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Reproductive management in sheep and goats

ESGPIP

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Foreword

This Technical Bulletin titled "*Reproductive management in sheep and goats*" is the 36th produced by the Ethiopia Sheep and Goat Productivity Improvement Program (ESGPIP). The ESGPIP is a USAID funded Project with the objective of improving the productivity of Ethiopia's sheep and goats.

Reproductive efficiency is one of the major determinants of the success of a sheep and goat enterprise. One should, therefore, aim at optimization of reproductive performance. This can be done by following reproductive management procedures that can be implemented at all systems of sheep and goat husbandry.

The ESGPIP is currently distributing improved sheep and goat genotypes to upgrade the productivity of indigenous stock. Optimum benefit from these animals can only be obtained through appropriate reproductive management to obtain the maximum possible number of offspring.

This technical bulletin presents reproductive management procedures and steps that need to be taken by sheep and goat producers. It is, therefore, believed that the information contained in this bulletin is useful for supporting the genetic improvement effort pursued by the ESGPIP in collaboration and partnership with Federal and regional bureaus of Agriculture. It is also useful for other users that want to be engaged in business ventures based on sheep and goat production.

At this juncture, I would like to thank all those involved in the preparation and review of this technical bulletin.

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Reproductive management in sheep and goats

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1. Importance of Reproduction

Success in sheep and goat production to a large extent depends on optimum level of reproductive performance of the herd or flock. The number of animals born and reared successfully to marketable weight, the percentage of ewes and does regularly reproducing, and the existence of proven sires (rams/bucks) with the ability to produce offspring will directly affect profitability of a sheep and goat production enterprise. Reproduction is so important that some people equate it with production.

Reproduction = Production

For this reason, due consideration has to be given to all aspects of reproduction in a sheep or goat enterprise. Producers need to be equipped with basic management tools not only to enhance reproduction but to identify reproductive problems and take timely action to solve them. This technical bulletin will deal with reproductive management tips that could benefit producers and extension agents.

2. Reproductive traits of economic importance

Reproductive traits of economic importance in sheep and goats are age at puberty, litter size, lambing/kidding interval, lamb/kid survival, ewe/doe fertility, and fertility of bucks and rams.

Table 1. Definitions of reproductive traits

Traits	Definitions	Trait values
Puberty	Age when the animal *first* exhibits behavioral estrus. In males, it is the stage of growth when they are able to produce spermatozoa capable of fertilizing an egg.	5 to 8 months for most tropical breeds
Age at first lambing/kidding	The age of ewe/doe at the time of first parturition	12-15 months
Litter size	The number of lambs/kids born per ewe/doe lambing or kidding	1.0 – 2.0
Lambing/kidding interval	The interval between successive lambings or kiddings	About 8 months for tropical breeds
Lamb or kid survival	The number of young surviving to a given age usually 3 months	A survival rate of 85 % is usually accepted

Age of puberty: There are several factors that influence reproductive traits. In the tropics, nutritional status and breed rather than photoperiod are important influencing factors. Age, weight and growth rate interact in determining the onset of puberty. For instance, a faster growth rate (post weaning) enables kids and lambs to attain puberty at younger ages. Though both energy and protein are important dietary factors affecting age of puberty, research has shown energy restriction has greater influence in delaying onset of puberty than protein restriction.

Breed differences in age at puberty are known with crossbred females (F_1) coming to estrus earlier than females of local breeds. It does appear that age at puberty is related to rate of maturity with earlier maturing breeds exhibiting estrus earlier than later maturing breeds.

When to breed a ewe lamb or doeling? The period from weaning until first breeding is usually considered an unproductive period. Life time productivity can be increased by shortening this period which will be particularly beneficial in intensive production systems.

Care must be taken that females have developed to the point of supporting reproduction before being bred. Manipulation of feeding practices can be used as a tool to induce earlier onset of puberty. Research has shown that supplementation that improves growth rate reduces age at first breeding. Oilseed cakes, feed blocks, wheat bran could be used as supplements. Use of feed blocks is a very promising solution to boost reproductive rate because the composition, quality, and timing of the supplementation can be precisely controlled by producers, thus allowing ease of focused feeding to mange flock reproduction. The level of supplementation depends on the quality and quantity of grazing herbage.

Ewe lambs and doelings may be bred at 7 to 10 months of age, depending on breed. As a rule of thumb it is advisable that they attain 60 to 70 % of their mature weight and have an acceptable body condition score (BCS) of 2.5 before being bred. Ewe lambs and doelings having BCS of less than 2 should not be bred. (To learn how to body condition score, see ESGPIP Technical Bulletin #8 Body Condition Scoring of Sheep and Goats.).

Depending on the breed and feeding conditions, ram lambs or bucklings could attain puberty and start giving service at 5 months of age. Weight, BCS and age should be considered in determining the appropriate time to begin using young males for breeding. Some exceptional ram lambs or bucklings can be assigned to mating groups at the age of 7 months.

Litter size: Litter size is a combination of ovulation rate and embryo survival. Litter size in does varies from 1.08 to 1.75 with an average of 1.38 kids born. In general, sheep and goats in the lowland areas produce singles, e.g., Somali goats and Black Head Somali sheep, and this has been attributed to the fact that pastoralists have selected against high litter size. Under harsh environmental conditions, such as those found in pastoral areas, multiple bearing ewes/does and their young ones could be at a higher risk of nutritional deprivation than their single bearing counterparts.

Table 2. Litter size of some breeds

Species	Location	Litter size
Menz	Highland	1.07 (primiparous)
		1.12 (mature)
Horro	Highland	1.34
Arsi-Bale (Adilo)	Adillo	1.42
Arsi-bale (kofele)	Kofele	1.24
Somali Goat	Hawassa	1.01

The Boer goat is known for its high liter size. Average litter size is close to 2. About 50% of does produce twins and 10 to 15% produce triplets (Lu, 2002). Full meat production potential could only be utilized by exploiting their prolificacy.

Flushing: Flushing is a feeding management technique commonly used to increase litter size. Flushing is defined as temporary but purposeful elevation in the plane of nutrition prior to and a few weeks after mating. The main purpose is to bring ewes/does into good body condition prior to breeding. This practice will increase ovulation rate (number of ova released), increase conception, and improve embryo survival and consequently increase multiple births. Inadequate nutrition is one of the many factors suggested as a cause of embryo loss. Other added advantages of flushing include decreased percentage of barren ewes and reduced percentage of still births.

- **Duration of flushing:** The duration could vary depending on body condition of females and available forage biomass. Usually a period of 3 weeks before and 3 weeks after the mating period is considered ideal.
- **What types of feeds are suitable for flushing?** In most cases energy feeds like maize, barley, etc., can be fed at a rate of 250 to 300 g daily. Flushing with high protein feeds is advantageous when sheep or goats are on a protein-deficient diet such as low protein pasture. At times, good quality forage can be used for flushing instead of grain. However, it is not recommended to use legumes for flushing (such as fresh alfalfa, clovers and vetch) because they contain estrogen-like compounds that can interfere with ovary function. Response to flushing is greatest in animals with below average BCS, especially those that had been stressed by a heavy lactation. Mature females respond better than young ones.

3. Estrous signs

In systems where females are kept separately from males, identification of animals in heat to allow mating at the appropriate time is crucial. Thus, producers need to be familiar with signs of estrus. Estrous signs for sheep and goats are given in Table 3

Table 3. Signs of estrus in sheep and goats

Sheep	Goats
Restlessness	Restlessness
Frequent urination	Frequent urination
Going off feed	Going off feed
	Decreased milk production
Seeking out the ram and standing to be mounted by him or other ewes	Constant vocalization/bleating
Rapid tail movement	Occasionally mounting other does
Raised tail in the presence of the ram	Constant tail wagging from side to side termed as tail flagging
Standing still when being mounted by ram	Standing still when mounted by buck

Figure 1. The surest sign of heat is 'standing heat'

Physical signs include redness and swelling around the vulva because of increased blood supply and mucus discharge. The consistency of mucus discharge from the vulva changes during the cycle. It is clear and stringy at the beginning of the cycle. However, the color and consistency changes gradually to become thick and white at the end of the estrus period. Compared to does, detection of estrus in ewes which are separated from rams over a period of time is difficult. Diminished estrus behavior is evident when ewes cannot hear, smell or see the ram.

In goats, tail flagging can be stimulated by placing one's hand on the loin and pressing down slightly. This mimics the pressure of the buck during mounting. Some producers in southern Ethiopia have indicated that a ewe in estrus will stand immobile when pressed by hand in expectation of being mounted.

4. Length of estrous cycle and duration of the heat period

The average length of estrous cycle along with the range and duration of the heat (estrus) period is given below.

Table 4. Average length, range and duration of estrus

Animal	Length of estrous cycle (days)		Duration of heat (estrus) period (hr)		Timing of ovulation
	Average	Range	Average	Range	
Ewe	17	13 – 19	30	18- 48	20 - 30 hrs after start of estrus
Doe	20	12-24	39	12- 72	30 -36 hrs after estrus

It has to be noted that the duration of estrus could be shorter for ewe lambs and doelings than it is for adult females. Furthermore, in hot climates the duration of heat could be markedly reduced.

Short estrous cycles are characteristic of *caprine* species. Some does have a short cycle of 5 to 7 days. The 5-day heats are normal as long as they are followed by 12-24 day period.

5. Heat detection aids

In systems where males are not continuously kept with females, estrus detection is crucial for successful reproduction. Estrus detection is a valuable tool for use in hand mating and when using artificial insemination. Apart from personal observation of estrus signs, estrus may be detected by using a male fitted with an apron or teaser rams/bucks. The flehmen response (curling the lip) is a courtship behavior displayed by goats, sheep and other animals; however, the flehmen response does not indicate which females are in heat.

Figure 2. The Flehmen response (Looks as if he is trying to smell something in the air)

- **Detecting estrus using males fitted with apron:** Rams/ bucks fitted with an apron can be allowed to move freely in pens to detect females in heat. This method should be used for 15 to 20 minutes twice daily, early in the morning and late in the afternoon. This should be done under supervision of the attendant as the apron may slide to one side and the male may service the female.

Figure 3. Use of an Apron

- **Use of teaser animal:** A teaser animal is one rendered infertile through surgery by cutting the tubes (vas deferens or epididymis) carrying the sperm to the penis. However, his libido and interest in mating remains. He is able to mate with females and even though he is infertile, he may spread venereal diseases throughout the flock/herd.

6. Parturition interval

In tropical countries does and ewes can exhibit estrus at any time of the year and potentially produce offspring throughout the year. It has been suggested that 3 kiddings/ lambings in 24 months is achievable in the tropics.

Breeding ewes/does every 8 months requires excellent management. Mating that results in conception should take place 3 months after the previous birth.

Parturition interval depends on the length of gestation which is about 150 days and the anestrous period which is the time between lambing or kidding to the subsequent conception. The anestrous period is variable and could range from 55 days to 150 days. The Boer goat has the shortest anestrous period of about 55 days (Greyling, 2000). In Somali does a post partum anoestrus interval of 92 days has been reported. Nutrition of the doe/ewe and suckling are the most important factors that are known to delay resumption of normal ovarian cycles.

Apart from breed differences, the anestrous period is regulated by the nutritional status of the doe/ewe and suckling regimes. Suckling will delay resumption of ovarian activity. It is important that excessive body loss during suckling is avoided if the does or ewes are intended to rebreed quickly. BCS is an excellent management tool to assist in this accelerated mating system.

7. Feeding management and reproduction

- **Feeding and management during pregnancy (gestation);** Pregnancy is the time interval between fertilization of an egg and the birth of the young. Gestation lengths vary between 145 to 152 in both does and ewes. Gestation costs about 3% of the daily energy requirement during the first 3 months and 20% during the last 2 months. Depending on species and breed, eighty to ninety percent of the birth weight is gained during the last trimester of pregnancy, i.e., between days 100 to 150 of gestation. Under-nutrition in late gestation leads to a decrease in birth weight and lowers lamb or kid survival. Although under-nutrition is the most common cause of reproductive failure, over-feeding during late gestation should be avoided as it can increase the occurrence of dystocia (difficulty in giving birth). In the long term, unbalanced nutrition during pregnancy has a consequence on the fertility of the offspring.

Early pregnancy: the goal of feeding should be to maintain BCS

Mid-Pregnancy: goal is slight increment in body weight

Late Pregnancy: goal is to increase nutrient intake to support fetal growth

- **Feeding during lactation:** Adequate feeding of the mother during lactation is important to ensure that ovarian activity starts soon after lactation. This is even more important in grazing animals where lactation accounts for 50% of the daily energy expenditure in grazing animals. To meet these requirements supplemental feeding with feeds having quality protein, like soybean meal or other oilseed cake, can improve milk production in sheep and goats.

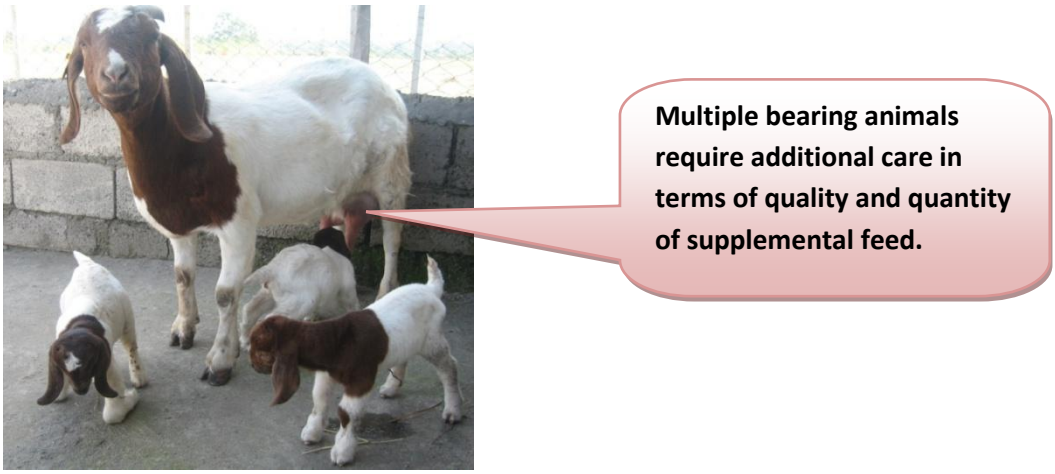

Figure 4. Boer doe with triplets

8. Male reproduction

The contribution of bucks to flock fertility is often overlooked. Male fertility is an important factor in sheep and goat reproduction. Hence, due consideration should be given to fertility of rams and bucks. In males, under-nutrition reduces sperm production and sperm quality. In addition under-nutrition affects libido of rams and bucks as part of a general decrease in vigor.

When should a buck start breeding and what is the optimum life of a breeding ram/buck?

A Ram/buck could start breeding at 7 to 8 months of age provided he has an acceptable size for his breed and has BCS of at least 3. The optimal breeding age is over 7 months and up to 5 years

Components of Breeding Soundness Examination (BSE): A Breeding Soundness Examination (BSE) will enable producers to identify males capable of impregnating females. A BSE consists of a physical examination, inspection of the reproductive organs, and semen collection and evaluation. Only the first two components are discussed as facilities for semen evaluation are available only in limited places and the evaluation is usually performed by technicians trained for that purpose.

- **Physical examination:** The first thing to look for in the physical examination is general health of the male animal.

- Does the ram/buck look healthy?
- Is he too fat or thin? Asses the body condition, ideally BCS = 3 or 3.5 before breeding season
- Is the hair coat shiny?
- Are the eyes and nose clear? Look for defects such as impaired vision
- Teeth should be checked for sound bite and for wear on the incisors. Bottom incisors should align correctly with the upper dental pad.
- Are feet and joints in good condition? Breeding males have to be able to move freely (without pain, and limping) to service females in heat. Reluctance or inability to mount may be due to painful hind legs, hips, hocks and feet.

Figure 5. Overgrown hooves

- **Assessment of the reproductive organs:** The reproductive organs should be examined including palpating the testicles for size and symmetry and inspection of the prepuce and penis. The texture of the testicles is important. Normal testicular tissue should feel resilient and approximately as firm as muscle and be moveable within the scrotum. The shape of the scrotum (normal ovoid or long ovoid), scrotum anatomy (split or undivided), and testicular symmetry (symmetrical or not) should be inspected. Furthermore, examine the prepuce and penis for infection and injury.
- **Libido (sex drive) test:** Libido refers to a ram's or buck's urge (sexual motivation) to mate. The onset of libido coincides with puberty and the beginning of sperm production. Since libido is crucial for fertility there is a need to conduct a standardized libido test for candidate sires. Such a test will distinguish sires having desirable libido from others. Libido is measured through a reaction time which is defined as the elapsed time between exposure to stimuli and first service. Apart from reaction time, mating enthusiasm can be scored as shown in the following box:

0 = rams/bucks do not mount, i.e., show no sexual interest
1 = sexual interest shown only once (e.g., sniffing of the perineal region)
2 = rams/bucks make a mounting attempt with sliding
3 = mounting between sliding and jumping
4 = rams/ bucks mount by jumping
5 = rams/bucks mount with great enthusiasm

Depending on the libido test, rams/bucks may be categorized as Excellent, Satisfactory, Deferred, Unsatisfactory and Culled

Nutrition and age have a marked effect on rams/bucks drive to mate. Under-nutrition will affect libido and sperm production and quality. Rams/bucks that are losing weight rapidly are most likely affected. On the other hand, over-fat rams/bucks may also show reduced libido, particularly in hot weather. In extensive systems, searching and fighting for females increases the energy cost of reproduction for males.Certain compounds in some plants, e.g., alkaloids (lupins), gossypol (cotton seed cake), phenolics (in brush and certain legumes) can affect reproductive performance. Feeding a feed block containing cotton seed meal (gossypol) reduced semen quality in rams without affecting the libido, suggesting that gossypol has a negative effect on sperm production.

Beware of toxic compounds in certain plants!!

- **Body size and testicular measurements:** Numerous studies have shown that testicular growth and development are closely related. Furthermore, some phenotypic measurements such as body weight, BCS, and linear measurements have been examined for their suitability to use as selection criteria in meat animals. Scrotal circumference is strongly related to the semen production capacity of rams/bucks. There is evidence that rams/bucks with large scrotal circumference will produce more semen of greater viability.

Table 5. Scrotal circumference of Menz and Horro rams at different ages (cm)

Breed	**Age**		
	6 months	**9 months**	**puberty**
Menz	14-15	19.7-20.1	23-23.5
Horro	13.5-14.5	20-20.5	23-24

The Scrotal circumference of yearly Boer goats is 25 centimeters while that of Dorper rams of about 15 months of age is reported to measure 33centimeters.

❖ **How to measure scrotal circumference:** A tape measure is commonly used to measure scrotal circumference but even a piece of string could be drawn around the testes and then measured on a ruler. Measurement is taken at the largest diameter of the scrotum after both testicles have been positioned beside each other in the scrotum.

Figure 6. Measuring scrotal circumference.

Used with permission: Langston University, USA.

9. Male to female ratio

In areas where large flock sizes are normal, such as in pastoral areas, the ram to ewe ratio or buck to doe ratio should be considered. The appropriate ratio could vary depending on the season of mating, e.g., if mating has to occur within a defined time period or if it is extended. In general a ratio of 1 male to 50 females (1:50) is recommend provided that the male is adult and in good body condition. Young rams/bucks should not be overworked and may be allowed to serve 15 does (i.e., a ratio of 1:15).

For best results, a ratio of 1 male to 25-30 females is recommended. However, when estrus is synchronized and, thus, mating occurs within a short time frame a ratio of 1: 5-10 is recommended.

10. Systems of mating

Mating is the pairing of opposite sexes for reproduction.

- **Hand mating:** This is mating in which the female is detected to be in estrus and then placed into a paddock or pen with a specific male for mating. It is recommended that each ewe/doe found in heat be mated twice (double mating) within 24 hours. If a ewe/doe is found in heat in the morning, she is mated once in the morning and again in the afternoon using the same ram/buck. If she is found in heat in the afternoon, she is mated once in the afternoon and for the second time on the following morning. This is done to optimize the chance of conception. With this system, mating is guaranteed to have occurred and an accurate recording of the breeding date is possible. However, fertility rate may not be as high as group mating systems as the frequency of mating is limited.
- **Group mating:** In group mating, groups of ewes/does (25 -30) run continuously or are kept together at night with a single ram/buck. A marking harness placed on the male will mark the female's rump as the male attempts to breed. Observe and record the dates of marking to know when ewes/does were mated, calculate kidding/lambing dates, and determine which animals have not been bred. In the absence of marking harness, calculating expected dates of delivery will be difficult.
- **Seasonal mating:** Under certain conditions it may be important to match lambing/kidding with seasons of ample feed availability. Experiments in the pastoral areas of Kenya have revealed that mating just prior to or during the long rainy season leads to low milk yield until weaning and significantly increase incidence of early kid deaths.

The type of mating systems to use could vary from place to place. For instance, under small holder condition where there are only 2 – 3 breeding females and where sires are available nearby hand mating could be preferred. However in pastoral areas where the flock size is high group mating could be practical.

Table 6. Effect of mineral deficiency on reproductive performance of sheep and goats *

Deficiency	Consequences on reproductive function	Comments
Calcium	Milk fever in ewes	
	Poor growth in lambs	
Phosphorus	Reduced lamb crop	
	Reduced milk production especially during first lactation	
Magnesium	Tetany in breeding ewes, mainly in the first month of lactation in twin-bearing ewes	
Copper	Delayed and depressed estrus	Effect associated with the presence of molybdenum
	Abortion, dead fetus	
Iodine	Arrested fetal development	Associated with thyroid function
	Abortion, still birth	
	Decline in libido in male , Deterioration of semen quality	
	Low milk yield	
	Postnatal mortality	
	Growth retardation in the offspring	
Manganese	Depressed or delayed estrus	Rare occurrence
	Poor conception rate	Effect via reproductive hormone or direct action on the gonads
	Reduction in testicular growth relative to body weight	
Selenium	High level of infertility in ewes	
	High embryonic mortality	
	Increased peri natal mortality	
	Increased susceptibility of lambs to cold stress	
	Rapid loss of weight in lambs	
Zinc	Block spermatogenesis in lambs	Complete recovery if supplement offered

**Adapted from Underwood and Suttle, 1999*

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