estrus and ovulation (see section on reproduction, page 11). Furthermore, farm labor often is busy elsewhere during fall lambing when the ewes need attention. Occasionally, fall-born lambs are weak and small because of heat stress during the summer gestation period.

Winter lambing. One advantage of winter lambing is that labor requirements of other agricultural enterprises are generally low at this time, so more attention can be diverted toward the ewes. This program is best for the producer who has an abundance of homegrown forages. Under this production system, slaughter lambs of market weight and condition are ready to be sold during May and June, when lamb prices are normally high.

For winter lambing, breed the ewes in late July, August, and early September. Since this is somewhat earlier than normal, it may be necessary to flush the ewes to increase ovulation rate. After the ewes are bred, graze them on good pasture that will satisfy their nutritional requirements until about four to six weeks before lambing. Prior to lambing, supplement the ewes with high-quality hay and possibly with grain to meet their

nutritional needs. Lambs born in the winter should be creep-fed as soon as possible with grains and high-quality legume hay.

If feed and pasture are available, lambs can be weaned at about 60 days. It is generally more economical to feed lambs directly than to feed nursing ewes. Many producers keep the lambs in a drylot and put the ewes back on pasture. This helps to prevent internal parasite problems in the lambs.

Spring lamb production. Spring lambing coincides with the natural breeding and lambing seasons. When ewes are bred from late September through November and lamb in late February through April, a higher percent lamb crop can be expected. With ideal conditions, the lamb crop should be 150 to 160 percent. The ovulation rate in sheep is normally at its peak in late September through November. Temperatures at this time are typically not high enough to decrease ram fertility or to cause embryo loss. Normally, spring temperatures are mild and death loss associated with weather conditions is minimal. But newborn lambs must be offered some protection from spring winds. In this type of system, ewes are bred when ovulation rates should be high, so that flushing, teasing, or control of environmental conditions has less effect on conception rate or length of lambing season. Ewes must have adequate feed and should not be on a declining plan of nutrition when bred.

After breeding, the ewe's nutritional requirements are at the lowest level and they can be maintained on various crop residues and pastures, if available. Before they lamb and during early lactation, the ewe's nutritional requirements are the highest. Ewes may need a protein and energy supplement at that time. In some areas, spring pasture may partially satisfy their nutritional needs. But some irrigated pastures have a high water content and the forage is "washy." The ewes may need supplemental feeds in addition to the pasture if they are to lamb and produce milk most efficiently.

If pasture is available, it may be feasible to separate the lambs from the ewes daily and put the lambs in a drylot or on pastures separate from the ewes. Generally, best results are obtained when the lambs are not pastured with the ewes.

Accelerated lambing. Accelerated lambing is lambing more than once a year. This takes intensive management and is not recommended for the sheep producer who has not yet achieved maximum production from a conventional once-a-year lambing program. Accelerated lambing may increase the number of lambs raised over a given period, but it adds to the production cost and requires more feed, labor, and facilities.

In a carefully controlled environment, sheep can be bred every six months. However, breeding every eight months for three lamb crops in two years is more practical than a six-month lambing schedule.

Accelerated lambing also may be used to gain an additional lamb crop from ewes before they are culled. Ewes that are old or dry in the spring can be rebred for fall lambing in their last year. The advantages of accelerated lambing include increased lamb production, having lambs available for market at different seasons,

Confinement rearing of sheep is one method of intensifying lamb production.

year-round use of labor and facilities, and, theoretically, increased income per ewe.

Accelerated lambing necessitates the use of fine-wool or Dorset ewes and an understanding of exogenous hormones. Excellent management, disease control, and exact nutritional requirements are fundamental to the success of such a program.

Early weaning is essential in an accelerated lambing program because it is difficult to breed ewes that are lactating. Most commonly, lambs are weaned at 30 to 45 days. An excellent nutrition and health program must be incorporated into the plan to get these lambs as large as possible before weaning.

Confinement systems. Sheep can adapt to a complete confinement system of production. The confinement may vary from a drylot to small pens with slatted floors. The object is to produce market lambs in a small space using mostly feeds harvested from the farm. The advantages are that lamb production can be increased on a small area using automated feeding equipment.

This program requires intensive year-round management. Confinement rearing is best associated with an accelerated lambing program for maximum use of facilities and labor. One system of confinement that has possibilities is the confining of range sheep before lambing. Ewes are hand-lambed in lambing sheds and the lambs are weaned early, within 30 to 45 days. The ewes are then returned to the range and the lambs are finished in a drylot. This program is particularly successful where predation makes it almost impossible to raise lambs under range conditions.

Seasonal-Use Production Systems

Many farmers in New Mexico could make excellent use of sheep on a seasonal basis if a year-round sheep production system is not suitable. An abundance of high-quality, fine-wool range ewes are sold every fall. Generally, these ewes are five to six years old. From a reproductive standpoint, this is an ideal age. Ewes of this age should have a high percentage of twins.

Select range ewes carefully. Cull those with bad udders and exceptionally bad mouths. Place the ewes on pastures or crop residue. Flush the ewes from three weeks before until three weeks after introducing the rams. The flushed ewes, if properly conditioned and bred for spring lambing, should have the potential to produce lamb crops of 140 to 160 percent.

The management alternatives for this type of a production system are numerous. If spring pasture or feed is not available, or if facilities are not available to lamb the ewes, there may be a demand for bred ewes in the spring or for ewes with young lambs. If pasture is not available for the ewes after lambing, the lambs can be weaned early for feeding in a drylot, and the ewes can be sold.

A seasonal-use program is a good way to market farm-produced roughages and keep labor busy in the off-season. The biggest objection to bringing range-raised sheep onto a farm is that they often are wild and sometimes difficult to manage.

If there is an abundance of winter pasture and crop residue, pasturing feeder lambs can be profitable. This is more speculative than other seasonal-use programs because market values can change, with potentially devastating results.

Selection and Breeding

Since life began, animals best adapted to their environment have survived and produced the largest number of offspring. For example, most breeds of sheep that originated in the British Isles survived only if they were born in the spring when the temperature was mild and feed was available. That is natural selection.

Selection should be a part of all breeding sheep production enterprises. It is effective for almost all the important economic traits in sheep. No selection program, however, can improve all these economically important traits at once. Generally, the more traits involved in selection, the less improvement will result for a single trait. The first step in any selection program is to identify the traits of greatest economic importance. They may be growth rate, carcass merit, fleece traits, or reproductive efficiency.

The improvement that can be made depends on:

- Accurate measurement of the trait.
- Complete records on the flock.
- The amount of selection pressure applied.
- The amount of variation of the trait or different traits among individuals within the flock. If the sheep do not vary genetically, then no improvement can be made. If they vary greatly, then improvement will be rapid when producers select only the individuals that excel in the expression of important traits.
- The heritability of the trait. Variation in any economic trait is caused by genetic differences and environmental differences. Variation that results from differences in heredity is broadly defined as heritability.

Researchers have estimated the heritability (the ability to "pass on" traits to offspring) of the economically important traits (table 1). Generally, if the heritability estimate is less than 20 percent, progress is slow. A heritability estimate of 20 to 40 percent is considered medium. A heritability estimate greater than 40 percent is high.

Purebred breeders should be committed to improving the economically important traits of their breed. Their breed serves as a source of genetic material for crossbreeding and for improving the industry.

On the other hand, commercial sheep producers might find it more profitable to crossbreed. Some economically important traits that can be improved only slowly within a breed can be improved more rapidly with effective crossbreeding. An example is rate of reproduction. By most estimates, the heritability of reproductive traits is low. However, hybrid vigor (expression of a trait above the average of the dam and sire for that trait) exists for rate of reproduction. Generally, crossbred ewes exhibit a higher reproduction rate, produce more milk, and their lambs are stronger at birth.

Table 1. Heritability of traits in sheep.

Trait	Percent
Birth weight	0.15
Weaning weight (60 days of age)	0.20
Weaning weight (120 days of age)	0.25
Mature body weight	0.40
Rate of gain (post-weaning)	0.40
Face cover	0.35–0.55
Skin folds	0.20–0.50
Grease fleece weight	0.25–0.60
Clean fleece weight	0.25–0.60
Clean yield	0.30–0.40
Staple length	0.30–0.65
Fleece grade	0.20–0.60
Multiple birth	0.10
Milk production	0.10
Ewe productivity[a]	0.20
Loin-eye area	0.35
Fat thickness over loin eye	0.30
Carcass weight	0.35
Retail cut weight	0.45
Dressing percentage	0.10

[a]Pounds of lamb weaned per ewe exposed to a ram.

Source: *Sheep Production Handbook.* 1996. American Sheep Industry Association, Inc. Production, Education, and Research Council.

Crossbreeding

Crossbreeding is not an immediate cure-all. The results will be disappointing with poor quality parent stock or with a breed or breeds that are not adapted to the environment. For a successful crossbreeding program, use breeds that contribute the highest combination to the economically important traits. For example, if a producer wants to market lambs, then ewes from breeds that excel in the following characteristics should be selected:

- Reproductive efficiency.
- Desired time and length of breeding season.
- Conception and lambing rate.
- Milk production.
- Maternal instincts.

Crossbred ewes with these characteristics could then be mated to rams of another breed to produce market lambs. Traits to look for in the ram breeds are:

- High fertility.
- Growthiness.
- Carcass quality.
- Sexual aggressiveness.

How to Select for Increased Fertility

- Identify lambs that were born as twins or triplets and select replacement lambs from this group. Twin lambs from young ewes have a greater potential for twinning than do twins from older ewes.
- If additional replacements are required, select single ewe lambs from young ewes.
- Select rams that were twins or from ewes that had high twinning records. Scrotal circumference should be 28 cm for 12-month-old rams and 32 cm for mature rams.
- Ewe lambs that exhibit estrus are typically more fertile and have a greater lifetime production of lambs than ewe lambs that do not reach puberty the first year. Selecting early maturing ewe lambs also emphasizes early season lambing, which might be advantageous in some management systems.

A crossbreeding program such as this would be most successful on farms where feed supplies are usually controllable and sheep are a primary source of farm income. The fine-wool breeds should be a primary source in the development of any ewe breed intended for a crossbreeding program. These breeds are particularly well adapted to New Mexico rangelands, produce the highest quality wool, are produced within the state, and have the ability to breed out of season.

If the objective is to accelerate market lamb production, it might be practical to introduce a newer breed such as the Finnish Landrace. If out-of-season breeding is not desired, the medium-wool, white-faced breeds could prove satisfactory. However, to produce market lambs, breed ewes to rams noted for their growthiness and carcass desirability. Suffolk and Hampshire generally have an advantage in desirable characteristics.

Improving Economically Important Traits

Growth rate. Consumer preference for heavier lambs with less body fat has created considerable change within the sheep industry to increase size and weight. Lambs that grow rapidly reach market weights at younger ages, which generally means they require a shorter feeding period and have less risk of death loss with improved feed efficiency.

Growth rate is easy to measure. Lambs can be weighed at weaning time or at a later age. Most producers with commercial flocks weigh lambs at weaning. A ewe's milk production greatly influences her lamb's weaning weight, but lamb weaning weight is still a valuable trait to select for because the maternal trait of producing more milk can be transmitted to replacement ewe lambs.

The heritability of growth rate is higher for post-weaning weights. Therefore, placing lambs in a controlled feeding program after weaning is useful in growth rate selection. Producers who use such performance testing programs select ram lambs after they have been weaned and place them on a uniform feeding test for approximately 90 days.

Weights at birth, at weaning, and at 12 to 16 months of age are related, but it is important to maintain a relatively low birth weight to minimize dystocia (birthing problems) and lamb mortality. Therefore, select primarily for the growth traits of weaning weight or post-weaning weight, but try to maintain low birth weights.

If weaning weight is selected for, correct the weight for age, sex, type of birth, type of rearing, and age of the dam. Use the adjustment factors in table 2.

When selecting individual animals within a flock, simply select within sex and within twin and single groups. By listing twins and singles separately and selecting within contemporary groups, type of birth is adjusted for automatically. Twins should be given preference in selection.

Table 2. Factors for adjusting lamb weights for age. Multiply 90-, 120-, or 140-day weight by the appropriate factor.

	Age of dam		
	3 to 6 years	2 years, or 6+ years	1 year
Ewe lamb			
Single	1.00	1.08	1.13
Twin, raised as twin	1.19	1.29	1.38
Twin, raised as single	1.10	1.19	1.29
Triplet, raised as triplet	1.38	1.54	1.80
Triplet, raised as twin	1.27	1.38	1.51
Triplet, raised as single	1.18	1.28	1.40
Wether lamb			
Single	.98	1.05	1.10
Twin, raised as twin	1.16	1.26	1.33
Twin, raised as single	1.08	1.16	1.25
Triplet, raised as triplet	1.33	1.50	1.72
Triplet, raised as twin	1.24	1.35	1.45
Triplet, raised as single	1.15	1.25	1.36
Ram lamb			
Single	.98	1.05	1.10
Twin, raised as twin	1.16	1.26	1.33
Twin, raised as single	1.08	1.16	1.25
Triplet, raised as triplet	1.33	1.50	1.72
Triplet, raised as twin	1.24	1.35	1.45
Triplet, raised as single	1.15	1.25	1.25

Example: To find the adjusted 120-day weight of a ram lamb born and reared as a twin from a 2-year-old ewe that weighed 90 pounds at 110 days of age, make the following calculations:

90 pounds ÷ 110 days of age = .82 pounds x 120
= 98 pounds x 1.26 (adjustment factor)
= 124 pounds

The adjusted 120-day weight of the lamb would be 124 pounds.

Note: If a lamb is born a single but raised as a twin, adjust it as a twin-born, twin-raised lamb.

Source: *Sheep Production Handbook*. 1996. American Sheep Industry Association, Inc., Production, Education, and Research Council.

Reproductive efficiency. Sheep have the potential for multiple births, especially in farm flocks. Therefore, select twins for replacements when possible. With good management, mortality of twins should not be much higher than that of singles.

Measures of reproductive efficiency include age at puberty, fertility, lambing rate, and length of breeding season. Reproduction in sheep is strongly influenced by environment. By most estimates, the heritability of reproductive rate is low, but breed differences exist. Fine-wool breeds are highly fertile and have been used successfully in crossbreeding programs to improve reproductive rate. Breeds that have been used under intensive management systems to increase lambing rate include the Finnish Landrace, Border Leicester, and Suffolk.

Another aspect of reproductive efficiency is frequency of lambing. Fine-wool breeds, Dorset, and fine-wool crossbred ewes have been used successfully in accelerated lambing programs. To increase reproduction rate, select for number of lambs born within a given year or frequency of multiple births. Older ewes twin more frequently than younger ewes. This is environmental rather than genetic. The heritability of barrenness in sheep is low. However, to maintain a high productive level within a flock, cull ewes that fail to lamb.

How to Select for Desirable Wool Traits

- Record grease fleece weight and staple length of each fleece at shearing.
- If possible, obtain clean fleece weight.
- Rank fleeces according to weight of fiber produced and staple length.
- If possible, rank sheep within a given grade of wool, within a given age classification, and within a group in which the number of lambs raised is known.

Carcass merit. Most of the measurable carcass traits are medium to highly heritable, thus it is possible to improve carcass traits through selection. It is more difficult, however, than selecting for traits that can be measured accurately on the live animal.

Among market lambs of the same size, carcass merit is most influenced by cutability (the ratio of lean meat to fat). Fat is the primary factor in evaluating the carcass yield grade (measure of cutability) and eventual value to the consumer. The amount of fat in the carcass at a given weight is closely related to the growth curve of the lamb. Lambs that grow rapidly and reach market weight at an earlier age generally have a higher cutability (lower yield grade). Therefore, one practical method of selecting for increased carcass merit is to select for rate of gain.

Wool quality and quantity are traits that quickly respond to selection.

More exact methods of selecting for carcass merit can be used if carcass traits of related individuals or groups can be measured. Carcass weight per day of age, loin-eye area, fat thickness at the 12th rib, percentage of closely trimmed retail cuts, and leg-loin index all are used in measuring carcass merit in progeny groups. Sire progeny group summaries can be compiled from progeny data. Ultrasound technology can be used to estimate fat thickness and loin eye area. This technology will allow selection for carcass merit in potential sires.

Wool traits. Wool can account for as much as a 20 percent of the total gross income. Of all the economically important traits in sheep, those related to wool are the easiest to improve. Generally, wool traits are highly heritable and easy to measure. Traits that most directly influence the value of a fleece include fleece weight, fiber diameter, and length of staple. Weight of the fleece, particularly clean fleece weight, is usually the most valuable trait. Ordinarily, clean fleece weight is associated with grease fleece weight (actual weight of the fleece when shorn).

To increase flock wool production, select sheep that produce the most wool. Beware, however, of selecting entirely on pounds of wool produced because ewes that are dry or have singles rather than twin lambs may have an advantage in wool production but not in economic return. Milk production is negatively correlated with wool growth, particularly when feed is limited. Keep records on lamb production and wool production. Furthermore, if selection is placed entirely on pounds of wool, it is conceivable that the coarser fleeces may be selected.

Staple length has an important effect on the monetary value of a fleece. Ordinarily, this trait is highly correlated with pounds of wool produced, and heavier fleeces typically have a longer staple length. Measure length of staple and fleece weight at shearing time, and select replacements based on a combination of these two economically important traits.

The grade of a fleece is also economically important. Fine-wool fleeces ordinarily bring higher prices per pound than do coarse-wool fleeces. The grade, or fiber diameter, of wool primarily depends on the breed of sheep. When selecting replacements, also emphasize uniformity of grade throughout the fleece. Fleeces with a high degree of variation in grade are undesirable and have a lower monetary value. To detect such variation, examine fleeces of ewes and rams before shearing. Cull ewes that have belly-type wool extending up the sides.

Other fleece traits that should be given attention are color, softness of handle, uniformity of length and of fiber diameter, and freedom from other defects. Cull sheep with a lot of black fiber, hair, or kemp.

Minimizing Genetic Defects

Fortunately, sheep have few inherited defects that reduce their survival or producing ability. A discussion of the major genetic defects follows.

Jaw defects. Jaw defects are present in almost all breeds of sheep and are associated with failure of the incisor teeth to properly meet the dental pad. A jaw is

undershot if the incisor teeth extend forward past the dental pad; it is overshot if the teeth hit in back of the dental pad (this condition is known as parrot mouth). Cull sheep with either of these genetic defects. If the sire and dam can be identified, remove them from the flock.

Rectal prolapse. Rectal prolapse is a serious defect most commonly associated with the meat-type sheep. It is most common among lambs fed a high-concentrate ration. It is believed that this weakness is due to inheritance. This condition is sometimes corrected by surgery, but affected animals often continue to prolapse after surgery. Cull from the flock breeding sheep in which this occurs.

Inverted eyelids. Inverted eyelid (entropion) is widespread among most breeds of sheep. This trait is highly heritable. Inverted eyelids are a "turning in" of the margin of the eyelid. This condition causes extreme irritation, and, if left unattended, can eventually cause blindness. The condition may be noted at birth and treated at that time. One method of treating this condition is to clip a metal suture to the center of the affected eyelid. Gather enough skin under the clip in a vertical direction to hold the lid away from the eye. The clip can be left in place for several days. Mark the affected lambs and do not allow them to enter the breeding flock.

Cryptorchidism. Rams with one or both testicles retained in the abdomen are cryptorchids. The condition usually is inherited as a simple recessive trait. There seems to be some association between this condition and the polled characteristic found in some fine-wool rams. Purebred breeders should make every effort to eliminate this condition.

Skin folds. Skin folds are highly heritable. They once were considered desirable in some fine-wool breeds because they provide more surface area to grow wool. This condition is no longer considered advantageous, and most purebred breeders are trying to breed smooth-bodied sheep. Excessive skin folds are positively associated with lower fertility and overall productivity. Additionally, folds are difficult to shear and are subject to insect attack.

Face covering. The amount of wool growing on the face is also highly heritable. Cull sheep with excessive amounts of wool growing below the eyes and on the lower part of the face because face wool can obscure vision. Ewes that have trouble seeing are generally not as productive as open-faced ewes.

Fleece defects. Some inherited fleece defects include the incidence of belly-type wool growing high on the side of the sheep, hairiness or hairy wool, and colored wool. Through a rigid selection and culling system, the potential for genetic defects can be minimized.

Reproduction in Sheep

In their natural state, sheep are seasonal breeders; offspring are born at the time most favorable for their survival. In some domestic sheep, the breeding season has been altered both naturally and through the use of hormones.

Normal Breeding Habits of Sheep

Age of puberty. Ewes typically reach puberty at 5 to 12 months, depending on breed, nutrition, and date of birth.

Anestrous period (reproductive inactivity). This is the period when ewes normally do not demonstrate estrus (heat). Three types of anestrous are observed in ewes: seasonal (influenced by length of day), lactation (influenced by the sucking stimulus of lambs), and postpartum.

Length between estruses, or heat periods. The normal cycle for ewes is approximately 17 days between heat periods. However, it can vary from 14 to 19 days.

Duration of estrus, or heat period. The heat period usually lasts 30 to 35 hours, with a range of 20 to 42 hours. Ovulation occurs late in the period.

Gestation period. The normal gestation period of ewes is approximately 147 days, ranging from 144 to 152 days. The medium-wool breeds and meat-type breeds ordinarily have a shorter gestation period than do the fine-wool breeds. High temperatures and high nutrition levels may shorten the gestation period two or three days. Ewes bred to white-faced, wool-breed rams may have a slightly longer gestation period than those bred to black-faced, meat-type rams.

Breeding ewe lambs. Ewe lambs that breed and lamb as yearlings generally have a greater lifetime production than ewes that have their that first lamb as 2 year olds. Since the onset of puberty depends largely upon body weight, ewe lambs should be provided adequate levels of nutrition to reach at least two-thirds of mature weight before breeding. Also, lambs born in winter or early spring are more likely to exhibit heat the first year than are lambs born later. Separate ewes that lamb as yearlings from mature ewes, and manage and feed them so that the yearling ewes can grow to their maximum potential size.

Ewe lambs and yearlings are normally rather shy breeders. For best results, breed them separate from older ewes. In some cases, it may be better to use rams of smaller breeds on young ewes to minimize the chance of lambing difficulties.

Effects of Environment

Sexual activity in sheep is primarily controlled by the ratio of daylight to dark. Estrus becomes more frequent as the days become shorter. In general, fertility is highest and most efficient when ewes are bred in September, October, or November; ewes bred at this time generally produce the highest percentage of multiple births.

High temperatures are detrimental to fertility, embryo survival, and fetal development. This is the biggest objection to fall lamb production. High temperatures at breeding can reduce conception rate. Heat stress during gestation impairs fetal development and can cause lambs to be significantly smaller at birth.

Psychological Stimulation

The introduction of a ram near the end of the anestrous period appears to psychologically stimulate ewes. It brings about earlier ovulation and estrual activity. The ram can be either fertile or surgically sterilized. Rams should be kept with the ewes for about 10 to 14 days and removed from the flock before breeding begins. Then, at the beginning of the breeding season, rested fertile rams that are intended to sire the lamb crop can be introduced. The stimulation does not occur when rams are placed with ewes earlier, or when rams are simply left with the ewes continuously.

Effect of Nutrition

Nutrition has a direct bearing upon reproductive performance. Ewes kept in acceptable condition before breeding normally produce more lambs if they are flushed, or given the chance to gain weight before and during the breeding season. They can be flushed with rested pastures or by supplementation. Begin flushing three weeks before breeding and, if possible, continue through the first cycle (approximately 17 days).

Flushing ewes is most effective when they are mated early in the breeding season. Since ovulation rate is near a maximum during the middle of the season, flushing at this time is not as beneficial. The results of flushing are quite variable. Sometimes, when farm flock ewes are already on a high nutrition level before the breeding season, flushing may not affect ovulation or lambing percentage.

Nutrition affects total lifetime productivity of sheep by influencing mature size. Well-developed ewes consistently have higher lamb crop percentages than smaller ewes. Fat ewes, however, are typically less fertile, do not respond to flushing, and may experience more embryonic death loss.

Ewes grazed on legume pastures, such as alfalfa and clover, may at times be less fertile. Under some conditions, the estrogen content of these legumes is related to reproductive disorders. Breeding dates may be delayed and conception rate reduced when ewes are on pastures that have a high estrogen content. However, the estrogen content of legumes declines during the later stages of maturity.

Effect of Lambing and Lactation

Both lambing and lactation suppress estrous cyclicity in ewes. Generally, the postpartum anestrous phase lasts through lactation, even though the uterus typically returns to normal two to three weeks after lambing. Most ewes that lamb in late winter or spring do not exhibit estrus until the following breeding season. However, ewes that lamb in the fall usually exhibit a fertile heat four to eight weeks after lambing, or approximately two weeks after weaning.

Flush ewes on high-quality pasture, field clean-up, or grain 2 to 3 weeks before breeding.

Effect of Disease and Parasites

Heavy infestation of internal parasites can reduce the body condition of breeding ewes and may reduce reproductive performance. To minimize negative effects, follow a regular parasite control program and vaccination schedule. A local veterinarian should be able to provide sufficient information to develop a flock health program.

Effect of Ram

Infertile, diseased, or disinterested rams often cause poor lambing rates. The average number of ewes that can be mated to a ram are as follows: well-matured ram lambs, 15 to 30 ewes; yearlings to five-year-old rams, 25 to 50 ewes. However, in many of the low-rainfall areas of New Mexico, the average number of ewes per ram may be 30 to 40 percent lower than these values. These rates depend upon season, temperature, sex drive, and body condition. Rams six years and older that are in good physical condition may still be suitable for pasture or hand breeding.

Rams vary in their sexual behavior. Some rams mate repeatedly with the same ewes, even though several other ewes in heat are present. Some rams prefer black-faced or white-faced ewes when both groups are in the same flock.

Temperature has a pronounced effect on the ram's semen quality. Rams may be completely sterile or show lower fertility during late summer as a result of the heat. If the temperature exceeds 90°F for an extended period, especially if the humidity is high, fertility of most rams is reduced. Rams must be in good physical condition for successful reproduction. Malnutrition, internal parasites, or disease can cause sterility or depress the ram's desire to mate. Common diseases, such as those affecting the feet or any of the external breeding organs, can make it impossible for a ram to breed ewes.

The formation and development of sperm requires six to seven weeks. Therefore, after recovery from sickness or heat stress, it takes six to seven weeks for a ram to produce sperm capable of fertilization. An infertile ram in a one-sire flock can cause complete lambing failure. Also, a single dominant infertile ram in a large flock incorporating several rams can prevent fertile rams from mating and result in a lower lambing rate.

It is important to fertility test rams, particularly in one-sire flocks. Semen testing by qualified veterinarians is recommended to farm-flock producers, especially when only one or two rams are being used. If semen testing is not possible, the use of a marking harness can be beneficial. If several of the ewes return to heat, it may be necessary to substitute another ram.

Using Hormones to Control Reproduction

Reproduction in sheep can be controlled by artificially inducing estrus, ovulation, and fertilization. The use of

Rams should be in strong physical condition but not overly fat before breeding.

hormones is effective if management, genetic selection of breeds, and strains of breeds allow for out-of-season breeding. For accelerated lamb production or out-of-season breeding, use sheep that most normally fit the desired reproductive pattern. To further alter the reproductive process, regulate conditions such as light, temperature, nutrition, association with the ram, and other environmental factors that affect reproduction.

Hormones, along with practical selection and management practices, are useful to:

- Synchronize estrus during the breeding season.
- Increase the ovulation rate and incidence of multiple births.
- Induce fertile mating during anestrus.
- Induce early puberty.

In general, three types of hormones are used alone or in combination to achieve these objectives.

Progestogens. These are female sex hormones. They include those produced naturally as well as artificially. Progesterone is produced after ovulation by the corpus luteum, which forms on the ovary. Exogenous progestogens are used during the breeding season to synchronize estrus and ovulation. They also may be used during the anestrous period to help prepare the uterus for pregnancy and to sensitize the animal to be more responsive to hormones that cause estrus and ovulation. They can be administered by ear implant, daily injection, daily feeding, or by insertion of an impregnated sponge (pessary) placed in the vagina.

During the normal breeding season, progestogens can be used to synchronize estrus when used for a 10- to 12-day period. Estrus and ovulation usually occur between the second and fifth day following the end of treatment. However, fertility is usually suboptimal on the first cycle after progestogens are administered. Higher fertility is obtained from breeding at the second estrus. When ewes have been synchronized, they generally remain well synchronized through at least the first three post-treatment estrous periods.

Estrogens. Estrogens also are female sex hormones. They are produced naturally by the ovary or they can be produced synthetically. The estrogen concentration in the blood is highest just before and during estrus. The follicles on the ovary from which eggs are developed and released are the main source of estrogens in the female. The estrogen level, therefore, drops rapidly near the end of estrus, when ovulation occurs. Estrogens are responsible for behavioral estrus (or heat). In combina-

tion with progesterone, they sensitize the animal to respond to ovulating hormones. They also influence uterine development and the preparation of the uterus for pregnancy.

Gonadotropins. Gonadotropins are hormones that cause ovulation. They are produced by the pituitary gland as well as by certain other tissues. The gonadotropin that is used most successfully in controlling reproduction in sheep is follicle stimulating hormone. Additionally, human chorionic gonadotropin (HCG) has been used to induce ovulation.

Synchronizing Estrus

Some farm-flock producers find it advantageous to plan their breeding season so that all ewes lamb at approximately the same time. This can be largely achieved by treating ewes with progesterone for 10 to 12 days to synchronize estrus. When the progesterone is removed, the ewes exhibit estrus and can be bred at this time. However, for the largest lamb crop, breed the ewes following the second estrus after progesterone treatment. An injection of gonadotropin can contribute to multiple ovulation. Therefore, pregnant mare serum gonadotropin (PMSG) can be given as the progesterone treatment is terminated, and again 16 to 18 days later.

Accelerated Lambing or Out-of-Season Lambing

Accelerated lambing means lambing more often than the conventional once-a-year approach. Since ewes are pregnant for five months and nurse lambs for only about three months, they can be considered idle four months of the year. It is possible to lamb ewes every eight months (in some cases, every six months). On the surface, this seems like a logical approach to efficient sheep production, but that is typically not the case. Even with use of hormones, the success of most accelerated lambing programs depends entirely upon the competence of management. Because of the increase in disease, stress, and death loss associated with lambing, accelerated lambing is likely to reduce the length of the ewe's productive life and increase feed, labor, and managerial expenses.

An accelerated lambing program necessitates that lambs be weaned early. The recommended hormone treatment is the same as for estrous synchronization in that progesterone should be administered for 10 to 12 days and followed immediately with an injection of 500 to 750 international units of gonadotropin, and again 16 days later. If the ewes are in an anestrous period, it is sometimes helpful to administer 2 milligrams of estradiol two days before the start of progesterone treatment.

Producers who lamb outside the natural season can expect some loss in reproductive efficiency. Only outstanding managers and those who can afford to experiment should try accelerated lambing.

Artificial Insemination

The use of artificial insemination (AI) in sheep has been the subject of research for a number of years in the United States. Currently, frozen ram semen is available commercially. Additionally, transcervical techniques for AI have allowed some commercial producers to introduce AI into their breeding programs, but it is not commonly used by seedstock producers.

Sheep Nutrition

Feed represents the largest single cost in all types of sheep production. Rations must be formulated to support optimum production, must be efficient and economical to feed, and must minimize the potential for nutrition-related problems.

A producer must know the animal's nutritional requirements during the different phases of production, the nutrient composition of available feedstuffs, and how to provide the available feedstuffs to meet the animal's requirements.

Nutrition of the Ewe

A ewe's nutritional needs are not static; they vary largely with her stage of production. For 16 to 20 weeks of the year, the ewe's energy needs are very critical (such as during breeding, immediately before lambing, and while lactating). Feed levels can be lowered to reduce the feed cost during the early stages of gestation and when ewes are dry.

Maintenance of the ewe is generally thought of in terms of her nutritional requirements when dry, because at that time her requirements are the lowest of the year. However, wool production is a continuous process that must be considered as part of the nutrient requirements throughout the year.

One of the most reliable sources of information regarding sheep nutrition is *The Nutrient Requirements of Sheep* (sixth edition, 1985), which was produced by the National Research Council (NRC). Table 3 illustrates the requirements of sheep of different biological types and in different physiological stages of production. Use the data only as guidelines, not as rigid standards. In any flock, sheep are of different sizes and in different stages of production, and it is not always possible to know at each feeding the exact nutrient composition of the feed. However, if the producers follow the NRC guidelines, the flock's nutritional requirements will be met as closely as scientifically possible at this time.

The energy requirements are a function of the animal's basic metabolic rate. However, several factors affect maintenance requirements.

Age. Yearlings tend to have about a 20 percent higher energy requirement than adult sheep. This is probably due to the yearling's additional requirements to support growth. This is of particular importance to producers who breed ewes to lamb first at 12 to 18 months of age.

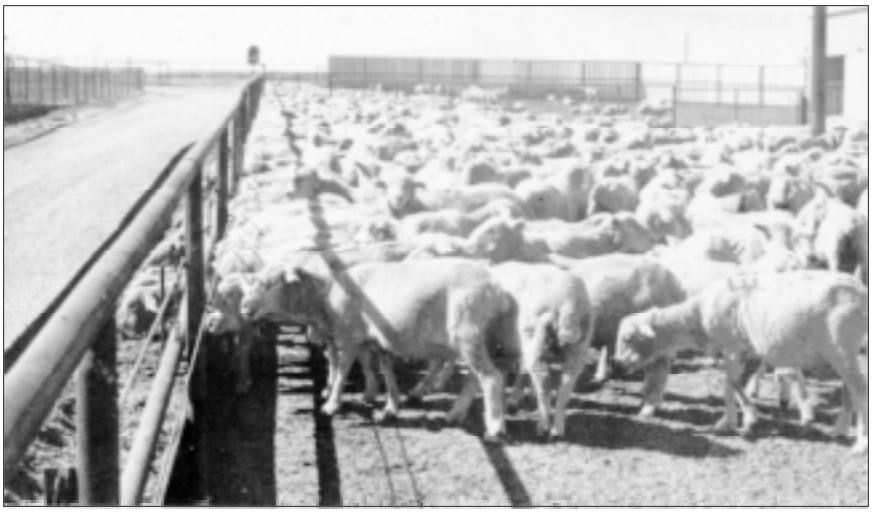
Exercise. Grazing sheep may use from 10 to 100 percent more energy than do sheep in drylot conditions. However, the magnitude of increase depends on the distance sheep must travel to feed and water, and on the topography of the range.

Climate. Temperature, wind velocity, and humidity can jointly affect energy requirements. The length and density of the fleece also affects energy requirements. Wool plays an important role in protecting sheep from both heat and cold. The insulating properties of wool help to cool the sheep in the heat of summer and keep body temperatures warmer in winter. Without wool, a sheep's energy requirements would be higher.

Body Condition. It takes more feed to maintain a fat sheep at a constant weight than it does a thin sheep. Keeping the sheep excessively fat is not only expensive because of the feed, but also it is detrimental to the ewe's reproductive capabilities and overall production efficiency. A ewe should lose 5 to 7 percent of her body weight during lactation and recover this weight loss during the dry period. Additionally, the ewe should gain body weight during gestation in proportion to the weight of the fetus and accompanying fluids.

In most sheep production situations, it is most economical to increase body condition of the ewes during the nonlactation period and "milk it off" in lactation, especially when low-cost pasture is available from early to mid-gestation.

Reproduction Requirements. Reproductive efficiency depends largely upon proper nutrition before and during the breeding season. Large-bodied ewes tend to produce more lambs per ewe. Do not confuse ewes of large size and scale with ewes that look large because they are fat. Usually, excessively fat ewes have lower conception rates and higher embryonic mortality. Furthermore, extremely poor body condition is not conducive to efficient fertility and reproductive performance. Ewes that have not had a properly balanced diet, including adequate phosphorus and vitamin A, may have a poor lamb crop percentage.



During the last 6 weeks of pregnancy, a ewe's total feed requirements are approximately 50 percent greater to allow for proper growth and development of the fetus and to prevent pregnancy toxemia.

Flushing. Flushing can improve the ewe's body condition just before and during the breeding season. Generally, the practice is thought to increase ovulation rate. Flushing has more effect early in the breeding season. It is also beneficial late in the season, as it tends to increase the opportunity for all ewes to become pregnant. Flushing may be achieved by moving the ewes to a better pasture shortly before breeding. The provision of a supplemental energy source (that is, 3/4 to 1 pound of whole corn per head per day) and(or) the introduction of ewes to fresh pasture also can enhance the potential for ewes to respond to flushing. The length of the flushing period can vary, but it probably should begin 21 days before the breeding season and continue through one estrous cycle (17 days) into the breeding season if possible.

Requirements During Gestation

During early gestation a ewe's nutrient requirements are only slightly higher than they are for maintenance. Ewes in good condition at the end of the breeding period can loose some weight without hindering normal production. This is particularly true of sheep that have recovered most of their lactational weight loss during the later phases of lactation. If the weight loss is entirely recovered before breeding, lack of gain for the first 60 to 90 days of gestation should not have a negative affect on subsequent production.

The last six weeks of gestation is the most critical period in ewe nutrition. Approximately 70 percent of the fetal growth occurs at this time. Nutrient restrictions during this period may result in lighter lambs at birth, increased postnatal lamb losses, lower levels of milk production, and possibly pregnancy disease (ketosis). In late pregnancy, ewes require approximately 50 percent more feed than they do earlier in gestation. If protein is limited during late gestation, lower birth rates and lighter ewe fleece weights can be expected. Very often inadequate phosphorus intake occurs during this period, especially with ewes on pasture or with ewes consuming hay.

Ewes in late pregnancy sometimes have difficulty consuming enough feed because of the space occupied by the fetus, particularly when they have twins or triplets. If the ewe is fed a high-roughage ration, she may not be able to consume enough to supply the necessary daily energy requirements. For ewes in late pregnancy consuming high roughage rations, it is generally advisable to feed supplemental grain.

Requirements During Lactation

During the first few weeks following lambing, a lactating ewe requires about the same feed as in late gestation, provided she is nursing a single lamb. The requirements shown in table 3 are for a lactating ewe that is producing 3 pounds of milk per day.

If the lamb does not consume all the milk produced daily, the ewe produces less milk and uses any excess energy to store fat.

Ewes suckling twin lambs normally do not deposit fat because the nutrient supply (primarily energy) does not meet the requirements of the lactating ewe. For maximum rate and efficiency of lamb gains, separate ewes nursing twin lambs from those nursing singles and feed accordingly. It is practically impossible to provide high-producing ewes nursing twin lambs enough feed during lactation to prevent loss of body weight. From a practical standpoint, these ewes must have reserves of body fat to maintain high levels of milk production. It is imperative that high-producing ewes are of acceptable body condition prior to lambing.

Table 3. Daily nutrient requirements of sheep.*

Body weight		Weight change/day		Dry matter per animal [a]			Nutrients per animal									
							Energy[b]								Vitamin A	Vitamin E
							TDN		DE	ME	Crude protein		Ca	P	activity	activity
(kg)	(lb)	(g)	(lb)	(kg)	(lb)	(% body weight)	(kg)	(lb)	(Mcal)	(Mcal)	(g)	(lb)	(g)	(g)	(IU)	(IU)
EWES[c]																
Maintenance																
50	110	10	0.02	1.0	2.2	2.0	0.55	1.2	2.4	2.0	95	0.21	2.0	1.8	2,350	15
60	132	10	0.02	1.1	2.4	1.8	0.61	1.3	2.7	2.2	104	0.23	2.3	2.1	2,820	16
70	154	10	0.02	1.2	2.6	1.7	0.66	1.5	2.9	2.4	113	0.25	2.5	2.4	3,290	18
80	176	10	0.02	1.3	2.9	1.6	0.72	1.6	3.2	2.6	122	0.27	2.7	2.8	3,760	20
90	198	10	0.02	1.4	3.1	1.5	0.78	1.7	3.4	2.8	131	0.29	2.9	3.1	4,230	21
Flushing—2 weeks prebreeding and first 3 weeks of breeding																
50	110	100	0.22	1.6	3.5	3.2	0.94	2.1	4.1	3.4	150	0.33	5.3	2.6	2,350	24
60	132	100	0.22	1.7	3.7	2.8	1.00	2.2	4.4	3.6	157	0.34	5.5	2.9	2,820	26
70	154	100	0.22	1.8	4.0	2.6	1.06	2.3	4.7	3.8	164	0.36	5.7	3.2	3,290	27
80	176	100	0.22	1.9	4.2	2.4	1.12	2.5	4.9	4.1)	171	0.38	5.9	3.6	3,760	28
90	198	100	0.22	2.0	4.4	2.2	1.18	2.6	5.1	4.2	177	0.39	6.1	3.9	4,230	30
Nonlactating—First 15 weeks gestation																
50	110	30	0.07	1.2	2.6	2.4	0.67	1.5	3.0	2.4	112	0.25	2.9	2.1	2,350	18
60	132	30	0.07	1.3	2.9	2.2	0.72	1.6	3.2	2.6	121	0.27	3.2	2.5	2,820	20
70	154	30	0.07	1.4	3.1	2.0	0.77	1.7	3.4	2.8	130	0.29	3.5	2.9	3,290	21
80	176	30	0.07	1.5	3.3	1.9	0.82	1.8	3.6	3.0	139	0.31	3.8	3.3	3,760	22
90	198	30	0.07	1.6	3.5	1.8	0.87	1.9	3.8	3.2	148	0.33	4.1	3.6	4,230	24
Last 4 weeks gestation (130–150% lambing rate expected) or last 4–6 weeks lactation suckling singles[d]																
50	110	180 (45)	0.40 (0.10)	1.6	3.5	3.2	0.94	2.1	4.1	3.4	175	0.38	5.9	4.8	4,250	24
60	132	180 (45)	0.40 (0.10)	1.7	3.7	2.8	1.00	2.2	4.4	3.6	184	0.40	6.0	5.2	5,100	26
70	154	180 (45)	0.40 (0.10)	1.8	4.0	2.6	1.06	2.3	4.7	3.8	193	0.42	6.2	5.6	5,950	27
80	176	180 (45)	0.40 (0.10)	1.9	4.2	2.4	1.12	2.4	4.9	4.0	202	0.44	6.3	6.1	6,800	28
90	198	180 (45)	1.40 (0.10)	2.0	4.4	2.2	1.18	2.5	5.1	4.2	212	0.47	6.4	6.5	7,650	30
Last 4 weeks gestation (180–225% lambing rate expected)																
50	110	225	0.50	1.7	3.7	3.4	1.10	2.4	4.8	4.0	196	0.43	6.2	3.4	4,250	26
60	132	225	0.50	1.8	4.0	3.0	1.17	2.6	5.1	4.2	205	0.45	6.9	4.0	5,100	27
70	154	225	0.50	1.9	4.2	2.7	1.24	2.8	5.4	4.4	214	0.47	7.6	4.5	5,950	28
80	176	225	0.50	2.0	4.4	2.5	1.30	2.9	5.7	4.7	223	0.49	8.3	5.1	6,800	30
90	198	225	0.50	2.1	4.6	2.3	1.37	3.0	6.0	5.0	232	0.51	8.9	5.7	7,650	32

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continued ...

Table 3. Daily nutrient requirements of sheep*, *continued*.

Body weight		Weight change/day		Dry matter per animal [a]			Nutrients per animal									
							Energy[b]				Crude protein				Vitamin A activity	Vitamin E activity
						(% body	TDN		DE	ME			Ca	P		
(kg)	(lb)	(g)	(lb)	(kg)	(lb)	weight)	(kg)	(lb)	(Mcal)	(Mcal)	(g)	(lb)	(g)	(g)	(IU)	(IU)
EWES[c], *continued*																
First 6–8 weeks lactation suckling singles or last 4-6 weeks lactation suckling twins[d]																
50	110	-25 (90)	-0.06 (0.20)	2.1	4.6	4.2	1.36	3.0	6.0	4.9	304	0.67	8.9	6.1	4,250	32
60	132	-25 (90)	-0.06 (0.20)	2.3	5.1	3.8	1.50	3.3	6.6	5.4	319	0.70	9.1	6.6	5,100	34
70	154	-25 (90)	-0.06 (0.20)	2.5	5.5	3.6	1.64	3.6	7.2	5.9	334	0.73	9.3	7.0	5,950	38
80	176	-25 (90)	-0.06 (0.20)	2.6	5.7	3.2	1.69	3.7	7.4	6.1	344	0.76	9.5	7.4	6,806	39
90	198	-25 (90	-0.06 (0.20)	2.7	5.9	3.0	1.75	3.8	7.6	6.3	353	0.78	9.6	7.8	7,640	40
First 6-8 weeks lactation suckling twins																
50	110	-60	-0.13	2.4	5.3	4.8	1.56	3.4	6.9	5.6	389	0.86	10.5	7.3	5,060	36
60	132	-60	-0.13	2.6	5.7	4.3	1.69	3.7	7.4	6.1	405	0.89	10.7	7.7	6,000	39
70	154	-60	-0.13	2.8	6.2	4.0	1.82	4.0	8.0	6.6	420	0.92	11.0	8.1	7,006	42
80	176	-60	-0.13	3.0	6.6	3.8	1.95	4.3	8.6	7.0	435	0.96	11.2	8.6	8,060	45
90	198	-60	-0.13	3.2	7.0	3.6	2.08	4.6	9.2	7.5	450	0.99	11.4	9.0	9,060	48
EWE LAMBS																
Nonlactating—First 15 weeks gestation																
40	88	160	0.35	1.4	3.1	3.5	0.83	1.8	3.6	3.0	156	0.34	5.5	3.0	1,880	21
50	110	135	0.30	1.5	3.3	3.0	0.88	1.9	3.9	3.2	159	0.35	5.2	3.1	2,350	22
60	132	135	0.30	1.6	3.5	2.7	0.94	2.0	4.1	3.4	161	0.35	5.5	3.4	2,820	24
70	154	125	0.28	1.7	3.7	2.4	1.06	2.2	4.4	3.6	164	0.36	5.5	3.7	3,290	26
Last 4 weeks gestation (100–120% lambing rate expected)																
40	88	180	0.40	1.5	3.3	3.8	0.94	2.1	4.1	3.4	187	0.41	6.4	3.1	3,400	22
50	110	160	0.35	1.6	3.5	3.2	1.06	2.2	4.4	3.6	189	0.42	6.3	3.4	4,250	24
60	132	160	0.35	1.7	3.7	2.8	1.07	2.4	4.7	3.9	192	0.42	6.6	3.8	5,100	26
70	154	150	0.33	1.8	4.0	2.6	1.14	2.5	5.0	4.1	194	0.43	6.8	4.2	5,950	27
Last 4 weeks gestation (130–175% lambing rate expected)																
40	88	225	0.50	1.5	3.3	3.8	0.99	2.2	4.4	3.6	202	0.44	7.4	3.5	3,400	22
50	110	225	0.50	1.6	3.5	3.2	1.06	2.3	4.7	3.8	204	0.45	7.8	3.9	4,250	24
60	132	225	0.50	1.7	3.7	2.8	1.12	2.5	4.9	4.0	207	0.46	8.1	4.3	5,100	26
70	154	215	0.47	1.8	4.0	2.6	1.14	2 5	5.0	4.1	210	0.46	8.2	4.7	5,950	27
First 6–8 weeks lactation suckling singles (wean by 8 weeks)																
40	88	-50	-0.11	1.7	3.7	4.2	1.12	2.5	4.9	4.0	257	0.56	6.0	4.3	3,400	26
50	110	-50	-0.11	2.1	4.6	4.2	1.39	3.1	6.1	5.0	282	0.62	6.5	4.7	4,250	32

60	132	-50	-0.11	2.3	5.1	3.8	1.52	3.4	6.7	5.5	295	0.64	6.8	5.1	5,100	34
70	154	- 50	-0.11	2.5	5.5	3.6	1.65	3.6	7.3	6.0	301	0.68	7.1	5.6	5,450	38
First 6–8 weeks lactation suckling twins (wean by 8 weeks)																
40	88	- 100	-0.22	2.1	4.6	5.2	1.45	3.2	6.4	5.2	306	0.67	8.4	5.6	4,060	32
50	110	- 100	-0.22	2.3	5.1	4.6	1.59	3.5	7.0	5.7	321	0.71	8.7	6.0	5,060	34
60	132	- 100	-0.22	2.5	5.5	4.2	1.72	3.8	7.6	6.2	336	0.74	9.0	6.4	6,060	38
70	154	- 100	-0.22	2.7	6.0	3.9	1.85	4.1	8.1	6.6	351	0.77	9.3	6.9	7,060	40
Replacement ewe lambs [e]																
30	*66*	227	0.50	1.2	2.6	4.0	0.78	1.7	3.4	2.8	185'	0.41	6.4	2.6	1,410	18
40	88	182	0.40	1.4	3.1	3.5	0.91	2.0	4.0	3.3	176	0.39	5.9	2.6	1,880	21
50	110	120	0.26	1.5	3.3	3.0	0.88	1.9	3.9	3.2	136	0.30	4.8	2.4	2,350	22
60	132	100	0.22	1.5	3.3	2.5	0.88	1.9	3.9	3.2	134	0.30	4.5	2.5	2,820	22
70	154	100	0.22	1.5	3.3	2.1	0.88	1.9	3.9	3.2	132	0.29	4.6	2.8	3,290	22
Replacement ram lambs [e]																
40	88	330	0.73	1.8	4.0	4.5	1.1	2.5	5.0	4.1	243	0.54	7.8	3.7	1,880	24
60	132	320	0.70	2.4	5.3	4.0	1.5	3.4	6.7	5.5	264	0.58	8.4	4.2	2,820	26
80	176	290	0.64	2.8	6.2	3.5	1.8	3.9	7.8	6.4	268	0.59	8.5	4.6	3,760	28
100	220	250	0.55	3.0	6.6	3.0	1.9	4.2	8.4	6.9	264	0.58	8.2	4.8	4,700	30
Lambs finishing—4 to 7 months old [f]																
30	66	295	0.65	1.3	2.9	4.3	0.94	2.1	4.1	3.4	191	0.42	6.6	3.2	1,410	20
40	88	275	0.60	1.6	3.5	4.0	1.22	2.7	5.4	4.4	185	0.41	6.6	3.3	1,880	24
50	110	205	0.45	1.6	3.5	3.2	1.23	2.7	5.4	4.4	160	0.35	5.6	3.0	2,350	24
Early weaned lambs—Moderate growth potential [f]																
10	22	200	0.44	0.5	1.1	5.0	0.40	0.9	1.8	1.4	127	0.38	4.0	1.9	470	10
20	44	250	0.55	1.0	2.2	5.0	0.80	1.8	3.5	2.9	167	0.37	5.4	2.5	940	20
30	66	300	0.66	1.3	2.9	4.3	1.00	2.2	4.4	3.6	191	0.42	6.7	3.2	1,410	20
40	88	345	0.76	1.5	3.3	3.8	1.16	2.6	5.1	4.2	202	0.44	7.7	3.9	1,880	22
50	110	300	0.66	1.5	3.3	3.0	1.16	2.6	5.1	4.2	181	0.40	7.0	3.8	2,350	22
Early weaned lambs—Rapid growth potential [f]																
10	22	250	0.55	0.6	1.3	6.0	0.48	1.1	2.1	1.7	157	0.35	4.9	2.2	470	12
20	44	300	0.66	1.2	2.6	6.0	0.92	2.0	4.0	3.3	205	0.45	6.5	2.9	940	24
30	66	325	0.72	1.4	3.1	4.7	1.10	2.4	4.8	4.0	216	0.48	7.2	3.4	1,410	21
40	88	400	0.88	1.5	3.3	3.8	1.14	2.5	5.0	4.1	234	0.51	8.6	4.3	1,880	22
50	110	425	0.94	1.7	3.7	3.4	1.29	2.8	5.7	4.7	240	0.53	9.4	4.8	2,350	25
60	132	350	0.77	1.7	3.7	2.8	1.29	2.8	5.7	4.7	240	0.53	8.2	4.5	2,820	25

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[a] To convert dry matter to an as-fed basis, divide dry matter values by the percentage of dry matter in the particular feed.

[b] One kilogram TDN (total digestible nutrients) = 4.4 Mcal DE (digestible energy); ME (metabolizable energy) = 82% of DE.

[c] Values are applicable for ewes in moderate condition. Fat ewes should be fed according to the next lower weight category and thin ewes at the next higher weight category. Once desired or moderate weight condition is attained, use that weight category through all production stages.

[d] Values in parentheses are for ewes suckling lambs the last 4 to 6 weeks of lactation.

[e] Lambs intended for breeding, thus, maximum weight gains and finish are of secondary importance.

[f] Maximum weight gains expected.

Assessing Nutritional Status

To assess the nutritional status of ewes, a subjective scoring system based on external body fat has been developed. The amount of fat cover is then used to estimate body energy reserves. The scoring system has a range of one to five, with one being extremely thin and five being extremely fat. The advantage of this system is that it is easy to use and is fairly reliable within a flock.

To score a ewe's body condition, use your fingertips to feel the fat cover over the vertebrae and ribs. However, the best area to estimate body condition is over the loin (vertebrae between the last rib and hip bone). In this area, palpate the spinous (vertical) and transverse (horizontal) processes of the spine to provide the most reliable estimate of body condition. The following illustrations (figs. 1–9*) show how to palpate this area and they describe the body condition scores.

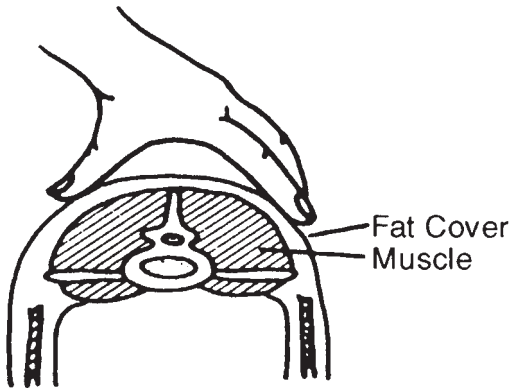


Figure 1. Feel for fullness of muscle and fat cover.

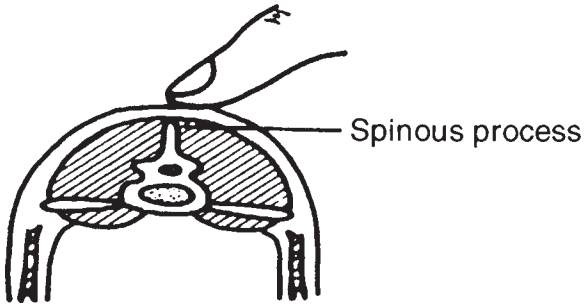


Figure 2. Feel for the spine in the center of the sheep's back behind the last rib and the anterior hipbone.

**Figures were reproduced from* Sheep Production Handbook *(1996) with permission from the American Sheep Industry Association, Inc., Production, Education, and Research Council.*

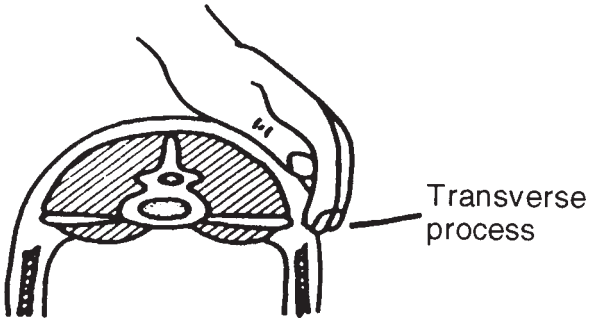


Figure 3. Feel for the tips of the transverse process.

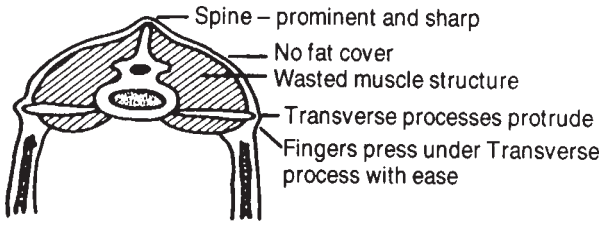


Figure 4. Body Condition Zero. Sheep is extremely thin, unthrifty, and weak. Skeletal features very prominent (for example, backbone, shoulder blades, and ribs). Wasted muscle tissue is evident. Eye socket is prominent and sunken. May be humpbacked and isolates self from flock.

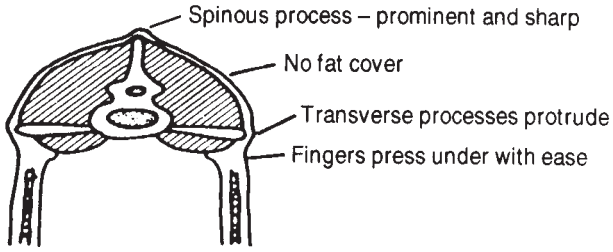


Figure 5. Body Condition One. Sheep is extremely thin, unthrifty, but agile. Skeletal features are prominent with no fat cover. No apparent muscle tissue degeneration. Has strength to remain with the flock.

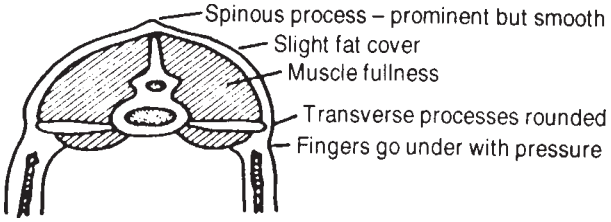


Figure 6. Body Condition Two. Sheep is thin but strong and thrifty, with no apparent muscle structure wasting. No evident fat cover over the backbone, rump, and ribs, but skeletal features do not protrude.

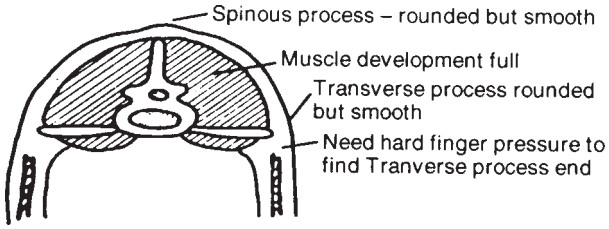


Figure 7. Body Condition Three. Sheep are thrifty with evidence of limited fat deposits in fore rib, over top of shoulder, backbone, and tail head. Hipbone remains visible.

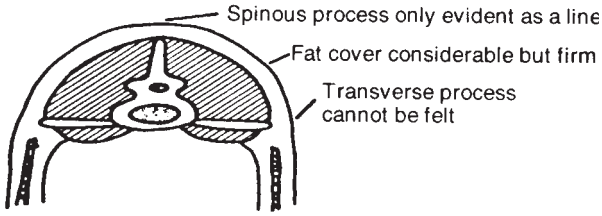


Figure 8. Body Condition Four. Moderate fat deposits give the sheep a smooth external appearance over the shoulder, back, rump, and fore rib. Hip bone is not visible. Firm fat deposit becomes evident in brisket and around tail head.

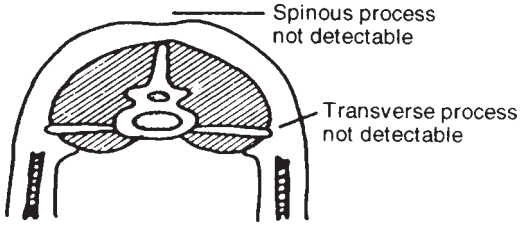


Figure 9. Body Condition Five. Sheep are extremely fat with the excess detectable over the shoulder, backbone, rump, and fore rib. Excess fat deposits in brisket, flank, and tail head regions lack firmness. Sheep appear uncomfortable and reluctant to move about. Quality fleeces are generally found.

Essential Nutrient Requirements of Sheep

Of primary importance in sheep nutrition are water, energy, protein, minerals (with salt, calcium, and phosphorus the most critical components), and vitamins (with vitamin A of primary concern).

Energy. Insufficient energy limits performance of sheep probably more than any other nutritional deficiency. An energy deficiency may result from inadequate amounts of feed or from feeds (generally forages) that do not contain enough protein to sufficiently "unlock" the energy in the feedstuff. The major sources of energy for sheep are hay, pasture, silage, and grains. Milo, barley, corn, oats, and wheat also can be used to raise the energy level of the diet when necessary. Energy deficiencies can cause reduced growth rate, loss of weight, reduced fertility, lowered milk production, and reduced wool quantity and quality.

Protein. In sheep rations, the amount of protein is much more important than quality of protein. However, since the sheep is a ruminant, mature sheep use effectively the naturally occurring protein and nonprotein nitrogen (urea) in their diets. Common sources of natural protein supplements include cottonseed, soybean, sunflower, linseed, and peanut meals. These oilseed meals contain from 40 to 50 percent protein and are excellent sources of supplemental protein. High-quality legume hays can contain from 12 to 20 percent protein and provide adequate protein for most classes of sheep when fed as a complete ration. Grains, however, are low in protein. They generally contain only 8 to 11 percent protein. Additional protein is necessary in high-grain, lamb-finishing rations for maximum performance.

Nonprotein nitrogen sources should not be fed to young lambs. Young lambs are not functioning ruminants until they are approximately 2 months old, depending upon how soon they have access to grain and forage. However, mature sheep can be fed low levels of nonprotein nitrogen. In general, supplemental nonprotein nitrogen is beneficial only when adequate energy is available. Urea should never make up more than one-third of the ruminally degradable protein in the diet. Additionally, nonprotein nitrogen sources should not be used when lambs are limit-fed. Urea can be toxic if consumed in large amounts over a short time, especially when the diet lacks ruminally available energy. Furthermore, urea is very unpalatable.

When supplementing range sheep in New Mexico, it is important to consider the quantity of available forage in the pasture. If adequate forage is present, but the standing forage is dry and brown (containing < 5 to 6 percent crude protein), it may be necessary to supplement with a high-protein feed (> 35 percent protein). However, if the amount of available forage is insufficient or if the forage is still somewhat green (> 6 percent

protein), a lower-protein supplement should be fed to provide additional energy, if needed. Lactating ewes have the highest protein requirement and may require supplemental protein if the range forage contains less than 10 to 12 percent crude protein.

Water. Water is essential for all livestock. Producers must plan for an adequate supply of clean water when designing any type of sheep enterprise. The quality of the water is also important. Sheep will not consume enough water if it is stagnant or of poor quality.

Ordinarily, sheep consume two to three times as much water as dry matter. Abundant, clean, ice-free water is a must in lamb feedlots. Without water, lambs may eat less. Water running through a low trough or water dripping into the trough can help to start the lambs drinking and eating.

Minerals. Approximately 13 different minerals are essential in sheep nutrition. Most of these requirements are met under normal grazing and feeding habits in New Mexico. Those that are most deficient are salt (sodium chloride) and phosphorus.

Salt is essential for many body functions. When sheep are deprived of salt, they generally consume less feed and water, produce less milk, and grow slowly. Animals that are deprived of adequate salt may try to satisfy their needs by chewing wood, licking dirt, or eating toxic amounts of poisonous plants. Inadequate salt intake may cause decreased feed consumption and decreased efficiency of nutrient use. When adding salt to mixed feed, add 0.3 percent to the complete diet or 1 percent to the concentrate portion. In general, supplemental salt should be provided to range ewes at a level of 8 to 11 g of salt per head per day. Provide loose salt rather than salt blocks. Sheep tend to bite instead of lick salt blocks; as a consequence, their teeth may break or wear down prematurely.

Almost all pastures and hays contain an abundance of calcium, but grains are lower in calcium. When lambs are fed on a high-concentrate diet, calcium supplementation may be necessary.

In New Mexico, pastures and hay are generally low in phosphorus. In grains, however, the amount of phosphorous is moderate to high. Since any efficient sheep operation uses a high percentage of roughage or pasture, it is good insurance to assume that the sheep need phosphorus supplementation. Phosphorus deficiency causes slow growth, reduced appetite, unthrifty appearance, listlessness, abnormal bone development, and poor reproductive performance. It may be beneficial to provide phosphorus supplements year-round for the breeding flock.

When purchasing commercial mineral blocks or loose forms of mineral supplements, look at the calcium-to-phosphorus ratio. The narrower this ratio, the better. However, it is important to make sure that the ratio is not inverted (more phosphorous than calcium). If producers prefer to mix a mineral supplement, mix 50 percent salt with 5 percent cottonseed meal and approximately 45 percent bone meal or dicalcium phosphate. Provide this supplement free choice and year-round in a feed box protected from rain and moisture.

Mature sheep require all the fat-soluble vitamins: A, D, E, and K. They do not require supplemental B vitamins, which are synthesized in the rumen. Normally, the forage and feed supply contain all essential vitamins in adequate amounts, except vitamin A, which is sometimes deficient in dormant forage. However, sheep can store vitamin A for a considerable time. If ewes have been pastured on green forage or have had access to high-quality legume hay, vitamin A is not usually deficient.

In some areas, lambs may develop white muscle disease. This is thought to be caused from a deficiency of vitamin E, selenium, or both. Treatment is most effective with early diagnosis and injection of a vitamin E-selenium material (see page 26).

Creep Feeding. The objective of any farm sheep enterprise should be to develop thrifty, fast-gaining lambs that can be marketed at an early age. Creep feeding may help accomplish this objective.

The most efficient conversion of feed to weight gain occurs during the first 100 to 120 days of a lamb's life. Lambs can easily gain 1 pound per day in their first 70 to 80 days. In well-managed flocks of efficient, fast-gaining breeds, it is common for lambs to reach weights of 110 pounds at 120 days of age.

Young lambs gain 1 pound for every 3 to 4 pounds of feed consumed. By comparison, old-crop feeder lambs require 5 to 6 pounds of feed per pound of gain. There are several potential advantages to using a creep-feeding program:

- Increased weight gains, especially for multiple-birth lambs.
- Highly efficient feed conversion.
- Early marketing.
- Early growth and development of the lamb lessens the stress of early weaning.

When practical, start lambs on creep feed as soon after birth as possible. Ordinarily, lambs do not consume much feed until they are 3 to 4 weeks of age. However, the small amount consumed at earlier ages is critical for establishing rumen function in the lamb. Most studies have shown that if the intake of the creep ration does not average 1/2 pound per day from 20 days of age to weaning, then no increase in lamb performance is realized from creep feeding.

Provide a palatable creep ration to promote growth and development of the young lamb.

Locate the creep feeders where the lambs will use them. In a drylot, place the feeders in a convenient, dry, well-bedded, protected area. In pasture areas, place the feeders relatively close to water tanks, resting areas, or salt and supplement feeders.

To get lambs started on a creep, make sure the starter ration is palatable. Soybean meal in the starter ration increases palatability and provides additional protein. However, soybean meal is expensive. High-quality alfalfa hay, alfalfa pellets, and oat grain also are very palatable.

The creep ration does not have to be complex. It should provide at least 15 to 16 percent natural protein. A simple creep ration containing 80 percent grain sorghum, 10 percent oats, 10 percent oilseed meal, with alfalfa hay free choice should be adequate. Depending on the cost of grain, corn can be substituted for grain sorghum, and wheat or barley can replace half the grain sorghum. In general, young lambs prefer coarse, rolled grains and pelleted feeds. The cost of preparation can make the ration costly, but rate of gain and feed efficiency are increased by pelleting complete feeds, concentrates, and roughages. Pelleting also allows the producer to include different additives, standardize the grain-roughage ratio, and lessen feed waste. Do not feed dusty, moldy, wet feeds. If practical, give any feed left in the creep feeder daily to the ewes, and provide the lambs with fresh feed every day. Add antibiotics to creep rations according to a veterinarian's recommendations to provide some protection against low-level infections.

Individual management systems differ, but often it is feasible to discontinue feeding the ewes grain after the lambs are approximately 6 weeks old and are eating adequate amounts of the creep feed. It is more efficient to feed the grain directly to the lambs because they will convert the feed to gain more efficiently than the ewes can convert feed to milk to lamb gain.

Some producers wean lambs when they are 60 days old. Early weaning of 40 to 50 pound lambs can be successful, provided the lambs are consuming adequate amounts of feed. Research has shown that the ewe's milk production reaches a peak at about four weeks following lambing, and steadily declines to about half as much by the 10th week of lactation. About 74 percent of all milk is produced in the first eight weeks of lactation.

Feeding Lambs. If the farm enterprise is geared to producing marketable lambs in the shortest possible time, creep feeding the lambs early in life is essential to early weaning and to subsequent rapid development in the feedlot. The size of the lamb at weaning is more important than its actual age. Generally, lambs should weigh at least 50 pounds before weaning. Lambs that are on full feed at weaning generally have little difficulty adjusting to a feedlot environment.

After weaning, ewes can be placed on lower quality pasture because their nutritional requirements are low.

One of the biggest advantages of not pasturing the lamb with the ewe is that lambs have less chance of internal parasite infestation. In some situations, it can be more economical to wean lambs and place them on clean, high-quality, fresh pasture, while continuing to provide them supplemental feed. However, this method of finishing lambs does not maximize growth rate under most situations. Ordinarily, pastures are most efficiently used by old-crop lambs. Typically, older lambs can more economically use alfalfa, grain sorghum stubble, wheat pasture, and corn fields. Temporary woven-wire fences or electric fences can be used to effectively control grazing on such fields.

Usually, the lambs must be placed in a feedlot to be adequately finished for market. Intensive management is the key to success in lamb feeding.

In the feedlot, the first few days are the most critical. Generally, lambs have been transported long distances without adequate feed or water, and they often are highly stressed when they arrive at the feedlot.

Range lambs sometimes refuse to drink or eat. For this reason, drylot range-raised lambs for three to four weeks on the ranch so that the lambs know how to eat feed from a bunk and drink from a trough.

Feed newly arrived lambs a high-roughage ration (unless they have previously been adapted to a high-grain diet) and allow them to rest. Lambs should be

Feeding lambs on a large scale requires intensive management.

placed on feed cautiously and gradually adapted to the desired concentrate level.

As soon as the lambs are over the stress of relocation, treat them for internal and external parasites. Also, vaccinate them for enterotoxemia type D, and sore mouth.

Adequate feeding pens should be available so that the lambs can be sorted by size and fed accordingly. Immediately isolate weak or sick lambs. Size and age of lambs influence the ration composition. Heavy lambs must be finished more rapidly, so they need a ration with a higher level of grains for energy. Lighter lambs can be fed rations containing more roughage. Generally, lambs are started on rations containing 60 to 70 percent roughage. For general lamb feeding, where both legume hay and feed-grains are readily available, a ration of 50 to 60 percent grain and 40 to 50 percent hay can produce very economical gains while minimizing the occurrence of digestive disturbances. Growth stimulants such as Ralgro® also can be beneficial in improving lamb performance in the feedlot. Ralgro® has been shown to stimulate growth rate and to improve feed efficiency.

Lasalocid (Bovatec) also can be incorporated into feedlot diets. Lasalocid will help prevent coccidiosis while promoting growth and improving feed efficiency.

Sheep Health

Disease and health problems of sheep are closely associated with management and nutrition. Medication cannot cure results of poor management and poor nutrition.

The first step in controlling a disease problem is to identify the disease. Producers should seek professional help from a qualified veterinarian. Autopsies and accurate health records can be helpful in improving the overall health program. Any time drugs are administered to livestock, it is imperative that the drugs are used strictly as directed on the label, unless otherwise directed by a veterinarian.

Enterotoxemia (overeating disease)

Enterotoxemia in sheep can be fatal. It results from the sudden release of toxins by the bacteria *Clostridium perfringens* type D in the digestive tract of sheep. Enterotoxemia affects sheep of all ages, but it is most common in lambs under 6 weeks of age that are nursing heavy-milking ewes, and in weaned lambs on lush pasture or in feedlots. Creep-fed lambs and sheep being fitted for show are often affected. Frequently, the most vigorous lambs in the flock are lost. In unvaccinated feedlot lambs, approximately 1 percent of the lambs can be expected to die from this disease, with an average of about 2 to 3 percent. In severe outbreaks, losses may range from 10 to 40 percent.

The bacteria that cause the disease normally are present in the intestine of most sheep. Under circumstances generally brought about by heavy feeding, the *Clostridium perfringens* type D bacteria grow rapidly and produce a powerful poison (toxin) that is absorbed through the intestine wall. Death typically occurs within only a few hours, often before the owner observes any sick animals.

Conditions that can bring about enterotoxemia include changing feed suddenly, feeding excessively high energy diets, feeding irregularly, increasing the grain content of the ration too rapidly, not providing enough space at the feed-bunk, and feeding lambs of different sizes together. Heavy internal parasite burden also can cause this condition.

Occasionally, animals may be observed sick for a few hours before they die. Affected lambs frequently exhibit nervous symptoms, their heads are drawn back, and they exhibit convulsive grinding movements of the teeth, congestion of mucous membrane of the eye, and frothing at the mouth. In addition, diarrhea may be present shortly before death.

There is no satisfactory treatment for this affliction, but there are some preventive measures. Prior to placing lambs in a feedlot, vaccinate them with a *Clostridium perfringens* type D bacteria or toxoid. Allow at least 10 days after vaccination for immunity to develop. Under certain conditions, a booster shot is required two to four weeks later. Fast-gaining lambs grazing pasture or on creep feed may require a vaccination at 6 to 8 weeks of age. If they continue on high-grain rations, revaccinate them after weaning. Losses may be prevented in young lambs up to 6 weeks old by vaccinating the ewe during pregnancy. Ewes that have not been vaccinated previously should be vaccinated twice, two to four weeks apart, with the second vaccination administered two to four weeks before lambing. An annual booster two to four weeks before lambing is advisable.

Acidosis (grain founder)

Acidosis is similar to enterotoxemia, and many people confuse the two. Acidosis is an acute founder usually associated with high-grain diets. Excessive ingestion of feeds rich in starch or sugars, such as any of the grains, result in large quantities of acid being produced in the rumen. Affected animals typically die fast and decompose rapidly. Only an autopsy can definitely establish whether death is due to acidosis or enterotoxemia.

In feedlots, lambs may sort the feed in a self-feeder unless it is processed to prevent sorting. In these situations, acidosis can develop when lambs eat large quantities of concentrates and do not consume enough roughage. A sudden change in grain processing or improper mixing can initiate an outbreak of acidosis. Treatment is seldom effective. Prevention lies in a sound nutrition management program.

Tetanus (lockjaw)

Tetanus is a disease caused by *Clostridium tetani*, an organism commonly found in the soil. It is much more prevalent on farms where horses have been kept. The spores live in the soil for years and can present a continuing disease problem on some farms. The organism can infect sheep through wounds from shearing, docking, castration, or vaccination. The organism also

can be introduced into the reproductive tract by unsanitary humans who assist ewes during lambing.

Stiffness of limbs and difficulty in moving or walking are commonly the most noticeable symptoms of tetanus. These early symptoms are similar to those of white muscle disease, polyarthritis, erysipelas, and navel ill. Affected animals are easily excited and muscle spasms can occur. Later, the jaw may become rigid such that the animal cannot open its mouth. Spasms of the neck and back muscles cause extension of the head and neck. The hind legs are rigid and extended backwards. Affected lambs may fall when excited.

Few lambs recover from this disorder, and there is no satisfactory treatment. Where tetanus is a problem, it is important to take preventive measures. Elastrator bands are not recommended for tail-docking and castration in areas where tetanus is an annual problem. All surgical procedures should be performed under strict sanitation.

If infection is likely, vaccinating with tetanus antitoxin provides protection for about two weeks. Vaccinate at castration and/or tail-docking. When tetanus is an annual problem, generally the best protection is to immunize the entire flock with the toxoid. Ewes can be immunized with two injections 30 to 60 days apart. Ewes also should receive an annual booster just before lambing, though this injection can be incorporated into the aforementioned two injections.

White Muscle Disease

Nutritional muscular dystrophy (white muscle disease) is a degeneration of the skeletal and cardiac muscles of lambs. White muscle disease is most commonly found among lambs grazing irrigated pastures. The incidence is generally higher for lambs on legume pasture, creep feed, or other high-quality diets. Generally, ewes being fed high levels of alfalfa hay are most likely to have lambs suffering from white muscle disease.

The condition is related to deficiencies in selenium or vitamin E. Selenium deficiency can interfere with the transport of vitamin E.

White muscle disease may be present at birth. Affected lambs may die from starvation or exposure, and they are more susceptible to scours and acute pneumonia. The disease is more common in lambs 3 to 8 weeks of age, but it also occurs in older lambs.

The disease affects skeletal muscles, causing symptoms of progressive paralysis. Typically, the back is arched such that affected lambs cannot move properly, particularly off the hind legs. They have an open-shouldered appearance because the muscles of the shoulder girdle relax, and the forelegs may be spread excessively. Muscles of the heart, diaphragm, tongue, and esophagus are also commonly affected. Some lambs die suddenly from heart failure without prior clinical symptoms. This occurrence is usually stimulated by an increase of physical activity. More often, a slow progressive cardiac failure results. This leads to passive lung anemia and slow death from suffocation. If passive lung anemia occurs, the disorder can be confused with pneumonia.

The condition can be effectively prevented and treated with injections of selenium and vitamin E. Where white muscle disease is an annual problem, best results are obtained by giving ewes a selenium injection one to four weeks before lambing. If white muscle disease is diagnosed in a flock, all lambs should be treated at birth. Affected lambs respond positively to injections of selenium, or selenium and vitamin E. Including grain sorghum, wheat, and linseed meal in the ration of pregnant ewes and linseed meal in creep rations can reduce the incidence of this disease.

Pneumonia

Pneumonia is a major health problem among all ages and classes of sheep. It can be caused by a number of organisms and foreign bodies affecting the lungs. The combination of viral and bacterial microorganisms with an elevation in stress is the primary cause of acute pneumonia. Moisture and temperature extremes are major factors contributing to stress. In New Mexico, moisture generally is not a common stress factor, but the extreme temperature changes during the fall are.

Acute pneumonia can affect lambs from birth to yearling age. They are probably infected early in life by the causative microorganisms, but they may resist the infection until some stress occurs, such as extreme changes in temperature, exposure to dust, shipping, or extended periods without feed. Afflicted lambs generally weaken, refuse feed, appear gaunt, and breathe rapidly. Depending on the time it occurs, the condition often is referred to as shipping pneumonia or acute summer pneumonia. Proper management from lambing throughout the life of the lamb is necessary to minimize the incidence of pneumonia.

When shed lambing, keep the premises clean, dry, and as draft-free as possible. The lambing shed should be well ventilated and moisture should be kept to a minimum. Avoid over-confinement. Shear ewes before lambing to reduce infection from wool tags around the udder.

Proper nutrition of the ewes is important. Vitamin C deficiency has been associated with the incidence of pneumonia. Treatment should consist of using broad-spectrum antibiotics as directed on the label. Reducing stress and administering high levels of antibiotics during susceptible periods may be of some value in reducing the incidence of pneumonia.

Sore Mouth

Sore mouth is caused by a virus. It commonly affects nursing or recently weaned lambs, but sheep of all ages can be affected. The disease is characterized by the

formation of lesions, which progress into thick crust or scabs, on the lips. Often, an entire group of lambs will become infected. However, mortality is low.

Sore mouth is spread by direct contact. The incubation period depends on the amount of virus present and varies from 8 to 10 days. Lesions begin as small red spots on the lips, and scabs develop two or three days later. Occasionally, the nostrils, eyelids, and mouth also are involved. When the scabs are prominent on the lips, lambs may eat less because eating is painful. Loss of body weight can be noticeable. Occasionally, a lamb might die from starvation or secondary pneumonia induced by sore mouth. Nursing lambs may spread the infection to the teats of the ewes. When this occurs, it is not unlikely for mastitis to follow.

Use extreme care and sanitation in treating infected sheep because the virus can affect humans. Lesions are sometimes found on the hands and faces of people working with infected sheep.

Treating sheep with sore mouth has not proven very effective. However, applying a topical antibiotic ointment may help reduce the potential for secondary infection. Commercially available vaccines also can be used on infected premises or in feedlots to prevent sore mouth. Apply vaccines as directed on the label. Generally, the application entails creating a small lesion (scratch) on the inside of the thigh, and applying the vaccine to the lesion. Vaccination of lambs at tail-docking time is a good management procedure. Vaccinate show flocks at least one month before the beginning of the show season.

Urinary Calculi (water belly)

Rams and wethers in feedlots or on high-grain rations are most often affected by urinary calculi, but the condition can occur in sheep on succulent pastures or on grain stubble. Rations high in phosphorus or rations with a phosphorus-calcium imbalance are most often associated with a high incidence of urinary calculi in feedlot lambs.

Urinary calculi occurs when salts that are normally excreted in the urine precipitate and form stones. The stones then lodge in the kidney, ureters, bladder, or urethra. Generally, affected animals stand with an arched back and strain to pass urine. An animal may kick at its belly, prefer to lie down, and become dull and disinterested in feed or water.

Preventing the disease by proper management is essential because treatment often is ineffective. Sheep must have a clean, constant source of water. Avoid excess phosphorus in the ration. When high-concentrate rations (which are high in phosphorus) are fed, feed-grade limestone can be added to the ration to increase the calcium level above the phosphorus level.

Adding ammonium chloride to a ration at the rate of 0.5 percent (8 to 10 pounds per ton), or about 0.25 ounces per head per day, is one of the most effective methods of controlling urinary calculi. Ammonium chloride can be included in pelleted or ground concentrate rations during the entire feeding period, but it cannot be effectively mixed with whole-grain rations because it settles out and is not consumed. Ammonium chloride also can be used as a drench for affected animals. Use up to 1.5 ounces per head, but administer only once at that level. Smooth-muscle relaxants may aid in passage of lodged calculi stones. Calculi also can be removed by surgery, but this is not practical for commercial sheep.

Polyarthritis (stiff lamb disease)

Polyarthritis is an infectious disease of nursing lambs, recently weaned lambs, and feedlot lambs. Symptoms are stiffness, reluctance to move, depression, loss of body weight, and conjunctivitis. Clinically the disease is primarily characterized by stiffness and by conjunctivitis. Usually the affected lamb's appetite remains good, but it may be too lame to graze or search for food. Affected joints are typically not enlarged, and stiffness and lameness are less apparent after lambs are forced to exercise. Kneeling and abnormal position of the limbs are sometimes observed. Lambs can be treated with several different broad-spectrum antibiotics or tetracycline drugs. Affected lambs should be confined in a dry, well-bedded area with readily available feed and water. Additionally, supplying antibiotics in the feed can be beneficial in feedlot conditions. Early isolation of lame lambs during an outbreak and addition of specific antibiotics to the feed may help control the disease.

Navel Ill (joint ill)

This disease affects young lambs and causes stiffness and swelling of the leg joints. Occasionally, the navel area also is infected. Navel ill is caused by bacterial infection and is usually associated with contamination of the umbilical cord in unsanitary lambing quarters. The navel cord of all newborn lambs should be disinfected with iodine.

Blue Tongue

Blue tongue is an insect-borne, viral, noncontagious disease that occurs in some areas of New Mexico. It is transmitted from infected animals to susceptible sheep by the bites of a small insect commonly referred to as a gnat. The disease normally occurs from midsummer until frost. Early symptoms usually include excessive salivation, reddening of the lips and mouth, and progressive darkening of the vascular areas of the mouth. Furthermore, the muzzle, lips, tongue, throat, and sometimes the ears and neck become swollen. Occasionally, sheep suffer from severe lameness as well. Not all signs of blue tongue appear in a single sheep or even in a single outbreak.

Best control methods involve controlling the gnat. Since this insect breeds in the mud along the edges of slow-moving streams or water tank overflow, try to eliminate these breeding sites. Breeding sites also can be sprayed with insecticides.

A modified live-virus type of vaccine is available, but it is estimated that six to seven different viruses cause blue tongue. Occasionally, the vaccine may cause a reaction that is nearly as bad as the disease itself.

Pregnant ewes, particularly in the first 50 days of gestation, should not be vaccinated. No satisfactory medical treatment has been found for animals with blue tongue. Generally, with proper care, most animals recover naturally within 14 days, although severely affected animals may recover more slowly. Isolate affected animals in a shaded area with palatable feed and fresh water. Antibiotics are of no value in the treatment of blue tongue, but they are helpful in preventing secondary infections.

Pregnancy Disease (ketosis, pregnancy toxemia)

Pregnancy disease is the most common metabolic disease of sheep. It affects improperly fed ewes in late pregnancy. Often it is observed in overly fat ewes and ewes in poor condition. Almost always, affected ewes are carrying twins or triplets. It is generally accepted that the basic cause of pregnancy disease is a carbohydrate metabolism disturbance that is associated with, or results in, low sugar levels, ketosis, depressed liver glycogen, and fatty infiltration of the liver. The disease is usually fatal.

From 60 to 80 percent of the growth of the fetus occurs during the last six weeks of pregnancy. If twins are present, the increase in total weight is considerable. The total metabolic rate increases by at least 50 percent during late pregnancy. Compared to dry ewes, ewes in late pregnancy require about 50 percent more feed if bearing a single lamb and about 75 percent more feed if carrying twins. This amount of feed may exceed their intake capacity unless grain is substituted for part of the ration.

It is likely that inadequate nutrition most commonly renders ewes susceptible to the disease, but many stresses can trigger pregnancy disease. Undernourished ewes may begin showing symptoms after they have been hauled or driven, during shearing, during short periods of fasting, during storms, during extreme cold or heat, or when they are excited by predators. Ketotic ewes normally lag behind the others when the flock is moving.

The nutrient intake of ewes must be increased during the last three to four weeks of pregnancy. Grains are especially effective in providing a higher energy level. Ewes should not be allowed to become fat in early pregnancy, but they should be maintained in good condition. Avoid severely stressing ewes during the last three to four weeks of pregnancy. Avoid drenching and excessive working in corrals during this period.

Treatment of this disorder usually is unsuccessful. However, intravenous administrations of glucose may be effective in the early stages of the disease. However, glucose (200 mL twice daily) given in this manner is used up rapidly, and frequent injections are necessary. Administering propylene glycol as a drench (2 ounces three or four times a day) is a common treatment for affected ewes.

Grass Tetany

Grass tetany can affect lactating ewes in the spring when ewes are allowed to graze rapidly growing or lush pasture. The disorder can occur any time there is an abrupt change to lush, rapidly growing forage, especially after irrigation and heavy nitrogen fertilization. Grass tetany is characterized by too little magnesium in the blood, but a low blood calcium level also may be present. Low magnesium concentration in the feed is usually a factor in the development of grass tetany, but the disease can occur even if the feed is not deficient in magnesium.

Affected sheep become separated from the flock and show muscular tremors, nervous excitement, and a staggered or stiff gait. Finally, they go into convulsions. The animal may appear intoxicated. Death usually occurs within a few hours. Attacks can be brought about by the excitement associated with moving or working sheep. Lactating and older ewes are most often affected.

If sheep are grazing early growth of cereal grains or heavily fertilized pastures, provide supplemental magnesium. Feeding dry alfalfa hay to penned ewes at night aids in preventing the disease. Magnesium oxide at the rate of 0.25 ounce per head per day can be mixed with grain or provided in pelleted rations. A mineral mix containing 16 percent magnesium oxide provided in the corral or loafing area also may be effective.

Mastitis (bluebag)

Mastitis is an infectious disease of sheep. There are two recognized types of mastitis, but the gangrenous type (bluebag) is more severe. With bluebag, gangrene develops rapidly in the udder; ewes become sick, depressed, and feverish. As the infection progresses, the udder, or more commonly, half the udder, becomes hard, red, and swollen. The pain often causes the ewe to limp as she tries to avoid hitting the udder with the rear leg. Affected ewes usually do not let lambs nurse. Within a day or two, the udder generally becomes very hard, gangrene develops, and the udder turns blue. Death occurs in about 25 percent of cases. In ewes that recover, the affected portion of the udder remains nonfunctional. In those that survive, the affected portion of the udder sloughs off.

The nongangrenous type may go unnoticed. The udder becomes hard, swollen, and inflamed, and the milk clots. Abscesses may form in the udder. Milk production is generally reduced, and the udder, or half of udder, becomes nonfunctional. Survival rate is greater than with the gangrenous type of mastitis.

The incidence of mastitis is greater in closely confined flocks than in flocks that are allowed to bed on relatively clean ground. The disease may be spread by the lamb of an infected ewe attempting to nurse other ewes or by milk excreted on the bed ground. Milk and fluids should never be "milked-out" of the teats in an area where other ewes may contact with the fluids. Separate affected ewes from the main flock and treat with antibiotics as recommended by a veterinarian. Examine the udders of all replacement ewes annually before breeding, and cull any ewes with hard udders.

Chlamydiosis

Chlamydiosis is a highly contagious infection that commonly occurs in sheep flocks of the western U.S. However, because laboratory confirmation of chlamydial abortion can be difficult, the true incidence is not easy to quantify and many infections are not reported. The organism that causes chlamydiosis is *Chlamydia psittaci*. Among flocks were the disease has been present for several years, most of the older ewes are immune and the annual abortion rate is around 1 to 5 percent (primarily due to ewe lambs and yearling ewes aborting during their first pregnancy). However, in recently infected flocks, or among nonimmune ewes recently introduced to an infected flock, the abortion rate can be as high as 30 percent. Lambs born weak at birth also are common.

The infective organism is excreted in high numbers in the aborted fetal membranes and fluids. Transmission often occurs when susceptible ewes lick the aborted fetus or consume feed or water that is contaminated by the aborted fluids or tissues. Once ingested, the infective agent incubates and can cause abortion within about 60 to 90 days. Ewes that become infected late in gestation may have weak lambs. Nonpregnant ewes and lambs and ewes in the final stages of gestation may become infected and harbor the organism until the next pregnancy, when they abort. Aborting ewes generally do not get sick unless secondary infection occurs.

Treatment of chlamydiosis usually is not an issue because ewes normally show no signs prior to abortion. However, prevention depends on interrupting the infective cycle. Removing afflicted ewes from the flock for several days after abortion and discarding the aborted fetus and fluids will lower the level of contamination. Additionally, feeding farm flock sheep in feeders may prevent them ingesting feed that has been contaminated on the ground. Vaccinating ewes will increase their disease resistance, but the resistance is neither absolute nor long-lasting. In flocks infected with *Chlamydia psittaci*, adding tetracyclines to feed for daily consumption throughout the lambing period may reduce the incidence of abortion. In flocks that experience some chlamydial abortions annually, prophylactic administration of tetracyclines in the feed during gestation may be beneficial.

Campylobacteriosis (vibriosis)

Vibriosis has been reported in different areas of New Mexico. This disease is caused by a bacterium, but it is not the same organism that causes the infection in cattle. Ewes afflicted with vibriosis abort in late pregnancy or occasionally give birth to dead or small, weak lambs. Ewes rarely show symptoms before aborting. After abortion, there is usually a brown, foul-smelling vaginal discharge. Aborting ewes usually recover completely without treatment and are immune to the effects of the disease in following years. The source of the infection is not completely understood, though birds and rodents could be carriers.

During and before lambing, sanitation is very important. If a ewe aborts, separate her from the flock and destroy all the placenta and aborted material. Commercial vaccines are available. Administer the vaccine prior to the breeding season. Antibiotics have been beneficial in controlling vibriosis outbreaks, but early diagnosis is essential. Feeding antibiotics for the last six weeks of pregnancy has been shown to significantly reduce abortions. Two consecutive daily injections of penicillin dihydrostreptomycin, administered five to six days after experimental infection, may reduce the number of abortions.

Epididymitis

Epididymitis is a disease that affects one or both testicles of the ram and may cause complete or partial infertility. The primary symptom is the development of a lump in a portion of the epididymis. The lump or lesion most commonly affects the tail of the epididymis and may be detected by palpation of the scrotum. The testicle itself usually is not involved. Rams with epididymitis produce semen of poor quality; the use of such rams is a major cause of poor conception rates. Examine all rams in the flock before the breeding season and again at shearing time. Immediately separate any affected ram from other rams and mark for slaughter only. Epididymitis can be transmitted by homosexual contact.

Sheath Rot

Sheath rot is caused by a bacterium and urea reaction from the urine. The reaction causes irritation of the prepuce. Sheath rot primarily occurs in rams on high-protein rations. Control of sheath rot consists of changing the ration. To reduce the potential for sheath rot, sheep can be grazed on dry grass pastures or fed a grass

hay in a drylot. External lesions associated with sheath rot can be treated with one part copper sulfate and eight parts of petroleum jelly, or with antibiotic ointments.

Ulcerative Dermatosis

This contagious disease of sheep is caused by a virus. Lesions of the prepuce, penis, and vulva occur as a result of transmission by breeding. In early stages of infection in rams, a small lesion on the prepuce may be the only visible lesion, so it is difficult to differentiate from sheath rot. As the condition spreads, the penis becomes infected and the ram may be unable to breed because of swelling and secondary infection. To minimize disease transmission, remove infected animals from the flock and do not return them until they are completely recovered. Recoveries with or without treatment normally require two to eight weeks. Treatment is of value if secondary infection occurs or if severe ulcerations interfere with the animal's ability to eat or walk. The scab may be removed from the ulceration and copper sulfate solution or other antiseptics applied.

Internal Parasites

Closely follow a drenching program for all sheep grazing on irrigated pastures. Often, treatment is too late if it is delayed until a diagnosis is made. In general, moist conditions and temperature should influence the time of drenching. Seasonal treatments should be designed to reduce worm burdens at critical periods. Treatment at these times should have two objectives: first, to prevent the build-up of heavy infections in the animal, and second, to reduce contamination of pastures with worm eggs. Drenching ewes before they are put on pasture, during the summer as needed when they are rotated to fresh pasture, and in the fall before they are placed in a

When drenching sheep, use one hand to close the nostrils and mouth until the sheep swallows the solution.

After shearing, treat sheep for external parasites with a pour-on dust, spray, or dip. Many producers with closed herds have completely eliminated the sheep ked with successive treatments and no longer have to apply insecticides after shearing.

drylot or on field cleanup, could fit into many management plans.

A drenching program can be adapted to the production system. Drenching lambs at weaning is beneficial in preventing a build-up of parasites. Lambs are much more susceptible to parasitism, although lambs that are born early and marketed without going to pasture usually do not need to be drenched. Throughout the year, alternate between at least two different drenches. If only one product is used, parasites that are not eliminated can become at least partly resistant to that particular drench. Common drenching products include phenothiazine, thiabendazole, Tramisol, Loxon, and Ivermectin. Sheep may have free access to phenothiazine salt mixture during the pasture season, but this should not replace a regularly scheduled drenching program.

External Parasites

The most common external parasite is the *sheep tick* or *ked*. The ked is a wingless fly. It lives on the sheep and sucks blood from the skin. It causes irritation and restlessness, and tick residue can detract significantly from the character of the fleece, ultimately affecting its value. Additionally, ked infestation will cause cuckles (raised blemishes) on the hide, resulting in a discounted hide or pelt value.

Three species of *lice* occasionally infest sheep. The usual symptoms of louse infestation are scratching and rubbing. This can affect the quality of the wool. Often the wool becomes matted and entangled because of excessive rubbing. Control measures are much the same for sheep ticks and sheep lice. These should be controlled by following a yearly spraying, dusting, or dipping program using only insecticides recommended and approved for that specific use. Currently, the pour-on treatments (synthetic pyrethroids) are the most popular and most effective for treatment of keds and lice.

Several species of *flies* attack sheep that have open sores, wool that is bloody from lambing, or wool soiled with urine and feces following grazing on green pastures. Adult blow flies lay eggs on damp or soiled wool. Maggots soon hatch and feed on the wet wool adjacent to the skin, causing the wool to loosen. Open sores infested by the maggots may become infected with bacteria.

Sheep should be tagged or crutched when favorable conditions for fly strike exist. To treat sheep for wool maggots, shear and treat the affected areas with a smear, spray, or aerosol product approved for fleece worm or wool maggot control. Approved insecticides change from year to year, so ask your county Extension agent or local veterinarian for the latest recommendations for approved insecticides.

General Management

Ram Management

It is important not to turn new rams in with the ewes as soon as they are brought to the premises. Separate the rams from the ewes for at least two weeks, treat for external parasites, and observe them carefully for contagious diseases before allowing them to breed any of the ewes.

The rams should be strong and in good condition at breeding time. If a ram is thin, or if he appears to be losing weight during the breeding season, it may be necessary to feed him separately from the ewes. Ordinarily, 1 to 1.5 pounds of oats or a grain concentrate mixture with good quality hay is sufficient. Ram lambs may need more concentrate. Also, shear rams about a month before the breeding season.

Lambing Methods

The ewes may be lambed in a lambing shed. With an abundance of high-quality pasture, it is possible to lamb successfully on pasture. Normally, however, a higher percentage of the lambs can be saved when ewes are lambed in a shed or other closely confined area. Lambing method depends on available labor, available facilities, and relative returns.

Shed lambing. Shed lambing requires adequate space to house lambing pens for at least 10 percent of the ewe flock. Lambing pens are usually 4 x 4 foot or 4 x 5 foot enclosures (jugs or jails). Large breeds may need 5 x 5 foot pens. Very often, machinery sheds or other existing buildings on the farm can be used during the lambing season.

Lambing pens should be in a draft-free area of the shed or barn. Prior to lambing, thoroughly prepare the lambing area. Clean the area, erect lambing pens, install necessary heat lamps, and obtain medication.

Gestation typically ranges from 147 or 152 days. However, some ewes may lamb a week early, so it pays to be ready.

Pasture lambing. Compared with shed lambing, feed costs are generally lower for pasture lambing. However, it is usually not possible to save as many lambs because it is impossible to observe all the ewes closely and frequently. However, even when lambing in the pasture, ewes not claiming their lambs or ewes that have extremely weak lambs should be placed in lambing pens. It is usually not advisable to lamb yearling ewes on pasture unattended. However, in New Mexico this is often the only practical method. When yearling ewes are lambing on pasture, graze them in a pasture where they can be observed relatively frequently, such as a trap close to the house or corrals.

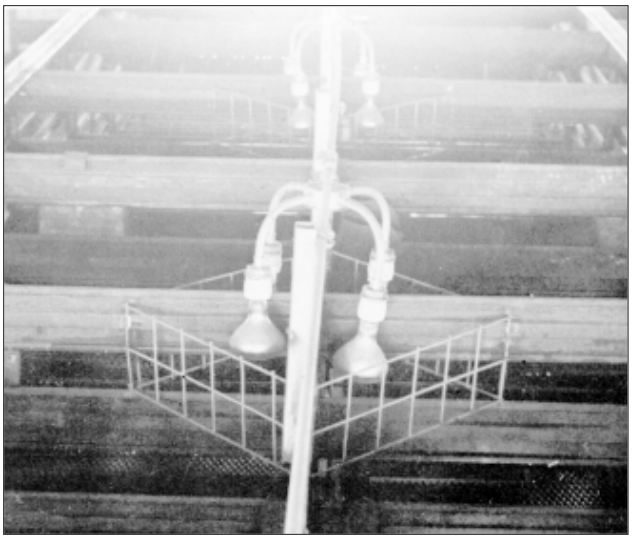
Shearing

In New Mexico it is a good practice to shear ewes at least four weeks before lambing. This makes it easier for lambs to nurse and improves sanitation. Fleeces are cleaner and freer of stains if the ewe is shorn prior to lambing. Plus, it is easier to tell when a shorn ewe is about to lamb, and more ewes can be maintained in a smaller area of the shed. Occasionally, if shearing is done immediately before lambing and the ewes are handled roughly, some lambs may be born prematurely and some ewes may experience ketosis. If the ewes are not shorn before lambing, the area around the dock and udder, and between the legs should be shorn. This procedure is called *crutching* or *tagging*.

Management at Lambing Time

Lambing time is probably the most critical period in the year. The higher the percentage of lambs kept alive, the higher gross and net return. Observe ewes closely during the lambing period. Many producers check their ewes frequently during the night as well as during the day. Give the ewe assistance if she is unable to deliver naturally. It is always best if the ewe is allowed to have her lamb naturally. Occasionally, pulling a lamb makes a ewe reluctant to claim the lamb.

If the ewe is having difficulty lambing, wash your hands thoroughly with soap and water and apply some lubricant before examining the ewe via the vagina. Lambing difficulties can result from the lambs being too large, the ewe having a small pelvic area, or both. Quite often, however, lambs are in an abnormal position. The normal position is with the head between and slightly above the front feet. If the lamb is coming forward with one or both legs turned back, or the head is turned back, first straighten the legs and neck. It is preferable to have both legs straight, but many lambs can be delivered with the head and one leg forward.



Lambing pens that are clean, free of drafts, and equipped with adequate heat lamps should be an integral part of all intensified production programs.

The first few hours of a lamb's life are the most critical. If the lamb does not nurse shortly after birth, it will weaken rapidly. Colostrum must be available to provide energy, protein, minerals, vitamins, and antibodies that provide the lamb with vital resistance to disease.

If the back legs are presented first, the delivery should be made in this position as rapidly as possible. Remove membranes and mucous from the lamb's face and mouth immediately after delivery, and lift the lamb by its hind legs to clear mucous from the nose. Applying gentle pressure to the rib cage can stimulate breathing. Blowing into the lamb's mouth may also be effective. As soon as the lamb is breathing properly, allow the ewe to lick the lamb clean. Then treat the navel with a 7 percent iodine solution; strip each teat on the ewe to remove the plug and to be sure that the ewe has colostrum available.

If it is extremely cold, a heat lamp over the lambing pen may be beneficial. Only use heat lamps long enough to dry the lamb. Prolonged use of heat lamps tends to increase a lamb's susceptibility to pneumonia.

The first few hours of a lamb's life are the most critical. If the lamb does not nurse shortly after birth, it will weaken rapidly. The lamb should only receive assistance to nurse if it is necessary. Best results are obtained if the lamb is allowed to nurse naturally, without assistance. Occasionally, very weak lambs may need supplemental colostrum. Colostrum must be available to provide energy, protein, minerals, vitamins, and essential antibodies that provide the lamb with vital resistance to disease. Very weak lambs may be fed with a stomach tube. Weak lambs may also be revived with a subcutaneous injection of 25 to 50 mL of a 5 percent dextrose solution.

It is essential to know that the lamb consumes colostrum soon after birth. Starvation is the major cause of death in very young lambs. Therefore, keep the ewe and lamb or lambs in a lambing pen until the lambs are strong and healthy and no problem is observed with the ewe. Often, a ewe with a single lamb can be removed from the lambing pen in 24 hours; ewes with twins usually can be removed after two days. The ewe and her lamb should be identified with corresponding numbers if possible. Overall flock production efficiency will also be enhanced if ewes with single lambs are separated from ewes with twin lambs, and fed accordingly. Ewes nursing a single lamb should receive approximately 1 to 1.25 pounds of grain concentrate daily, while ewes nursing twin lambs should receive 1.50 pounds or more of grain concentrate daily.

Grafting Lambs

If a lamb is not receiving enough milk from the ewe (because of triplet lambs, ewes with bad udders, or some other reason), it is a good management practice to graft the lamb onto another ewe or to feed the lamb artificially.

There are several methods of grafting lambs, such as using special sprays to make the ewe accept the lamb. The most successful method is as follows: locate a ewe in the process of lambing a single lamb. After her lamb

Scourable paints should be used sparingly so wool quality is not adversely affected.

is delivered, check to be sure that she is not going to have another lamb. Do not let her get up until the lamb to be grafted has been brought over and thoroughly saturated in the placental fluids the ewe has just excreted. Then rub the lamb that is being grafted together with the newborn lamb. Tie the legs of the newborn to the lamb that is being grafted. Then allow the ewe to get up and lick the lambs. If the grafted lamb is thoroughly saturated and rubbed together with the newborn lamb, the ewe usually cleans both lambs and readily accepts both.

Then place the ewe and the two lambs in a lambing pen, keeping the lambs tied together until she has thoroughly cleaned both lambs. The lambs can then be untied and allowed to nurse. It may be necessary to restrict the older grafted lamb from nursing too much until the newborn lamb has had a chance to receive its share of the colostrum.

Occasionally, ewes refuse to claim their lambs. This is more common with ewes lambing for the first time. If ewes tend to do this year after year, they should be culled. There is not a best method of getting a ewe to claim her offspring. However, one method is to put the ewe in a stanchion and tie the ewe with a halter until she allows the lamb to nurse.

Tail-Docking and Castration

Lambs should be tail-docked and castrated at about 7 to 10 days of age. There is less bleeding and lambs heal more quickly when these operations are done at an early age. Elastrator rings may be used, but they are painful

At an early age, dock tails on the end of the caudal folds on the underside of the tail.

and there is a greater likelihood of tetanus. A pocket knife, emasculator, or burdizzo is very effective.

Cut off tails about 1 inch from the body. A good place is at the end of the caudal folds on the underside of the tail. Push the skin on the tail toward the body before cutting to allow enough loose skin to cover the end of the stub. If tetanus is a problem, vaccinate the lambs for this disease. (Your county Extension agent has more detailed instructions for these operations.)

Colostrum

Colostrum, the first milk produced by the ewe, is essential to the newborn lamb. Colostrum contains high levels of antibodies that are necessary to combat infections. It is also rich in various vitamins and minerals. Lambs must be provided colostrum within the first eight hours after birth for protection with the antibodies. If colostrum is not available from the ewe, the lamb can be allowed to nurse another ewe that just lambed, or colostrum can be obtained from heavy-milking ewes, goats, or cows and frozen in ice-cube trays in preparation for the lambing season. The colostrum cubes can be thawed (not in a microwave) and used as needed. Feeding 4 to 6 ounces of colostrum per lamb every four to six hours during the first 18 hours after birth has proven satisfactory. In the event that natural colostrum cannot be obtained, a synthetic colostrum may be used. One popular formula consists of 24 ounces of cow's milk, 1 beaten egg, 1 teaspoon cod liver oil, and 1 heaping tablespoon of sugar. Feed this formula at the rate of 6 ounces per lamb, four times daily. This substitute colostrum is more valuable than no colostrum, but it does not contain the necessary antibodies.

Artificial Rearing of Lambs

Orphan lambs can be successfully raised on milk replacer, goat's milk, and, occasionally, cow's milk. However, cow's milk contains less fat than ewe's milk. Milk goats can raise several orphan lambs each. Commercial milk replacers are available for lambs. These contain 30 to 32 percent fat, 22 to 24 percent crude protein, and 22 to 25 percent lactose. Do not use calf milk replacer on lambs.

If only a few lambs are to be raised on milk replacer, they can be bottle fed, if labor is available. However, they must be fed every four hours during the first week and then every six to eight hours until they are weaned.

Orphan lambs can be raised successfully on commercial milk replacer with a dispensing system that provides cold milk, free choice.

With newly developed systems, it is possible to feed several lambs at the same time. A milk dispensing system provides milk free-choice. In this situation, mix a new batch of milk replacer each day. Generally, milk-feeding systems use the lam-bar nipple (a rubber teat connected to a polyethylene tube). The teats are connected through a hole in a metal plate inside the lamb pen panel with tubes leading to a bucket of milk outside the pen. As the lambs stop nursing, there is no leakage from the nipple because the milk returns to the bucket by gravity flow.

Research shows that feeding cold milk is much more beneficial than feeding warm milk when the lambs are on a self-feeding system. The cold milk is not as likely to

spoil and lambs do not overeat, so they have fewer digestive disorders. Keep the milk cold by placing plastic jugs full of ice in the feeding unit.

Offer creep feed to the lambs soon after they have started on liquid milk replacer. Soybean meal is an excellent feedstuff to include in creep feed for very young lambs. The starter creep should contain 17 to 20 percent protein. Ordinarily, lambs are weaned from the milk replacer in four to six weeks.

Space Requirements for Sheep Production

The amount of space required for efficient sheep production varies with the breed, level of productivity, drainage, and management system. See table 4 for the average space requirements under most conditions, according to the 1974 Mid-West Planning Service's *Sheep Handbook*.

Well-planned facilities, such as this gate with two pens entering into the cutting chute, facilitate handling and working of sheep.

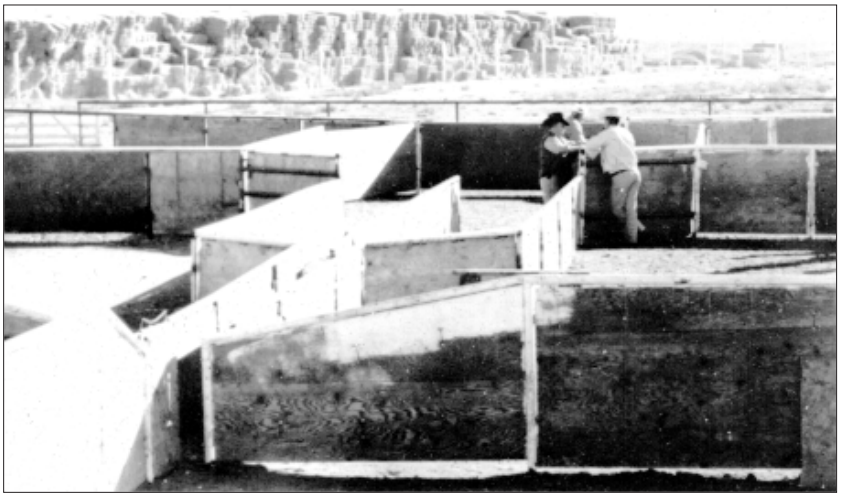


Table 4. Space requirements for sheep production.

Feeder space	
Group-fed:	
	16 to 20 inches per ewe
	9 to 12 inches per feeder lamb
Self-fed:	
	10 to 12 inches for silage per ewe
	8 to 10 inches for hay per ewe
	3 to 4 inches per feeder lamb
Creep-fed:	
	1 to 1.5 inches per lamb
Water	
Per automatic bowl	
	40 to 50 ewes or ewes with lambs
	50 to 75 feeder lambs
Per foot of tank perimeter	
	15 to 25 ewes or ewes with lambs
	25 to 40 feeder lambs
Shelter space	
Open-front building with lot:	
	10 to 12 square feet per ewe
	12 to 16 square feet per ewe and lambs
	6 to 8 square feet per feeder lamb
Lot:	
	25 to 40 square feet per ewe
	25 to 40 square feet per ewe and lambs
	15 to 20 square feet per feeder lamb
Lambing pens	
4.5 x 4.5 x 3 — depending on size of ewes	
Creep panels — adjustable opening of 6 to 10 inches	

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